

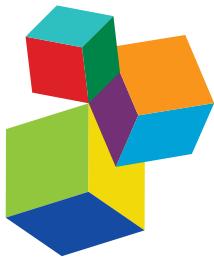
INTERNATIONAL PARTNERSHIPS FOR STRENGTHENING HEALTH CARE WORKFORCE CAPACITY: MODELS OF COLLABORATIVE EDUCATION

EDITED BY: Jeanne Mahoney Leffers, Jennifer Gail Audette, Kevin S. Hardwick
and William Van Cleve

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Health Volunteers Overseas
Transforming Lives Through Education



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Image: Health Volunteers Overseas. "HVO internal medicine volunteers & Mulago Hospital staff" courtesy of Rebecca Kruisselbrink, MD, MPH

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For more than 30 years, Health Volunteers Overseas (HVO) has partnered with institutions in resource-scarce countries to strengthen health workforce capacity through the education and mentorship of health care professionals. HVO brings people together, facilitating professional relationships and promoting partnerships to harness a vital human resource – health care workers – to break the cycle of poverty and illness endemic to resource-scarce countries.

HVO is honored to sponsor this Frontiers Research Topic and facilitate the contribution of peer-reviewed research in successful partnership and program models for capacity building. We hope this special collection will serve to cross-pollinate best practices in the field and promote an open exchange of ideas and methodologies.

We congratulate and thank the editors and authors who contributed to this Research Topic. Your hard work and dedication will undoubtedly benefit the global health community and strengthen future partnerships in capacity building. We look forward to the continued exchange of ideas and future collaborations.



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INTERNATIONAL PARTNERSHIPS FOR STRENGTHENING HEALTH CARE WORKFORCE CAPACITY: MODELS OF COLLABORATIVE EDUCATION

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Image: Health Volunteers Overseas. "Grand Rounds" by Lon Dubey, MD

A critical problem in resource-scarce countries across the globe is the shortage of appropriately trained health care providers. According to the World Health Organization, the current global health workforce shortage of 7.2 million providers is estimated to increase to 12.9 million by 2035. This disproportionately affects resource-scarce countries, denying basic health care to millions and limiting access to life-saving treatments. Due to limited resources in these countries, not enough health professionals receive training, few have the opportunity for continuing education, and the ability to develop or implement educational programs and curricula is constrained. Additionally, many existing providers choose to emigrate in pursuit of professional advancement opportunities, contributing to the overall shortage of qualified health care providers in these environments.

Efforts to strengthen health workforce capacity not only increases access, safety and availability of care, but is critical to building resilient health systems capable of caring for the world's neediest populations. This requires not only cultivating new health care providers, but also providing ongoing professional development to retain and support current providers, advancing the level of practice in accordance with current clinical science, cultivating educators, and enhancing training curricula. It is critical also to contribute to the limited body of research documenting the effectiveness and impact of various models of collaborative education and partnership to improve health worker training and retention.

This Research Topic examines strategies for building health workforce capacity through the prism of educational partnerships, offering significant examples of effective models of international collaborative education as well as insight and guidance on the structure and operation of successful global partnerships. Collectively, the 31 articles accepted and included in this eBook represent a diversity of health professions and geographies across academic, non-governmental organizations and other global partnership forms. The published manuscripts highlight various elements of partnerships with several consistent themes emerging: capacity building, local empowerment, mutual trust and respect, long-term commitment, equity, collaboration, and the importance of integrating theory and practice, for a balance of academic and clinical development. The manuscripts provide examples of partnership and educational programs that are in the formative, early stages of implementation and others which have been sustained long term, some for decades.

The following eBook is divided into two parts, with each part broken down into sections. Part I of the eBook includes 18 manuscripts that showcase long-term educational programs that strongly exemplify multiple, foundational aspects of international partnerships in education including mutual collaboration and project management, empowerment of host partners to lead and sustain programs, and capacity building. While individual manuscripts included in Part I look broadly at multiple aspects of successful, international partnerships in education, Part II manuscripts focus intently on one-two elements. Part II includes 13 articles that highlight partnership through short- rather than long-term educational initiatives as well as program development and broad academic partnerships.

This Research Topic was sponsored by Health Volunteers Overseas – a United States based non-profit that collaborates with over eighty international universities and health institutions to send volunteer health professionals to low-resource countries to provide continuing education, train the trainer courses, professional support, and consultation on academic program and curricula development.

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Table of Contents

PART I

- 10 Editorial: International Partnerships for Strengthening Health Care Workforce Capacity: Models of Collaborative Education**
Jeanne Mahoney Leffers and Jennifer G. Audette

CHAPTER 1

ESTABLISHMENT, DEVELOPMENT, AND SUSTAINABILITY OF INTERNATIONAL PARTNERSHIPS

- 13 Health Volunteers Overseas: 30 Years of Leveraging International Partnerships to Strengthen Health Worker Capacity**
April Pinner and Nancy A. Kelly
- 18 Nursing Partnership Activities, Components, and Outcomes: Health Volunteers Overseas in Uganda 2001–2016**
Scovia Nalugo Mbalinda, Rose Chalo Nabirye, Elizabeth Ayebare Ombeva, S. Danielle Brown and Jeanne M. Leffers
- 25 Collaborating with Communities and Higher Education to Address the Health-Care Needs of Individuals with Disabilities in Ecuador**
Donna J. Cech and Zully J. Alvarado
- 34 The Guatemala-Penn Partners: An Innovative Inter-Institutional Model for Scientific Capacity-Building, Healthcare Education, and Public Health**
Maria Alejandra Paniagua-Avila, Elizabeth Messenger, Caroline A. Nelson, Erwin Calgua, Frances K. Barg, Kent W. Bream, Charlene Compher, Anthony J. Dean, Sergio Martinez-Siekavizza, Victor Puac-Polanco, Therese S. Richmond, Rudolf R. Roth and Charles C. Branas
- 43 Constructing a Global Learning Partnership in Physiotherapy: An Ireland–Uganda Initiative**
Cliona O’Sullivan, Herman Kazibwe, Zillah Whitehouse and Catherine Blake
- 50 The Global Health Service Partnership: An Academic–Clinical Partnership to Build Nursing and Medical Capacity in Africa**
Eileen M. Stuart-Shor, Elizabeth Cunningham, Laura Foradori, Elizabeth Hutchinson, Martha Makwero, Jill Smith, Jane Kasozi, Esther M. Johnston, Aliasgar Khaki, Elisa Vandervort, Fabiola Moshi and Vanessa B. Kerry

CHAPTER 2

PARTNERSHIPS TO PROMOTE PRIORITY HEALTH NEEDS

- 59 Developing a Sustainable Need-Based Pediatric Acute Care Training Curriculum in Solomon Islands**
Daniel Ta Yo Yu, Jason T. Gillon, Raymond Dickson, Karen A. Schneider and Martha W. Stevens
- 67 A Sustained Partnership Between a Haitian Children’s Hospital and North American Academic Medical Centers**
Michael P. Koster, Jackson H. Williams, Jacqueline Gautier, Renee Alce and Bernard E. Trappey

- 72** *Collaborative Implementation Strategy for Newborn Resuscitation and Essential Care Training in the Dominican Republic*
Alexandra Leader, Claudia Cadet, Davina Lazala, Wanny Roa, Olga Arroyo and Lloyd Jensen
- 80** *Building Sustainable Partnerships to Strengthen Pediatric Capacity at a Government Hospital in Malawi*
Michelle Eckerle, Heather L. Crouse, Msandenii Chiume, Ajib Phiri, Peter N. Kazembe, Hanny Friesen, Tisungane Mvalo, Marideth C. Rus, Elizabeth F. Fitzgerald, Allyson McKenney, Irving F. Hoffman, Megan Coe, Beatrice M. Mkandawire and Charles Schubert
- 87** *Increasing Regional Anesthesia Use in a Serbian Teaching Hospital Through an International Collaboration*
Curtis L. Baysinger, Borislava Pujic, Ivan Velickovic, Medge D. Owen, Joanna Serafin, Matthew S. Shotwell and Ferne Braveman
- 93** *The Need for Hematology Nurse Education in Low- and Middle-Income Countries: A Community Case Study in Tanzania*
Julie M. Buser

CHAPTER 3

INTERNATIONAL COLLABORATIONS THAT DEVELOP, REDESIGN, AND UPGRADE TRAINING CURRICULA

- 100** *Utilizing the "Plan, Do, Study, Act" Framework to Explore the Process of Curricular Assessment and Redesign in a Physical Therapy Education Program in Suriname*
Jennifer Gail Audette, Se-Sergio Baldew, Tony C. M. S. Chang, Jessica de Vries, Nancy Ho A Tham, Johanna Janssen and Andre Vyt
- 111** *Empowering the Physiotherapy Profession in Ethiopia Through Leadership Development Within the Doctoring Process*
Cheryl Burditt Footer, Hailu Seifu Tsegaye, Tesfaye Asnake Yitnagashaw, Wintana Mekonnen, Tizita Destaw Shiferaw, Endashaw Abera and Alice Davis
- 122** *Leadership Development of Rehabilitation Professionals in a Low-Resource Country: A Transformational Leadership, Project-Based Model*
Maureen Romanow Pascal, Monika Mann, Kim Dunleavy, Julia Chevan, Liliane Kirenga and Assuman Nuhu

CHAPTER 4

EDUCATIONAL STRATEGIES AND PEDAGOGICAL APPROACHES

- 131** *Developing a Mentorship Program in Laos*
Helen Nita Catton
- 139** *Telehealth to Expand Community Health Nurse Education in Rural Guatemala: A Pilot Feasibility and Acceptability Evaluation*
Kelly A. McConnell, Lyndsay K. Krisher, Maureen Lenssen, Maya Bunik, Saskia Bunge Montes and Gretchen J. Domek
- 147** *Crisis Team Management in a Scarce Resource Setting: Angkor Hospital for Children in Siem Reap, Cambodia*
Richard Alynn Henker, Hiroko Henker, Hor Eng, John O'Donnell and Tachawan Jirativanont

PART II

- 154 Editorial: International Partnerships for Strengthening Health Care Workforce Capacity: Models of Collaborative Education Part II**
Jeanne M. Leffers

CHAPTER 5

NEEDS ASSESSMENT FOR PARTNERSHIP PLANNING

- 156 Assessment of Health Needs in Children with Congenital Upper Limb Differences in Nicaragua: Community Case Study**
Maria F. Canizares, Jairo J. Rios Roque, Gabriel Ramos Zelaya and Michelle A. James

CHAPTER 6

PROGRAM DEVELOPMENT

- 164 The Development of a Postgraduate Orthopaedic Manual Therapy Residency Program in Nairobi, Kenya**
Shala Cunningham, Richard Jackson, Daniel Kangutu Muli and Joni McFelea
- 168 Internal Medicine Residency Program in Guyana: A Collaborative Model for Sustainable Graduate Medical Education in Resource-Limited Settings**
Dev Persaud, Joanna Cole, Ramdeo Jainarine and Zahira Khalid
- 177 Pediatric Hand Surgery Training in Nicaragua: A Sustainable Model of Surgical Education in a Resource-Poor Environment**
Mary Claire B. Manske, Jairo J. Rios Roque, Gabriel Ramos Zelaya and Michelle A. James
- 185 Where Are They Now? Evolution of a Nurse Anesthesia Training School in Ghana and a Survey of Graduates**
Melissa G. Potisek, David M. Hatch, Evans Atito-Narh, Jerry Agudogo, Adeyemi J. Olufolabi, Michael Rieker, Holly A. Muir and Medge D. Owen
- 193 The Influence of an Orthopedic, Manual Therapy Residency Program on Improved Knowledge, Psychomotor Skills, and Clinical Reasoning in Nairobi, Kenya**
Shala Cunningham and Joni McFelea

CHAPTER 7

UNIQUE UNIVERSITY PARTNERSHIPS WITH MULTIFACETED OFFERINGS

- 198 Enhancing an International Perspective in Public Health Teaching Through Formalized University Partnerships**
Patrick Brzoska, Seval Akgün, Bassey E. Antia, K. R. Thankappan, Kesavan Rajasekharan Nayar and Oliver Razum
- 204 The Institute for Global Orthopedics and Traumatology: A Model for Academic Collaboration in Orthopedic Surgery**
Devin James Conway, Richard Coughlin, Amber Caldwell and David Shearer

CHAPTER 8

SHORT TERM EDUCATIONAL OFFERINGS

- 211 Advancing Physical Therapy Practice Through Curriculum Revision: The Malawi Experience**
Janna Beling and Enock Chisati

- 218** *Building Surgical Research Capacity Globally: Efficacy of a Clinical Research Course for Surgeons in Low-Resource Settings*
Theodore A. Miclau, Kathryn Chomsky-Higgins, Alfredo Ceballos, Roberto Balmaseda, Saam Morshed, Mohit Bhandari, Fernando de la Huerta and Theodore Miclau
- 226** *Strengthening Educational Capacity Through Context-Relevant Curriculum Design and Evaluation*
Elizabeth Downes, Judith Wold, Mesrak Belatchew, Amani Mustafa and Stephen Blount
- 231** *How a Training Program Is Transforming the Role of Traditional Birth Attendants from Cultural Practitioners to Unique Health-Care Providers: A Community Case Study in Rural Guatemala*
Sasha Hernandez, Jessica Bastos Oliveira and Taraneh Shirazian
- 239** *Utilizing Behavior Change Techniques to Elicit Adherence to Clinical Practice Guidelines*
Daniel Ferreira



Editorial: International Partnerships for Strengthening Health Care Workforce Capacity: Models of Collaborative Education

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Editorial on the Research Topic

International Partnerships for Strengthening Health Care Workforce Capacity: Models of Collaborative Education

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According to the World Health Organization, by 2035 the availability of health care workers will fall short of meeting the need by a figure of 12.9 million (1). This shortage disproportionately impacts low resource settings where great disparities in health outcomes exist. To address this serious problem, many governmental, non-governmental, and academic organizations develop educational partnerships to strengthen capacity among health care workers where the need is the greatest. However scholars are critical of some of the approaches utilized in the growing participation in international service (2–4), since these approaches often fail to develop equitable partnerships. Reports suggest that effective partnerships should be culturally appropriate, collaborative, bidirectional, and sustainable with strong leadership from the host partners (5–7). This E-Book, *International Partnerships for Strengthening Health Care Workforce Capacity: Models of Collaborative Education*, offers significant examples of effective models of international collaborative education to build health workforce capacity to improve health care outcomes, and provide guidance for what true partnerships can and should look like.

The manuscripts include examples from a variety of professional disciplines and geographic settings. Further, the focus of the projects range from addressing the needs of pregnant women, newborns, children, and adults with acute and chronic health needs for both emergent and restorative care. Initially, more than 40 manuscripts were submitted for this specific Research Topic (RT). Of the 38 deemed appropriate to the RT, 31 have been accepted for publication. Those chosen for publication provide a fairly equal distribution of medical subspecialties, nursing and midwifery, and physical and occupational therapy. The partnerships represent a broad geographic spectrum, with papers reporting projects in Cuba, Haiti, Nicaragua, Guatemala, Ecuador, Guyana, Dominican Republic, Suriname, Nigeria, Kenya, Uganda, Sudan, Malawi, Tanzania, Ghana, Ethiopia, Rwanda, Nepal, Laos, Cambodia, Nepal, India, Turkey, Serbia, and the Solomon Islands.

From the collection of 31 published manuscripts from the RT, we selected 18 that represent perspectives, community case study, curriculum, instruction and pedagogy and evaluation types across academic, non-governmental organization and other global partnership forms. The published manuscripts highlight various elements of partnerships, with a strong focus upon collaboration, mutual planning and capacity building. Some of the examples are in the early stages of planning and partnership development, while others highlight initiatives that have been sustained over many decades. Approximately one-third of the manuscripts report academic partnerships between higher

resource and low resource settings, another third are from Health Volunteers Overseas sponsored programs and the final third are from other global health organizations such as Save the Children International, the Global Health Service Partnership, and Kybele.

Every manuscript included in this Research Topic addresses partnerships, but some directly address many of the central elements of partnership formation or continuance, such as the importance of developing trust between partners, respect for local culture, mutuality for planning and outcomes, capacity building for health care workforce, bidirectional programming, and empowerment of host partners to lead and sustain programs. Pinner and Kelly provide an overview of the establishment and development of projects designed to build collaborative partnerships with academic and health institutions across the globe over the 30-year history of Health Volunteers Overseas (HVO). Other long-term partnerships discussed by Mbalinda et al.; Cech and Alvarado; and Panigua-Avila et al. offer insights about how the partnership is structured, showing the shared roles of the collaborating partners, achievements over time, and as models of how partnerships can build sustainability or broaden their collaboration.

Mbalinda et al. focus upon an HVO collaboration in nursing education that has been sustained for more than 17 years to the mutual benefit of the HVO volunteer nurses as well as the academic and clinical nurses in Kampala, Uganda. Cech and Alvarado report on a 20-year collaboration to improve health, education and advocacy for children with disabilities in Ecuador while Panigua-Avila et al. describe a 12-year partnership between three universities in Guatemala and the University of Pennsylvania in the US, whose aim is to develop mutually beneficial exchanges to build clinical, educational and leadership skills to improve health for underserved communities in both locations. O'Sullivan et al., discuss key elements of partnership formation through their case study of an Ireland-Uganda initiative designed to explore joint educational opportunities for students in both settings to strengthen educational and research capacity for global health, disability and rehabilitation.

Other manuscripts by Yu et al.; Buser; Leader et al.; and Koster et al. focus upon priority health needs in countries with scarce resources and limited health care workforce. Specifically, Leader et al.; Koster et al.; and Baysinger et al. address the high rates of infant and child mortality in resource scarce settings that are a serious problem in many locations globally. Eckerle et al. highlight educational innovations to address this health issue.

A common critique of global aid programs (4, 7, 8) is the number of programs based in high resource settings, such as the US, that send health professionals to low resource settings without acknowledging or realizing that services and programs already exist. Efforts are then duplicated without collaboration. In fact, these situations may undermine or interfere with local efforts already underway. With this in mind, Eckerle et al. offer an example of a partnership between Kamuzu Central Hospital in Malawi and three US-based institutions that strengthen health systems through a coordinated approach. The program forges stronger expertise among all partners and avoids the risk of duplication that is so common in global health programs. Additionally, Koster et al. report a partnership between three US institutions

and the Hopital Ste. Damien-Nos Petits Freres and Soeurs in Haiti that reduces redundancy and builds collaboration by limiting the visiting partners from the US to a smaller group of clinicians.

International collaborations are also used to develop, redesign, and upgrade training curricula. This often serves two purposes: it advances the status of the profession and often has the effect of increasing the number of participants and results in more graduates. This is particularly important in low resource settings where dire shortages of providers persist. Such a partnership is described in the paper by Audette et al. The manuscripts by Footer et al. and Pascal et al. describe the importance of empowering and developing leadership skills in young professionals, many of whom are among the first of their discipline to practice in their country.

Education is a vital key to strengthening capacity of health care workers, and many of the manuscripts offer educational strategies, describing a variety of pedagogical approaches. Although mentorship is not a new pedagogy, Catton reports how Save the Children International has had success in an educational partnership in Laos to increase the skills and capacity of the midwifery workforce using a mentorship strategy. Pediatric specialists McConnell et al. offer a case example of a Telehealth program that uses technology to sustain a partnership for ongoing education in Nicaragua for pediatric nurses. To build capacity for health, Leader et al. used two well-developed and standardized educational programs: *Helping Babies Breathe* and *Essential Care for Every Baby*. The programs employ a train-the-trainer model, in a partnership between a broad range of entities: the Ministry of Health, the Dominican Pediatric Society, the Pan American Health Organization, UNICEF, multiple international and Dominican NGOs, and individuals from three different US medical institutions. The project partners were able to educate 17 trainers who then reached nearly 350 providers.

Henker et al. highlight a simulation course developed at the request of the Angkor Hospital for Children in Siem Reap, Cambodia. While the partnership has continued for many years, this innovative educational training highlights the successes of technical training in settings where advanced technology for health education and clinical care is not available. A number of educational initiatives include program evaluation to support the educational innovation as reported by Buser, Yu et al., Leader et al., McConnell et al., and Henker et al.

Paramount to any successful collaboration is sustainability. Partnerships where a focus on sustainability has been a key element from the start are included in several of the manuscripts. Issues such as maintaining strong partnerships and keeping a program flexible and innovative over the course of time are elements of the manuscripts by Leader et al., Cech and Alvarado, and Mbalina et al. The nature and complexity of international partnerships, paired with the difficulties inherent in measuring programmatic and learner outcomes result in challenges in evaluating long-term outcomes. Many of the articles report attempts to meet that challenge by creating programs where student assessment leads to outcome measurement. Stuart Shor et al. provide evaluation data for the first 3 years of the Global Health Service Partnership (GHSP), a unique collaboration between the Peace Corps, SEED and PEPFAR in Malawi,

Uganda, and Tanzania. Almost 100 nurse and physician educators provided training to more than 8,000 partner trainees, practicing health professionals and faculty over the 3-year period. Significant findings emphasize the importance of culturally appropriate and locally tailored educational strategies. Others such as Pinner and Kelly have built systematic program assessment processes into their models.

We are pleased to be able to share so many creative, interesting, and diverse models of global health initiatives. It is exciting to reflect on how this work has evolved over the past decades and to think about all of the potential there is for even more innovative work in the future. In closing, it seems appropriate to include the words of Paul Farmer: “with rare exceptions, all of your most

important achievements on this planet will come from working with others—or, in a word, partnership” (9).

AUTHOR CONTRIBUTIONS

JL was lead author for the editorial submitted for this RT. JA contributed to and helped to edit the editorial submission.

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Health Volunteers Overseas: 30 Years of Leveraging International Partnerships to Strengthen Health Worker Capacity

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Health Volunteers Overseas (HVO) is a United States-based non-profit that collaborates with over 80 universities and health institutions around the world to send volunteer health professionals to provide continuing education, train the trainer courses, professional support, and consultation on academic programs and curricula development. By establishing mutually beneficial partnerships, HVO is able to deliver effective models of collaborative education that contribute sustainable solutions to strengthen health workforce capacity in resource-scarce countries—ultimately improving health outcomes and the quality of life for millions throughout the world. This paper provides an overview of HVO, outlines the role of international partnerships within HVO's structure, describes the processes used to select partners, and analyzes lessons learned around the key indicators of how to establish and maintain successful international partnerships in education and health worker capacity building.

Keywords: global health, health workforce, partnership, Health Volunteers Overseas, health worker capacity building

INTRODUCTION

Health Volunteers Overseas (HVO) is a United States-based non-profit that collaborates with over 80 universities and health institutions around the world to send volunteer health professionals to provide continuing education, train the trainer courses, professional support, and consultation on academic programs and curricula development. By establishing mutually beneficial partnerships, HVO is able to deliver effective models of collaborative education that contribute sustainable solutions to strengthen health workforce capacity in resource-scarce countries—ultimately improving health outcomes (Anand and Bärnighausen, 2004; Frenk et al., 2010) and the quality of life for millions throughout the world.

This paper provides an overview of HVO, outlines the role of international partnerships within HVO's structure, describes the processes used to select partners, and analyzes lessons learned around the key indicators of how to establish and maintain successful international partnerships in education and health worker capacity building.

Background

A critical problem in resource-scarce countries across the globe is the shortage of appropriately trained health-care providers. According to the World Health Organization, the current global health workforce shortage of 7.2 million providers is estimated to increase to 12.9 million by 2035 (Campbell et al., 2013). This disproportionately affects resource-scarce countries, denying basic health care to millions and limiting access to life-saving treatments. Due to limited resources in these

countries, not enough health professionals receive training, few have the opportunity for continuing education, and the capability to develop or implement educational programs and curricula is constrained. Additionally, many existing providers choose to emigrate in pursuit of professional advancement opportunities, contributing to the overall shortage of qualified health-care providers in these environments.

Health Volunteers Overseas' mission reads, "HVO is dedicated to improving the availability and quality of health care through the education, training, and professional development of the health workforce in resource scarce countries." Since 1986, HVO has worked in resource-scarce countries to educate new health-care providers, provided ongoing professional development to retain and support current providers, advanced the level of practice in accordance with current clinical science, cultivated educators, and enhanced training curricula.

Health Volunteers Overseas' projects aim to increase intellectual, clinical, and educational capacity of physicians, nurses, physical therapists/rehabilitation specialists, dentists/oral health specialists, and various other allied health professionals and technicians. Activities focus on direct delivery of clinical and didactic training through both formal (degree-based programming, structured continuing education, etc.) and informal (on-the-job training, mentorship, etc.) education, as well as train the trainer courses and faculty development initiatives.

From its founding in 1986 through December 2016, HVO has sent 5,910 volunteers on 10,846 trips to 234 projects. **Table 1** provides a summary of HVO's programs and activities in 2016. A map and details about current programs by country and clinical specialty can be found at www.hvousa.org.

HVO Structure

Health Volunteers Overseas' projects vary according to the needs of each health institution and country, avoiding a one size fits all approach to project design. However, all of HVO's projects adhere to certain principles that guide training, including: focus on local diseases and health conditions, use of locally available equipment and supplies, and when possible, train both providers and educators. These principles help foster long-term sustainability of HVO's activities (Health Volunteers Overseas, 2017a).

Health Volunteers Overseas relies on a short-term volunteer model with average volunteer assignments of 2–4 weeks.

TABLE 1 | HVO 2016 program overview.

Health Volunteers Overseas: 2016 in numbers

Number of programs	18 ^a
Number of projects	92
Number of international partners	54
Number of countries	28
Number of volunteers	388
Number of assignments	410
Number of trainees	3,993
Repeat volunteers	45%

^aAnesthesia, dermatology, hand surgery, hand therapy, hematology, internal medicine, nursing, obstetrics and gynecology, oncology, oral health, orthopedics, pediatrics, physical therapy, wound and lymphedema, and other projects (mental health, emergency medicine, pharmacy).

Volunteers are senior in stature and experienced practitioners and educators from both clinical and academic backgrounds. Volunteers not only provide the critical man power needed to travel overseas for the direct delivery of education and training but also serve in key leadership roles for each project.

"Program areas" are defined by clinical specialty. Each of HVO's 18 program areas is overseen by an HVO-appointed Steering Committee, which works with HVO staff to manage all of the projects within a given program area. Each committee consists of 5–8 members who have extensive experience as HVO volunteers and/or in international health-care education within their specialty. Each project has a volunteer project director (PD), primarily in the US, and a volunteer on-site coordinator (OSC), based at the host institution. The PD and OSC are both health-care professionals who work closely with HVO staff to approve and orient volunteers, guide and monitor project activities, and assess impact. The PD and OSC provide critical technical expertise related to their health specialty, which complements HVO's staff experience in volunteer and project management and international health and development. The OSC officially represents the partner institution in terms of project management and is responsible for overseeing all volunteer activities on the ground. The OSC collaborates with the PD in order to provide the necessary feedback to HVO to promote continuity between volunteers and ensure activities are not duplicative, remain relevant, and maintain a forward progression toward realizing project goals.

PROJECT LIFECYCLE

Health Volunteers Overseas has developed an organizational Logic Model that defines our program theory and describes the effectiveness of our programs. The model lays out the inputs, outputs, and outcomes of HVO programs at an individual, institutional, and sectoral level with consideration of both HVO and our partner's contribution to each step. This tool helps guide the organization through the development of new program areas and the lifecycle of each project, ensuring projects align with our mission and capacities.

Project Initiation and Design

Each HVO project actively engages partner institutions throughout the entire project lifecycle from initiation → design → management → and closure. The *Guide to Starting New Projects* (GTSNPs) is a tool that HVO has developed to ensure all projects are designed using a systematic and consistent methodology (Health Volunteers Overseas, 2017b). Prior to detailing the steps to developing a project, the GTSNP defines the HVO model; lays out basic parameters that must be present to facilitate the development of any HVO project; and defines HVO's capacities and the scope of educational opportunities that may be considered during project development.

Health Volunteers Overseas' GTSNP outlines six steps that guide project design.

1. Approve the site assessment. This step ensures that the potential partner's needs align with HVO's educational

- capacities and ensures that basic project parameters are in place. Essential parameters include relative political stability in the country, English language capacity, and local support for the project.
2. Gather background information about the country along with its health care delivery, education system, and the institution requesting volunteers.
 3. After adequate background information is collected, an appropriate site assessor is identified to conduct a site assessment. Two priorities of this process include: (a) confirmation that the needs of a potential partner can be addressed through education and training and if so then (b) investigating the educational needs of the potential partner to confirm they align with HVO's mission and capacities.
 4. Initiate the project, which includes: (a) identifying potential trainees, (b) defining the type of training, (c) outlining volunteer qualifications/requirements, (d) determining the types of educational materials, equipment, and/or technology available on site, (e) defining expectations for a successful project both short and long term, and (f) considering logistical issues related to project management and volunteer placement.
 5. Develop specific, measurable, action-oriented, realistic, and timed (SMART) goals and objectives collaboratively with the partner/host institution.
 6. The site assessor prepares a final report for HVO leadership and the appropriate HVO Steering Committee (a Site Assessment Report Outline is provided in the GTSNP to guide and standardize report preparation).

Once a project has been approved by the respective HVO Steering Committee, HVO staff drafts a preliminary *Letter of Agreement (LOA)*. The *LOA* is reviewed and approved by both HVO staff and the partnering institution(s) before being finalized for signature. No project activities, marketing, or volunteer recruitment begins until the *LOA* is signed by all partners.

Project Management

Project management includes the coordination and oversight of ongoing project activities, continuous project monitoring, and annual project evaluation. Project management is a collaborative process between HVO leadership (PD, OSC, and Steering Committee) and HVO staff. Continuous engagement of partner institutions is facilitated through the OSC.

Through a robust system of project monitoring and evaluation, HVO is able to work with our international partners to track progress toward project goals and objectives and determine impact. Annual surveys are conducted as well as occasional on-site evaluations to supplement the ongoing feedback received through continuous communication among the PD, OSC, and staff. Annual analyses and reports are then compiled and presented to enable HVO to remain responsive to our partners' needs and adapt project activities and structure in a timely and effective manner.

Project Closure/Redefinition

Multiple scenarios may lead either HVO and/or a partnering institution to determine a project should be closed. The ideal situation is mutual agreement that a project has accomplished

its goals. However, external circumstances may lead one or both partners to conclude that the project is no longer viable before the goals are entirely met:

- Basic project parameters are no longer in place—political instability in the host country, loss of partner support, and engagement, etc.
- The host institution's priorities no longer align with HVO's mission or educational capacities.
- Leaders change at the host institution.

If there is little to no volunteer activity at a project but opportunities to engage and support the partner institution remain viable, a shift in project status from "active" to "affiliate" may be considered. In this situation, active volunteer recruitment is suspended but HVO continues to support the partner institution according to a redefined set of activities, which may include visits from previous volunteers to the site (active recruitment suspended), efforts to obtain educational materials, facilitation of attendance at educational conferences, or other forms of professional support.

THE ROLE OF INTERNATIONAL PARTNERSHIPS

Definition of Partnership

A central component of HVO's educational model is the organization's reliance on international partnerships to achieve its mission. The justification for adopting the partnership approach relies on the belief that intra and cross sector collaboration can maximize impact and promote sustainability when attempting to address complex global health issues. Historically, international partnerships have not been built around the principle of equity in decision-making, mutual collaboration, or shared responsibility (Lewis, 1998). Instead, they often employed a hierarchical approach where power imbalances led to unevenness of influence between partners (Ashman, 2001), typically disadvantaging low and middle income country partners and leading to unsustainable interventions (Freeman, 2015).

While defining the specific terms of individual partnerships can be quite nuanced, HVO has found that the most successful model of partnership relies on a "collaborative relationship between two or more parties based on trust, equality, and mutual understanding for the achievement of a specific goal. Partnerships involve risks as well as benefits, making shared accountability critical" (World Health Organization, 2009). For over 30 years, HVO has relied on this collaborative model of partnership to ensure the success of individual projects and sustainability of interventions.

Health Volunteers Overseas uses the term "partner" to refer to institutions of other countries that co-sign with HVO a formal *LOA* for a project and/or host HVO project activities as defined in the *LOA*. Over 80% of HVO's partners (also referred to as host institutions) are universities or teaching hospitals but partners may also include other non-profit organizations or smaller health clinics. These institutions may be private, government, or non-profit entities. Over the last three decades, HVO has worked with at least 107 unique partners on 234 projects spanning 60 countries.

LESSONS LEARNED/KEY INDICATORS OF A SUCCESSFUL PARTNERSHIP

Instilling a culture of cooperation throughout each level of the organization is foundational to sustaining a successful and inclusive model of partnership. This requires a structured and strategic approach to partnership that must be cultivated by executive leadership and actively incorporated into the organization's practices and procedures.

Over 30 years, HVO has continually refined its model by learning from failure and adapting to change. Every 5 years, HVO undergoes a strategic planning process that involves the HVO Board of Directors, staff, leadership, volunteers, and other stakeholders. This process has been invaluable over the years by enabling the organization to respond to the evolving needs of our partners and the global health community at large. Three decades of experience has also enabled the organization to refine the indicators of a successful partnership.

Key indicators of a successful partnership:

1. Mutual goal setting (Wildridge et al., 2004; Leffers and Mitchell, 2011). When host institutions actively engage in defining project goals, objectives, and activities, both partners are invested in realizing project outcomes. This applies not only in the project design phase but is necessary throughout the project life-cycle as goals and objectives may evolve over time. Ongoing collaboration on project goal setting helps ensure project activities and interventions continuously align with host institution priorities and instill a sense of project ownership and responsibility on the part of the host institution, thereby increasing the likelihood of sustainable change.
2. Honest and open communication (Tennyson, 2003; Wildridge et al., 2004). Establishing and maintaining effective communication instills confidence that partners are moving toward the same goals. Language and cultural barriers can often present communication challenges, especially when working with international partners. HVO has found that partners may be hesitant to provide honest or constructive feedback on the project due to concerns it may negatively impact the relationship or project status. It is important to acknowledge these challenges exist and integrate strategies to mitigate potential misunderstandings and facilitate honest communication. In this regard, HVO has developed orientation materials and provides guidance to volunteers and leadership to address cross-cultural communication challenges and enhance their oral and written communication. Further, HVO works with the host institution to encourage constructive feedback through ongoing project monitoring and evaluation. Facilitating honest and open feedback relies on HVO framing the discussion appropriately and demonstrating that constructive feedback is welcomed, non-threatening and critical to the success of the project.
3. Equity (Tennyson, 2003). Initiating and sustaining a partnership requires a dedication of time, staff, and resources. HVO recognizes that each partner will provide different types of resources to a project based on their unique capacities and

available resources. While resource contributions often cannot be calculated or equated in financial terms, each partner's contributions are essential to project success. During the project design phase, each partner's commitments and projected contributions are outlined and, then, included in the *LOA*, which requires annual reassessment as external variables may influence available resources. Ultimately, seeking equity within a partnership recognizes each partner's right to be "at the table," regardless of an imbalance in resource contribution.

4. Mutual benefit (Tennyson, 2003). Often, partners are independently accountable to stakeholders external to the immediate partnership. Considering this, it is critical to identify where strategic, organizational priorities align when designing a project. HVO's Logic Model was designed with this key tenet of successful partnerships in mind and clearly maps out broad areas of alignment that have been identified.

In addition to institutional/organizational benefits, mutual benefit is realized at the level of the individual trainee and volunteer. HVO orients volunteers through phone calls and documents, including the *HVO KnowNet* (a password-protected tool, open to all HVO members and colleagues at our project sites around the world that serves to orient volunteers preparing for overseas assignments and promote educational exchange) prior to their departure for a site. The benefits to the trainees are outlined in the project objectives and result in changes in knowledge, skills, and attitudes as a result of the teaching and training provided. HVO has also documented a positive personal and professional impact on volunteers as reported in post-trip surveys, including broadened professional perspectives, increased cross-cultural competency, strengthened professional networks, and increased clinical confidence.

5. Active partner engagement throughout the project lifecycle (Afsana et al., 2009). While one partner may be responsible for a larger percentage of project oversight and ongoing management, each partner must be kept up to date on project activities and engaged in decision-making. It is important that expectations and roles are strategically and realistically mapped out during the project development phase and solidified in the *LOA*. Ultimately, HVO is a guest within the host country and institution where each project operates. This perspective is foundational to our approach and active engagement of our partners throughout the project life-cycle reflects this philosophy.
6. Flexibility (Wildridge et al., 2004). Partnerships require flexibility to evolve and transform over time. This is especially true in global health where priorities and needs may shift as a result of changing health demographics, donor trends, local resources, leadership, or the strategic mission or capacities of one or both partners. Through mutual and ongoing project monitoring, evaluation, and effective communication, HVO is able to work with our partners to continuously re-assess if the nature of the partnership and/or the goals of a project need to be updated. In Bhutan, this flexibility has enabled our partnership with Jigme Dorji Wangchuk National Referral

Hospital (JDWNRH) to sustain for over 25 years. HVO initiated its partnership with JDWNRH in 1991 to begin training in orthopedics as there was no Bhutanese orthopedist or formal orthopedic training program in Bhutan at that time. Since 1991, HVO has been able to adapt to meet local needs to establish a physician assistance program (1993–2005), followed by an orthopedic technician program (2006), orthopedic internships (2014), and most recently, an orthopedic residency program (2017). Since 2001, HVO's partnership with JDWNRH has also broadened in scope to include projects in physical therapy, anesthesia, mental health, emergency medicine, internal medicine, pediatrics, and oncology.

7. Clearly define leadership roles (Wildridge et al., 2004). As mentioned previously, HVO's model relies on volunteers at all levels of the organization, including leadership. HVO has defined a broad set of roles and responsibilities for all PDs and OSCs. However, HVO has learned that each partner has a unique set of capacities and, therefore, the exact roles and responsibilities for the OSC (and partner institution more broadly) are defined during the project design phase and stated in the *LOA* for each project.
8. Local champion. Identifying a local champion at a host institution helps maintain project momentum and often guides the evolution of the partnership (Leffers and Mitchell, 2011). HVO has found a local champion may or may not have an official leadership role within the HVO project or the host

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institution. However, they have a demonstrated ability and willingness to leverage their personal or professional power and go beyond task related deliverables that may be defined in a formal leadership role. Common skills and traits of a local champion include the ability to motivate, inspire, negotiate, be resourceful and liaise with all parties to effectively and efficiently move the project forward.

CONCLUSION

Over 30 years, HVO has been able to identify key indicators of a successful international partnership and integrate strategies into our internal structure and processes that promote these key principles. However, it is important for organizations such as HVO to recognize each partnership is unique and as the global health environment and priorities of our partners evolve, models of international partnership must adapt to stay relevant. HVO remains committed to learning and refining our philosophy and internal processes around equitable international partnerships to promote integrated and sustainable contributions to strengthening health worker capacity.

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AP and NK conceived the paper jointly; AP prepared the first draft; NK reviewed and refined the draft. Both authors edited and approved the final submission.

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Nursing Partnership Activities, Components, and Outcomes: Health Volunteers Overseas in Uganda 2001–2016

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Nurses increasingly form global health partnerships through academic and voluntary organizations that are designed to improve health outcomes. Many such partnerships are funded for specific time periods and have short- or long-term goals to achieve during the partnership. Other partnerships are sustained for longer periods of time through the efforts of partners committed to their joint work. The case example of the Health Volunteers Overseas Nursing Education partnership in Kampala, Uganda, demonstrates key components of partnerships that promote sustainability of programs. This case example is analyzed using literature that reports partnership models to identify those factors that have led to sustainability. Additionally, both objective and subjective program outcomes are reported. Recommendations for further evaluation are included.

Keywords: collaboration, partnerships, education, evaluation, nursing

INTRODUCTION

Partnerships are essential to the work of global health professionals to improve health outcomes (1). The organization Health Volunteers Overseas (HVO) works in partnerships comprised of health-care professionals across international borders to strengthen the numbers and capacity of the health-care workforce in resource scarce settings (2). Founded in 1986 with the support of the former Orthopedics Overseas, in 2015, the organization sent 87 volunteers from a variety of health-care specialties to more than 25 countries. Over the past 30 years, this totals more than 10,000 completed assignments (3). HVO is a 501c3 non-profit organization based in the United States (US) that partners globally with host countries at their request. Since the establishment of the HVO Nursing Education Program in Kampala, Uganda, more than 108 nurses have served for stays of 1 month to as long as 6 months. Many volunteers (14) have returned for several volunteer assignments with 1 volunteer serving 12 times for a total of more than 18 months. This paper will examine the key contributions, sustained projects, and outcomes of this collaborative partnership.

BACKGROUND

The HVO nursing education program began in Uganda in 2000. At that time, Ms. Speciosa Mbabali, the Acting Head of the Department of Nursing at Makerere University, approached the HVO orthopedics team liaison at Mulago National Referral Hospital to inquire about HVO support for the newly formed undergraduate nursing baccalaureate degree program. Ms. Mbabali recognized that without

opportunities in Uganda for higher education in nursing, that a partnership with out of country nurses with advanced degrees was essential in order to build capacity for a strong faculty. HVO sent two experienced nurses, Marie O'Toole, EdD, RN, FAAN, and Julia Plotnick, RN, MPH, FAAN, RADM, USPHS (RET), to collaborate with Ms. Mbabali and the department of nursing at Makerere (4). The continuation of this partnership for 16 years results from some key factors for successful partnerships.

Makerere University is one of the oldest and most prestigious universities in East Africa founded in 1922 in Kampala. Currently, the Department of Nursing is part of the College of Health Sciences with schools of Medicine, Public Health, Biomedical Sciences, and Health Sciences. Dean Rose Chalo Nabirye currently leads the School of Health Sciences, composed of the Departments of Nursing, Dentistry, Pharmacy, and Allied Health Sciences. The Department of Nursing has approximately 12 full-time faculty of whom 3 have now completed a PhD and all others have an MS degree with 4 enrolled in PhD programs.

Partnership Characteristics

The current literature about partnerships for global health designates key factors that increase the likelihood of successful and sustainable partnerships. Relationship building strategies such as knowledge of the host country social, cultural, economic, and political factors for mutual planning, clear expectations, intentional listening, honesty and openness, mutual trust, cultural respect, and willingness for commitment are integral to partnership formation (1, 5, 6). Continuance of the partnership requires open and 2-way communication, steady leadership, respectful negotiation, teamwork, strong involvement of host partners, program champions, and capacity building in order to build effective collaboration. Commonly reported outcomes of global partnerships are program sustainability, host country ownership, joint publications with shared authorship, ongoing professional development for host partners, strengthened research capacity, and improved curriculum (1, 7, 8).

Since the establishment of the HVO nursing education partnership with the nurse leadership at Mulago National Referral Hospital and Makerere University in 2000, there have been significant projects completed and some that currently continue. The primary goal of the Ugandan partners at the outset was to build capacity for nursing faculty and for clinical nurses at Mulago National Referral Hospital with a focus upon pediatrics due to the high infant and child mortality rates. Data reported in the 2000/2001 UDHS report showed infant mortality rate of 89 deaths per 1,000 live births and under-five mortality rate to be 152 deaths per 1,000 live births. Results reported in the 2011 UDHS report showed a decline in infant mortality of 39% to 54 deaths per 1,000 live births, while the under-five child mortality declined from 152 to a rate of 90 deaths per 1,000 live births. This indicates that about 1 in 18 Ugandan children dies before their first birthday and 1 in 11 Ugandan children dies before their fifth birthday (9).

RESULTS

The priority for the nursing education partnership in Uganda was to strengthen health-care capacity to improve child health

outcomes. Collaborative educational approaches were designed to empower host country nurses for the development of best practices for clinical practice and nursing education. Since that time, the Makerere University faculty-to-faculty partnership projects include (1) improvements to the pediatric nursing curriculum, (2) improvements to the fundamentals of nursing course, (3) introduction of a critical care curriculum, and (4) the establishment of Masters Degree Program. At Mulago National Referral Hospital, the nursing clinical partnerships have been in the following areas: (1) partnerships for the Special Care Babies Unit to build capacity for care of newborns, (2) clinical care for pediatrics, (3) clinical care for critical care, and (4) the diabetes partnership. Using exemplars from four of these collaborative projects, we show how the key factors for successful partnerships have positively impacted the HVO nursing education partnership in Kampala, Uganda. First, we will provide brief descriptions of each project and then highlight the key partnership factors. Finally, we will describe outcomes from the HVO nursing education collaboration (see Table 1).

Mulago National Referral Hospital Clinical Partnership for Special Care Babies Unit

The first project began in 2001 when the HVO nursing education partnership matched two US nurse volunteers with expertise in the care of high-risk newborns, with the Ugandan nurses who

TABLE 1 | Case exemplar partnership and sustainability factors.

Uganda Nursing Education Project	Partnership and relationship building factors	Sustainability factors
Mulago National Referral Hospital Special Care Babies Unit	Cultural respect, trust, open communication, teamwork, and ongoing interdisciplinary collaboration for capacity building and willingness for commitment	Ongoing assessment, open and two-way communication, steady leadership, program champions, teamwork, and strong involvement of host partners
Mulago National Referral Hospital Critical Care Units	Expressed need from Ugandan partners, clear expectations and two-way communication grounded with cultural respect, coordination of activities, and willingness for commitment	Open and two-way communication, program champions, appropriate resources, program champions, and capacity building
Makerere University Pediatric Nursing Curriculum	Needs assessment and joint planning, strong involvement of the Ugandan partners, mutual trust, shared learning, cultural respect, teamwork capacity building, and willingness for commitment	Ongoing assessment, open and two-way communication, program champions, teamwork, strong involvement of host partners, and capacity building
Makerere University Graduate Education Curriculum	Response to an expressed need, mutual trust, shared decision-making, and commitment to the project	Open and two-way communication, appropriate resources, respectful negotiation, teamwork, strong involvement of host partners, program champions, and capacity building

worked in the Special Care Babies Unit at Mulago National Referral Hospital. The US nurses joined a US neonatologist on that first as well as many subsequent visits. Mulago National Referral Hospital was founded in 1913 and expanded in 1962. With a capacity of 1790 beds, the Mulago government hospital serves more than 750,000 inpatients and more than 800,000 outpatients annually. Currently, the hospital is undergoing a major renovation at a cost of \$40 million. Some clinical services are housed at the “New Mulago” site, the 1962 facility while others are housed across the hillside in buildings that date to 1913. This includes some maternity and most pediatric services as well as clinics and specialty services (10). Both the university and the hospital maintain collaborations with many US universities such as Johns Hopkins, Yale, Baylor, and the University of California San Francisco, as well as the Karolinska Institute in Sweden.

Each of the original nurse volunteers has returned to Mulago regularly since that first visit. One has completed her 12th volunteer assignment in 2016, while the other has returned frequently as well. They additionally bring other neonatal nurse specialists to join their team. The activities and programs that have been built and sustained as a result of this collaboration include formal classes such as newborn resuscitation, clinical education for Ugandan nurses with nurse volunteers working jointly on the unit side by side, and outreach across Uganda for the Saving Babies Lives (11) program. The success of these efforts is due to the long-term relationship built upon cultural respect, trust, open communication, teamwork, and ongoing interdisciplinary collaboration for capacity building. Further, the collaboration has been sustained due to the commitment of HVO and Ugandan nurse champions or leaders. Challenges related to the lack of essential material supplies, inadequate staffing, and lack of other essential resources often threaten the success of the projects. However, this program continues due to the long-term commitment of the HVO volunteers, the long-standing collaboration with both the nurses and the Mulago pediatricians, and the capacity building of the Ugandan nurses working with the high-risk newborns.

Mulago National Referral Hospital Critical Care Initiatives

Highly trained physicians and nurses in critical care or intensive care units care for patients with life-threatening conditions. These units are well established in high resource settings and are fully equipped with the latest in medical technology. However, these types of units are still in the development phase in Uganda (12). Dedicated physicians and nurses care for patients with systemic trauma, respiratory, and cardiovascular compromise without a sufficient number of ventilators, cardiac monitors, advanced imaging capabilities, and adequate lab support. While generous donors have supplied equipment, the need has been for continuing education to build capacity for the nursing staff caring for these patients.

The collaboration for critical care began in 2013 when a critical care component was added into the undergraduate curriculum at Makerere University. At that time, there were two nurse faculty members with preparation in critical care nursing but they had not yet implemented a critical care curriculum. An HVO

volunteer with expertise in critical care nursing came to partner with the Makerere faculty and to jointly design the didactic and clinical experience. The first offering of this clinical component was in March of 2015 to the senior undergraduates. The students completed their clinical rotations in the critical care unit, the pediatric intensive care unit, the dialysis unit, the emergency room, and the trauma unit. The HVO nurse volunteer supported the Makerere nursing faculty and provided direct supervision of the students at the clinical sites at Mulago during the first course offering.

From their observations of the nursing students with the HVO volunteer, the nursing staff in the patient care units at Mulago National Referral Hospital, noting the value of continuing education in the care of the complex, critically injured patient and with the technology being utilized, recognized an available resource. On-site classes were provided by the HVO volunteer in the critical care unit and the trauma unit. This initiative will continue with future nurse volunteers. Nurse to nurse clinical education increases the capacity of the nursing staff in the critical care units.

Future plans include collaboration to develop a Master's degree in Critical Care Nursing as a second clinical focus of the MS degree in Nursing at Makerere University. HVO volunteers and nursing faculty are in the process of developing the curriculum, collecting the necessary supplies such as mannequins for the simulation lab to teach resuscitation and so forth. This course will complement the support and continuing education for the hospital staff.

The partnership factors that have contributed to the success of this more recent project include the fact that the HVO nurse volunteer responded to a clear need expressed by the Ugandan partners. Further, clear expectations and two-way communication grounded with cultural respect facilitated the coordination of activities at both the university and the hospital clinical sites.

Pediatric Curriculum Building at Makerere University Department of Nursing

The other early collaborative nursing education project was built from a partnership with an HVO nurse volunteer with expertise in pediatrics who volunteered first in 2002 and continued her collaboration through 2007. During one volunteer assignment of 6 months duration, she was able to partner with the Makerere faculty to develop a comprehensive pediatric nursing curriculum for classroom learning. In 2008, a new volunteer built upon that work extending the curriculum into the clinical setting in collaboration with Makerere pediatric nursing faculty and clinical nurses at Mulago National Referral Hospital. Further activities related to building faculty pediatric expertise included the development of teaching modules for relevant course content, development of faculty supervision of clinical learning at Mulago National Referral Hospital, and a mentorship program using an HVO nurse expert paired with a novice Ugandan nurse.

In this pediatric project, the partnership components included comprehensive needs assessment and joint planning, strong involvement of the Ugandan partners, teamwork, and capacity building that strengthened the collaboration. The needs assessment included collaboration with former US nurse volunteers

and communication with Ugandan nurse leaders. Joint planning with the leadership at Makerere University led to extensive preparation of teaching materials for class presentations and handouts, all available on a portable USB drive, edited for appropriateness to the Ugandan health setting to ensure cultural relevance. All materials became part of the Department of Nursing resources to ensure sustainability. Second, meetings with clinical nurse partners at Mulago built trust between the HVO volunteers, the clinical nurse partners, and the pediatric nursing faculty. During three subsequent volunteer assignments over 7 years, the HVO nurse provided guest lectures, clinical supervision, and teaching materials for course updates to sustain the partnership.

Development of Graduate Education at Makerere University

Many of the Makerere BSN nursing graduates had assumed clinical, leadership, and administrative positions in the Ministry of Health, public and private hospitals, non-governmental organizations, nursing schools, research organizations, and universities. However, despite the outstanding contributions made by the BSN graduates from the Department of Nursing at Makerere University and other universities, health indicators showed an urgent need for nurses trained at the Masters Level for Advanced Clinical Practice Nurses. By 2008, the Department of Nursing had built the capacity of the faculty to include three faculty members who were completing a PhD, and four who had completed an MS degree and had the capacity to begin a graduate program. A goal of that time was to establish a Master of Science in Nursing (MSN) program at Makerere University.

The Department of Nursing administration engaged with its former students, nurses, and stakeholders in the country for a needs assessment. Former and current students and stakeholders raised concerns and urged the department to provide them with an opportunity for a clinically focused Masters Degree in Nursing. In recent interviews with more than one half of the BSN graduates of the Makerere Program, 90% of those who had not acquired a Masters degree stated they were motivated to return to school for a Masters in Nursing. The faculty at MU identified the lack of available clinical specialist at the masters' level in nursing to serve as educators, clinical practitioners, and nurse researchers as a high priority.

In 2008, an HVO volunteer with experience as a graduate program director and nursing curriculum chair came to work with the department at Makerere. Among her other collaborative assignments, she was asked to write a proposal for an MSN program. Partnership factors that positively affected the collaboration were the response to an expressed need, mutual trust, shared decision-making, and commitment to the project. While this was not the final proposal that led to the MSN program that began in 2011, it helped to provide a template for the faculty to move forward with a partnership to develop an East African joint program where the specialties would be shared across countries to minimize duplication and share resources. Since the Makerere University Department of Nursing had strong capacity for midwifery, that program was launched first.

The Aga Khan University Advanced Nursing Studies Department in East Africa and the University of Nottingham School of Health Science worked on a prestigious European Union funded program called Improving Nursing Education and Practice in East Africa (INEPEA). This ambitious program was supported by the WHO and involved three universities in East Africa, Makerere University, Muhiimbi University of Allied Health Sciences, and Zanzibar College of Health Sciences. It resulted in the development of a shared competency framework and MSN curriculum for advanced nursing practice (ANP) in East Africa. The program developed ANP in the East African context. The Master of Nursing-Midwifery and Women's Health (MN-MWH) was developed to help to address the urgent needs and demands in the country and the region for primary care practitioners who are competent and skilled in midwifery and women's health. The program also produced nurse educators and scholars, and nurse researchers in Ugandan and regional universities, hospitals, and other settings. The MN-MWH program also provided candidates for doctoral studies in nursing and subsequently researchers to develop locally relevant research in Uganda. The MN-MWH program has prepared students at the postgraduate level and equipped them with clinical, leadership, teaching, and research skills to practice in the primary care settings, in hospitals, schools of nursing, universities, research organizations, and other settings. In addition, the HVO nurse who in 2008 helped develop the first draft of the MN-MWH program proposal returned in 2012 to teach a course for the first cohort of that program.

DISCUSSION

As an organization of volunteer health professionals primarily from the US and Canada, HVO partnerships during much of this 16-year partnership lacked formal evaluation measurements for each project required of most program partnerships that are funded through public or private sources. Instead, volunteers completed Trip Reports until recently and now complete Volunteer Surveys or for returning volunteers Impact Assessment Surveys in an effort to develop stronger evaluation measurements (13). In addition, HVO requires annual evaluation reports from each Project Director and collectively reports outcomes for each program. The latest Nursing Education Report is from 2015 and notes some of the outcomes discussed in this paper including positive feedback from both the HVO Project Director and the On-site Coordinator (14). Despite the limitations for evaluation of individual projects, many HVO partnerships are able to identify process (or often referred to as formative), impact, or outcome evaluation results. Evaluations for global health partnerships include not only measures to track improved health outcomes, but also elements of sustainability such as building capacity of the host or recipient community, continuation of program activities, host partner ownership of the project, and continuation of program innovations (1, 7, 8, 15).

For most of the duration of the long-term collaboration between HVO nurse volunteers and the Ugandan nurse partners, there has not been a formal evaluation method in place to guide planning and ensure sustainability until recent years. Instead, there have been several structural components that

have contributed to continuity. First, HVO nurse volunteers have submitted trip reports that highlight program activities and achievements for each volunteer experience and these are posted on the HVO KnowNet website to allow for future volunteers to build upon the work of prior participants. Second, each HVO program has a US-based Project Director whose job is to coordinate not only the screening of applicants for the program but to work with the host partners to ensure continuance of key collaborative projects or to prepare for new collaborative innovations based upon the skill set of the HVO volunteer. During the 16-year history, two prior Project directors each served for 7 years contributing to the continuity to of the program. The ongoing engagement of the stakeholders in the Department of Nursing with the HVO project directors helps to identify areas of need for support. This continues to involve both groups of partners in planning for future volunteers and projects. Third, HVO sponsors an HVO staff person in Uganda to assist all HVO volunteers coming to Uganda with their professional and logistical accommodations including obtaining a professional license in Uganda, housing, and setting up meetings with professional partners. Each of these processes serves to advance the partnership and collaboration.

Examples of Outcomes Related to Capacity Building for Ugandan Nurse Partners

Some outcomes of the long-term partnership between HVO nurse education volunteers and the Ugandan nurse partners are objective and could be measured by formal evaluation tools. These include outcome measures such as the number of nurses educated at training sessions, number of courses taught and students in attendance, actual teaching materials and presentations developed for the partnership, number of joint publications, number of joint research projects, and formal feedback from the Ugandan nurses. While some of these objective data are reported in HVO volunteer trip evaluation reports, there has not been a uniform evaluation tool in use across HVO nursing education programs. However, there are sustained outcomes as educational programs continue for each of the projects discussed in this paper (see Table 2).

Other evaluation data are more subjective in nature. Three significant areas include capacity building for faculty and clinical nurses, engagement and strengthening participation in professional networks, and mutual learning for curriculum design, teaching methodologies, and health-care system approaches. These are particularly challenging to measure as they are highly subjective and internal to both host and volunteer nurse partners. Despite the challenge to evaluate these subjective outcomes, during this 16-year partnership, there are examples of joint publications and support for scholarship. HVO volunteers have served to review manuscripts or conference abstracts for Ugandan partners as well as sharing information about professional meetings of relevance for Ugandan partners.

The Uganda Nursing Education Project Director from 2008 to 2015 sought qualitative feedback from nurses at Makerere University and Mulago National Referral Hospital on each visit

TABLE 2 | Case exemplar outcomes.

Uganda Nursing Education Project	Outcomes
Mulago National Referral Hospital Special Care Babies Unit (since 2001)	<ul style="list-style-type: none"> Sustained partnership for clinical best practice Newborn resuscitation training Saving Babies Lives training
Mulago National Referral Hospital Critical Care Units (since 2013)	<ul style="list-style-type: none"> Sustained partnership for clinical best practice Development of critical care course for nursing students In-service education classes for clinical critical care nurses
Makerere University Pediatric Nursing Curriculum (since 2002)	<ul style="list-style-type: none"> Sustained partnership for pediatric curriculum Development of pediatric course curriculum Development of clinical practice curriculum Formal class lectures Faculty mentorship Host country ownership
Makerere University Graduate Education Curriculum (since 2008)	<ul style="list-style-type: none"> Sustained partnership from proposal through first cohort instruction Initial Masters Degree Program proposal Ongoing support throughout the proposal process Faculty mentorship for teaching MS courses Host country ownership

to Uganda as well as by email correspondence with the Makerere University Department chair. Two examples of such qualitative feedback are as follows.

Elizabeth Ayebare who was a student and now is pursuing a doctorate wrote:

The Health Volunteer Overseas program is largely responsible for my love of and career as a pediatric nurse. In 2002 when I was an undergraduate nursing student in my third year, I encountered HVO nurse Martha Tanicala, who taught me to love nursing children. Although I loved children from childhood, having a teacher who was passionate about pediatrics was crucial. She nurtured my desire to continue working with children even in my career. I was employed by Makerere University in the nursing department as a teaching assistant/clinical instructor with special focus on pediatric nursing. I used materials developed by Martha Tanicala for teaching and these still act as a reference to date. In 2008 as I figured out my role as a clinical instructor for Pediatric Nursing, I met with HVO nurse Jeanne Leffers who further mentored me to become the clinical instructor I am today. We worked with students together both in class and clinical areas. I had a full time individual mentor with loads of experience and skill. She also provided tools for use, facilitated innovative use of resources in the skills lab and hospital and also helped with assessments. I have since then taken a postgraduate diploma course in child nursing from the University of Cape Town. The HVO volunteers keep coming year after year to give the department of nursing a boost. Currently I am pursuing my PhD on birth asphyxia in the newborn area due to the contribution it makes to under five mortality. I am always grateful to the HVOs for opening up my horizon.

The Dean of the School of Health Sciences, Dr. Rose Chalo Nabirye wrote:

The Department of Nursing at Makerere University has had a long relationship with Health Volunteers Overseas. The volunteers have supported the department in form of human resources when the faculty capacity was limited to effectively teach all the nursing specialties. They helped the faculty with classroom teaching as well as clinical supervision of students especially in medical- surgical, pediatrics and critical care nursing specialties. Working with the HVO volunteers built the capacity of faculty through peer-to-peer learning and mentorship. Further, their vast experience and zeal to work has continued to inspire and develop the passion for nursing among the faculty. When the HVO volunteers observe lack of certain critical supplies for student's learning, they have often come with them in their subsequent visits. The HVO volunteers have not only supported the department in teaching and student supervision, they have also helped in the development of the Master of Nursing (Midwifery and Women's Health) curriculum (2008-2011). This program was the first clinical Masters in Nursing at Makerere University, Uganda in 2011. The HVOs were also involved in the operationalization of the curriculum for the first cohort and continue to participate in the teaching of this program.

One important feature of the partnership has been the ongoing relationship between several nurse volunteers and Ugandan nurse faculty members. This has been aided not only by the return visits to Uganda by many of the volunteers over 3- to 15-year time periods but also with the aid of technology such as email, Skype, and cell phones to sustain the partnership over time (4).

Further, the partnerships impact the HVO nurse volunteers in a variety of ways that are difficult to measure. First, in their trip report evaluations, they noted that the opportunity to live and work in a culture very different from their own culture and work environments expanded their understanding of cultural practices and health-care systems. Second, they learned to become more adaptable in planning nursing care due to the lack of material resources and technology they had been accustomed to at home. Finally, for some, the partnership fostered opportunities for research and scholarship.

Outcome measurement of the HVO/Uganda partnership in Kampala is complicated by the fact that the contributions have not been made in isolation. During the same time period that HVO nurse volunteers offered support to the Makerere University nursing faculty and Mulago National Referral Hospital clinical nurses, many other partnerships were operating as direct collaborations between academic or clinical partners throughout Africa as well. The capacity built by intra-continental collaboration as well as global partnerships all were influential in strengthening capacity. The long-term partnership with the Karolinska Institute

of Sweden included bilateral exchange for both nursing faculty and students alike as well as opportunities for support for higher education, research, and scholarship. The Bill and Melinda Gates Foundation "Partnership for Building the Capacity of Makerere University to Improve Health Outcomes in Uganda," a grant funded Collaborative Learning Initiative with Johns Hopkins University (14) provided both human and material resources over the 3-year grant cycle. Other opportunities for higher education, research partnerships, and program initiatives with a variety of eastern and southern African institutions also advanced the capacity of Ugandan nurses.

Recommendations and Future Implications

The examination of this case example of the partnership between HVO nurse volunteers and the academic and clinical nurses at Makerere University and Mulago National Referral Hospital in Uganda offers global health professionals lessons for future partnerships and program sustainability. Capacity building remains a high priority to build stronger academic programs (16). Spies et al. (17) report that clinical practice and nursing education are priority areas for nursing research and that research findings must be translated into practice and policy development to advance the profession and to improve health outcomes (17). One recommendation for future nurse volunteers would be to work with the Ugandan nurses for collaborative research and scholarship. Ugandan nurses and health professionals report that research priorities and research utilization in clinical practice are high priorities for future work (16, 17).

A second recommendation is that formal evaluation tools be developed by HVO for use with specific projects. These would support the evaluation measures currently in place (13, 14). This could include quantitative measures such as the numbers of educational offerings, attendees, curricular innovations, joint research projects, joint publications as well as post presentation surveys. In addition, subjective measures such as open-ended questionnaires, exit interviews, and other feedback would help demonstrate partnership effectiveness.

Finally, a pre-trip preparation tool to supplement the resources available on the HVO KnowNet link on the HVO website would be helpful for new volunteers in order to learn about ongoing projects and allow them to increase their effective contributions both while in country and as ongoing partners. The tool could include content areas for the new volunteer to complete related to history and culture of the host setting, health-care system information, and summary of host country ongoing projects with a focus upon components for successful partnerships in order for the volunteer to prepare fully for the assignment. Both the pre-trip and post-trip evaluation tools could be useful for all HVO projects across countries and professional disciplines.

CONCLUSION

The case example of the nursing partnership between HVO volunteers and Ugandan nurses in Kampala, Uganda, advances knowledge of partnership factors that promote successful

partnership and sustainability. Although outcome measurement is more difficult than for shorter term funded projects with defined goals and outcomes, the ability to sustain the partnership over almost two decades fosters greater potential for new innovations over time. Long-standing relationships between health professionals from visiting and host settings promotes the honesty and openness, clear communication, mutual trust, cultural respect, and strong involvement of host partners necessary for relationship building to create successful partnerships.

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Collaborating with Communities and Higher Education to Address the Health-care Needs of Individuals with Disabilities in Ecuador

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Individuals with disabilities experience inequities in access to health care, education, employment, and social inclusion. Causes for Change International (CCI), a non-governmental Organization (NGO), using a community-based rehabilitation approach has worked for 20 years to build self-sufficiency, improve health-care services, and education for women, children, and persons with disabilities in Ecuador. CCI initially addressed health; advocacy for individuals with disabilities; and promoted educational opportunities for children with disabilities, starting in one rural community. CCI's outreach has expanded through Ecuador's coastal provinces, Andean provinces, and Galapagos Islands. CCI also focused on local health-care workforce development, developing employment skills for individuals with disabilities and social inclusion for this population. CCI collaborated with local organizations, government, and universities to provide resources, managed by local leadership. Key program elements of the CCI approach include (1) develop trust between CCI, local communities, local agencies, and government; (2) empower local groups to assume leadership and sustain programs; (3) support communities and groups invested in developing self-sufficiency; and (4) strengthen collaborations and partnerships between local and international organizations, universities, and government agencies. Key lessons learned by CCI are to be supportive of cultural differences; understand that limited financial and material resources may limit the program development; recognize that it is difficult not to foster dependent relationships with communities and appreciate the importance of working with and within the host country's governmental systems. CCI is expanding its service base to other regions of Ecuador and is focusing on development of the Ecuadorian health-care workforce and social inclusion opportunities for individuals with disability. The efforts of a small NGO have helped build community self-sufficiency in meeting the health care and rehabilitation needs of all Ecuadorian citizens and a greater awareness of the abilities and potential contributions of individuals with disabilities.

Keywords: community-based rehabilitation, individuals with disabilities, health care, international collaborations, global health

INTRODUCTION

Global inequality in access to the health-care resources exists across the globe. Health care needs are the greatest in developing countries and in countries with significant proportions of their population living in rural areas. Health-care resources are difficult to access for indigenous populations and individuals with disabilities. Individuals with disabilities also experience inequities in

other aspects of life such as education, employment, and social inclusion. Health is defined as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (1). To most positively impact health of individuals with disabilities, all three of these domains of health must be addressed. Individuals with disabilities, in developing countries, face challenges both related to living in their country and with their disability. Access to health is impacted by economics, transportation challenges, decreased accessibility of buildings, limited understanding by health-care workers regarding health-care needs, and limited knowledge of individuals with disabilities regarding their rights and needs related to health care (2). Global efforts have focused on improving health and well-being of individuals in developing countries and often have involved multinational collaborations to meet the needs of all citizens of the world.

The community-based rehabilitation (CBR) approach was introduced and adopted by the World Health Organization more than 25 years ago, as a way to support and empower individuals with disabilities where access to support systems and rehabilitation might be limited. CBR programming strives to enhance health care, education, social inclusion, and employment opportunities, leading to an improved quality of life through collaborative efforts of multiple partners (3). The approach strives to help individuals with disabilities become contributing members of their communities. The five key components of CBR, called the CBR matrix, are health, education, livelihood, social inclusion, and empowerment for individuals with disabilities (3, 4).

Community-based rehabilitation programs are usually initiated by governments or by non-governmental organizations (NGOs). NGOs are not-for-profit, private organizations that have assumed a greater role in global health and development since the 1980s, providing private support to reduce poverty, improved health care, and assistance in supporting development, within low- to middle-income countries (5). Many NGOs focus on bringing services to communities with limited services and underserved segments of a society. Within the CBR model, stakeholders in local communities develop partnerships with the NGO or other umbrella group to bring quality services into the community, close to people's homes. Local partners take an active role in developing and supporting activities. Individual stakeholders and their families, community members, local agencies, and local government then collaborate with the outside NGO or governmental agency, ultimately assuming management of the CBR program. Through these partnerships, the umbrella agency, university, or NGO can provide mentorship for local partners. The mentorship and involvement of local stakeholders increases the sustainability of the CBR program (6, 7).

Important elements of CBR include acknowledgment and respect of local customs, establishment of community partnerships, and involving individuals with disabilities and their families into decision-making (3, 8). By respecting local customs and knowledge, CBR programs are more likely to become part of the community context. Working within the cultural framework helps the community see the contribution and needs of individuals with disabilities. Individuals with disabilities are empowered to become participants and valued members of the community.

When community partners are active in the development and implementation of CBR initiatives, program sustainability is enhanced (9). When individuals with disabilities and their families are involved in the decision-making, they become more active community members and gain leadership skills. Within the collaborations, it is important to recognize the goals of the local community and that all collaborators are equal partners in best meeting the needs of the community.

Ecuador, a geographically diverse country, has a population of approximately 16 million people, including several indigenous groups. Almost two-thirds of the people live in urban areas and one-third in rural areas (10). Until recently, most health-care services were available only in the largest cities. Over the past decade, the government has built infrastructure including hospitals and clinics. In the 1990s, the WHO identified Ecuador as having a high global burden of disease, with high child and adult mortality (11). From 1990 to 2015, significant improvements were made in lowering infant, child, and maternal mortality; improving sanitation and water supply; and reducing incidence of diseases such as malaria (9). In 2007, the Ecuadorian government worked to determine the number and needs of individuals with disability in the country. The government then began providing financial assistance for individuals with disabilities. Ecuador ratified the United Nations Convention on Rights of Persons with Disabilities in 2008 (12). Services, opportunities for education, and jobs for individuals with disabilities have increased, supporting inclusion of these citizens within their communities. The Ecuadorian government has also been instrumental in supporting training of the elementary education teachers and a highly skilled health-care workforce.

Causes for Change International (CCI), a NGO, was founded 20 years ago to assist the people of Ecuador build self-sufficiency and improve services related to health, education, and economic self-sufficiency for women, children, and persons with disabilities. CCI took a grassroots approach, working with local citizens in the poorest communities and helping build health care and community-based services. Early focus was on domestic violence, dentistry, and services to increase independence of individuals with disabilities. Through outreach, training, and partnerships with local organizations (elementary schools, community service groups, NGOs), government (local and provincial), community health centers and universities, CCI has built stronger communities, managed by local leadership. CCI now has collaborations with local and provincial government in several provinces, the Ministry of Inclusion, and public University system.

Causes for Change International educated the people who needed services unavailable in small, rural communities. As the citizens learned about improved health and self-sufficiency, they influenced and educated local government and organizations to gain support for projects. Involving local citizens in identification of solutions developed needed local leadership to implement and sustain services. Five dental clinics were set up in small towns, with CCI assisting in acquisition of necessary equipment and supporting young Ecuadorian dentists to practice in rural areas. Local involvement resulted in expansion of these clinics to include health care and rehabilitation services. Local health-care workforce development was targeted through continuing education

courses, taught by CCI volunteers. A school for children with disabilities was developed, and professional education programs in social work and physical therapy are being developed within a public university. The purpose of this case report is to describe the development of a sustained collaboration between CCI and Ecuadorian partners in improving the health, social inclusion, and quality of life for individuals with disabilities in Ecuador.

CONTEXT

Causes for Change International's initial outreach was to an economically challenged, rural community near the cities of Guayaquil and Milagro, Ecuador. These cities are part of Guayas province, but, in 1996, were not easily accessible by road from the community. This region, commonly referred to as the "coastal region" supports banana, plantain, cacao, and sugar cane production. Guayaquil is also a major shipping port. CCI expanded outreach through Guayas and eventually expanded through the "coastal region" to communities within Manabi province and other regions within Ecuador (see **Figure 1**).

Local citizens, supported by CCI, approached local businesses, agencies, and government to invest and improve the community.

The University of Milagro (UNEMI), a regional public university, became an early partner in these efforts. CCI worked with local leaders to establish locally run clinics and disability advocacy programs. These services were made available to individuals with disabilities, in the local community. CCI also became active in Azuay, Cañar, Chimborazo, Pichincha, and Santa Elena provinces and the Galapagos Islands.

Key Program Elements

The CCI approach has been centered on elements of: (1) developing trust between communities, CCI, local/regional services, and all CCI partners; (2) empowering local groups to develop, lead, and sustain programs; (3) focus on communities and groups that are invested in developing self-sufficiency; and (4) facilitating development of strong community partnerships. Development of trust has been reciprocal. Local communities needed to trust that CCI would be a consistent resource, not just a one-time event. CCI also needed to trust that the community would follow through and assume responsibility for initiatives. In addition, CCI needed to foster trust and respect between local communities, international volunteer teams, Ecuadorian service agencies, and providers. Local professionals and international volunteers

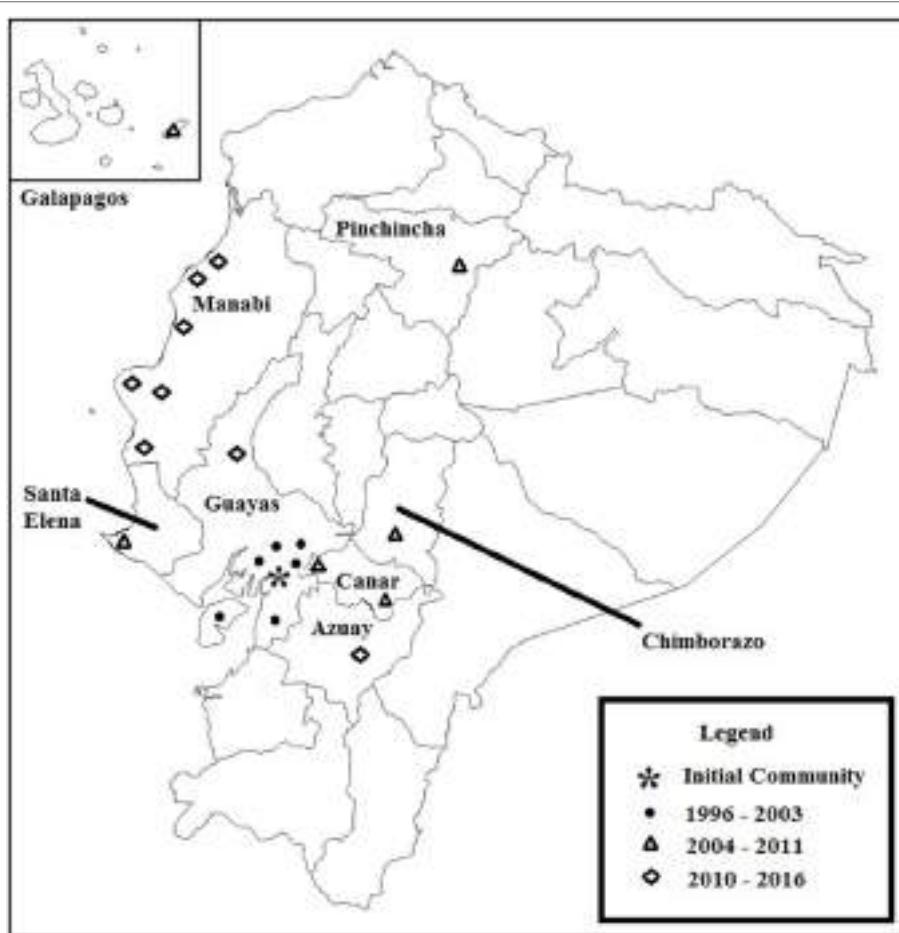


FIGURE 1 | Causes for change international involvement in Ecuador.

learned from each other, valuing each other's expertise. This professional interaction established local professionals as valued partners, reinforcing their ability to carry out community initiatives. When developing trust, it is also important to honor the cultures of the citizens and communities. Beliefs and cultures of members of indigenous communities, rural communities, and urban communities vary. In empowering local groups, CCI works with communities who have identified a need and asked for assistance. CCI mentors local community leaders to assume management of the efforts. CCI asks local hosts to assist with expenses related to local travel, housing, and meal costs for international volunteer teams, demonstrating a commitment by the community and building self-sufficiency of local groups. Sustainability is also strengthened by building local partnerships. For example, a school for children with disabilities was linked with a University to provide professional internships and student teaching opportunities. To meet a need for wheelchairs, CCI partnered with Free Wheelchair Mission involved engineering students from a state university to assemble all wheelchairs and helped chapters of the Lion's Club of Ecuador distribute the wheelchairs throughout the country. A local organization has now assumed responsibility of the relationship with the international organization regarding acquisition of additional wheelchairs.

Causes for Change International's activities have paralleled the components of the CBR matrix, focusing initially and primarily on health services and elementary education. These health services have included prevention efforts in improving sanitation; provision of needed dental, medical, and rehabilitation services; and providing access to assistive devices. Currently, CCI activities support development of a well-qualified local professional workforce. Consistent efforts have also focused on the empowerment component, through advocacy, communication, and support of organizations addressing the needs of individuals with disabilities. CCI has also participated in job skill development activities, supported employment of individuals with disability in the shipping and shrimp industries, and collaborated with local governmental service agencies to provide for the needs of individuals with disabilities. A timeline describing CCI initiatives and partnerships (**Table 1**) demonstrates the evolution of CCI activities and involvement, starting in one community and expanding across Ecuador.

The Early Years from 1996 to 2003—Identifying Needs and Building Local Leadership

Health Initiatives

Original CCI initiatives focused on serving populations in small, rural communities. Leadership training of local community members and education related to health and hygiene, domestic violence, and disability advocacy were provided. Local citizens solicited assistance from local businesses and local government, increasing awareness of local needs and the issues important to the community. General medical services in the initial community served were not readily available in the community. CCI volunteers (physicians, nurses, dentists, audiologists, educators) traveled to Ecuador 1–2 times per year to provide services and help link the community with local hospitals in Guayaquil and

Milagro. CCI volunteers (environmental engineer, teacher) also stayed for longer periods of time to support the local leadership in sanitation efforts and develop health, hygiene, and personal development skills at a local orphanage and schools.

Social Inclusion and Quality of Life Initiatives

Causes for Change International formed relationships with schools in Guayaquil for children with special needs, provided staff training at rehabilitation centers and assisted the local disability community in organization of a "Disabilities March" in Manta. Relationships were also established with a program for children with Down syndrome and continued support for a local orphanage was provided, creating a playroom with educational toys and a library.

Another main focus of CCI was development of a local leadership team. In 2001, a 6-week leadership training course was sponsored for individuals, personnel from local schools, and local organizations. By 2003, these local leaders urged CCI to assist them in incorporating an Ecuadorian division of CCI and Causas para el Cambio—Ecuador was incorporated.

The Middle Years, 2004–2011—Mentoring and Supporting Local Initiatives and Building Expanded Partnerships

Health Initiatives

Within this time period, Ecuadorian partners began initiating events and requesting support from CCI. CCI continued to bring volunteer providers (physicians, nurses, therapists, dentists, optometrists) to Ecuador every year, to meet basic needs of local populations. On one visit, CCI volunteers worked with a boy with bilateral lower extremity amputations, who had no means of mobility other than scooting on the ground. CCI leadership worked with provincial officials in Guayas and the local mayor to identify services for the child. A CCI volunteer brought a hand-propelled tricycle, donated by AMBUCS organization in the USA. CCI also initiated fund raising and made contact with a prosthetist in Quito so that the boy could receive prosthetic limbs. CCI brought donated equipment to help support the opening and operation of Ecuadorian run dental and rehabilitation clinics, bringing these health-care services to individuals with disabilities in their communities. Causas para el Cambio—Ecuador also implemented a new clean water initiative to help bring clean drinking water to areas where it was unavailable, improving health of the communities.

Social Inclusion and Quality of Life Initiatives

Causes for Change International continued to focus on the needs of individuals with disabilities and shipped containers of crutches, walkers, and wheelchairs to Ecuador. CCI met with the Ecuadorian government and was invited to help make Ecuador accessible for persons with disabilities. CCI participated in a disability conference for governmental agencies and NGO in Ecuador and provided training on disability awareness, inclusion of persons with disabilities, and universal design to education and medical personnel. CCI volunteers included physicians, architects specializing in accessibility, and disability advocates. Consultation was provided to the city of Milagro and UNEMI

TABLE 1 | Causes for Change International (CCI) community-based rehabilitation activities in Ecuador.

	1996–2003	2004–2011	2012–2016
Health: general health and hygiene	Community trash collection with local businesses asked for donations of gloves, brooms, etc. Hygiene (hand washing and dental health) curriculum in local schools and orphanage Domestic violence awareness	Partnered with CCI-Ecuador to bring clean drinking water to communities where it had not been available	Earthquake relief/response related to housing and health care
Health: provision of medical, dental, etc. services	CCI volunteers provided medical, dental, audiology services Donation of hearing aids for 500 children Establishment of partnership with local hospitals to provide cardiac surgery, craniofacial surgery, burn care to local children	CCI volunteers and local professionals provided medical and dental services to 7,000+ children, optometry services to 400 children Planned and implemented opening of 5 Ecuadorian dental clinics, donating dental chairs from USA	Supported development of University training programs for health-care professionals in social work, occupational therapy, and physical therapy Partnered with local non-governmental organization to provide medical, dental, and therapy services in Alausí, provide services in Canar
Social inclusion and quality of life	Formed relationships with (1) schools in Guayaquil for children with special needs; (2) program for children with Down syndrome Staff training at rehabilitation centers Disability awareness “Disability March” in Manta	Donated assistive devices (walkers, crutches, 500+ wheelchairs) Disability awareness, inclusion, and universal design training to special education, primary school teachers, education, and medical students; University of Milagro (UNEMI) and Milagro local government Disability conference for governmental agencies and NGOs in Ecuador Training at UNEMI, Naval and Military Hospitals Met with senior staff of Vice-President of Ecuador; CCI invited to work with government on making Ecuador accessible Begin development of Exploration Institute	Partnered with Free Wheelchair Mission -80 wheelchairs to Ecuador Accessibility and Universal Design Conference in Guayaquil Needs assessment of disability community in the Galapagos OT and PT Conference on Management of the Child with Cerebral Palsy Physical therapy consult/training for families of children with disabilities scheduled for orthopedic surgery (sponsored by CCI—Manabí) Develop national assistive device lending library, Bucay Presentations to families of children with Down Syndrome and professionals working with them in Quito Support (training, medical/dental/therapy services) to community built for individuals with disabilities in Milagro
Leadership development	Trained women in 26 km, local schools, and organizations Incorporated CCI component, CCI-Ecuador with local leaders	Causas para el Cambio—Ecuador established with its own volunteer board Provided support and mentoring to orphanage in Guayaquil to open bakery and help girls develop bread and pastry baking skills Hosted Ecuadorian delegations in USA for leadership training, disability awareness	Ecuadorian delegations and individual leaders visited USA sites to learn about access, professional education programs, and nutrition Supported existing CCI-Ecuador leaders and communities with Earthquake relief

regarding building of accessible ramps on campus and in city parks. The idea of developing an “Exploration Institute” for children and youth with disability was also introduced with local government and leadership in Guayas province. This institute would provide an opportunity for children and their families to enhance the child’s strengths and abilities while exploring nature and the environment.

Local leadership development continued with Causas para el Cambio—Ecuador establishing a volunteer board. CCI continued to provide mentorship and support to the Ecuadorian NGO, as it also developed branch organizations in Manabi province. The orphanage in Guayaquil, an early CCI partner, requested assistance in providing job training to the girls living in the orphanage so that they would have the skills to become self-sufficient. CCI provided them support and mentoring to open a bakery

business and develop bread and pastry baking skills. Partnerships were expanded to include: Ecuadorian and USA universities; Ecuadorian agencies and service organizations, service organizations in the USA, and several local government units (**Table 2**). In this middle period, CCI continued with a focus on the health and empowerment components of the CBR matrix, as well as with initiatives that addressed livelihood and social CBR components.

The Most Recent Years, 2012–2016: Supporting Local Leadership and Initiatives, Building Professional Workforce

Health Initiatives

Today, CCI’s reach has expanded to provide education and support to provincial governments, local hospitals, universities, and organizations throughout coastal and highland areas. Although

TABLE 2 | Partnerships fostered and developed with CCI.

Ecuador	USA and International	
Local agencies/NGO	Causas para el Cambio-Ecuador □ Manabi Instituto Perpetuo Socorro (orphanage) AVINNFA—school for children with disabilities Voluntad de Dios, Milagro, EC (accessible housing community) Lions Clubs—Ecuador (35 chapters) Foundation SOMAS Galapagos fire department Rotary Club of Guayaquil	CCI Starkey Foundation (hearing aids) Free Wheelchair Mission Manaaiki Foundation (mobile dental clinic funding) Nuestros Pequeños Hermanos Internaciona Encuentro Medico de Alausí Rotary Clubs of Cicero and Chicago, IL, USA
Local government	Mayoral offices in Manta, Jama, Ayampe, Canar (city of), Milagro, Bucay, Porto Viejo, Porto Lopez, Montichristi, Naranjal, Jipijapa, Bahia	Town of Cicero, IL, USA
Provincial government	Office of Prefectura—Manabi, Guayas	
National government	Office of the Vice-President re-accessibility and needs of individuals with disability Ministry of Inclusion—MIES	
Universities	UNEM University of Guayaquil Technical University of Manabi University of Agronomy, Naranjal, EC	University of Illinois at Chicago Dominican University, IL, USA Midwestern University, IL, USA

basic health services continue to be provided, new initiatives focus on helping to build health-care workforce capacity and services for individuals with disabilities. Workshops have been developed to provide advanced training to Ecuadorian health-care providers. Long-term partnerships have been established between universities in the USA (Dominican University and Midwestern University) and UNEMI to develop university-based training programs in social work, physical, and occupational therapy. When developing the social work program, CCI linked UNEMI and Dominican University to an elementary school for children with disabilities, increasing services for the students and their families. UNEMI has also integrated student internships and student teaching at the school, building the local workforce available to work with this population. Social work students from Dominican University have completed internships at the school and in Milagro, providing services within the community. These partnerships have also included faculty exchanges, visits to USA universities by Ecuadorian university administrators and faculty, and curriculum development.

In Spring, 2016, Causas para el Cambio-Manabi was supported by CCI in recovery efforts after a strong earthquake. CCI and Causas para el Cambio leadership began monitoring local needs immediately after the earthquake and CCI volunteers have assisted in building temporary shelters, as well as distribution of food and medication.

Social Inclusion and Quality of Life Initiatives

Collaborative international and local efforts have successfully provided wheelchairs, which were distributed throughout Ecuador. Partners included Rotary clubs (in the USA and Ecuador), Lion's Club-Ecuador, and the UNEMI. Another local

service agency has assumed responsibility for further acquisition of donated wheelchairs. CCI is assisting in the development of a national assistive technology lending library, acquiring a variety of equipment and developing policies and procedures to support the long-term viability of this library. CCI also participated in the Accessibility and Universal Design Conference in Guayaquil, providing volunteer faculty including architects specializing in accessible design, occupational therapists, and disabilities advocates. CCI has hosted a delegation of Ecuadorian community leaders to visit Chicago, where they were able to learn more about providing access for individuals with disabilities.

Causas para el Cambio-Manabi has asked CCI for support in initiating new economic opportunities along the coast that would provide social inclusion in sports, leisure, and recreation activities for individuals with disabilities and build tourism. CCI and Causas para el Cambio began working with Olas para Todos (Waves for All) and the Office of Tourism in developing a surfing program, which would (1) enhance the abilities of children and adults with disabilities to encourage participation, (2) provide internship opportunities for university students majoring in the health professions to work in this specialized field, and (3) create programs to increase tourism in the area. These most recent initiatives continue to support the CBR matrix components of health, education, social inclusion, and empowerment of individuals with disabilities.

As local leadership assumes primary responsibility for efforts in Guayas and Manabi provinces, CCI has expanded the geographic scope of its CBR efforts in Ecuador. A needs assessment of the disability community in the San Cristobal Island, Galapagos was completed by USA volunteers. Presentations were made to service organizations in Quito serving children with Down

syndrome and their families and children with cerebral palsy. Health services and training were provided in highland areas of Alausí and Cañar, and a formal partnership with the local government of Cañar has been established.

DISCUSSION

Over the past 20 years, CCI has noted improved awareness of the needs, abilities, and potential contributions of people with disabilities in Ecuador, as well as availability of services. Letters of agreement and collaborations were developed between CCI and local communities, provinces, local agencies, and a public university. CCI is discussing a collaboration with the Ministry of Inclusion of Ecuador, partnering with Universities to develop health-care education programs and provide continuing education resources for practicing professionals. CCI's CBR initiatives have evolved from partnering with one small, poor community and have expanded across Ecuador.

Local leadership development has been demonstrated by the formation of Causas para el Cambio—Ecuador, with a provincial chapter in Manabí, and identification of local representatives in several communities. Local dental and health clinics have been developed and continue to operate in several communities. Not all efforts have been sustained. In one community, training and donation of school supplies were part of initial interactions. The community requested help in developing a park, but after several visits by CCI, the local community did not make progress in this planning and, instead, requested continuing financial assistance from CCI. Because the local community did not appear to be able to assume responsibility for development of the initiative, CCI was unable to continue to work with the group. Changes in local government have also led to dissolution of programs, despite community support for them. In a recent election cycle, new local government officials closed one of the dental and rehabilitation clinics, claiming the newly refurbished, accessible space as the local government office space.

Practical Implications and Key Lessons Learned

CCI's 20-year experience in Ecuador has demonstrated that individuals with disability have a desire to be active in their communities. For this to occur, CCI has learned that community participation starts within the family. Family acceptance of the family member with disability is important, but often limited by family belief systems and embarrassment. Families need support to appreciate the role and value of the family member within the family unit and community. As families feel more empowered to bring individuals with disability into community activities, community beliefs regarding the value of the individual to the community are also enhanced. Community education efforts assist in the inclusion of individuals with disabilities in the community. Increased community engagement and understanding of the needs and contributions of individuals with disability then lead to enhanced local government support.

The CCI experience has also shown that local leadership, with support and mentoring, can develop and implement

community services. Today, local leaders are successfully assessing community needs and mobilizing resources to provide needed services.

In thinking about the programs that have been sustained and those that have not achieved self-sufficiency, CCI has learned some key lessons. An important lesson learned was that foreign NGO's may not understand local customs, culture, and resources, bringing unrealistic expectations of local communities (6). It is very important to be supportive of cultural differences in management of time and organizational structures. Foreign volunteers need to be patient as timelines are often extended. It may also be difficult to identify and work with appropriate personnel within agencies and government. The reliability of systems of communication may be an issue. Although frustrating for many foreign volunteers, these factors reflect the culture within which they are volunteering.

Non-governmental organizations and volunteers must understand that limited financial, human and material resources may limit the program development. Although many partners may be willing, it is difficult to connect with professional support to move a project forward. For example, CCI volunteers were unable to find local surveyors, when trying to select land for the Exploration Institute, resulting in postponing the project. CCI had also supported land use and flora and fauna studies in another community, but as that community began to appreciate the benefits of increased tourism and the value of that land, it became unavailable for the Institute. CCI has also learned that a sufficient number of local, well-trained professionals to staff and volunteer at the Exploration Institute may not be available. Until a larger local workforce can be developed, it may be difficult to implement the project. These experiences have led to a modification of the original vision for the Exploration Institute, to better meet community needs. It may be possible to achieve the original goal of the Exploration Institute by supporting multiple local efforts to increase social inclusion opportunities for individuals with disabilities, while allowing them to enhance their strengths and abilities. One example of a local program that has the potential to foster economic development and tourism in the community, while providing opportunities for individuals with disabilities in the surfing program being developed in Santa Elena.

Another important lesson has been to recognize the importance of working with and within the host country's governmental systems. Understanding the local, regional, and national governmental system assists in helping individuals with disabilities access resources. Positive collaborative relationships with governmental agencies and officials also support effective utilization of NGO and local resources. When working with the government on national and local initiatives, the NGO can be supportive and improve effectiveness in meeting the needs of the citizens, but must also be clear that they do not support any specific political party. The NGO should clearly communicate that there is no political or government affiliation, which is important for establishing and maintaining trust with the local community. Both governmental and community CBR efforts are important. Programs sponsored by government may have more

TABLE 3 | Recommendations to meet the needs of individuals with disabilities and their families within their communities.

Recommendations	
Health	<ol style="list-style-type: none"> Initially, need to evaluate needs of communities and individuals with disability within the community <ul style="list-style-type: none"> Provide individual patient care and screenings with volunteer providers Link individuals with special needs with local and regional resources <ul style="list-style-type: none"> Meet needs of individuals Build awareness among local resources related to needs of individuals with disabilities Support local health-care workforce development <ul style="list-style-type: none"> Continuing education programs Professional preparation programs in university settings
Social inclusion	<ol style="list-style-type: none"> Empowerment of individuals with disabilities <ul style="list-style-type: none"> Build positive self-concept Build confidence related to abilities for individual, family, and community participation Work with families if individuals with disabilities <ul style="list-style-type: none"> Address issues related to feelings of guilt, cultural beliefs, and values Build awareness of the role and value of the individual with disability within the family and community Work with community related to: <ul style="list-style-type: none"> Needs of individuals with disability Potential role and contribution of individual with disability Issues related to access Include individual with disability and their family in identifying and implementing solutions
Quality of life	<ol style="list-style-type: none"> Help individual with disability, their family, communities assume leadership roles in meeting the needs of all citizens <ul style="list-style-type: none"> General health and hygiene issues Access issues Recreation and leisure time activities Foster collaboration between local and regional resources to meet health care, recreation, employment opportunities for individuals with disabilities and their families

resources and reach a broader area, making them more sustainable. Community-run programs may be more effective in difficult (rural or indigenous settings) and invoke greater community participation and ownership. For these reasons, it is important to support collaboration and partnerships between the government and community groups (3).

Finally, it is very difficult to avoid dependent relationships with communities. In situations where resources have been limited, local communities may see free services as a new resource. It may be difficult to help the community appreciate that developing the skills to be self-sustaining is the worthwhile outcome. Local leadership may also desire to maintain a dependency upon the NGO partner. This may be related to local customs and beliefs regarding advocacy and leadership, or may reflect poor self-assurance that the local community can proceed without significant support. If local leadership cannot be mobilized, it may be better for the NGO to move support to another community to maximize potential for developing local self-sufficiency. CCI actively tries to provide support only in the early stages of project implementation. For most projects, the community leaders are very effective in helping the programs thrive.

Conceptual and Methodological Constraints

Non-governmental Organizations should be cautious about overextending themselves. As CCI became more well known, multiple requests were made for assistance. After collaborating with international and local health-care resources to provide services to a child with severe burns, CCI found itself partnering with local firefighting groups to help them obtain equipment and training. While this does support the health and safety of citizens in the community, these initiatives did significantly expand the CCI scope. Other countries also sought assistance. It was difficult to maintain original focus of CCI, requiring CCI leadership to review the mission and purpose of the organization.

An NGO needs to develop its infrastructure to ensure sustainability. CCI's structure now includes CCI and Causas para el Cambio-Ecuador, with international and Ecuadorian volunteer corps. Over the past 20 years, CCI has built a substantial Ecuadorian leadership base. Initially, significant efforts were made to help individuals appreciate the concept of volunteerism and the satisfaction and personal growth that comes from being a volunteer. It was often felt that foreign volunteers were wealthy and that was why they could volunteer. Local volunteers now give of themselves, not because they are wealthy, but because they believe that volunteerism is a good way to support their country and humanity. Ecuadorian volunteers are now mentoring and supporting additional volunteers.

The growth and success of CCI's Ecuadorian initiatives has also brought challenges related to the level of volunteer expertise needed to meet the community's needs. As CCI has seen local communities become more self-sufficient in meeting basic health care and educational needs of individuals with disabilities, the CCI leadership has needed to reach out to volunteers with different types of expertise to meet the challenges of developing community accessibility, workforce development, and national advocacy.

Causes for Change International has never focused on financial growth of the organization. Trips to Ecuador are self-funded by the international volunteer team and economical travel plans are maintained. Even with this, CCI has had to build a small fund-raising base to cover operational expenses such as phone bills, Internet costs, web page development, local travel, and board meetings. This type of fund raising takes significant time and effort, but is very necessary.

CONCLUSION

During the 20 years, CCI has been working within Ecuador, the national government has greatly enhanced the country's infrastructure related to transportation and health care, making access to services and mobility through all regions of Ecuador possible. As monitored by the World Health Organization, improved health, economic, and health-care workforce status has been seen from the 1990s to present (8). CCI is fortunate to have been working in Ecuador at this time and has hopefully helped services reach the rural, indigenous, and poor communities of Ecuador. In 2017 and beyond, CCI hopes to contribute to implementation of

the adaptive equipment lending library for the country, development of the Exploration Institute, expansion of efforts to build disability awareness and inclusion of individuals with disabilities in community activities, recreation, and leisure activities. CCI would like to work with local leaders in the Galapagos Islands and other regions of Ecuador to better meet the needs of individuals with disabilities. In addition, CCI hopes to partner with agencies and universities to facilitate advanced continuing education courses, develop professional education programs, and to assist in local faculty development.

The methodology and approach that CCI has followed when working with communities meets the ethical considerations of a CBR approach, which is important to support fairness and social justice in providing needed services to people with disabilities (8). The Ecuadorian government also supports a CBR approach to best serve the needs of the citizens of Ecuador and is requesting all health-care provider education programs to include a CBR experience. Recommendations for strategies to help meet the needs of individuals with disabilities and their families within their communities are summarized in **Table 3**.

The efforts of CCI have helped build community self-sufficiency in meeting the health care and rehabilitation needs

of all Ecuadorian citizens and a greater awareness of the abilities and potential contributions of individuals with disabilities. Local leadership has been developed that supports improved health conditions in local communities. This leadership has become an important part of the community and has demonstrated its resilience as some communities are faced with challenges following recent earthquakes.

The CCI Mission states: it starts with one ... but it grows into something amazing: a thriving, vibrant community, a changed nation. CCI has had the good fortune to partner with strong local partners in Ecuador and a visionary government supporting improved resources and quality of life for individuals with disabilities.

AUTHOR CONTRIBUTIONS

Both authors (DC and ZA) fully contributed to the conception and design of the manuscript. DC drafted the work and ZA and DC critically reviewed and revised the work. Both DC and ZA gave final approval of the submitted manuscript and agreed that they are accountable for all aspects of the work related to accuracy and integrity.

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The Guatemala-Penn Partners: An Innovative Inter-Institutional Model for Scientific Capacity- Building, Healthcare Education, and Public Health

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Population health outcomes are directly related to robust public health programs, access to basic health services, and a well-trained health-care workforce. Effective health services need to systematically identify solutions, scientifically test these solutions, and share generated knowledge. The World Health Organization (WHO)'s Global Healthcare Workforce Alliance states that the capacity to perform research is an essential factor for well-functioning public health systems. Low- and middle-income countries have greater health-care worker shortages and lower research capacity than higher-income countries. International global health partnerships between higher-income countries and low-middle-income countries aim to directly address such inequalities through capacity building, a process by which human and institutional resources are strengthened and developed, allowing them to perform high-level functions, solve complex problems, and achieve important objectives. The Guatemala–Penn Partners (GPP) is a collaboration among academic centers in Guatemala and the University of Pennsylvania (Penn), in Philadelphia, Pennsylvania that echoes the vision of the WHO's Global Healthcare

Abbreviations: CME, continuing medical education; EM, emergency medicine; FIC, Fogarty International Center; GPP, Guatemala–Penn Partners; GHI, Guatemala Health Initiative; IGSS, Institute of Guatemalan Social Security, Instituto Guatemalteco de Seguridad Social; INDERMA, Instituto de Dermatología y Cirugía de Piel; IRB, institutional review board; LMIC, low- and middle-income countries; MPH, Masters of Public Health; MSCE, Masters of Science in Clinical Epidemiology; MOH, Ministry of Health; NIH, National Institutes of Health; NCD, non-communicable disease; NGO, non-governmental organization; RCR, responsible conduct of research; USD, United States dollar; USA, United States of America; UFM, Universidad Francisco Marroquín; USAC, Universidad San Carlos; UVG, Universidad del Valle de Guatemala; URL, Universidad Rafael Landívar; Penn, University of Pennsylvania; WHO, World Health Organization.

Workforce Alliance. This article describes the historical development and present organization of the GPP according to its three guiding principles: university-to-university connections, dual autonomies with locally led capacity building, and mutually beneficial exchanges. It describes the GPP activities within the domains of science, health-care education, and public health, emphasizing implementation factors, such as sustainability and scalability, in relation to the guiding principles. Successes and limitations of this innovative model are also analyzed in the hope that the lessons learned may be applied to similar partnerships across the globe.

Keywords: Guatemala, global health, capacity building, scientific diplomacy, partnership

INTRODUCTION

Health is improving more slowly in many low- and middle-income countries (LMIC) than in nations with more resources, increasing health disparities around the globe (1). Population health outcomes are directly related to robust public health programs, access to basic health services, and a well-trained health-care workforce (2). Therefore, the World Health Organization (WHO) recommends that a country maintain no less than 2.28 workers per 1,000 population in order to achieve basic health-care coverage (3). Based on this statistic, there is a global shortage of 2.4 million doctors, nurses, and midwives (3). As the burden due to non-communicable diseases grows in LMIC, this shortage will become a major limitation for expanding the scope of health systems to address health needs (2).

The improvement of public health systems goes beyond increasing the number of health workers. Effective health services need to systematically identify, develop and test solutions, and finally share and apply the generated knowledge (4). Therefore, the WHO states that the capacity to perform health research is an essential factor of public health systems (1). Unfortunately, LMIC have extremely low expenditures in research compared to higher-income countries and the density of researchers per population is 1,000 times lower than in developed nations (4). Global health partnerships between higher-income countries and LMIC aim to directly address such inequalities by building capacity, a process by which human and institutional resources are strengthened and developed, allowing them to “perform functions, solve problems and achieve objectives” (5).

The Guatemala–Penn Partners (GPP) is a collaboration among academic centers in Guatemala and the University of Pennsylvania (Penn), in Philadelphia, Pennsylvania that echoes the vision of the WHO’s Global Healthcare Workforce Alliance (6). This article describes the historical development and present organization of the GPP according to its three guiding principles: university-to-university connections, dual autonomies with locally led capacity building, and mutually beneficial exchanges. It discusses the implementation of activities in the domains of science, health-care education, and public health in relation to such guiding principles. We analyze the successes and limitations of this innovative model with the hope that the lessons learned may provide a useful model for similar partnerships across the globe.

BACKGROUND AND RATIONALE

Guatemala is a multilingual and multicultural Central American country with 22 ethnic groups that speak 23 separate indigenous languages in addition to Spanish. Forty percent of its population is ethnically indigenous Maya and the rest are non-indigenous or of mixed indigenous and European ancestry (7). Although Guatemala is a LMIC, most of Guatemala’s indigenous, rural populations live on less than one United States dollar per day (8, 9). Health disparities, poor education, and racial discrimination disproportionately affect the indigenous and rural populations (10, 11). Guatemala’s first democratic elections were held in 1985 during a civil war that lasted 36 years. Although the Peace Accords were signed in 1996, the country continues to be affected by political instability, corruption, and slow moving institutions (11, 12). The rates of interpersonal violence still remain one of the highest in the world outside of active theaters of war (12).

Guatemala is currently undergoing an epidemiologic transition in which it continues to struggle with communicable, maternal, neonatal, and nutritional issues while facing new epidemics of non-communicable illnesses and injuries that are some of the highest in the world (13, 14). Adding further challenge to the poor health predictors, there are only 1.25 health workers per 1,000 population in Guatemala, a number that is significantly lower in the rural areas, the lowest in Central America, and approximately half of the WHO recommendations (15).

Guatemala’s training institutions for health-care and scientific education consist of one public university and seven private universities. In 2005, the Interinstitutional Commission of the Academic and Health Sectors was formed with the goal of improving Guatemalan public health by leveraging public and academic resources (16). However, the national expenditure in research and development is one of the lowest ones in Central America and the number of researchers and scientific publications is significantly lower than many other Latin American countries (17).

The Penn is located in Philadelphia, United States of America (USA), a city affected by socioeconomic and health disparity challenges akin to those of Guatemala. Philadelphia has some of the worst health indicators, poverty, and violence rates of the largest USA cities. Over 40% of its population is ethnically Black non-Hispanic and the remainder is Asian, Hispanic, and White (18). Black populations in Philadelphia are medically

underserved and disproportionately affected by socioeconomic and health challenges such as premature death, smoking, diabetes, and violence (18).

DESCRIPTION OF THE CASE

Historical ties between Guatemala and Penn have existed for almost a century. Beginning in 1930, scholars from Penn traveled to Guatemala to study its culture, linguistics, and ancient artifacts. In 1970, the Penn Museum developed the “Pennsylvania Declaration” which worked to end the practice of removing native archeological objects from their countries of origin, including Guatemala (19). The declaration established as an ideal the responsibility of the researcher to respect the autonomy of the studied country. Although imperfect in practice, the declaration served an important function in laying a foundation of integrity upon which the collaboration of the GPP program rests.

Building upon this important doctrine, a group of orthopedic surgeons from Penn and one of the private Guatemalan universities, Universidad Francisco Marroquín (UFM), created an exchange program for medical residents during the 1980s. Its purpose was to promote experiential and knowledge interchange among Penn and Guatemalan medical residents, with a focus on violence and injury, as Guatemala was recovering from a civil war. Participants used to visit and practice medicine for a short period of time at one of the Guatemalan public hospitals or at one of the Penn health centers. A group of Penn academicians and Guatemalan individuals recognized the importance of added scientific collaborations to such exchanges and endowed the partnership with a renewed emphasis on scientific and health capacity building.

As a result, in 2005, the GPP was founded, with the participation of UFM, Universidad de San Carlos de Guatemala (USAC), the public Guatemalan University, and Penn. To formalize the partnership, Memoranda of Understanding were signed among the participant institutions. In addition, two faculty members, one from UFM and one from USAC, were contacted by Penn to represent and run the GPP in Guatemala. Continuing the focus on violence and injury, the first of three National Institutes of Health (NIH) Fogarty International Center (FIC) Training grants were obtained, which facilitated the training of the first cohort of Guatemalan scientists. As the GPP gained support and credibility, additional individuals representing multiple disciplines and university departments in Guatemala and at Penn became active participants, creating new interventions, and collaborating with existing ones. Ten years later, two other private Guatemalan universities, the Universidad del Valle de Guatemala and Universidad Rafael Landívar entered the GPP. In addition, the GPP maintains a connection with the Guatemalan Ministry of Health (MOH) through USAC and collaborates with multiple municipalities, private and public hospitals, the Instituto Guatemalteco de Seguridad Social Institute of Guatemalan Social Security health system, and non-governmental organizations (NGOs).

The GPP today is a multidisciplinary platform that facilitates communication among professionals in public health,

anthropology, business, dentistry, engineering, medicine, nursing, nutrition, and other domains of the arts and sciences. The GPP echoes the vision of the WHO’s Global Health Workforce Alliance strategies of partnerships and health-care education (2, 6).

METHODOLOGICAL ASPECTS

The GPP is founded on the principles of university-to-university connections, dual autonomies with locally led capacity, and mutually beneficial exchanges. The partnership promotes collaborations within the domains of scientific capacity building, health-care education, and public health. **Figure 1** provides an overview of the principles, main partners, and initiatives of the GPP. **Table 1** shows the starting year, priorities, and main entity targeted by the GPP initiatives.

Central Principles of the Guatemala–Penn Partners Program

University-to-University Connections

The GPP is principally based on university-to-university connections rather than on interactions with non-academic, government, and NGOs. This is a key principle because universities tend to have historically established and ongoing stability that is often lacking in other types of institutions. Universities tend to be more resistant than other national institutions to political changes or fluctuations in funding. As such, universities are often enduring partners and university-to-university connections may lead to more sustained, long-term relationships. Additionally, universities facilitate the participation of individuals and departments from multiple disciplines, allowing for the creation of initiatives that follow a diverse range of methodologies that complement and synergize each other.

Dual Autonomies with Locally Led Capacity

The GPP methodologies involve recognizing the local capacity and respecting the autonomies of the parties involved. Recognizing the local capacity involves the identification and appreciation of the local human and institutional resources. The GPP accomplishes these goals by operating under the principle of dual autonomies, which means that Guatemala’s and Penn’s respective resources remain under intrinsic control. Each party may therefore choose to share resources, emphasizing the continued autonomy of the local owner, and resources will never be taken without permission. In addition, the principle of dual autonomies means that each of the parties involved is independent and self-controlled. Through this method, the GPP echoes the Pennsylvania Declaration’s premise that the best and most sustainable scientific collaborations respect the local capacity by assuring the autonomies of all partners.

Mutually Beneficial Exchange

The principle of mutual exchange refers to the concept that all GPP participants benefit from the sharing of ideas, spaces, cultures, and resources to promote scientific and health-care

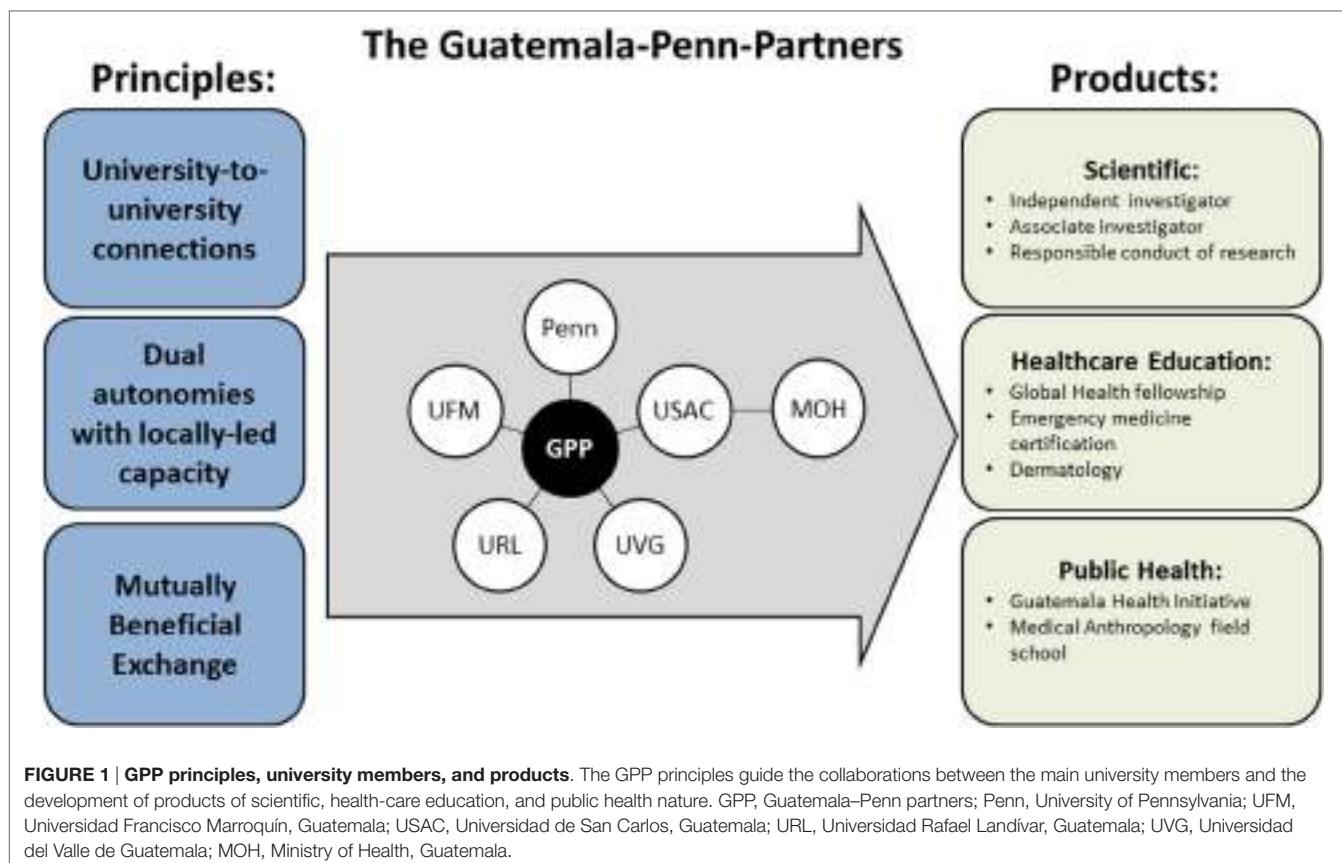


FIGURE 1 | GPP principles, university members, and products. The GPP principles guide the collaborations between the main university members and the development of products of scientific, health-care education, and public health nature. GPP, Guatemala–Penn partners; Penn, University of Pennsylvania; UFM, Universidad Francisco Marroquín, Guatemala; USAC, Universidad de San Carlos, Guatemala; URL, Universidad Rafael Landívar, Guatemala; UVG, Universidad del Valle de Guatemala; MOH, Ministry of Health, Guatemala.

TABLE 1 | GPP initiatives.

Domains	Initiatives	Start	Priority	Main entity targeted
Scientific	Independent investigator	2006	Research and public health leadership development in Guatemala	Individuals and universities
	Associate investigator	2006	Research user training in Guatemala	Individuals and universities
	RCR	2014	RCR development in Guatemala	Individuals and universities
Health-care education	Global health fellowship	2013	Global health training for University of Pennsylvania (Penn) PCP	Individuals
	Emergency medicine (EM) certification	2017	Institutionalization of EM residency in Guatemala	Universities and Public Health Hospitals
	Dermatology	2010	Dermatology training and cultural exchange for Penn and Guatemalan residents	Individuals and health-care facilities
Public health	Guatemala Health Initiative	2005	Development of community-based health interventions in rural Guatemala	Individuals, health-care facilities, and communities
	Medical Anthropology Field School	2005	Multidisciplinary research training for Penn students	Individuals

The GPP initiatives, classified within the scientific, health-care education, and public health domains, address health priorities in Guatemala or at Penn and target unique entities.

RCR, responsible conduct of research; PCP, primary care providers.

capacity. This principle acts to ensure that benefits are accessible to “all its parties, at every level” (19). In recognition of the similarity of issues faced by Penn and Guatemala’s communities, the GPP therefore believes that each exchange has the potential to serve as a mutually beneficial learning opportunity for each party as they study and attempt to correct shared issues. While the GPP does acknowledge the disparity in resources either party has in order to face such struggles, this approach encourages constant bilateral learning and exemplifies the respect each partner holds for the other. There must be a mindset of readiness to contribute and learn from the challenges of the partner institutions and countries. It is important to note that the academic and educational resources that Guatemalan institutions may receive from their northern partner may be equaled or exceeded by the benefit for the USA institution of the opportunity to work in a low-middle-income country and build its reputation in the field of global health.

Guatemala–Penn Partners’ Initiatives in the Domains of Scientific Capacity Building, Health-care Education, and Public Health

Scientific Initiatives

Independent Investigator Program

The mission of the independent investigator program is to prepare Guatemalan researchers and public health professionals for successful careers as principal investigators and

program leaders. By focusing on chronic illnesses or injury and violence, this 2-year program targets the main causes of morbidity and mortality in Guatemala. Candidates consist of motivated physicians and other clinicians who are seeking to access higher education that is currently unavailable in Guatemala in order to advance their careers. During the first year of the program, students enroll and complete the course load of the Masters of Science in Clinical Epidemiology or the Masters of Public Health (MPH) departments at Penn. Simultaneously, participants must plan a research thesis relevant to health within Guatemala and are assigned a mentoring team. Students return to Guatemala during the second year of their training to implement the research project and embark on fieldwork. They receive a Penn diploma upon completion of their thesis.

The independent investigator program is designed to promote careers in research. By fostering such careers, it is hoped that research capacity will be built in a sustainable and self-perpetuating manner. Trainees are instructed in scientific and grant-writing instruction, presentation skills, and responsible conduct of research (RCR) training. Since its initiation in 2010, a dozen Guatemalans have been trained as independent investigators, producing almost 20 peer-reviewed publications. One GPP Fogarty trainee also received the Lancet Outstanding Global Health Research Project of the Year in 2011 for his cross-sectional time series study of violence and mental health during and after the civil war using data from the Guatemalan mental health survey (20).

Associate Investigators

The associate investigator certification seeks to train Guatemalan health researchers through a part-time program taught in Guatemala over 6 weeks. Participants include health workers, educators, and managers. Courses are taught in Spanish by USAC, UFM, and Penn faculty, as well as previous independent investigators. Participants learn about biostatistics, epidemiology, RCR, and appraisal of the scientific literature. Three dozen Guatemalans have participated in this program, including two university deans and a university president. Associate investigators may complement their professional careers with research skills or may choose to have collaborative roles in research.

Responsible Conduct of Research

The RCR program aims to develop a research ethics knowledge base in both Guatemalan Universities and Penn. It seeks to professionalize the capacity of institutional review boards (IRBs) in Guatemala and to enhance the sensitivities of the Penn IRB to the RCR in low-middle-income nations. The program trains USAC and UFM faculty, graduate students, and staff in RCR, teaching, and evaluation to build educational programs at the Guatemalan universities. It is also training a cohort of Guatemalan IRB administrators. Enrolled fellows receive basic RCR training in Guatemala, followed by a 6-month fellowship at the Human Research Protections Program at Penn. Upon their return to Guatemala, fellows participate in a field practicum at a local IRB. Dozens of Guatemalan have additionally been trained by this NIH FIC grant.

Health-care Initiatives

Global Health Fellowship in Comprehensive Health

The Department of Family Medicine and Community Health at Penn created the Global Health Fellowship in Comprehensive Health, in concert with the GPP, in 2013. This fellowship aims to develop clinical, educational, and leadership skills in the care of underserved patient populations in the western highlands of Guatemala and in Philadelphia. Primary care physicians from the USA can enroll in a 1- or 2-year program. Fellows enrolled in the 1-year track receive a global health certificate. The 2-year program provides an MPH degree with a concentration in global health. Both tracks require equal periods of clinical service in Guatemala and Philadelphia. This way, fellows experience the culture of both places and can elect to participate in local educational activities or research projects related to their interests. Fellows receive training at Penn through the MPH program, and serve as educators in the international educational exchange program in the Hospitalito Atitlán for Guatemalan physicians most of whom are not residency trained. To date, four fellows have been enrolled.

In addition, a continuing medical education course taught at Hospitalito Atitlán provides cultural immersion and medical Spanish for health-care providers from the USA and opportunities for cultural exchange and clinical lectures for the Guatemalans. Courses include medical terminology, Guatemala health-care systems, health-seeking behavior among Guatemalan Mayans, and impact of the history of violence and social disruption on health. Course teachers include a Mayan physician, language educators from Guatemala and USA physicians.

Emergency Medicine (EM) Certification

Penn's Department of EM has been involved with the Guatemalan health-care initiatives since 2003 in the form of teaching missions and disaster relief efforts (21). Through continued interactions, it was recognized that emergency treatment in Guatemalan regional hospitals was often led by providers in their senior year of medical school or in their first year out of residency. In larger teaching hospitals, providers come from a wide array of medical fields and have limited EM career experience. By contrast, EM as a medical specialty has been established since the 1970s in the USA and providers receive postgraduate residency training in the management of a diverse range of undifferentiated emergency illness.

In order to increase emergency care in Guatemala, Penn faculty had ongoing interactions with leading physicians, mostly at USAC, about the need for EM certification in Guatemala. Guatemalan and Penn staff have discussed the history and current needs and practices of emergent care in their respective settings. Frameworks were discussed to make EM a formal department, and Penn faculty members were given Affiliate Professor appointments at USAC, according them with official status as teachers and eligibility for clinical practice in Guatemala. Since then, partnerships have been forged with other USA entities interested in global health and international EM, including Wayne State University in Michigan, the International Section of the American College of Emergency Physicians, and the International Federation of Emergency Medicine.

From among the group of physicians currently working in emergency services in Guatemala, leaders from surgery and pediatrics have volunteered to be the directors of the USAC EM residency program. In its special role as the only medical licensing agency in Guatemala, USAC has approached the MOH and the Social Security Institute for approval of the new specialty as well as for funding of EM residency training slots. In support of this effort, the USA government has awarded a nine-month Fulbright Scholarship to allow for an extended period of activity in country for the purpose of curriculum development, training the first group of residents, mentorship of faculty members, mechanisms for specialty certification, establishment of a specialty society, and arrangement for meetings. At the time of the writing of this article, the matriculation of the first class of EM residents is anticipated in 2017.

Dermatology

In 2010, faculty of Penn's Department of Dermatology established a partnership between Penn and the Instituto de Dermatología y Cirugía de Piel (INDERMA), the sole dermatology residency program in Guatemala. Through this program, INDERMA residents and attending physicians rotate through Penn's clinical settings. In addition, each year two Penn dermatology residents, and two attending physicians, join INDERMA staff and residents to establish a week of clinics in rural communities in the Western Highland of Guatemala. The first rural clinic delivered dermatologic care to over 300 patients in seven sites. In addition, Penn helped to develop a teledermatology system, through which Guatemalan physicians are able to use smart phones to exchange medical information from one site to another, as well as with physicians in the US and at Penn. The goals of this technology are to develop a network between INDERMA, other Guatemalan dermatologists, and Penn dermatologists to share difficult cases, assist in dermatology teaching in Guatemala, provide access to dermatology services in the rural clinics of Guatemala, to encourage further collaborative research, and to provide exposure to dermatologic pathologies uncommon in Philadelphia.

Public Health Initiatives

Guatemala Health Initiative (GHI)

The GHI was founded in 2005, becoming the local, community-based arm of the GPP. Health interventions are based on community health surveys and mixed-methods evaluations that are performed by a partnership between Penn and communities in the Western Highlands of Guatemala. The GHI works with local NGOs and municipalities to perform locally relevant public health projects and train Guatemalan and USA students in community health assessment and research skills. Specifically, Penn has partnered with the Hospitalito Atitlán, a local non-profit hospital that closed during the civil war and was decimated by repeated mud-slides, but that has now been rebuilt and re-opened. Community assessments have revealed that diabetes and other non-communicable illness are reaching epidemic levels. In response, a team of local health-care workers and Penn faculty, supported by the World Diabetes Foundation, initiated a longitudinal program that aims to improve diabetes care through improved prevention, diagnosis, and treatment (22). Other community efforts

address questions related to asthma, indoor air pollution, water and sanitation, skilled birth attendant training, and health-care strategic planning and networking. Through the GPP, numerous medical providers, undergraduate and graduate students from Penn, and some intermittent students from USAC and UFM have offered health services at Hospitalito Atitlán. The GHI has worked in three rural areas in Guatemala including: the Municipality of Santiago Atitlán at the Hospitalito Atitlán, the public health center in Comalapa, and the Clínica Bárbara in San Juan Sacatepéquez.

Medical Anthropology Field School

One of the primary activities of GHI has been an annual 10-week field school in medical anthropology, which mostly takes place in Santiago Atitlán, in the Western Highlands of Guatemala. These have included community health surveys every 6 years as well as projects investigating the baseline needs and impact of local initiatives. Core to the field school is the principle that the knowledge created belongs first to the local community and second to the broader scientific community as it is generalizable to medicine, community health, and global health that focuses on underserved populations. Field school participants work on projects and concerns identified through community needs assessments or through local municipal and public health leadership. These locally led projects recognize the dual autonomy of the community as well as the scientific autonomy of the learners. At the end of the field school, participants present their findings back to the community, documenting that they have learned skills, and benefiting the community in the area public health. Topic areas have included the ecology of motherhood and the role of traditional birth attendants in gaining skills in delivery, contamination with attention to food and waterborne illness, mental health and the impact of trauma on culture-bound and foreign-defined illness, indoor biomass combustion and the impact on wellness and respiratory health and asthma, nutritional practices throughout the lifespan, contraception, health economics, and care-seeking behaviors, the built environment, and the epidemiologic transition and the epidemic of diabetes.

DISCUSSION

The GPP is an example of a partnership between academic institutions from a LMIC and a higher-income country. Founded on a century-old relationship between Guatemala and Penn, the GPP was formalized in 2005 with a renewed emphasis on science and health. The GPP seeks to promote the capacity of health workers and researchers in Guatemala and at Penn by developing multiple synergistic initiatives within the domains of science, health-care education, and public health, following the WHO's Global Health Workforce Alliance strategies. Since its inception, the initial three-partner program derived from an orthopedics exchange initiative and has evolved to now include five Guatemalan universities spanning many health sciences and clinical departments including medical anthropology, dermatology, family medicine, and EM. The GPP's reach sustainability and scalability have been promoted by its three guiding principles.

The university-level connections have allowed for the development of a durable, yet flexible partnership, within a politically

changing environment. Such academic foundation provides a steady source of leadership, a necessary factor to achieve the program's sustainability. Academic centers gather individuals from multiple disciplines, a process that facilitates the creation of different types of initiatives that are needed to address the diverse health needs of Guatemala and Penn. This endows the partnership with the ability to upscale with ease and flexibility. As an example, the needs identified through previous initiatives are beginning to be addressed by recent activities, sometimes developed by new GPP participants. The independent investigator initiatives led by the epidemiology department at Penn highlighted the need of RCR in both countries, which triggered the creation of the RCR led by the bioethics department at Penn. Additionally, through continuous clinical interactions between Penn and the Guatemalan health facilities, the need for an EM certification was recognized, leading to the establishment of the first EM residency program in Guatemala. However, one weakness of this approach is the lack of immediate national involvement. The GPP circumvents this issue by maintaining a national connection with the Guatemalan health system through its connection with USAC and MOH.

Just as important as identifying the core partners of the collaboration, is how one goes about engaging with them. The principle of dual autonomies with locally led capacity dictates the methodology of the GPP. First, it establishes that all the GPP relationships are characterized by mutual respect and trust, which are essential elements of a successful global health partnership. Second, it capitalizes on locally derived leadership which helps to identify motivated individuals who then become essential partners of the GPP as they help implement the program initiatives on the ground. This principle promotes the sustainability and scalability of the GPP activities. As an example, the Medical Anthropology Field School emphasizes the importance of respecting the autonomy of the community's human, intellectual, and financial resources. Penn students develop research projects that follow the Guatemalan community members' suggestions. The obtained results are taken back to the community by holding meetings with local leaders, and the findings often guide initiatives that aim to address the identified health needs. Such initiatives take into account the available resources and seek to promote capacity of local human resources for health. Another example is the NIH-funded graduate programs, which have trained over 30 Guatemalan researchers, many of whom have returned to work at academic and public health centers in Guatemala, reaching an expanding network of Guatemalans. However, this program also highlights the challenges faced by the GPP Guatemalan partners. As independent investigators trained at Penn return to Guatemala, they are often restrained by an environment with limited financial resources, infrastructure, and human resources, a lack of scientific career structure and political instability. The fact that training individuals is only one of the essential steps toward improving health systems in LMIC is one of the greatest challenges faced by global health partnerships (4).

The principle of mutually beneficial exchanges is both a product and an example of the respectful GPP collaborations. An innate inequality of resources exists between Guatemala and Penn, as the Penn has relatively greater access to funding, educational

facilities, and approachable mentorship. Similar disparities often lead to power differentials among global health partnerships that include a higher-income country and a LMIC. However, the GPP recognizes that Guatemala and Penn participants are able to advance their careers in different but mutually reinforcing ways. Cultural, academic, experiential, and interpersonal skills are important aspects to a global partnership, just as financial resources are. In general, Guatemalan participants benefit from the academic expertise and financial resources that are lacking in Guatemala. In turn, Penn participants conduct international research, gain global health skills, and experience a different culture, all of which are highly demanded skills in the USA academic centers (23). The scientific initiatives allow Guatemalans to access the research education provided by Penn, while Penn mentors gain teaching experience and disseminate their scientific work in international settings. The health-care education activities allow Penn and Guatemalan residents to obtain clinical knowledge, skills, and resources not available in their countries. Finally, the Public Health initiatives generate information about the health status of the Guatemalan communities and build health capacity at the community and institutional level while Penn participants obtain real-world community health and research skills. It should be noted, however, that similar partnerships may have the unintended consequence of pressuring LMIC partners to engage in compensatory exchanges. The GPP attempts to alleviate such feelings through the notion that both parties involved in an exchange may benefit despite being devoted predominantly toward improving the health-care of one partner. This serves to acknowledge the true audience of the GPP and other similar initiatives by creating equally valuable opportunities for exchanges, independent of either partner's resources.

While the GPP remains imperfect, it continues to represent a sustainable and scalable model of a global health partnership that improves the scientific and health-care capacity among its participants. Key factors and recommendations are summarized in a list below.

LESSONS LEARNED/ RECOMMENDATIONS

- Building a partnership founded on university-level connections allows for continuity within politically unstable environments and functional scalability as academic centers facilitate the incorporation of multidisciplinary groups of students and faculty. However, academic partnerships need not to exclude the local public health authorities in order to obtain their financial and administrative support and to avoid diluting their responsibility over national health issues.
- Recognizing the power differential between partners in LMIC and higher-income countries is a necessary initial step toward achieving a relationship that respects dual autonomies and promotes equitable collaborations.
- Basing a global partnership's initiatives upon local leadership promotes local ownership, which increases sustainability.
- Investing in mutually beneficial initiatives, rather than in initiatives that primarily benefit one partner, increases the

sustainability and scalability of the partnership by creating an incentive for individuals affiliated with both parties to participate.

- By identifying and training motivated and engaged individuals, the partnership creates an expanding network of trainers and trainees, which favors the sustainability, scalability and reach of the program.
- Training the right set of individuals is necessary, but not sufficient to improve health systems. The success of such individuals, and hence global health partnerships, also depends on systemic factors, such as a reinforcing environment with supportive local institutions and financial incentives, which are challenging and require long-term investments.

In conclusion, the GPP represents a collaboration between Guatemalan public and private universities and Penn that is founded on the principles of university-to-university connections, dual autonomies with locally led capacity building, and mutually beneficial exchange. Its ongoing initiatives in the domains of science, health-care education, and public health strive to fulfill the WHO's Global Health Workforce Alliance strategies of partnerships and education. The goal of both describing and analyzing the success and limitations of these initiatives is to provide insight into strategies that can be adapted to other contexts in order to promote and strengthen similarly oriented global partnerships.

AUTHOR CONTRIBUTIONS

The following authors contributed substantially to the conception and design of work or acquisition, analysis, or interpretation

of data for the work; provided final approval of the version to be published; provided agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved: MP-A, EM, CN, EC, FB, KB, CC, TR, SM-S, VP-P, AD, RR, and CB. In particular, design of the program: EC, FB, KB, SM-S, and CB. Authors responsible for research on the history of the program: MP-A, EM, CN, EC, FB, and CB. The following authors contributed to the draft and/or revisions of the draft for important intellectual content: MP-A, EM, CN, EC, FB, KB, CC, TR, SM-S, AD, RR, and CB. Particular contributions and revisions were made by the following: RR and CN to dermatology clinical initiatives; AD to emergency medicine clinical initiatives; CC and TR to the background information on Guatemala nutrition and community health initiatives; MP-A, EM, KB, CB, and FB on the field school of anthropology, clinical sites, and historical background of the partnership; EC, MP-A, KB, and SM-S on the Guatemalan health background data; EM, CN, and AP on the Philadelphia health background data. MP-A and EC designed **Figure 1**. AP designed **Table 1**. MP-A, EM, CN, EC, RR, and CB oversaw all drafts and revisions to the entire paper content in addition to the aforementioned roles.

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Constructing a Global Learning Partnership in Physiotherapy: An Ireland–Uganda Initiative

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Background and aim: There is a strong correlation between disability and poverty and it is acknowledged that until disability issues are addressed, the goal of poverty reduction in low-income countries is unlikely to be achieved. Despite the high prevalence of disability in developing countries, there remains a significant shortage of rehabilitation professionals as highlighted by the WHO report, Human resources for Health (2006). The purpose of this project was to develop a collaborative and sustainable partnership to strengthen educational and research capacity in global health, disability, and rehabilitation between two physiotherapy schools; University College Dublin, Ireland, and Mbarara University of Science and Technology, Uganda. This article aims to describe the approach used and initial project outcomes.

Methods: This project involved a bilateral visit to both institutions by two members of staff of respective physiotherapy programs. These visits entailed stakeholder meetings, clinical site visits, and workshops to identify the priorities for the partnership and shape the collaboration going forward. Appreciative inquiry methodology was used during the workshops and the four-dimensional framework for curriculum development was used to guide analysis and underpin findings.

Findings: The key priorities identified were (i) development of joint global health learning initiative, (ii) to explore the possibility of postgraduate learning and research opportunities for Ugandan colleagues, and (iii) to develop joint clinical placements. The rationale and context and a plan of action is described.

Discussion and conclusion: The project is ambitious and in order to be sustainable, the importance of long-term interinstitutional commitment and further funding cannot be ignored. This work provides a framework for other universities and institutions wishing to undertake similar activities. Such partnerships provide rich learning opportunities for students and health professionals and facilitate a deeper understanding of global health issues, social and cultural health determinants, and development of enhanced professional skills.

Keywords: global health, physiotherapy, disability, rehabilitation, curricula, collaborative learning, partnership

INTRODUCTION

Eighty percent of the world's disabled population lives in developing countries (1). There is a strong correlation between disability and poverty and it is acknowledged that until disability issues are addressed, the United Nations (UN) sustainable development goal of poverty reduction is unlikely to be achieved (1, 2). Child disability research in low-income countries highlights the significant negative impact of disability on families, particularly women, financially, educationally, psychologically, and culturally (3, 4).

The recent World Health Organization report (5), Human Resources for Health, highlights the chronic shortage of health workers, particularly in developing countries. Most of the available evidence relates to numbers of nurses, midwives, or physicians per 10,000 population, with a dearth of information regarding health professionals working in the area of disability and rehabilitation, such as physiotherapists.

Physiotherapists are an integral part of the multidisciplinary team that serves to prevent disability and maximize function and quality of life. The World Confederation for Physical Therapy (WCPT) states that: "Physical therapy is concerned with identifying and maximizing quality of life and movement potential within the spheres of promotion, prevention, treatment/intervention, habilitation, and rehabilitation. This encompasses physical, psychological, emotional, and social well-being." It is a discipline that lends itself well to being practiced in low resource settings.

The prevalence of disability in Uganda is estimated to be between 16% and 19% (6, 7). The World Report on Disability (1) estimates that there are 0.25 physiotherapists per 10,000 population in Uganda compared to 5 per 10,000 in the United Kingdom, a statistic which Ugandan physiotherapists consider an overestimation (personal communication). The report also advocates for the support of universities in developed countries to build and strengthen educational and research capacity by supporting training programs in developing countries and developing research partnerships.

The purpose of this project was to develop a collaborative and sustainable partnership to strengthen educational and research capacity in global health, disability, and rehabilitation between two physiotherapy schools; University College Dublin (UCD), Ireland and Mbarara University of Science and Technology (MUST), Uganda. This article aims to describe the approach used and initial project outcomes.

METHODS

Purpose

The overarching vision for this project was to develop a collaborative and sustainable partnership between the discipline of physiotherapy in UCD and MUST. Initial discussions took place between COS and HK via e-mail and Skype to discuss the philosophy and rationale for the partnership, potential mutual benefits, and feasibility. The philosophy underpinning the project was that all physiotherapy graduates should have

knowledge and understanding of global health issues and an awareness of different health systems. It was recognized that the partnership would have mutual and bilateral benefits to students and staff of both universities in terms of knowledge transfer and skills development. Finally, it was recognized that good communication and commitment were key to the success of the partnership. Through this project, the authors aimed to generate a framework which will facilitate collaboration and transfer of knowledge, understanding, experience, and research skill, between UCD and MUST physiotherapy students and academic staff regarding global health, disability, and rehabilitation.

Setting

Mbarara University of Science and Technology is the second public university in Uganda founded in 1989. It has since grown to have 3,000 students over 6 faculties and 2 institutes (Faculty of Medicine, Faculty of Applied Science, Institute of Management Science, Institute of Computer Science, Institute of Interdisciplinary Training and Research, Institute of Forestry Management and Institute of Child and Maternal Health). The Faculty of Medicine trains students in medicine, nursing, medical laboratory science, pharmacy, pharmaceutical science, physiotherapy and counseling at a variety of diploma, degree, and postgraduate levels. The vision of the Faculty is "to be recognized as a center of excellence in health sciences education, research, and community service."

The BSc Physiotherapy Course at MUST was envisioned by staff in the neighboring government hospital in 2007 and started in 2012. It is a 4-year degree program and currently has 60 students. The program is expected to grow to 100 students over the next 5 years. The first pioneer students completed their degree in June 2016. The mission of the Department of Physiotherapy is "To provide high-quality evidence-based education in Physiotherapy with emphasis on producing innovative, research orientated students who will translate the knowledge and skills into practices that will improve the health and well-being of the nation and beyond."

University College Dublin is Ireland's largest university and is ranked in the world's top 100 university in clinical, preclinical, and health sciences. Physiotherapy at UCD is based in the multidisciplinary School of Public Health, Physiotherapy, and Sports Science. The physiotherapy program at UCD is more than 60 years old and it is the largest provider of undergraduate and graduate physiotherapy education in Ireland. There are two entry-to-practice level programs in physiotherapy: a 4-year BSc physiotherapy program and a 2-year professional master of physiotherapy program. It also offers a range of postgraduate programs for physiotherapists.

Background to Collaboration

Similar to many health professions, there is a strong tradition of Irish physiotherapy students choosing to undertake clinical elective placements in low and middle income countries and indeed working in developing countries after graduation. Building on this tradition, in 2013, together with a UCD graduate physiotherapist who was working in Uganda, an international

elective clinical placement was developed in conjunction with the university charity, UCD Volunteers Overseas (UCDVO) in Kisiizi Hospital, a rural hospital in the Rukungiri district of South Western Uganda, one of the nine priority countries of Irish Aid.

At the same time, MUST was building links with Kisiizi Hospital through a physiotherapy colleague who had met some of the visitors from Ireland and recommended that a link would be positive. From there subsequent meetings were arranged. As the physiotherapy department was new, the faculty at MUST was also recommending the establishment of international links.

The link between Ireland and Uganda was further strengthened in 2015, during a visit to Mbarara University of Science and Technology to explore the possibility of developing a partnership between the two Schools of Physiotherapy. In line with recommendations from the International Health Links Manual (8), the schools of physiotherapy at UCD and MUST share a mission to produce high-quality graduates who are active citizens and can adapt and lead in challenging health care environments. Training for rehabilitation and other health professionals in developing countries is complex due to the need for graduates to work independently with limited resources and often without support services (1). In addition, the World Report on Disability, advocates for the support of universities in developed countries to build and strengthen educational and research capacity by supporting training programs in developing countries and developing research partnerships (1). Between 2015 and 2016, physiotherapy staff at both UCD and MUST have worked together via e-mail and telephone to develop this proposal for funding which would facilitate the establishment of a partnership between the two schools. The project was awarded funding in 2016 from the ESTHER Alliance (<http://www.esther.ie/>).

Project Structure

This project involved bilateral visits to both institutions by two members of staff of each of the respective physiotherapy programs. These visits entailed general discussion with a variety of stakeholders including students, academic and clinical staff, and clinical site visits, in order to gain a deeper appreciation of the context and priorities of the respective health systems, the practice of physiotherapy, and the potential for physiotherapy to meet the current and future health needs of the respective communities, in a multidisciplinary context. At the end of both visits, a structured workshop using an appreciative inquiry (AI) methodology was undertaken. The purpose of the structured workshops was to harness the knowledge and experience of academic and clinical colleagues to best identify the priorities for the partnership and shape the collaboration going forward.

The project was conducted in two phases. Phase 1 took place at UCD between June 6 to June 10, 2016 and Phase 2 took place in Uganda from July 4 to July 10, 2016. Both visits had a similar schedule with workshops being conducted in the respective physiotherapy schools both in Dublin and Uganda (Figures 1 and 2). The final workshop in Uganda focused on identifying the key priorities



FIGURE 1 | Workshop conducted at UCD.



FIGURE 2 | Workshop conducted at MUST.

for the partnership and designing a plan of action in relation to same.

A method known as AI was used to achieve the goal of each workshop. AI has been used in organizational change management, education, and healthcare settings. It is a qualitative approach that adopts a positive and strengths-based approach to maximize a project's potential (9). Contrary to "traditional" problem solving approaches, where the "problem" or deficit is central, key to this strengths-based appreciative approach is valuing the best of what exists in the present and envisioning the potential based on existing strengths. Core to the concept is rather than asking "what is wrong" in a particular case, project or organization, the focus is on "What is good?" It is proposed that using this model promotes collective strengths to problem solve and envisage a better situation in the future (9).

Each workshop (Ireland and Uganda) was conducted in four steps, in line with the AI approach: discover, dream, design, and deliver. Participants in the workshop in Ireland included UCD physiotherapy academic staff, clinical tutors, and visiting faculty from Uganda ($n = 9$). In Uganda, participants were MUST physiotherapy academic staff and visiting faculty from Ireland ($n = 6$). Each workshop began with a brief presentation by the facilitators regarding the overarching project goal, and the rationale for

and structure of the workshop. The visitors also presented an overview of their country, health system, physiotherapy practice, school information, and curricula.

Step 1: Discover

The objective of this step was to allow the participants to learn about the visiting institution but also to reflect and relate personal experiences and opinions. Open discussion across a broad range of topics was encouraged. Participants were encouraged to ask questions and share experiences. Questions used to prompt discussion and reflection included:

- What have you learned/“discovered” about the visiting institution?
- What is your experience with collaborations and partnerships? What worked well/what didn’t work well?
- Why/how has this process/experience occurred?
- Is this process/experience important/valuable? If so, why?
- What else would you like to know?

Step 2: Dream

The objective of Step 2 was to create a vision for the partnership with “blue skies thinking.” Groups were seated in a circle and each participant had a card upon which they wrote as many ideas as they could in 1 min. They then passed the card to the next person, who reviewed their statement and added more of their own. The rationale is that ideas and thoughts are generated and strengthened as they are peer-reviewed.

The group then reviewed all statements and emerging topics were grouped thematically. Each theme was then discussed and group consensus was used to determine whether it was a priority for the partnership or not.

Steps 3: Design

Once key priorities were agreed upon, the group planned processes that would work well to achieve the desired priority.

Step 4: Deliver

Finally, the group discussed how the proposed design would be implemented and plans of action were developed.

Theoretical Framework

The 4DF approach was used as a theoretical framework on which to guide our analysis and describe our findings. This framework allows the relationship between curricula and bigger issues that shape health professional education practice and policy to be explored (10). This conceptual framework suited the project needs, as it facilitated the development of a learning partnership which considered the differences, as well as the similarities, across both programs and socio-cultural, economic, and environmental contexts. The four curriculum dimensions are described (10): Dimension 1: identifying future healthcare practice needs; Dimension 2: defining and understanding capabilities; Dimension 3: teaching, learning, and assessment; and Dimension 4: supporting institutional delivery.

FINDINGS

Dimension 1: Identifying Future Health Care Practice Needs

Burden of Disease

The priorities for physiotherapy practice across both countries are different and reflect the burden of disease that is unique to each country. Current WHO data reveal that the leading causes of death in Ireland are ischemic heart disease, stroke, and lung cancer, while in Uganda the leading causes of death are HIV/AIDS, lower respiratory tract infections, and malaria, (11). Non-communicable diseases are main contributors to the burden of disease in Ireland while in Uganda, HIV, TB, malaria, and neonatal conditions are significant contributors to the burden of disease as measured by disability-adjusted life years (11). An increase in the aging population in Ireland poses further challenges while in recent years, the increase in non-communicable disease such as ischemic heart disease and stroke observed in Uganda highlight the growing double burden of both non-communicable and infectious diseases in many low-income countries.

The increase in non-communicable diseases observed in recent decades is directly related to lifestyle and non-invasive and non-pharmacological interventions such as physiotherapy have been demonstrated to be highly effective in preventing and managing such conditions (12).

Evidence-Based Practice

Recently, disability has been placed centrally on the development agenda with the publication of the World Disability Report in 2011 and also by its inclusion in the sustainable development goals. The link between poverty and disability is well established and it is acknowledged that until disability issues are addressed, the global goal of poverty reduction will not be achieved. There is therefore an opportunity for physiotherapists to lead to advocate for disability awareness and inclusion, disability services and research across the health, education, and social spectrum.

While there is significant evidence to support physiotherapy in the prevention and management of chronic disease, less is known about the impact of physical rehabilitation on many of the conditions encountered by physiotherapists working in low-income settings such as HIV/AIDS and cerebral palsy (sometimes as a result of cerebral malaria). Small-scale qualitative studies have highlighted the positive impact of rehabilitation on patients with HIV/AIDS (13) and children with cerebral palsy (3, 14). However, larger scale longitudinal studies are necessary.

There is now an opportunity to collaborate on and strengthen chronic disease research (stroke, diabetes, ischemic heart disease, low back pain) that is currently being undertaken in UCD and MUST. Therefore, graduates from both institutions will have robust research skills so that the evidence base for physiotherapy in a global context can be strengthened.

Dimension 2: Defining and Understanding Capabilities

The physiotherapy curricula at both UCD and MUST adhere to the guidelines for entry-level physical therapy education as

set out by the WCPT and are accredited by the Irish Society of Chartered Physiotherapists and the Allied Health Professions Council in Uganda respectively. Therefore, both curricula have strong similarities, with themes such as health promotion, physical activity, and exercise emerging strongly. Professional practice and interprofessional learning was also key to both programs, particularly at MUST, where educators developed a 10-week interdisciplinary community placement during every recess term, where students from all the healthcare disciplines work together in a rural community setting for holistic health delivery. Furthermore, the Department of Physiotherapy at MUST delivers a module on rehabilitation medicine to both medical and nursing students so that these health professionals have an awareness of disability issues and the rehabilitation of the same. The importance of interprofessional learning to enhancing patient care and health outcomes has been highlighted by the WHO (15) and is increasingly part of health professions curricula by accrediting bodies (16).

Clinical Education

Clinical education is a significant component of both programs with all students completing a minimum of 1,000 h of clinical education. Clinical education is key to all health professions programs: it is here that theory is translated to practice and development of professional competencies and behaviors come to the fore.

There is a value to participating on clinical placement with students and staff from other countries. It leads to greater understanding of respective health systems, health challenges and allows a deeper understanding of respective cultures and belief systems and their influence on health.

The value of overseas placements to health professionals is well established with some health systems actively creating opportunities for staff to participate in overseas programs because of the tangible benefits to their staff including: development of soft skills such as communication awareness, leadership, and teamworking skills (17). Similar benefits are observed in studies of students undertaking placements overseas (18), including physiotherapy students (19).

Dimension 3: Teaching Learning and Assessment

Education Resources

Differences existed in terms of the physical and online resources available, particularly access to online library resources and other information resources which are restricted in Uganda. However, social media (Twitter, Facebook, and What's App) was used extensively in Uganda as a means of sharing information and drawing students' attention to useful information or events. There was an opportunity to share learning resources and this has already begun in an informal manner. Lecturers have agreed to facilitate recorded lectures or lectures/tutorials via Skype.

Development of Joint Global Health Learning Initiative

There was agreement that the collaboration provided an opportunity to establish and develop a joint global health learning

initiative. This was deemed a rich learning opportunity for students from both programs to improve knowledge and understanding regarding global health and disability issues and the link between disability and development. It would also serve to improve student knowledge regarding cultural influences as a determinant of health.

Postgraduate Study Opportunities for Staff

The lack of postgraduate study opportunities for physiotherapists in Uganda was highlighted across all areas of physiotherapy practice. A member of faculty is interested in pursuing postgraduate study in the area of cardiorespiratory physiotherapy and funding opportunities will be explored. This is deemed important considering the rise in the burden of non-communicable diseases particularly ischemic heart disease, stroke, and cancers.

Dimension 4: Supporting Institutional Delivery

Dimension 4 addresses the aspect of cultural norms, protocols, and procedures inherent within the educational context. During both visits, the visiting lecturers had the opportunity to meet stakeholders from disciplines such as development studies, medicine, nursing, dietetics, and public health. There was agreement that there were tangible benefits related to teaching and learning and research, and there was support for formal agreement being developed between the two departments. The partnership is also aligned with university strategies. Discussion also took place about the opportunity to embed this work and collaborate with external agencies such as international non-governmental organizations.

Key Priorities

At the end of the workshop in Uganda, three priorities were identified and action plans were developed. Two members of faculty at each institution will lead on realization of the identified priorities (UCD-COS, CB, MUST-HK, and ZW).

Priority 1: Develop a Joint Global Health Learning Initiative for Entry-Level Physiotherapy Students in Uganda and Ireland

Plan of Action

Physiotherapy graduates from both institutions will need to have the skillset required to identify and respond to current and future health care practice needs across different contexts. To facilitate a greater understanding of health systems, burden of disease, and physiotherapy priorities for both countries, it was proposed that students from both programs will work together on discrete learning activities. The learning activities have two goals: (i) to develop a greater awareness of a different health system and (ii) to share knowledge and understanding in terms of physiotherapy practice. This will be realized by developing case studies that are relevant to both student groups (e.g., cerebral palsy, stroke, HIV/AIDs). This approach was developed as a initiative of Oxford Brookes University and Mbarara School of Physiotherapy was one of the pioneering participants. It is proposed that student groups will work together to present the relevant social context

and how the case is managed within their health system. Use of technology, online learning resources and social media will be harnessed to promote collaborative and shared learning across the groups. Examples may include wikis, blogs, and social media. Students will present their final work via video link to their peers on both programs. Achievement of this activity will be dependent on internet connectivity and cost issues.

Both programs are accredited by their respective national accreditation bodies. This learning activity will be facilitated by the project leads (COS, HK) and will be embedded in relevant modules and therefore part of accreditation submissions. We believe that the proposed global learning partnership will strengthen curricula, particularly in the development of soft skills such as communication, teamwork, cultural competency, the development of which are an integral part of accreditation standards. The effectiveness of this educational activity in developing these soft skills will be evaluated in future studies.

Priority 2: Explore the Possibility of Postgraduate Learning and Research Opportunities for Ugandan Colleagues

Plan of Action

A pathway for postgraduate study in cardiorespiratory physiotherapy will be created in UCD and scholarship funding will be sought jointly. Funding opportunities for joint PhD research in the area of physiotherapy and rehabilitation will be explored and proposals developed. In addition, the opportunity for joint undergraduate research projects will be explored, particularly comparative studies between the two countries. Each of these serve to strengthen the evidence base for physiotherapy, particularly in low-income settings.

Priority 3: Establish Joint Clinical Placements for Entry-Level Physiotherapy Students in Uganda and Ireland

Plan of Action

Since 2015, a small number physiotherapy students from both UCD and MUST (three from each university) have participated in a joint clinical placement in a rural hospital in Uganda. For UCD students, this is part of the curriculum while for MUST students it is an extracurricular activity. This initiative will be expanded to include community settings. The opportunity to develop this as an interprofessional placement will also be explored, to include UCD medical, nursing, and dietetics students working together with students from MUST, to engage with local communities and experience health systems in developing countries. The experience of students participating in this initiative will be evaluated during the coming year.

DISCUSSION

This article aims to describe an approach used to establish a global learning partnership to strengthen educational and research capacities in global health, disability, and rehabilitation between two physiotherapy schools; UCD Physiotherapy and the Department of Physiotherapy at MUST.

The main priorities identified were aligned to the 4DF approach and are (i) develop a joint global health learning initiative, (ii) to explore the possibility of postgraduate learning and research opportunities for Ugandan colleagues, and (iii) to develop joint clinical placements.

The 4DF approach facilitated a comprehensive description and presentation of the key priorities for the partnership. It has also allowed clear alignment of activities and outputs for each priority. As this project develops, the 4DF approach will continue to be used to identify and monitor achievements and milestones. An evaluation of the activities undertaken will be presented in future studies.

Developing this partnership has the potential to affect both educational (short term) and health outcomes (long term). The partnership will improve student knowledge and understanding regarding global health and disability issues, cultural influences on health, and awareness of strategies for management of minority, migrant, and "hard to reach" groups. It will foster and develop transferable skills in students, such as communication, professionalism, cultural competency, leadership, and advocacy skills. It will facilitate the development of sound research skills among students in the area of disability and global health and increase opportunities for students to pursue MSc and PhD level education.

The improved quality of education resulting from this partnership will translate to improvement in functional capacity and quality of life for patients with disabilities and their carers, as a direct result of enhanced quality of rehabilitation. The partnership will strengthen the evidence base for rehabilitation in both low- and high-income countries, improving quality of care.

There are many examples of existing partnerships between health science schools in high- and low-income countries (8) and the benefits for both partners is well established (8). This work adds to the literature and provides a framework for universities and institutions to guide the development and growth of such partnerships.

The project is ambitious and in order to be sustainable, the importance of long-term inter-institutional commitment and further funding cannot be ignored. This article seeks to describe the initial steps taken in establishing a partnership and determining common priorities for the partnership going forward. There are many challenges that must be overcome if the priorities identified will be realized. These included sustained commitment between the two institutions. To date, this has been achieved through regular Skype meetings and e-mail contact. Funding opportunities for travel, postgraduate study, and research scholarships must be explored and acquired. Finally demands on time and internet connectivity provide challenges.

To conclude, partnerships such as this can provide rich learning opportunities for students and health professionals and facilitate a deeper understanding of global health issues, social, and cultural health determinants and development of enhanced professional skills. Future work will focus on the implementation and evaluation of the priorities identified during this initial stage, therefore building the evidence base for global learning partnerships.

AUTHOR CONTRIBUTIONS

COS and HK developed the original proposal. All authors contributed to the design, implementation, analysis, and write-up. COS led the submission of the manuscript.

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The Global Health Service Partnership: An Academic–Clinical Partnership to Build Nursing and Medical Capacity in Africa

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The World Health Organization estimates a global deficit of about 12.9 million skilled health professionals (midwives, nurses, and physicians) by 2035. These shortages limit the ability of countries, particularly resource-constrained countries, to deliver basic health care, to respond to emerging and more complex needs, and to teach, graduate, and retain their future health professionals—a vicious cycle that is perpetuated and has profound implications for health security. The Global Health Service Partnership (GHSP) is a unique collaboration between the Peace Corps, President's Emergency Plan for AIDS Relief, Seed and host-country institutions, which aims to strengthen the breadth and quality of medical and nursing education and care delivery in places with dire shortages of health professionals. Nurse and physician educators are seconded to host institutions to serve as visiting faculty alongside their local colleagues. They serve for 1 year with many staying longer. Educational and clinical best practices are shared, emphasis is placed on integration of theory and practice across the academic–clinical domains and the teaching and learning environment is expanded to include implementation science and dissemination of locally tailored and sustainable practice innovations. In the first 3 years (2013–2016) GHSP placed 97 nurse and physician educators in three countries (Malawi, Tanzania, and Uganda). These educators have taught 454 courses and workshops to 8,321 trainees, faculty members, and practicing health professionals across the curriculum and in myriad specialties. Mixed-methods evaluation included key stakeholder interviews with host institution faculty and students who indicate that the addition of GHSP enhanced clinical teaching (quality and breadth) resulting in improved clinical skills, confidence, and ability to connect theory to practice and critical thinking.

The outputs and outcomes from four exemplars which focus on the translation of evidence to practice through implementation science are included. Findings from the first 3 years of GHSP suggest that an innovative, locally tailored and culturally appropriate multi-country academic–clinical partnership program that addresses national health priorities is feasible and generated new knowledge and best practices relevant to capacity building for nursing and medical education. This in turn has implications for improving the health of populations who suffer a disproportionate burden of global disease.

Keywords: global health, health professionals education, health promotion, clinical education, mentoring

INTRODUCTION AND BACKGROUND

Well-prepared and adequately resourced educators of nurses, physicians, and other health professionals are the basic building blocks of stronger health systems and quality education is a prerequisite for effective achievement of other investments in health infrastructure and care delivery. Despite these facts, the education of health professionals in resource-limited settings is chronically under-resourced. The World Health Organization (WHO) estimates a global deficit of about 12.9 million skilled health professionals (midwives, nurses, and physicians) by 2035 (1). These shortages limit the ability of countries to deliver basic health care, to respond to emerging and more complex needs, and to teach, graduate, and retain their future health professionals—a vicious cycle that is perpetuated and has profound implications for global health security (2–6).

THE GLOBAL HEALTH SERVICE PARTNERSHIP (GHSP)

The GHSP is a unique collaboration between three US partners [Peace Corps, US President's Emergency Plan for AIDS Relief (PEPFAR), Seed Global Health (Seed)], and host-country institutions. The primary purpose of GHSP is to strengthen the breadth and quality of medical and nursing education and care delivery in places with a high burden of disease and a dire shortage of health professionals. GHSP focuses on four key areas; (1) Deploying qualified and committed nurse and physician educators for 1 year to work as visiting faculty, alongside local faculty counterparts, to expand and enrich health professional education in a culturally appropriate, locally tailored and sustainable way; (2) working with partner academic institutions to identify and support urgently needed expertise and educational resources that improve the learning environment, with a priority on integration of academic–clinical teaching and learning and health-care specialties in greatest need; (3) aligning efforts and resources with the priorities of host governments and other institutions committed to health system strengthening; and (4) Providing financial assistance to and practical support for US educators that volunteer through GHSP to facilitate effective and fulfilling service.

Identifying host-country institutions with whom to partner is a multi-stage process. Peace Corps, guided by PEPFAR, identifies resource-constrained countries with a high burden of disease

where they feel that GHSP can have an impact on improving accessibility to and quality of care. The Ministry of Health and/or Ministry of Higher Education in the countries of interest make the determination of whether they feel GHSP can add value to meeting their country's priority human resources for health needs and they identify the nursing and medical training institutions where they would like GHSP to partner. Last, GHSP leadership meets with key stakeholders at the training institutions to identify their priorities and areas where they feel that seconding visiting faculty to their institution can help them meet their institutional goals. If the identified training institution wants to partner with GHSP, Peace Corps, and Seed collaborate to recruit, orient, and deploy nurse and physician educators to serve as visiting faculty at their school. GHSP educators are drawn from the US and have experience with both classroom and clinical teaching. They commit to serving for one academic year but many extend for longer periods. The GHSP program commitment to the partner institution is a multi-year commitment with structured hand-off between GHSP educators year to year. Within the framework of this partnership, the Peace Corps and Seed work closely together to provide the infrastructure, logistics and clinical/pedagogical expertise necessary for GHSP to support the deployed educators and to meet the needs of the host institution.

In the first 3 years of the program (2013–2016), GHSP placed 97 nurse and physician educators in the field to serve as Peace Corps volunteers and work as visiting faculty at the invitation of 15 academic institutions in Malawi, Tanzania, and Uganda. These educators represented 18 core medical and nursing specialties and ranged from early to late career. Recognizing that many US health professionals face financial barriers to volunteer service, Seed offers up to \$30,000 per volunteer in needs-based assistance for each year served. From 2013 to 2016, more than \$2.1 million dollars in debt assistance was offered as a catalyst for GHSP volunteers to serve in some of the world's most challenging and most needed settings.

The 97 GHSP nurses and physician educators deployed in the first three years provided over 128,300 h of service on site, including: classroom and clinical teaching, skill lab pedagogy, student and faculty mentoring, continuing professional development, practice improvement projects, curricula improvements, resource and infrastructure development, community health outreach, and clinical protocol development. GHSP educators taught 454 courses and workshops to 8,321 trainees, faculty members and practicing health professionals across the curriculum (community health nursing, critical care nursing,

family medicine, internal medicine, mental health, medical/surgical nursing, midwifery, obstetrics and gynecology, pediatrics, and public health). An ongoing mixed-methods evaluation of the program including interviews with host institution students and faculty suggests that GHSP educators provided enhanced clinical supervision (quality and breadth) resulting in improved student clinical skills, self-confidence and ability to connect theory to practice. Faculty reported enhancements in curricula pedagogy resulting in improved student critical thinking skills and the promotion of an open, collegial working environment.

As noted above, GHSP nurse and physician educators primarily teach in the classroom and clinical setting with an intentional emphasis on the integration of theory and practice across the academic–clinical domains. Student success is supported through a variety of pedagogical best practices that focus on translation of evidence to practice, critical thinking, and empowerment. In addition to these traditional teaching roles and strategies GHSP faculty partner with local faculty and hospital/community clinical staff to identify local practice or knowledge gaps and to propose evidence-based, locally tailored and sustainable practice improvement projects. GHSP does not identify the focus of the improvement; this is determined by the host institution(s) based on a local problem. The trigger or rationale for the improvement might be a sentinel event, high morbidity and mortality in a specific population, poor quality care or a knowledge gap. Students participate in the improvement initiatives thus integrating a culture of evidence-based practice in the next generation of African clinicians. In addition GHSP and Seed provides resource support to these academic/clinical partnerships to develop, implement, and evaluate these practice improvement projects as well as to host-country conferences which value and highlight local science and best practices. These service-oriented activities extend beyond the classroom to provide opportunities for academic faculty and practicing clinicians to work together to have a direct and immediate impact on the health of the population. The projects also create a fluid teaching and learning environment and contribute to enhanced opportunities for student learning.

The following four exemplars demonstrate efforts that emanate from a national health priority, that have contributed to the development of clinical and academic excellence, and translate evidence to practice through implementation science. The projects highlighted in this manuscript were intended to improve care at the point of service and did not test new theories or procedures. Therefore the projects do not meet the criteria for human subjects research and formal ethics review was not sought.

EXEMPLARS

The Family Medicine Training Program in Malawi

Local Problem

Malawi, similar to other resource-constrained countries in Africa bears a disproportionate burden of disease in the context of

threats from new and emerging infectious diseases and an epidemiologic shift toward the high prevalence of non-communicable disease (7–9). To address these needs, the WHO has advocated for a strong primary care health system at the district level that cares for patients across the lifespan (10, 11). Family medicine, a core contributor to primary health care, is critical to the achievement of equitable health outcomes for all (11) and this is a pivotal time for family medicine expansion globally. Many countries are reorienting family medicine as the cornerstone of their health-care system and expanding family medicine training. Although the practice of family medicine will have distinct characteristics around the world, the core values remain: providing care that meets the fundamental health needs of the patient, is integrated, is prioritized, and offers healing above cure when appropriate.

What We Did

Countries introducing family medicine, such as Malawi, face many challenges in integrating this broad discipline into their specialty-based medical system. Starting in 2014, two Malawian family medicine faculty at the University of Malawi College of Medicine (CoM) launched their first class of family medicine residents at a new district hospital training site. The goal of this program was to meet the national need for an enhanced primary care system. Not only did they create new curriculum, certify the program with the Malawi Medical Council, determine training sites, and recruit clinical faculty, but they also worked to create a new medical culture. In collaboration with the CoM Department of Family Medicine in Malawi, GHSP and Seed sent family medicine physician educators to support this new academic endeavor.

In addition to faculty support, family medicine residents engaged with a range of learners and teachers, which fostered teamwork and promoted exchange of knowledge and ideas. This includes US residents, who worked with GHSP faculty to augment their efforts to build an academic learning environment at the district training site. Senior family medicine residents from University of Washington-affiliated programs committed to working in Malawi for 9 months of the year for 5 years. US residents travel two at a time to Malawi for 4-week rotations. Their work is to participate in clinical care alongside the Malawian residents and students (from several health science disciplines), conduct bedside and didactic teaching, and support quality improvement and research projects. After the US residents receive an extensive pre-travel orientation, they work under the supervision of both GHSP and in-country faculty. There is opportunity for ongoing monitoring, evaluation, and frank discussions about mutual benefit for both the host country and the visitors.

What We Found and What It Means

The program was evaluated after the first year using anonymous surveys given to Malawian trainees, staff and faculty. Six questions were asked, half of which were Likert scale and the other half free response. On a scale of one to five, the reported impact on medical knowledge, clinical skills, medical student teaching, and medical student supervision averaged 4.3/5. Regarding registrar and faculty mentorship and training, scores were 3.64/5 and

3.5/5, respectively. Regarding improvement of clinical care on the wards, the visiting residents were given a 4.68/5. Comments included: “*Patients’ care was directly improved.*” “*Misdiagnoses were corrected.*” “*Better treatment plans were made.*” “*Seeing patients today created opportunities for in-depth teaching.*”

Regarding impact on morale and the overall learning environment in the hospital, responses averaged 4.37/5 and 4.44/5, respectively. There was a slight positive response to assistance with research projects in the hospital and improved understanding of the principles of family medicine. Mostly positive comments about the partnership were made illustrated by the excerpts noted below:

They [US residents] put a very positive impact on the learning environment because each time you approached them with your problem, they were eager to help you and would exhaust every knowledge that they have that made the learning environment favorable.

They have improved my zeal for clinical medicine; They reminded me to improve my clinical skills based on the discussions we had with several patients.

They are excellent teachers who took their time to make sure the students completely understood the lesson being taught.

They helped me understand clearly about family medicine, which I did not quite understand it.

Boosted morale knowing you can ask for help any time.

They gave us inspiration that we can treat our patients using the locally available resources.

Malawi’s efforts to put broadly trained family medicine doctors in the critically important district hospital setting where many patients first seek care is based on more than 30 years of strong evidence. This strategic process and thoughtful approach is progressive and has the potential to set a precedent for other nations in the region. Malawi has the vision and desire to bring family medicine to the rural parts of its country but in this resource-scarce setting, the startup capital (human and material) can be prohibitive. The GHSP Family Medicine initiative provides reciprocity and bidirectional benefits to accrue to all of the partners (GHSP, the host institution and US Family Medicine Program). Specifically the initiative adds value to the clinical and educational mission of the host-country training program without overburdening local faculty while also providing a meaningful high quality global health experience for US Family Medicine residents and allows GHSP to fulfill its core vision of strengthening medical education and care delivery in a resource-constrained setting.

“Redressing the Wound” in Uganda: A Deeper Look at Burn and Wound Care Local Problem

When the Uganda GHSP nurse educators began accompanying nursing students on their clinical rounds at Mbarara Regional Referral Hospital (MRRH) they were distressed by the lack of

priority given to treating/controlling pain particularly during dressing changes. This was especially baffling as Mbarara is one of the three primary centers where Hospice Africa-Uganda works and this would seem to indicate an awareness of the importance of palliation of pain in this region. To understand this paradox GHSP visiting faculty in collaboration with students reached out to patients, local faculty and hospital staff, and through these discussions several important barriers to effective pain management emerged including staffing and supply constraints, fear of addiction, and a lack of knowledge regarding pain management (e.g., a belief that alleviation of pain causes wounds to heal more slowly). In the surgical ward, GHSP educators and their students also witnessed poor wound-management practices and a severe shortage of wound-care supplies that prevented appropriate and timely dressing changes. These observations are consistent with reports in the literature that in resource-constrained settings, simple pain regimens, typically relying on inexpensive drugs, are often not followed due to inadequate health-care systems (12). Specifically it has been noted that pain management appears to have a lower priority than other aspects of health care in resource-constrained settings due in part to a lack of medications but also to misunderstandings about drug side effects and the fact that staff have become so accustomed to severely limited resources to treat patients in pain that non-treatment becomes the norm. Patients themselves often believe that nothing can be done and may suffer in silence (12, 13). Similar constraints in the treatment of burns in resource-limited settings, particularly in the pediatric population, have been noted in the literature (14, 15). Students, faculty, hospital staff, and GHSP educators agreed; it was time to do something.

What We Did

To that end, GHSP educators and their host-country counterparts across multiple Ugandan training institutions organized an interdisciplinary conference bringing together nurses, physicians and students from all GHSP-partner institutions to discuss locally relevant best practices in pain management, wound and burn care. Emphasis was placed on drawing from local expertise to review current published best practices in pain management but, more importantly, to stimulate active discussion among the participants around locally tailored solutions. The goal was to highlight local best practices and to identify knowledge, practice, and research gaps in order to chart a way forward. Inclusion of students (the future of evidence-based practice) and interdisciplinary care were also prioritized. The GHSP educators assumed responsibility for the logistical support. Several planning meetings for the conference were attempted via Skype, with mixed success, resulting in most of the conference planning conversations being informal and spontaneous.

What We Found and What It Means

The conference was held in northern Uganda with over 200 health professionals from around the country attending. Participants included hospital nurses and physicians, university lecturers, hospital and university administration, and many medical and nursing students. Engagement in the conference activities was high and post-conference evaluations were strongly positive.

The group from Mbarara University of Science and Technology (MUST) and MRRH (including hospital and university personnel) were very excited to visit northern Uganda and curious to see the facilities there and meet their northern Ugandan counterparts. MUST nursing students were excited to be afforded the opportunity to attend the conference and to be treated as the budding professionals they would soon be. In addition, the Master's level nursing students appreciated the opportunity to meet other professional nurses and network with potential employers. Overall, both nursing and medical students were engaged in the conference and actively participated in the question and answer sessions. It was powerful for the Ugandan nurses to see the keynote speaker (a Uganda physician) ask a Ugandan nurse colleague to join him at the speaker's podium to jointly answer questions from the conference attendees.

Post-conference evaluations noted that teamwork was emphasized in efficient and effective pain management, as was the necessity of having the will to critically assess the wound to determine the method of dressing and documentation. As a way forward from the discussions, participants saw that there was a need to set up burns units or cubicles in different hospitals to maintain asepsis that will promote healing. One participant noted that "Best practice is the goal for every day performance on a wound." Networking and interactions with different health workers from other institutions was valued as an opportunity to make a difference in redressing the wound. The following quotes emanating from the conference summarizes the intentions of wound care by individual nurses in Ugandan hospitals.

You can't change the whole world, and you certainly can't change other people, but you do have the ability to change yourself. You can have a positive impact in redressing the wound in a pain free environment, the communication and comfort to patients that you dress, and the entire community...the choice is up to you.

As a team, let us flash pain down the drain while re-dressing the wound.

Outcomes from this conference illustrate the value added of supporting local conferences. Networking, sharing of best practices, valuing local science and practice, cross-disciplinary discussions, and inclusion of students all led to a culture of commitment to improving pain management and wound care that will directly and immediately benefit the care of everyday Ugandans. In addition, the conference led to partnerships culminating in grant applications for both practice improvement and research in this important area. At least one research application was funded and that work is underway.

Neonatal Resuscitation Program (NRP) in Tanzania Local Problem

It has been estimated that worldwide 6.3 million children under the age of 5 years died in the year 2013 alone, and notably 44% of those deaths occurred in the first 4 weeks of life (16).

In Tanzania, 2013 country-level estimates report that 21 newborns died out of every 1,000 births. The Every Newborn Action Plan, endorsed by governments, the private sector, civil society, and other stakeholders, calls for reducing neonatal mortality rates in all countries to fewer than 10 deaths per 1,000 live births by 2035 thus providing a benchmark for Tanzania to aspire to Ref. (16). UNICEF has suggested that up to 30% of newborn deaths could be prevented with access to essential care, including basic resuscitation. Despite country-specific high infant mortality rates, evidence that access to basic resuscitation could significantly decrease newborn mortality, and national recognition of the importance of this training, neonatal resuscitation has not historically been well-integrated in medical and nursing school education in Tanzania (17). In addition to lack of prioritization of the problem, supplies to conduct resuscitation properly are frequently unavailable (18).

What We Did

In 2014–2015, GHSP expanded to a new site in Dar es Salaam, placing educators in medicine and nursing at the Hubert Kairuki Memorial University (HKMU) School of Medicine and HKMU School of Nursing. Within the first few months on-site a student approached one of the GHSP educators to raise concerns about the frequent neonatal deaths witnessed every day in the nursery at the local regional hospital. Countless infants faced respiratory distress at birth, but local hospital staff and learners who rotated through the facility lacked knowledge and supplies to resuscitate these newborns.

One GHSP physician educator reached out to a local NGO conducting a Helping Babies Breathe master training session in Dar es Salaam to obtain a training manikin and educational materials. Starting with medical students on their fourth-year pediatrics rotation, a multi-session training course was offered in which students learned about the philosophy and principles of neonatal resuscitation following the Neonatal Resuscitation Program (NRP) (19). Students learned about teamwork and assignment of roles during resuscitation. They embraced the underlying principles for each step in the protocol and practiced the actual skills extensively using manikins. When it became clear that hands-on skills training was both desired and effective in teaching the students, additional financial support was requested and received from Seed and GHSP to purchase 11 additional manikins.

Following the initial training sessions, the HKMU Student Association recognized the need to teach and train other students across the medical and nursing school to perform neonatal resuscitation. Over three separate sessions, several dozen committed nursing and medical student leaders attended "train the trainer" workshops in which they received extensive training on both the NRP protocol and how to effectively teach resuscitation skills. Members of the fourth-year pediatrics rotation who had previously been trained served as assistant teachers for these sessions. On April 24, 2015, these committed student leaders organized and led a school-wide continuing medical education (CME) workshop on neonatal resuscitation, attended by a local academic leader and advocate for neonatal resuscitation training in Tanzania. The students offered a detailed lecture presentation

and hands-on skills training to over 200 students, faculty, and staff nurses and physicians from the local private and regional public hospital. At the workshop, one local physician approached the GHSP physician educator to inform her that a baby the fourth year medical students had resuscitated the day before was alive and well, thanks to their efforts.

What We Found and What It Means

Since the initial CME workshop, HKMU students have gone on to lead a skills workshop for a local Medical Students Association, a training session at Mwananyamala Regional Hospital (funded by Jhpiego), and another CME workshop for the HKMU community. All told, these students have trained over 600 of their fellow students and local health-care workers in neonatal resuscitation techniques. One of these student leaders has gone on to obtain formal Master Trainer certification from Helping Babies Breathe and subsequently trained fourth year medical students at HKMU. The current student leaders at HKMU are committed to training new trainers in order to ensure sustainability of their resuscitation training. Pre- and post-workshop quizzes continue to provide evidence that knowledge level improve as a result of the training and ample anecdotal evidence from community health-care providers indicates that these trainings have translated to lives saved in the nursery as providers become more confident and effective in implementing neonatal resuscitation techniques. One of the students was recently at a private hospital when a neonate coded; the nurse present started resuscitation, however the student noticed the resuscitation wasn't according to protocol and stepped in to offer help; the baby survived. Soon after the nurse asked the student to help her refresh her skills and they were able to discuss the correct steps of resuscitation. The art of this training is that it has a direct effect to the neonate as well as demonstrates the power of interdisciplinary learning.

Cervical Cancer Prevention Training in Tanzania

Local Problem

Cervical cancer is the most common female cancer in sub-Saharan Africa. Of all new cervical cancer cases in Africa, it is estimated that 40% of new cases occur in Eastern Africa. Tanzania has one of the highest rates of cervical cancer and it is the leading cause of cancer *and* cancer death among women ages 15–44 (20). Worldwide, more than 85% of cervical cancer deaths are in low-resource settings, such as Tanzania. This is despite the fact that cervical cancer is preventable—with early detection and treatment of pre-cancerous lesions and early cancers (21, 22). Women die in such large numbers because most are diagnosed in advanced stages of cervical cancer, when treatments are no longer available (23, 24).

In Tanzania there has been a considerable cervical cancer prevention effort over the past 20 years (23, 25). Tanzanian health-care providers are trained in visual inspection with acetic acid (VIA) and cryotherapy per the Tanzanian Ministry of Health and Social Welfare (MOHSW) Guidelines (24, 26). This is an effective, affordable screening and treatment option for pre-cancer of the cervix and echoes the guidelines from the WHO

for low-resource settings (24). Despite these efforts to scale-up cervical cancer prevention services, screening and treatment coverage has not yet been achieved and a high disease burden persists (20, 27).

To bridge the gap in coverage, Ministries of Health and the international community are developing novel, cost effective, locally applicable training, screening and treatment approaches for low-resource settings (27–31). Regardless of the technology used to screen and treat cervical pre-cancer, however, frontline health workers require specialized training to provide this life-saving service and many challenges to both training and maintaining core competencies in this area have been reported in the literature (27–31). This suggests that including this content in pre-service education might be important. At present, most pre-service nursing and midwifery students in Tanzania do not receive training in cervical cancer prevention with VIA and cryotherapy. To that end, a GHSP nurse educator and faculty at the University of Dodoma piloted a program to train Tanzanian pre-service students of nursing and midwifery in core knowledge for cervical cancer prevention using VIA and cryotherapy.

What We Did

The first steps taken were to conduct a needs assessment of cervical cancer prevention screening and focus on relationship building with providers and trainers both regionally and nationally. This process included a broad review of local MOHSW resources and NGO partners engaged in cervical cancer prevention efforts. Next, through funding support from Seed and GHSP and collaboration with the local HIV implementing partner, the team ensured that local clinical sites had crucial supplies required for performing VIA and cryotherapy.

The team then conducted a refresher training in VIA and cryotherapy for local MOHSW trained providers and key district and university leadership. The training evaluated skills and learning needs of clinical providers and initiated a process to strengthen foundational knowledge about VIA and cryotherapy. This 1-day didactic conference also introduced key university nursing/midwifery faculty to the cervical cancer prevention content and laid the groundwork for future training of pre-service nursing and midwifery students in cervical cancer prevention at these sites. Once the clinical MOHSW sites were engaged, refreshed and equipped, the pilot shifted focus to the training of upper year bachelors and diploma students at the University of Dodoma.

In total, 187 pre-service nursing and midwifery students completed a 1-day didactic training in cervical cancer prevention with a focus on VIA and cryotherapy. Of those students trained, 27 were diploma candidates in their final year of training. The remaining 160 were third- and fourth-year bachelor's students. The didactic training was an interactive training adapted from high quality training materials from the Tanzanian MOHSW National Training, Jhpiego, PATH and Grounds for Health.

Currently, clinical training in VIA and cryotherapy is underway for those pre-service students who completed the didactic training by nurses trained and certified by the Tanzanian MOHSW. While they will not be certified to independently perform VIA and cryotherapy, they will have received foundational training

that they will apply in their future practice, ideally in locations where cervical cancer prevention programming is already in process.

What We Found and What It Means

As part of the initial assessment, the team found that student nurses and midwives had little prior knowledge about cervical cancer, basic cervical anatomy including variations of normal, or how to perform speculum and bimanual exams. Yet, students were eager to acquire any possible knowledge and skills to improve the health of their communities, especially life-saving preventive services that can be provided by nurses and midwives in remote areas. Despite strong University and MOHSW interest in cervical cancer prevention, urgent and competing priorities made it difficult to prioritize the integration of this vital life-saving care into the health system, which makes it all the more important to integrate this training into the pre-service curriculum.

Challenges to scaling-up this education are myriad. In sub-Saharan Africa, cervical cancer incidence is impacted by the HIV/AIDS pandemic. As of 2014, the UN estimated that 24.7 million people are living with HIV in sub-Saharan Africa, 58% of whom are women (24). Women living with HIV have a higher prevalence and incidence of cervical pre-cancer compared to HIV-negative women (32). Thus, women living in this region are at higher risk for cervical cancer and this is occurring in the tandem with constrained and decreasing cervical cancer prevention and treatment funding (20, 27). This double burden of high prevalence and few resources requires new, clinically and cost-effective approaches to the sustainable cancer prevention training of health professionals. In that context, building cervical cancer screening education into the pre-service curriculum is an important step and helps achieve Tanzania's goal to address cervical cancer while also increasing the awareness and clinical knowledge of the soon to be graduates (32).

To this end, further capacity building efforts focused on nursing and midwifery educators in Tanzania are crucial. These educators are well positioned to provide the pre-service didactic content but will need support from expert MOHSW trainers and care providers to assure that the information and skill-building provided to students is state-of-the art and evidence based. Regardless of the myriad challenges, access to life-saving reproductive health care for all women, especially in the global south, is a human right and must be a priority (27).

DISCUSSION

Findings from the first 3 years of GHSP suggest that an innovative, locally tailored and culturally appropriate multi-country academic partnership program is feasible and generated enhancements in nursing and medical education as well as the implementation of practice improvement initiatives relevant to capacity strengthening for nursing and medical education. The exemplars demonstrate that twenty-first century health professional education needs to be responsive to national and local health priorities and be creative in developing teaching and learning strategies that are linked to service and cross the academic/clinical domains.

Key features of the GHSP program emphasize and support these needs, including the intentional pairing of the US/African educators, emphasis on faculty supervised clinical instruction, involvement of students in academic enrichment activities such as practice improvement projects, and a sustained commitment to host-country institutions over time. Although GHSP nursing and physician educators are seconded to academic institutions and teach primarily in the classroom and clinical setting, access to support (financial and pedagogical) for practice improvement projects contributes to their ability to create a fluid learning environment for students and staff across academic-clinical settings. Continued evaluation of the model will help inform optimizing classroom and clinical pedagogy in resource-constrained settings to both improve the health and well-being of populations who suffer a disproportionately high burden of disease, as well as to demonstrate the retention of health-care providers in a system in which they feel invested and able to make an impact.

The body of work described in this manuscript focuses on translating evidence to practice and as such does not attempt to create new knowledge that is generalizable. Rather, our work addresses a practice gap by implementing evidence-based teaching/learning strategies and clinical practice interventions to achieve an immediate improvement in education or care within the local context. Accelerating the uptake of evidence into the education and practice environment has been identified as a priority for translational science. The GHSP outcomes and exemplars described in this manuscript demonstrate that with attention to local context and culture, evidence-based best practices can be implemented in health professionals training and clinical practice even in resource-constrained settings.

An important lesson learned from the Ebola crisis is that global health security is dependent on individual health security and that individual health security is dependent on having a sufficient number of qualified health professionals and faculty (6). It is not enough to have a sufficient pool of health professionals; they must be well prepared to respond to existing and emerging health threats in their country. To do that requires that we move outside traditional pre-service/in-service silos and create dynamic learning environments that promote critical thinking, that empower students and clinicians to tailor best practices to meet local context, and that challenge students and clinicians to think across disciplines and across the care delivery domains. Challenging the norm and charting new models to address primary care, pain and wound management, neonatal mortality, and cervical cancer prevention required the will to address a current health threat, to not be constrained by the reality of scarce resources or the *status quo*, to work across the academic-clinical domains and to feel empowered to act. GHSP, with its focus on assisting academic institutions, health-care facilities, and individual faculty and students to create a culture of academic/clinical excellence, is well positioned to collaborate with these host-country partners to achieve their aspirational goals.

AUTHOR CONTRIBUTIONS

ES, EC, LF, and VK conceptualized the manuscript, were intimately involved in the work described in the manuscript, and

worked on the drafts and final version of the manuscript. EH and MM wrote the draft for the family medicine exemplar and approved the final draft. JS and JK wrote the draft for the wound care exemplar and approved the final draft. EJ and AK wrote the NRP exemplar and approved the final draft. EV and FM wrote the cervical cancer exemplar and approved the final draft.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Developing a Sustainable Need-Based Pediatric Acute Care Training Curriculum in Solomon Islands

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Background: The Johns Hopkins Hospital Pediatric Emergency Department (PED) was invited to collaborate with the National Referral Hospital (NRH), Solomon Islands, to establish an acute care pediatric education program for the country's inaugural class of national medical graduate trainees.

Objective: To develop and evaluate a sustainable, need-based post-graduate training curriculum in pediatric acute care, resuscitation, and point-of-care ultrasound.

Methods: A need-based training curriculum was developed utilizing the ADDIE model and was implemented and revised over the course of 2 years and two site visits. Implementation followed a train-the-trainer model. The curriculum consisted of high-yield didactics including workshops, simulations, hands-on ultrasound sessions, and lectures at the NRH. A mixed-methods design was used to evaluate the curriculum, including pre/posttesting, qualitative group discussions, and individual surveys. The curriculum was revised in response to ongoing learner evaluations and needs assessments. Continuing educational sessions after the site visit demonstrated sustainability.

Results: The curriculum included 19 core topics with 42 teaching sessions during the two site visits. A total of 135 pre/posttests and 366 individual surveys were collected from 46 trainees. Completion rates were 78.2% for surveys and 71.3% for pre/posttests. Pre/posttest scores increased from 44 to 63% during the first site visit and 69.6 to 77.6% during the second. Learners reported a mean 4.81/5 on a standard Likert scale for curriculum satisfaction. Group discussions and surveys highlighted key areas of knowledge growth, important clinical care advances, and identified further needs. Initial sustainability was demonstrated by continued ultrasound sessions led by local graduate trainees.

Conclusion: A collaborative team including Johns Hopkins PED staff, Solomon Islands' graduate trainees, and NRH administration initiated a professional education curriculum for the first class of Solomon Islands' medical graduates. Knowledge growth and positive impacts of the program were reflected in learner survey and test scores. Graduate trainees were identified as local champions to continue as course instructors. This innovative

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curriculum was developed, revised, and initially sustained on site. It has been successful in introducing life-saving pediatric acute care and graduate training in Solomon Islands.

Keywords: curriculum design, train-the-trainer, Solomon Islands, pediatric acute care, global health medical education, ADDIE model

INTRODUCTION

One of the most difficult elements for establishing a functional health-care system for a low middle income country such as the Solomon Islands is having a sufficient supply of locally based trained health-care workers (1). Solomon Islands, located in the South Pacific, is comprised of six major islands among more than 900 smaller islands (1–4). With 70% of the population living in remote or very remote areas, access to medical care in Solomon Islands is complicated by the long travel distances and dispersed islands (1).

In 2007, Solomon Islands established a new health aid program with Cuba, which provides consistent education for Solomon Islands medical students every year. In 2014, the first 22 newly graduated doctors arrived home facing the challenge of practicing medicine with limited resources and a shortage of further structured graduate medical training. With the support of the Embassy of Taiwan in Solomon Islands and a Solomon Islands-based medical team from Kaohsiung Medical University Hospital in Taiwan, the Johns Hopkins Hospital (JHH) Pediatric Emergency Department (PED) has collaborated with the National Referral Hospital (NRH) to establish a training curriculum with a heavy focus on pediatric acute care clinical education for these new doctors.

The NRH is the largest hospital and the only referral hospital in Solomon Islands. It is located in the capital city of Honiara on the island of Guadalcanal. The NRH offered a pediatric emergency team from Johns Hopkins the opportunity to provide medical education to the inaugural class of graduate trainees with particular emphasis on the acute care of critically ill children. Teaching consisted of high-yield didactics in the form of workshops, simulations, and lectures. The curriculum was designed based on the ADDIE method (analysis, development, design, implementation, and evaluation) of instructional systems design, with the curriculum content developed according to real-time needs assessment. In addition to teaching basic hands-on pediatric resuscitation skills and pediatric acute care topics, a primary goal was to establish a curriculum that could be repeated by local instructors at the NRH after completion of a site visit.

The ADDIE model is a popular instructional design process used in creating a teaching curriculum that is geared toward producing specific learning outcomes and behavioral changes (5). It provides a systematic approach to the analysis of learning needs, the design and development of a curriculum, and the implementation and initial evaluation of a training program (5, 6). This model of developing new training programs is particularly useful if the focus of the program is targeted toward changing participant behavior and improving performance (6, 7). While it was first widely used by the US Armed Forces for technical training and flight training in the 1970s (8), recent studies have successfully adopted the ADDIE model to improve patient safety, procedural

competency, and disaster simulation (7, 9, 10). It has also been effectively used in medical training to change practice behaviors in the management of various medical conditions (11–13). While frequently cited, it is important to note that the ADDIE model does not appear to have an original author and authoritative definition. Its application has evolved informally through each individual author's interpretation (14, 15). This flexible yet organized approach in creating relevant focused learning outcomes was an ideal roadmap for the curriculum design process.

OBJECTIVES

This project was conducted to provide need-based pediatrics training to the Solomon Islands medical graduate trainees. Using the ADDIE model, we aimed to develop a training curriculum in acute pediatric care, resuscitation, and point-of-care ultrasound. We aimed to implement the curriculum utilizing a train-the-trainer model and evaluate the impact of the curriculum, including knowledge growth, learner experience, satisfaction, future needs, and sustainability.

METHODS

A mixed-methods design was used to develop, implement, and revise a curriculum over the course of 2 years and two site visits. The study protocol received JHH Institutional Review Board exemption, approval from the NRH, and all participants consented to surveys and interviews.

SETTING

Over the course of two 4-week site visits in September 2015 and September 2016, a training program was developed and implemented at the NRH of Solomon Islands. The participants were local health-care practitioners who were required to manage a wide range of medical complaints with limited resources and direction. The vast majority of participants were medical graduates of Solomon Island citizenship who completed their medical school education in Cuba with the remaining minority graduating from regional medical schools in Fiji or Papua New Guinea. All local practitioners were fluent in English as well as Pijin, the nation's lingua franca; however, the inaugural class of residents who graduated from medical school in Cuba were further faced with the challenge of translating their medical knowledge from Spanish into their local dialects and English.

PROJECT DESIGN

The design process of the pediatric acute care curriculum consisted of an adaptation of the five phases of the ADDIE model (**Figure 1**), beginning with identifying trainee needs, educational

Analyze	<ul style="list-style-type: none"> Initial needs assessment with key stakeholders identifying educational goals and ideal approach Targeted real time needs assessment with graduate trainees in situ
Design	<ul style="list-style-type: none"> Topic assignment based on real time targeted needs assessment Topic goals and objectives Survey question design and revision
Develop	<ul style="list-style-type: none"> Curriculum content development by medical team and trainees based on local needs assessment Practice in curriculum implementation and educational strategies Feedback sessions for practice curriculum delivery
Implement	<ul style="list-style-type: none"> Pilot implementation of curriculum with 1st year graduate trainees Identification of local champions for curriculum propagation Repeat curriculum implementation with teaching led by local instructors
Evaluate	<ul style="list-style-type: none"> Individual assessment by learner knowledge evaluation with pre/post-tests Program evaluation with surveys Group discussions

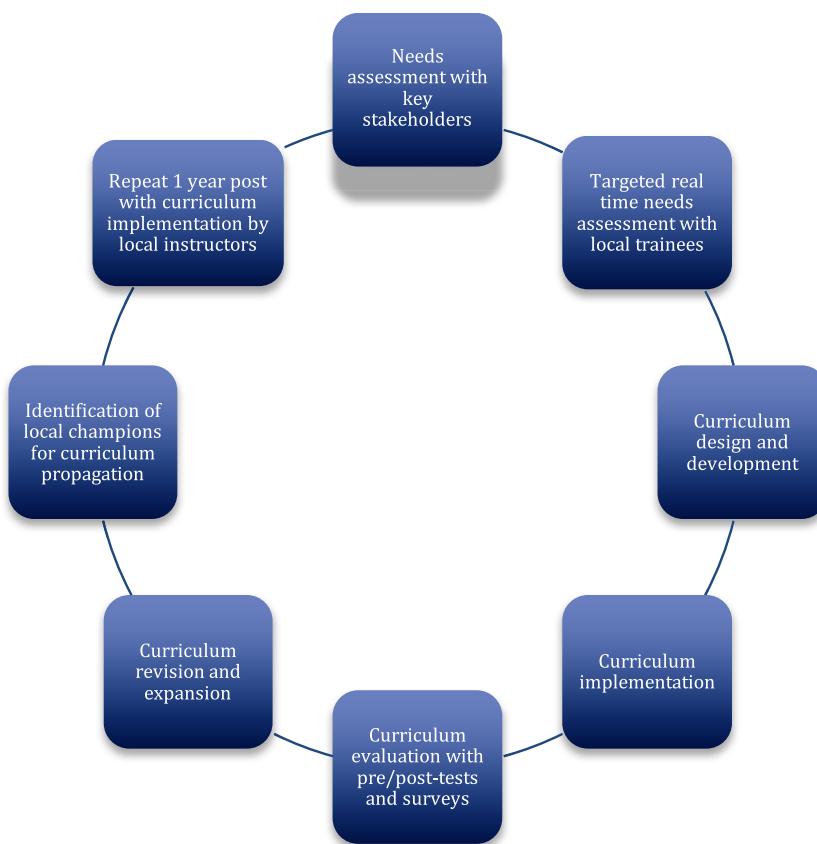


FIGURE 1 | ADDIE model and project design.

goals, and optimal methods of content delivery. This was followed by implementation and evaluation of the resulting curriculum and learner performance. Finally, emphasis was placed on curriculum maintenance and sustainability by employing a train-the-trainer model in the second curriculum implementation phase. Although the ADDIE model phases are written in a linear order, its application is often considered to be iterative and cyclical (14). Concepts

from Kern's Six-Step Approach to Curriculum Development and Medical Education were applied to the ADDIE model (16). Kern's six-step approach consists of (i) problem identification and general needs assessment, (ii) targeted needs assessment, (iii) goals and objectives, (iv) educational strategies, (v) implementation, and (vi) feedback and evaluation (16). Kern's approach placed particular emphasis on a non-linear progression of curriculum

development process. While the ADDIE model appeared more user friendly and was the primary framework of curricular design of this project, a more dynamic approach was used with each step contributing to changes and improvement of the final product.

ANALYSIS

An initial needs assessment was conducted by interviewing key collaborators including the NRH Superintendent, Head of Pediatrics and Hospital Education Coordinator. These administrators were invited by email to identify graduate educational needs and specific equipment availability. This preliminary needs assessment guided development of a preliminary curriculum prior to the first site visit. We were also assisted by the Embassy of Taiwan in Solomon Islands and a locally based medical team from Kaohsiung Medical University Hospital to establish local government, hospital leadership, and media connection. Government and leadership recognition not only permitted smooth passage through customs control with large quantities of medical supplies but also helped facilitate our complex conference scheduling of a resulting total of 42 formal teaching sessions.

Once on site, we formally met with the key educational stakeholders, the graduate trainees, to discuss the preliminary curriculum and identify the most relevant needs in pediatric acute care instruction for an initial curriculum. After each educational session with the trainees, we obtained immediate feedback with qualitative surveys and group discussion to assess the educational impact of that session and identify shortcomings. This feedback was directly applied to the design of future sessions, allowing for continuous quality improvement of our curriculum.

DESIGN

During initial immediate feedback sessions, the trainees identified several high-yield topics for further instruction. These real-time feedback sessions not only informed the development of overarching goals and objectives for these topics but also allowed for ongoing modification of the overall educational curriculum.

Post-session surveys were designed to assess learner experience with open-ended questions and 5-point Likert scale responses. We adapted Floyd and Fowlers reference book on Improving Survey Questions (17). We followed a quality control checklist for each survey question and revisions were based on feedback from a pilot group of five physicians in the JHH pediatric emergency medicine division.

DEVELOPMENT

The curriculum development team consisted of three groups: the JHH group, the NRH administration, and Solomon Islands' graduate trainees. The JHH team consisted of medical volunteers from the PED, including a pediatric emergency medicine attending and fellow, pediatric residents, and a pediatric emergency nurse. The NRH administrative team consisted of the Head of Pediatrics, the Medical Superintendent of the NRH, and the Hospital Education Coordinator. The graduate trainees group was previously described in Section "Setting." Curriculum

development was iterative and ongoing throughout the 2 years, and sustainability measures are ongoing currently.

Teaching consisted of high-yield didactics in the form of workshops, simulations, hands-on ultrasound sessions, and lectures at the NRH. Different topics, depending on the learning objective and available material, required different delivery strategies and content preparation. The curriculum was practiced and prepared according to available resources. Teaching feedback to graduate trainee instructor was provided by the JHH pediatric emergency medicine fellow and attending.

IMPLEMENTATION

The pilot implementation phase during the first visit in September 2015 targeted the inaugural class of Solomon Island medical graduates who predominantly obtained their medical degrees in Cuba. During the second site visit in September 2016, an expanded training curriculum utilizing a train-the-trainer model was implemented, targeting a new class of medical graduates in addition to the class taught the year prior.

Local volunteer instructors from the second-year group were identified prior to the second site visit in order to take over responsibility of the curriculum. Formal ongoing feedback was provided for local instructor-led sessions. Due to high level of interest and positive survey response, particular focus was placed on point-of-care ultrasound during the second site visit.

EVALUATION

A mixed-methods approach was used to evaluate the curriculum, which consisted of pre/post-event knowledge testing as well as post-event qualitative group discussion and individual qualitative surveys. Participant knowledge growth was evaluated from scores from pre/posttesting of each session. Test questions written by the pediatric emergency fellow and attending covered key learning objectives from the education sessions. Pre/posttesting of sessions during the first and second site visits were identical but questions were presented in a different order.

The post-session group discussion and individual qualitative surveys reflected the impact of the curriculum, learner experience, and learner satisfaction. Group discussions were conducted with focused questions assessing what was learned, what could be improved, applicability of practice with available resources, confidence in teaching the same topic again independently, and other topics to include in the future. The curriculum was further revised in response to the first site visit evaluations and needs assessments. Educational sessions that were led by local instructors after the site visit were used to evaluate sustainability.

RESULTS

The curriculum was delivered to a total of 57 participants. Average age of participants was 29.3 years old. A total of 46 participants were graduate trainees who completed medical school abroad. Two graduated from medical school in Fiji and two graduated from medical school in Papua New Guinea. A total of 42 graduated from medical school in Cuba; 20 were first-year trainees that

graduated in 2015 and 22 were second-year trainees that graduated in 2014. Other participants included six visiting medical students from Australia and five local nurses.

Through qualitative surveys, graduate trainees identified topics of greatest interest. **Figure 2** shows the topics that were requested by individual trainees and the number of times each topic was requested. The curriculum was tailored to cover the most requested topics (in blue). Topics with less than three requests were not listed. Even though ultrasound teaching was not initially requested by trainee surveys, a special bedside ultrasound curriculum was requested by key hospital stakeholders (NRH Superintendent, Head of Pediatrics and Hospital Education Coordinator) in the general needs assessment prior to the second site visit.

The resulting curriculum consisted of 16 core topics delivered during two site visits comprising a total of 42 teaching sessions. These included early newborn care, drowning, seizures, sepsis, pediatric/neonatal resuscitation, airway management, common rashes, suturing, respiratory emergencies, diabetes, child abuse, pain management, cardiac murmurs, point-of-care ultrasound, and trauma (**Table 1**).

Our curriculum was evaluated using three methodologies: post-event qualitative group discussions, individual surveys, and pre/post-event knowledge testing. Group discussions occurred after all 42 sessions. Individual surveys were collected after 15 of 42 sessions. Pre/post-event knowledge testing was completed after selected resuscitation topics (trauma, sepsis and shock, and airway management). Completion rates are shown in **Table 2**.

Overall knowledge gains were reflected by a pre/posttest score rise from 44 to 63% during the first site visit and 69.6 to 77.6% during the second site visit. The first site visit group consisted of 22 trainees that graduated in 2014. The second site visit group

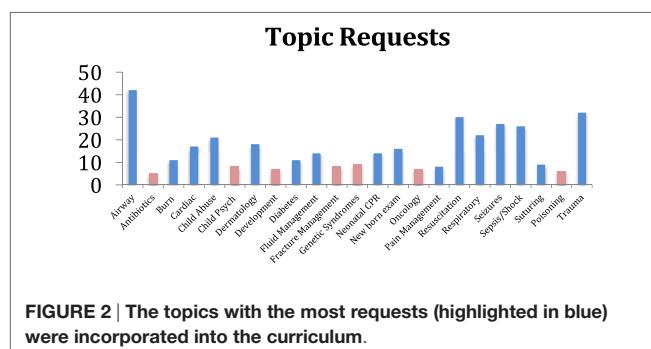


FIGURE 2 | The topics with the most requests (highlighted in blue) were incorporated into the curriculum.

TABLE 1 | Curriculum content and delivery.

Workshops	Simulations	Lectures
Basic airway	Trauma	Early newborn care
Suturing	Sepsis	Drowning
FAST ultrasound	Pediatric resuscitation	Seizures
Cardiac ultrasound	Neonatal resuscitation	Shock
Lung ultrasound		Common rashes
		Respiratory emergencies
		Diabetes
		Child abuse
		Pain management
		Cardiac murmurs

consisted of 46 trainees, which included the initial group of 22 trainees from the first site visit. Due to test anonymity, individual participant progression was unable to be tracked.

Learners reported a mean 4.81/5 (5 = very satisfied) on a standard 5-point Likert scale for curriculum satisfaction and 4.5/5 (5 = very relevant) for relevance of teaching session to current practice. Upon self-assessment, learners reported a mean 3.3/5 (5 = understands topic very well) for understanding of topic before the teaching session and 4.1/5 for understanding of topic after the teaching session. Learners reported 3.85/5 (5 = very confident) for confidence in teaching the same topic again if given access to teaching supplies and materials.

QUALITATIVE FEEDBACK AND GROUP DISCUSSION

Focus group discussions and surveys highlighted key areas of knowledge growth and important clinical care advances. The evaluation process focused upon what was learned, what could be improved, and other topics to be included in the future.

When asked about practice changes, feedback included: “I learned about the different ways to give oxygen,” “I learned how to correctly use a defibrillator,” and “I learned that oral salbutamol is not as effective as inhaled salbutamol.” Participant response also reflected increased confidence in managing pain, seizures, and caring for infants: “I feel comfortable with the practice of pain management and using different types of analgesics for mild to severe pain,” “Excellent presentation, I feel more confident in managing children with seizures, especially febrile seizures,” and “I feel more prepared looking after newborn infants in the first min after birth.”

Child abuse was a particularly well-received topic based on survey feedback. The majority of trainees reported no prior formal instruction of this topic. Participants wrote: “We really need a good reporting system for child abuse, today’s topic really got me thinking the victim are people who can’t speak for themselves and it is up to me to see that the help they need is provided,” “Thank you so much for this valuable session, I feel more confident in recognizing child abuse. I think this condition is always ignored here,” and “This is very valuable in our daily practice.”

When asked about recommendations for changes and improvement, most responses indicated the need to provide more education—more topics, more time per session, and more repeat sessions. Many requested video format of the sessions (18 responses). Feedback also revealed that the teachers were speaking too fast (14 responses). As the ADDIE model was applied in a dynamic iterative manner, the response to this feedback could be

TABLE 2 | Survey and testing completion rates.

Site visit	366 surveys	135 pre/post tests
	n (% complete)	n (% complete)
2015 ^a	167 (84.3)	57 (86.3)
2016 ^b	199 (72.1)	78 (56.3)

^a22 trainees.

^b46 trainees.

made in real time. Subsequent survey comments demonstrated improvement in lesson delivery after speaking at a slower pace (three responses).

When asked open-ended questions about teaching–learning strategies and which aspects they found new or useful, answers were overwhelmingly positive about demonstrative teaching methods combined with PowerPoint slides. Representative responses included: “I’ve never seen actual demonstrations of the standard approach to assessing trauma patients and also practice them directly after.” Another wrote: “I learned a new approach of teaching by using slides combined with practical demonstrations” and “The seizure management demonstrations were wonderful.”

SUSTAINING THE CURRICULUM

The maintenance and enhancement of the curriculum relied on collaborative efforts. The Johns Hopkins team and the NRH administration were responsible for the initial development of the curriculum content, but it was through the active participation, input, and feedback from graduate trainees that the curriculum was tailored to be need-based and the preferred content delivery was established. This ensured appropriate high-yield teaching topics that were pertinent to the graduate trainees’ level of knowledge, local practices, and available resources. This in turn likely promoted the trainees’ high level of interest and engagement. This is thought to have helped with bridging the cultural gap as the local Polynesian and Melanesian culture have been observed as shy and reserved when “exposed” to Western culture, which can be initially misinterpreted as being disinterested to the outsider.

Curriculum material including airway supplies, simulation manikins, referencing resources, and the complete series of PowerPoint lectures were left behind for local use. Two local volunteer instructors were selected from the second-year group to take over responsibility of the curriculum. Formal feedback was provided for local instructor-led point-of-care ultrasound sessions. An additional three hands-on ultrasound sessions were led by a local volunteer instructor showing initial evidence for sustainability. Periodic emails with the local instructor helped to maintain ownership and responsibility. The program was featured three times by Solomon Islands’ local news agency, with one story in particular highlighting the local volunteer instructor demonstrating ultrasound use. This further added to local stakeholder satisfaction of the program and in turn can motivate this local curriculum champion to further expand on the curriculum.

The Hopkins team plan to maintain contact to continue to support and evaluate program needs.

DISCUSSION

The training program was well received and demonstrated further generalizability of the ADDIE model. This was the first formal post-graduate training program implemented in Solomon Islands for pediatric acute care.

The “analysis” component of the ADDIE model, in which daily lectures and/or simulations were designed to address the specific topics requested by local trainees, was critical to learner attendance. While numerous lectures and simulations were prepared

in advance based on needs identified by the hospital leadership, lectures on topics such as diabetes and seizure management were identified from learner request, implemented into the lecture schedule, and highly attended. This adaptability proved quite popular, and end-of-lecture negotiation about the following day’s topic resulted in sustained attendance of the majority of the trainees.

The mixed teaching methods consisting of PowerPoint lectures, simulations, and workshops received very positive feedback but could have been easily modified within those parameters if a trainee learning preference was identified. While we were able to bring six pediatric-sized mannequins and a wide array of airway equipment for simulations, other simulation materials were obtained from local resources, including banana peels for mock flesh for a suturing workshop and empty plastic juice bottles as mock neonatal mannequins for neonatal resuscitation simulation. While higher fidelity simulations are preferable, pretest and posttest scores were comparably improved between simulations regardless of materials used. Taché et al. used inner tubes from bicycle tires as mock small bowel and plastic tubes covered with foam and vinyl as mock saphenous veins beneath flesh to teach small bowel repair and venous cutdown among other procedures to senior medical students at a teaching hospital in Tanzania (18). They found through objective structured clinical examination (OSCE) scores a fourfold improvement in skill compared to pre-training OSCE scores with large effect sizes, demonstrating utility of low-cost, low-fidelity simulations.

The largest limitation of effective implementation of the ADDIE model was effective curriculum propagation after the first site visit. It was difficult to pre-identify local champions of the curriculum nor was there sufficient time to repeat the curriculum with teaching led by local instructors. After first-year trainees had been exposed to the curriculum, it was much easier recruiting interested now-second-year trainees to teach part of the curriculum during the second site visit. Depending on time constraints, it is likely that at least two site visits will be required to recruit local curriculum champions as the first site visit foremost served as an opportunity not only to develop the curriculum, but more critically to develop friendship and trust between medical teams and foster an academic partnership. A second site visit confirmed ongoing commitment to the host institution, and the local instructors we hoped to recruit—the second-year graduate trainees—were already familiar with our team and generally knew what to expect.

Two second-year graduate trainees were identified as curriculum champions and given the opportunity to lead various lectures, workshops, and simulations. At 3-month follow-up, one local volunteer champion had taught cardiac and lung ultrasound a total of three times and had been featured in the local newspaper teaching a workshop. This workshop was most likely in demand as it is skill based, utilizes an important technology in a very resource-limited setting, and had received strongly positive survey feedback. It is likely impromptu ultrasound training sessions were easier to set up compared to simulations and lectures, which tend to require greater organization. Compared to the other teaching topics that were not technology dependent, this one unfortunately relies on the sole ultrasound machine continuing to function.

Another potential limitation of curriculum propagation was the lack of repetition of the curriculum. Identified local trainees received no more than two sessions per topic separated by 1 year. The overall demonstrated increase in pre/posttest knowledge score averages from the two site visits, along with the positive qualitative survey responses does not necessarily translate into achieving competency in performance. It is likely that even with intensive feedback given to the second-year graduate trainees after their training sessions during the second site visit, they may not feel adequately trained to autonomously lead teaching sessions without support. The train-the-trainer approach was hybridized with primary curriculum delivery given time constraints, and more formal and separate instructor training sessions may have led to further success in curriculum propagation. It is well documented, particularly in regards to cardiopulmonary resuscitation, that brief but frequent “booster” training is important for skill retention (19).

Since time was limited, it may have been more beneficial to focus on a smaller selection of the most requested topics, such as airway and ultrasound, allowing ample time for repetition and local trainee teaching practice. Malan et al. (11) were able to implement a widely adopted motivational interviewing program for primary care providers in the Western Cape of South Africa through use of the ADDIE model. Factors likely contributing to their success include a focused curriculum related to a defined topic (motivational interviewing) and formal train-the-trainer instruction in which trainers were taught the curriculum with the explicit expectation that they would propagate it. While the variety of lectures was appreciated and likely contributed to high learner attendance and participation, the capacity for curriculum propagation and long-term reinforcement was compromised.

As a result of this experience, it is our impression that the ADDIE model is a useful training curriculum implementation tool targeted toward medical graduate trainees in Solomon Islands. Cuba, where the vast majority of trainees obtain medical degrees, has very different social determinants of health, available resources, and the sociocultural relationship to Western medicine is quite different. The ADDIE model served as a way to integrate sociocultural nuances into the curriculum since curriculum design is directly based on a real-time needs assessment. As an example, when a lecture on child abuse during the first site visit was being presented, attendees mentioned that pediatric burn patients are frequently encountered because open fires, particularly for trash burning, are commonplace, and many were curious from their own experiences about distinguishing accidental from non-accidental burns. Consequently, the child abuse lecture during the second site visit was largely focused specifically on burn patterns and burn management.

In future site visits, our inter-hospital team will continue to apply the ADDIE model consistently to demonstrate long-term validation of the model in Solomon Islands. Future goals include promoting the successful propagation of the ultrasound workshop and teach additional targeted applications of point-of-care ultrasound such as obtaining peripheral intravenous access and assessing cardiac function. It has been shown in rural Rwanda that ultrasound teaching is sustainable, particularly with ongoing quality assurance by review of emailed key images to instructors between site visits, identification of ultrasound champions to

sustain enthusiasm, and ultrasound machines that are maximally durable to resist the elements (20). Finally, we will restrict the remaining curriculum to fewer topics determined from real-time targeted needs assessment to leave ample time for both knowledge or skill reinforcement and intensive local champion teaching practice and feedback. We will also be persistent with establishing ongoing dialog with identified local champions after future site visits to help encourage curriculum propagation and identify solutions to any barriers.

CONCLUSION

Based on our experience, we believe that the ADDIE model is an efficient and effective way to develop a local professional education curriculum in Solomon Islands. The curriculum was successfully implemented for the first class of Solomon Islands' medical graduates. Knowledge growth and positive impacts of the program were reflected in survey and test scores. Local champions were identified to continue as course instructors and efforts are in place to sustain the curriculum and continue future collaboration. Future education endeavors will focus on a similar model with particular emphasis placed on more frequent booster training for instructor-led sessions on a smaller selection of topics to further enhance sustainability. The curriculum should be adapted to local resources available at the time of a site visit and continually refined to optimize sociocultural relevancy.

ETHICS STATEMENT

The JHM IRB has determined that the above-referenced study (IRB00081486) qualifies as exempt research under the DHHS regulations 45 CFR 46.101(b)(1). Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

AUTHOR CONTRIBUTIONS

DY (Johns Hopkins Hospital) was primarily involved in the overall design and development stages of the project. The rest of the training sessions, data collection, and evaluation of feedback was mostly done by DY, JG and RD and overseen by KS and MS. All the authors contributed to the article and approved the final manuscript.

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A Sustained Partnership between a Haitian Children's Hospital and North American Academic Medical Centers

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Global health initiatives from academic medical centers have rapidly proliferated over the last decade. This paper endeavors to describe our 5-year experience as an academic medical collaborative supporting healthcare delivery, medical training, and research at Hôpital Saint Damien-Nos Petits Frères et Soeurs, the only freestanding children's hospital in Haiti. Descriptions of the history and current activities of our academic medical collaborative, its partnership and communication structure, its evolution to fill the expressed needs of our host site, its funding mechanisms, and its challenges and opportunities for the future are included.

Keywords: global health, collaborative, Haiti, pediatrics, academic medical center, medical education, training, capacity building

INTRODUCTION

According to the World Bank, Haiti is the most financially constrained nation in the Americas and one of the most economically depressed nations in the world. Over 2.5 million Haitians are under the national "extreme poverty line" living on less than United States (US) \$1.23 per day (1, 2). Delivery of adequate pediatric healthcare remains a challenge in Haiti and was greatly complicated by the devastating earthquake of January 12, 2010. After the earthquake, the under-5-year-old mortality rate spiked to over 150 deaths per 1,000 children (1, 2). The country is now making strides toward recovery, but training an adequate number of physicians—and specifically pediatricians—remains a challenge. It is estimated that there are as few as four health professionals per 10,000 people (1, 2). Agencies like USAID have identified human resources for health as a key challenge for Haiti (3). Given the magnitude of health disparity and lack of capacity building for human resources, the process of developing a sustainable, long-term partnership with a children's hospital in Haiti is described.

Abbreviations: AMC, academic medical center; CPR, cardiopulmonary resuscitation; HSD, Hôpital Saint Damien-Nos Petits Frères et Soeurs; HBM, Hôpital Bernard Mevs; NA, North America; NGO, Non-Government Organization; PALS, pediatric advanced life support; RLS, resource-limited setting; SDC, Saint Damien Academic Medical Collaborative; USAID, United States Agency for International Development.

HISTORY OF HÔPITAL SAINT DAMIEN-NOS PETITS FRÈRES ET SOEURS (HSD) AND THE SAINT DAMIEN ACADEMIC MEDICAL COLLABORATIVE (SDC)

Nuestros Pequeños Hermanos International, “Our Little Brothers and Sisters,” is a Catholic relief charity established in Mexico since the 1950s. The organization expanded to Haiti in 1988 and founded the HSD in 1991. HSD began as a pediatric hospice facility for children dying of HIV/AIDS, but soon developed into a full-service children’s hospital. The hospital currently provides over 50,000 services per year to the children of Haiti and provides the only pediatric oncology treatment center in the country. A high-risk maternity unit was also developed and coupled with a neonatal intensive care unit, one of only six in the country. After the earthquake of 2010, HSD was one of the few hospitals near Port-au-Prince that was left largely intact. As a result, medical and surgical teams from around the world descended on HSD as part of the relief effort. This resulted in overflowing rooms, and hallways with courtyards converted into temporary patient wards and housing for staff and international volunteers. After emergency relief efforts wound down, a group of faculty and resident physicians from several North American (NA) academic medical centers (AMCs) continued to make regular trips to support HSD. Executive leadership at HSD asked for one site to lead coordination efforts. The result was the SDC, the beginnings of which were several phone conversations and decisions about when groups would be traveling so as not to overlap and cause a drain on the HSD system (4). In 2011, monthly conference calls ensued and minutes were kept in order for teams to have up-to-date information and synchronize efforts. Conference calls became more robust and eventually lead to videoconferences that have standing agenda items beginning with an update from HSD. All members have a dedicated email and access to a virtual drive where conference call minutes and other shared items can be found. The institutions and their year of their matriculation are listed in **Table 1**.

The SDC determined fundraising was a priority, and in 2012, a conference and fundraiser took place at the primary coordinating site. This inaugural event led to other partner institutions leading similar pediatric global health conferences and fundraisers for HSD each year, with \$94,640 raised over four events. Most recently in 2016, in a matched fundraising drive, the SDC raised \$50,000 resulting in \$100,000 for HSD. The SDC’s activities are largely funded, independent of its member institutions, through private fundraising events and grants. Each member institution pays a small annual membership fee which helps fund a coordinator and chief resident position at HSD, both of whom support the visiting members of the collaborative and the Haitian Pediatric residency program.

At each conference, there has been an annual meeting of the SDC, with representation from the HSD leadership, and often with the introduction of new member institutions. The focus has always been on the current needs of HSD and the strategic plans for how SDC can partner to help meet these needs during the next year. Each partner site is able to share integral face-to-face time

with HSD administration and clinicians, hearing their goals and expressed needs.

In the fall of 2013, HSD started a pediatric residency program with curriculum created by Haitian staff and faculty. Importantly, while this was a local initiative targeting their own identified needs, the breadth of the SDC provided an educationally supportive backdrop to the residency. The Haitian pediatric residents rotate at two hospitals: HSD and Hôpital Bernard Mevs (HBM). The combination of HSD’s large pediatric patient volume and the Pediatric Intensive Care Unit at HBM gives the residency a blend of experience unique in Haiti. Since 2010, visiting faculty and residents have continued to regularly rotate at HSD, but as a result of SDC efforts, more structure and coordination now exists. Supporting the HSD-HBM residency program was identified as the primary mission of the SDC, solidifying its commitment to improving human resource capacity building for pediatrics in Haiti. A tabulation of faculty and trainee visits from 2010 to 2016 can be found in **Table 2**.

NUTS AND BOLTS OF THE SDC

The overarching goal of the SDC is partnership with HSD in a mutually rewarding and long-term collaboration that seeks to support the academic mission: enhance delivery of care, support medical education, and develop research capacity.

TABLE 1 | Saint Damien Academic Medical Collaborative institutions and year of enrollment.

Institution	Academic affiliation	Year joined
Akron Children’s Hospital	Northeast Ohio Medical University	2012
Children’s Hospital of the King’s Daughters	Eastern Virginia Medical School	2012
Hasbro Children’s Hospital	Brown University	2012
Rainbow Babies and Children’s Hospital	Case Western University	2012
UMass Memorial Children’s Medical Center	University of Massachusetts	2012
Masonic Children’s Hospital	University of Minnesota	2012
Baystate Children’s Hospital	Tufts University	2014
Omaha Children’s Hospital and Medical Center	University of Nebraska	2014
Dell Children’s Medical Center	University of Texas Dell Medical School	2015
Niswonger Children’s Hospital	Quillen College of Medicine, East Tennessee State University	2016
Montreal Children’s Hospital	McGill University	2016

TABLE 2 | Visiting participants by role.

Position	Total individuals	Total visits
Resident	53	67
Fellow	15	16
Faculty	43	102
Medical student	7	7
Other staff	6	6
Total visits	124	198

Clinical Care

Initially, providing clinical care was the primary objective of most partner sites. Looking to lend a helping hand, the NA institution's global health faculty visited HSD to provide direct patient care. The early visits focused on relief efforts, but also sought to undertake needs assessments to determine if HSD would be an appropriate long-term partner site. Many of the backing AMCs had significant experience creating partnerships and global health programs. Initially, much of the relief work focused on seeing patients in the emergency room, helping with triage, and providing relief for overwhelmed Haitian physicians dealing with the earthquake aftermath. The model for visiting teams in Haiti is to have an attending present for 1 week and visiting senior residents (typically two) remain for 1 month. This process allows for better acculturation of visiting residents over time, and for a seasoned attending to help with orientation and culture shock in the first week, relieving busy Haitian faculty from this burden. Over time, groups have also worked on the inpatient wards and outpatient areas. Teams participate in hospital-wide rounds twice weekly with a senior Haitian attending physician, and since 2013, with the introduction of the HSD-HBM residency program, morning report and resident noon conference have become commonplace. The strength of an AMC collaborative is that each site can send residents resulting in several months of continuous presence. This also allows HSD staff to also acclimate to visiting physician presence. HSD administration report that Haitian staff comment that having visiting doctors encourages their own self-directed learning. Cardiac surgery is a specific example of collaborative subspecialized care with one partner site. This partner hospital linked with other Non-Government Organizations interested in providing cardiac screening and surgery. Over the last 5 years, nine children have come to the US for cardiac surgery. The focus of this program has now shifted to performing these cases at HSD, and thus incorporating surgical training for Haitian staff. Through 2016, four separate training programs have been conducted, which included cardiac surgery for 36 Haitian children at HSD. Two examples of remote care include review of radiological studies from pediatric radiologists at partner sites and a real-time case consultation via email to allow subspecialists from partner sites to weigh in on complicated clinical cases as part of the ongoing support of the HSD-HBM residency program.

Education

Education is the foundation of quality medical care, balancing the pillars of healthcare delivery and research. All visiting partner sites that rotate through HSD participate in the education of trainees and staff. The educational elements consist of grand rounds lectures, presentations at the bi-annual National Haitian Pediatric Congress, dissemination of research findings, development of case-based learning modules, hands-on learning of life support and cardiopulmonary resuscitation [i.e., pediatric advanced life support (PALS)], suturing, other procedural workshops including chest tube placement, and bedside ultrasound techniques. When each partner site sends a group to HSD, the attending physician, often a subspecialist, will present grand rounds to the entire hospital staff, including

nurses and administrators. HSD has a fully functional conference room, providing a forum for internationally recognized lecturers year round. Since the inception of the HSD-HBM residency program, there is also a daily noon conference, during which the visiting resident rotators can also present topics. An additional area of focus for one partner had been to develop case-based modules, focusing more on problem-based learning and clinical reasoning skills. This was an expressed need from both the medical student clerkship director and the HSD Pediatric residency director. Manuals that included a primer on case-based learning for facilitators and topic areas of neonatal fever, cough, diarrhea, and seizure were created. In early analysis, all involved learners found the session helpful and enjoyable; citing developing differential diagnoses, collaborative learning, and clinical reasoning as major learning themes (5). Another example of training that has been successful is the annual resuscitation workshop, based on the PALS curriculum, which has always elicited a positive reception from the HSD staff.

One partner site, with an emergency medicine subspecialist lead, also provides an annual procedural skills workshop. This workshop trains HSD-HBM residents in practical skills such as suturing, intubation, and chest tube placement. The importance of these workshops cannot be overstated, as residents often put these skills into practice that very same week. These initiatives mold and adapt at the request and expressed needs of HSD and over the last 3 years have included more involvement with directly teaching Haitian residents. The HSD-HBM residency leadership has also encouraged residents to present lectures, often anchored to a particular challenging case, at the National Haitian Pediatric Congress; providing public-speaking and leadership experience for these residents. In addition, SDC was able to support the printing of HSD-HMB senior pediatric residents' posters of case reports, quality improvement, and research projects for the 2016 National Haitian Pediatric Congress.

Most importantly, the collaborative has also committed to bidirectional exchange, providing each senior resident at HSD with the opportunity to participate in 4-week rotations at SDC partner sites in NA, with the goal of obtaining experience in more technologically advanced subspecialties, not yet as developed in Haiti. In 2016, five of the six senior HSD-HMB residents traveled to partner sites and completed observerships in cardiology and pediatric intensive care. The Haitian residents rated this experience very highly, stating that the opportunity allowed them to gain clinical skills that help them better care for patients, become better educators, and strengthen their sense of partnership with members of SDC. In addition, the members of SDC have obtained funding and provided opportunities for a number of the HSD faculty and staff, including attending physicians, nurses, radiology technicians, pharmacists, microbiology technicians, and hospital administrators, to participate in experiences and other training not available in Haiti. Visiting residents to Haiti are exposed to clinical cases and acuity not often seen in NA, but common in a resource-limited setting (RLS). Upon return, visiting residents give case presentations to their home institutions, further embedding global health indicators in their curriculum and allowing others to benefit. In addition, many of the NA partner sites ask

that the returning visiting residents engage in ongoing fundraising efforts for HSD.

Research

One SDC partner site offers a funded 3-week intensive research training program that allows researchers from RLS to attend at no cost. Seven Haitian healthcare professionals, four from HSD, have successfully completed the advanced research training. This is a small step toward building an infrastructure that can bring measurement and evaluation science to HSD. In addition, this partner site allows for its own trainees and faculty to apply for seed funding to support small research projects that provide mutually beneficial data and advance research capacity (6). Another partner site began a large prospective randomized study evaluating the feasibility of hydroxyurea in sickle cell disease. This project enrolled 43 participants in 2016 and is actively collecting data. Hydroxyurea has limited data for use in RLS, yet holds potential for cost savings and improved clinical outcomes that could improve sickle cell care in Haiti. Measurement and evaluation of interventions will be essential to identify best practices in Haiti and RLS and as a priority also reflects the SDC commitment to transparency and responsibility to the field of global health.

CHALLENGES

The SDC was developed primarily to facilitate coordination of visiting faculty and thus target a common challenge in global health, specifically: how to help without hurting. HSD was clear that large groups were disruptive and that long-term relationships seeking to find common goals were favored over short-term relief missions. Early visits from partner sites were not always well structured, resulting in confusion for the supervising Haitian attending in delegating clinical responsibility to visiting staff. This also made it difficult for visiting residents to define their role in caring for patients. The coordination provided by the SDC leadership helped to identify specific roles that were more clearly defined. One example is partnering HSD-HMB residents with visiting residents in the emergency department with a Haitian attending overseeing their efforts. In this model, residents work together to provide patient care, and in the process, share medical knowledge as well as information about culture and systems. Another example is the practice of posting a welcome sign for each visiting group which both welcomes and clarifies the partnership. This seems to help with expectations of reciprocity. While political unrest in Haiti has prevented groups from traveling, it has been institutional specific and beyond control of the collaborative. During one visit, protests and roadblocks prevented Haitian staff from getting to HSD. The visiting team, staying in housing close to the hospital, was able to staff the hospital in their absence. In the past, coordination in Haiti has fallen heavily on the shoulders of the Medical Director and CEO. The addition of a residency coordinator at HSD and support for a chief resident has defrayed this responsibility, allowing the CEO and Medical Director to address more pressing issues. Developments such as these have been supported directly from SDC fundraising and build on successful identification of needs from both sides.

CONCLUSION

The 5-year collaborative effort between NA-AMCs with Haiti's only freestanding children's hospital described here provides an example of an ethically responsible academic medical collaborative with efforts that are sustainable, focused on building local capacity, and driven toward meeting the expressed needs of HSD. SDC provides a potential model for other institutions wishing to transition from immediate disaster response to long-term partnerships.

A recent shift in the approach of AMCs from single site projects reserved for participation by a single institution to multi-institutional collaboratives and partnerships has been observed (7–9). An advantage of this model is coordination of efforts among AMCs to ensure continuity of services and support while attempting to minimize overlap and redundancies. It is often a challenge to maintain exclusive bidirectional partnerships except for those from very large AMCs. Small to medium size AMCs and residency programs may struggle to maintain continuity of services and support in exclusive bidirectional partnerships. The model presented here allows resident physicians from numerous AMCs of all sizes to experience a partnership in an RLS. A disadvantage of this model is that the majority of trips to Haiti are for a month or less due to time constraints of visiting faculty and resident physicians. Other bidirectional partnerships such as SEED Global Health, and the Rwanda Human Resources for Health program have emphasized longer term commitments (1 year or longer). In the case of Haiti, it is hoped that some of the disadvantages of shorter term personal commitments are overcome by scope of the project and the close coordination of the members, which allow for a nearly continuous presence at HSD.

There are several unique features of SDC when compared to similar AMCs:

- Focus on supporting the training of local physicians
- Bidirectional exchange of residents, faculty, and staff
- Combination of small, medium, and large residency programs
- Nearly continuous presence of staff and host institution
- Largely self-funded
- Annual fundraising efforts at partner sites to directly support host institution.

This collaborative was born out of an effort to create a sustained partnership with Haiti after the immediate international response to the 2010 earthquake. Unlike the program in Rwanda, our efforts have largely been self-funded through privately organized fundraisers with little financial investment from home institutions; however, our model demonstrates that when AMCs combine efforts, much can be done with minimal expense. Another important feature of our collaborative is the bidirectional exchange model, where we successfully invited Haitian pediatric resident physicians from HSD to participate in month-long electives at AMCs in NA. The benefits of intercultural learning and wider clinical exposures are win-wins on both sides, but metrics to quantify these benefits are needed to support funding and grant requests.

Academic medical centers seeking to become involved in efforts to improve global health in RLS should strongly consider putting their energies toward collaboratives to increase the potential impact and to develop programs in a mutually beneficial and sustainable way. Increasing the capacity to educate healthcare workers should be a priority for these partnerships since the shortage of healthcare professionals is the root cause of health disparities in the world.

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AUTHOR CONTRIBUTIONS

All authors participated in all aspects of planning and drafting of this manuscript. Each author independently participated in the events described and are active members of the collaborative. MK and JW had equal efforts as first authors in the initial draft, though all authors provided input, edits, and approved the final manuscript as submitted.

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Collaborative Implementation Strategy for Newborn Resuscitation and Essential Care Training in the Dominican Republic

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Background: Neonatal mortality accounts for 45% of under-5 mortality worldwide, with 98% of newborn deaths occurring in developing countries. The Dominican Republic (DR) demonstrates one of the highest neonatal mortality rates in Latin America despite broad access to care. Strategies to support professional capacity building and strengthen the local health care system are needed to improve neonatal outcomes in the DR.

Rationale: Helping babies breathe (HBB) and essential care for every baby (ECEB) are evidence-based newborn resuscitation and essential care training programs that have been shown to improve providers' confidence, knowledge, and clinical skills. Lack of professional support and infrequent resuscitation skills practice are commonly cited as barriers to skill retention after HBB training, while establishment of program mentoring and regular skills refreshers are associated with retention of clinical knowledge and skills and improved clinical performance and outcomes. Global partnerships to facilitate implementation of a comprehensive newborn resuscitation and essential care training program with ongoing clinical and program mentorship in the DR should have a lasting impact on workforce capacity, quality of care, and clinical outcomes.

Methods: A multidisciplinary, international group of clinicians partnered with the Ministry of Health to design and implement a comprehensive newborn health initiative in the DR. A train-the-trainer model structured the regional rollout of a combined HBB/ECEB program with integrated quality improvement (QI) initiatives and systems for ongoing program monitoring, reinforcement, and mentorship. Cognitive, affective, behavioral, and clinical outcomes are being measured.

Abbreviations: DR, Dominican Republic; HBB, helping babies breathe; ECEB, essential care for every baby; MT, master trainer; QI, quality improvement; HMS, helping mothers survive.

Results: Seventeen local champions representing six hospitals participated in the HBB/ECEB master trainer course and design of a QI tool for site-specific clinical performance monitoring. One hundred seventy-eight and 171 providers participated in HBB and ECEB courses, respectively, at pilot sites during the following year. Participants completed prior training need assessment, pre-/post-knowledge assessments and course evaluations. Program mentorship and monitoring of continuing education and clinical performance are ongoing. The Ministry of Health has assumed responsibility for program sustainability and current scale-up, including integration of maternal resuscitation training.

Conclusion: International partnerships facilitated the collaborative implementation of scalable, locally sustainable newborn resuscitation and essential care training in the DR, mobilizing local resources and empowering the workforce to capably pursue improved care of an exceedingly vulnerable community.

Keywords: neonatal mortality, neonatal resuscitation, perinatal mortality, helping babies breathe, essential care for every baby, resource-limited settings, maternal mortality, helping mothers survive

INTRODUCTION

Neonatal mortality, defined as death within the first 28 days of life, accounts for 45% of under-5 mortality worldwide. Of the 3 million newborns that die each year, 98% of these neonatal deaths occur in developing countries, principally due to complications of prematurity, birth asphyxia, and infection (1, 2). The urgency of addressing neonatal mortality worldwide is framed by the UN's Sustainable Development Goals (SDG 3.2) to end preventable deaths of newborns and children under 5 years of age, and specifically reduce neonatal mortality to as low as 12 per 1,000 live births in every country by 2030 (3).

The Dominican Republic (DR), which shares its western border with Haiti on the Caribbean island of Hispaniola, has an estimated population of 10.6 million people and demonstrates one of the highest neonatal mortality rates in Latin America at 22 per 1,000 live births in 2015 (4). Principal causes of neonatal mortality in the DR are low birth weight, asphyxia, and neonatal sepsis/infection, reflective of global causes of early newborn death (1). However, unlike many under-resourced countries where high neonatal mortality rates correlate with widespread lack of health-care access, the DR has a comprehensive infrastructure consisting of primary-, secondary-, and tertiary-level health-care facilities that provide strikingly inclusive coverage: 99% of all deliveries in the DR are reported to take place in health facilities and 98% of deliveries are reportedly attended by skilled birth attendants (5–7). There are numerous underlying factors likely contributing to this paradox of widespread health-care access and poor outcomes in the DR, including lack of medical equipment for newborn resuscitation and care, lack of professional supervision in clinical settings, and absence of national protocols reinforcing effective perinatal and neonatal interventions (8, 9). The Dominican National Health Plan reinforces that the *quality* of health services, rather than health coverage itself, is the challenge to improving health outcomes and relates the poor quality of care to limited resources in clinical and administrative management of the health sector, limited professional supervision, and other weaknesses of

national health care infrastructure (10). These elements of the local health care system present a pivotal opportunity to reduce persistently elevated neonatal mortality by targeting sustained improvements in the quality of health care in the DR. Utilizing partnerships to support the investment of resources for newborn resuscitation and essential care and further implementing high-impact interventions to promote professional capacity building and ongoing supervision within the maternal–infant health workforce should address major limitations of the quality of health care and contribute to improved neonatal outcomes in the DR. If monitored appropriately, these predicted improvements in neonatal outcomes may provide critical evidence to champion the implementation of effective national guidelines in newborn resuscitation and care.

BACKGROUND AND RATIONALE

Helping Babies Breathe (HBB) is an evidence-based, cost-effective neonatal resuscitation training program that has been shown to reduce neonatal mortality and improve birth attendants' resuscitation skills in low-resource settings (11–13). Essential Care for Every Baby (ECEB) is a companion training program that reinforces basic interventions in newborn care and has been demonstrated to improve health-care providers' confidence, knowledge, and skills related to newborn care in the first days of life in resource-limited settings (14). HBB implementation was most notably associated with an initial 47% reduction in early neonatal mortality and fresh stillborn rates in Tanzania (11). The combined implementation of HBB and ECEB in Belize was similarly associated with short-term improvement in neonatal resuscitation knowledge and skills and reduction in national neonatal mortality and stillborn rates (15).

Despite HBB's initial success, it has also been demonstrated that providers' resuscitation skills decline significantly over time as seen in a variety of low-resource settings in India, Kenya, and Tanzania (12, 16). Bellad et al. additionally demonstrated that rapid local scale-up of HBB training in semi-urban and rural sites

in Kenya and India was not associated with consistent reduction of neonatal mortality (17). The evidence supports the need for comprehensive training and ongoing education to sustain clinical improvements. As such, a one-day HBB course in a rural Kenyan hospital did not impact course participants' clinical resuscitation behaviors (18), whereas an initial HBB course with the complementary introduction of course refreshers and local mentorship in Tanzania was, in fact, associated with a sustained clinical impact in reduction of perinatal mortality (19). Similarly, when routine refresher training was conducted every 3 months after implementation of a neonatal resuscitation program training in Indonesia, there was observed retention of knowledge and skills of trained birth attendants 9 months after the initial training session (20). Lack of local professional support, infrequent resuscitation skills practice, and transitory nature of maternal–infant workforce are commonly cited as barriers to skill retention, while establishment of mechanisms for program mentoring and regular skills refreshers are associated with retention of clinical knowledge and skill, improved clinical performance, and improved patient outcomes (16, 21).

Sustainable improvements in maternal–infant workforce capacity and neonatal health outcomes require the development of integrated, locally sustainable training that is responsive to the specific needs of the community. The implementation of a comprehensive hospital-based newborn resuscitation and essential care training program in the DR should have a sustainable impact on the capacity of local health-care workers and thus contribute to improved quality of care and clinical outcomes if the program is founded on partnerships that facilitate continuing education and mentorship. HBB and ECEB were chosen as the optimal newborn resuscitation and essential care training programs because in addition to the evidence supporting the programs' positive impact on knowledge, skills, and clinical performance, HBB and ECEB are disseminated using a train-the-trainer model that promotes workforce capacity by empowering local providers to be both physicians and teachers, engaging actively in the partnerships that initiate trainings and then taking responsibility for ongoing local program dissemination and clinical supervision.

What follows is a process evaluation meant to present elements of program design, content, activities, and administration of a newborn resuscitation and essential care training initiative in the DR. We will discuss the role of multidisciplinary international partnerships in bolstering the local workforce and strengthening the supply of clinical resources, leading to improvements in the quality of health infrastructure. Outcome evaluations and policy analysis based on ongoing data collection and program scale-up are forthcoming.

METHODS

This evaluation will assess the design and implementation of a neonatal health intervention composed of dual HBB and ECEB training, provision of clinical neonatal resuscitation equipment, introduction of quality improvement (QI) monitoring, and establishment of a mentoring framework to support ongoing education in the northern region of the DR.

Site Description

The newborn resuscitation and essential care initiative have been implemented in the northern Cibao region of the Dominican Republic, in the provinces of Santiago, Espaillat, Puerto Plata, and Monte Cristi. These provinces correspond with Health Region II and part of VII (Monte Cristi) and demonstrate neonatal mortality rates comparable to the national rate of 22 per 1,000 live births, with the notable exception of Monte Cristi, where recent national statistics report a neonatal mortality rate of 31 per 1,000 live births (7). The Cibao region was chosen as the rollout site for the current initiative in the setting of ongoing successful international partnerships in various hospitals in Santiago, which is the second largest city in the DR and the capital of the Santiago Province, in addition to being the principal city in the Cibao region. Prior international collaborations in the region were redirected to focus specifically on newborn interventions at the request of hospital leadership, epidemiologist, providers, and trainees, all who feel the persistently high rates of neonatal mortality to be a call to action.

Partnerships

A multidisciplinary group of Dominican and US-based clinicians and public health advocates, collectively representing the Ministry of Health, the Dominican Pediatric Society, the Pan American Health Organization, UNICEF, multiple international and Dominican NGOs, and individuals from three different US medical institutions met to discuss the design, implementation, and timing of the newborn health initiative. This multidisciplinary partnership represents many collective decades of clinical work, collaborative training interventions, and health promotion projects in the DR; it bears mentioning, however, that the impetus for the abovementioned stakeholders to partner for this specific project was the vital effort of one of the clinicians to communicate with other groups committed to newborn health initiatives in the DR and so prevent isolating global health efforts in the same geographic region. This early communication has been essential to the strength and success of the international partnership underlying the current newborn health initiative.

Pilot Site Selection

Extremely high rates of mortality noted in neonates transferred to the tertiary-level Arturo Grullón Children's Hospital in Santiago in 2013 led to the choice of five secondary-level centers within the catchment area of the Children's Hospital as pilot sites for the newborn resuscitation and essential care intervention. In the DR, secondary health centers offer emergency, outpatient, inpatient, and basic medical specialty care services, while tertiary centers offer emergency, outpatient, inpatient, and sub-specialty services, the most advanced level of care available in the country. Four of the five intervention facilities are regional secondary-level hospitals in the provincial capitals of Santiago, Moca, Puerto Plata, and Monte Cristi, representing a significant percentage of deliveries/births in these provinces. The fifth intervention facility is an additional secondary-level teaching hospital in Santiago. Needs assessments and feasibility analyses were conducted prior to definitive site selection at the five intervention facilities to assess each hospital leadership team's interest in the initiative,

commitment to ongoing training and QI monitoring, available clinical resources, and specific barriers to newborn resuscitation and care at each site. It was during these early assessments that the process was initiated to identify multidisciplinary local champions to lead the newborn initiative at each site.

Program Interventions

The newborn health initiative in the DR is composed of four major components: HBB and ECEB training, provision of clinical neonatal resuscitation equipment, introduction of QI monitoring, and establishment of a mentoring and supervision framework to support continuing education in the target population in the DR. The specific content and activities associated with each of these program components will be discussed in detail.

HBB and ECEB Training

A train-the-trainer model was used for program implementation and dissemination with the goal of ultimately training all health care providers involved in newborn resuscitation and essential care partnership at each intervention site. A 4-day HBB/ECEB master trainer (MT) course was conducted in Santiago for the identified local champions from each of the five pilot intervention sites, in addition to two local champions identified at the tertiary-level Children's Hospital in Santiago. The course was facilitated in Spanish by a multidisciplinary team of US-based clinicians with experience in HBB/ECEB and many years working in health promotion projects in the DR. Participant to facilitator ratio was 6:1. Members of the national and regional Ministry of Health services were present throughout the training. The 4-day session was divided as follows: 1.5 days for the HBB MT course, 1.5 days for the ECEB MT course, and 1 day for planning of HBB and ECEB provider courses at intervention sites, introduction of QI principles, and development of a site-specific QI tool (Data Sheet S1 in Supplementary Material).

For the planning of future HBB/ECEB provider courses at intervention sites, MTs were prompted to divide into groups according to intervention site and formulate an "Action Plan" (a format utilized in the HBB/ECEB curricula) for course dissemination, with the goal of teaching their first courses within 3 months of the MT training in Santiago. MTs were given several prompts to formulate the action plan, including questions regarding which clinical indices would be tracked to measure change (Data Sheet S2 in Supplementary Material).

The MTs subsequently returned to their health facilities and co-facilitated HBB/ECEB provider courses. The initial provider courses at three of five intervention sites were co-taught with international partners utilizing the format of 2-day sessions for the combined HBB/ECEB courses. The MTs at one intervention site in Santiago found it more feasible to structure their initial provider courses to be conducted in 2-h segments over 2 weeks and the second HBB/ECEB trainings in 3-h segments over 7 days.

Provision of Clinical Neonatal Resuscitation Equipment

In addition to several sets of training materials for teaching HBB and ECEB courses, including multiple NeoNatalie manikins and

two MamaBreast breastfeeding/manual expression simulators, each intervention site was additionally given a number of neonatal bag-mask ventilators and suction devices for clinical use in the delivery room, an attempt to address one of the identified factors underlying poor quality of care in the DR. Included in the HBB/ECEB training materials is information regarding reprocessing of clinical equipment.

Introduction of QI Monitoring

The purpose of the last day of training during the MT course was to prepare the local champions for future dissemination of HBB/ECEB training with a focus on behavioral change in the clinical setting. Based on the content of the course material, the MTs were prompted to determine which clinical practices would be most challenging to consistently perform and which clinical parameters most important to measure (Data Sheet S2 in Supplementary Material). The MTs from each intervention site ultimately decided on a similar set of clinical parameters, including temperature at 1 h of life, skin-to-skin positioning initiated within the first hour of life, and essential care including eye care, cord care, and vitamin K administration. A QI tool was designed according to the MTs input (Data Sheet S1 in Supplementary Material) and was distributed in the form of a book of identical checklists to local champions at each intervention site for integration into the clinical setting and monitoring of clinical practices during the first hours of life.

Data Collection

Demographic data and assessment of prior training experience, clinical roles, and nature of clinical practice are collected from course participants in the form of a questionnaire prior to the HBB/ECEB MT and provider courses. Data for knowledge outcomes are collected prior to and following both training courses in the form of standardized pre/post multiple-choice knowledge assessments published by the American Academy of Pediatrics for HBB and ECEB. Program-specific evaluations for affective outcomes related to participants' reception of the HBB/ECEB courses and changes in attitude and confidence related to course material are collected in the form of Likert scale and free response survey questions following each pair of courses.

QI data collection is being conducted at each of the five intervention sites in the form of the QI book checklists (Data Sheet S1 in Supplementary Material), measuring the aforementioned variables of clinical practice related to newborn resuscitation and essential care.

There is additionally clinical data collection being conducted at the Children's Hospital in Santiago. Clinical indices and care requirements of all newborns referred to the hospital (approximately 900 per year) are measured, including reason for patient transfer, vital signs and clinical status on arrival to Emergency Department, requirement for procedural interventions during first 48 h of hospitalization, and 30-day mortality. These data will allow the research team to evaluate clinical stability and survival of newborns transferred from study intervention sites as opposed to those referred from other primary and secondary centers that have not received HBB/ECEB training.

Ethical Considerations

The American Academy of Pediatrics' HBB and ECEB training programs are founded on global standards of care for the resuscitation and early care of newborns. The study protocol for this initiative was submitted and approved by the Institutional Review Board of Eastern Virginia Medical School. The study protocol was also reviewed and approved by the national Perinatal Program and North-Central Regional Health Service of the DR Ministry of Health. The study was additionally reviewed and approved by hospital leadership at all intervention sites, as well as the hospital leadership, residency leadership, research committee, and regional epidemiologist at the Arturo Grullón Children's Hospital in Santiago, DR.

RESULTS

Seventeen local champions representing five secondary-level intervention sites and the tertiary-level Children's Hospital participated in the HBB/ECEB MT course and design of a QI tool for site-specific clinical performance monitoring. The group of MTs included nurses, physicians, and medical technicians, all of whom participate in newborn resuscitation and essential care in their health facilities.

Over the course of the following year, 178 and 171 providers participated in HBB and ECEB courses, respectively, at four of five intervention sites and within the pediatric residency program at the Children's Hospital (**Figure 1**). Participants in provider courses represented pediatrics, obstetrics/gynecology, and family medicine specialties, all of whom participate in newborn resuscitation and essential newborn care. A variety of training formats was utilized depending on needs and workforce availability of the intervention site. One of the five intervention sites was unable to conduct any provider courses during the 12-month period following the MT course despite ongoing mentoring

from international and regional partners. All course participants completed previously described questionnaires assessing prior training and current clinical practice, pre-/post-knowledge assessments, and course evaluations at each course. International and regional program mentorship and monitoring of continuing education and program-related clinical performance parameters are ongoing.

Establishment of Mentoring Framework

During the 12 months following the initial MT course, a member of the international training partnership was present in-country every 2 months to assist with implementation of provider courses and skills refreshers at intervention sites, troubleshoot challenges in course dissemination and implementation of QI data collection, and maintain close contact with the regional Ministry of Health and hospital leadership at each intervention site. Local champions maintain frequent communication through e-mail and WhatsApp messaging to report successes and request guidance in program dissemination and programming skills refresher sessions.

Selected local champions have assumed the role of regional mentors in addition to program leaders in their home facilities, offering to facilitate skills refreshers and co-facilitate HBB/ECEB courses with partners at other intervention sites.

The two MTs from the Children's hospital, pediatric trainees whose residency is affiliated with the local university, *Pontificia Universidad Católica Madre y Maestra*, will focus their academic theses on issues related to the regional implementation of the newborn initiative with mentorship through international partnerships facilitating the program. As the initiative is scaled up and the QI monitoring ongoing, there are great opportunities for the research team to grow with the addition of more local trainees and ongoing mentoring from a committed multidisciplinary and international team.

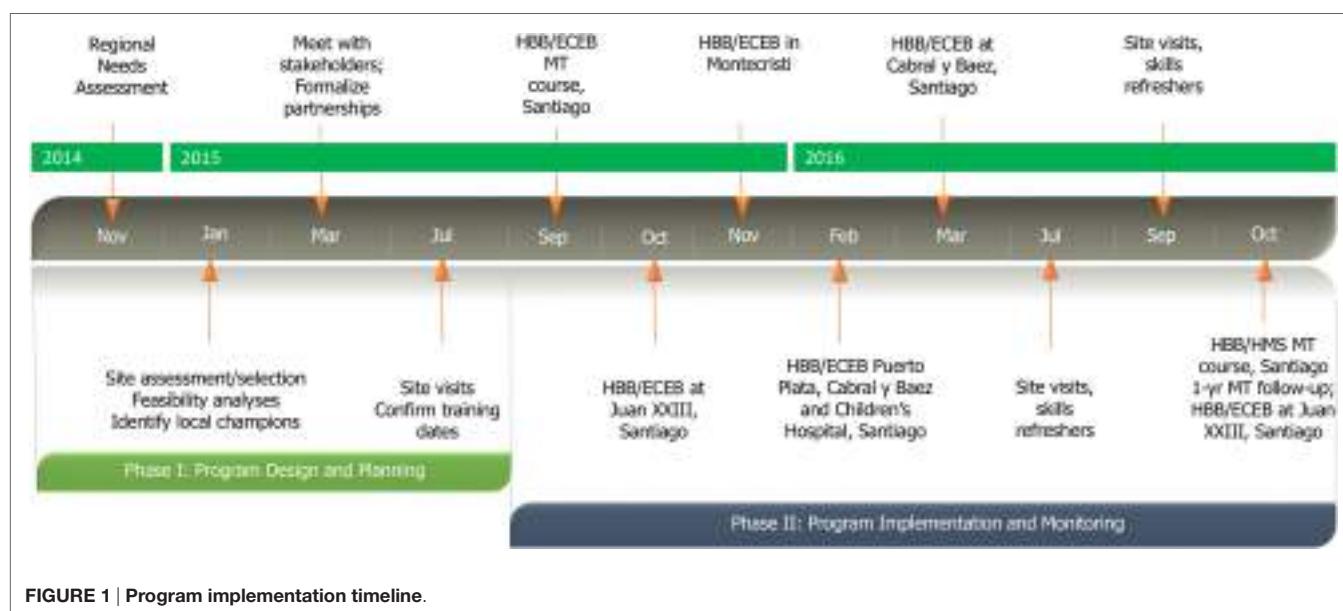


FIGURE 1 | Program implementation timeline.

Local Sustainability

The Ministry of Health has provided consistent support of training implementation throughout the intervention sites. One year after initial course rollout, the North-Central Regional Health Service appointed a Director of Pediatric Program Dissemination to supervise further regional implementation of HBB/ECEB programs, assuming full responsibility for newborn resuscitation and essential care program sustainability and scale-up in the region.

DISCUSSION

In the DR, where broad perinatal health-care coverage is paradoxically associated with unacceptably high rates of neonatal mortality, there is urgency to address the availability of neonatal resuscitation supplies, professional capacity building, and clinical supervision in order to promote the quality of care delivered in the country's health facilities. High-impact interventions to address these identified gaps in care can effectively build local workforce capacity and acquire sustainability when implemented through partnerships that support the provision of clinical and training equipment as well as empower local champions to assume responsibility for health promotion initiatives, training of their peers, and improvement in patient outcomes. HBB and ECEB are evidence-based, cost-effective newborn resuscitation and essential care training programs that have been demonstrated to build capacity for improved quality of care in newborn providers in resource-limited settings when program implementation includes continuing education and mentorship.

Strong international partnerships with a focus on collaborative training implementation facilitated the successful regional implementation of HBB and ECEB programs and initiation of QI monitoring in the northern Cibao region of the DR. The foundations for program implementation began with regional hospitals' needs assessments and feasibility analyses at each potential intervention site and identification of local champions as early as 10 months prior to the first MT course (**Figure 1**). Meeting with program stakeholders to discuss design, content, and timing of regional newborn initiative 6 months prior to program rollout was decisive in substantiating the international partnerships and the Ministry of Health's commitment to the program, which were both critical to initial program success and potential sustainability. The regional Ministry of Health's appointment of a Director of Pediatric Program Dissemination to supervise the newborn health program sustainability and scale-up is perhaps one of the most powerful outcomes of the international partnerships and mentoring that have driven this initiative and are now supporting the reinforcement of improved quality of newborn care within the local health infrastructure.

Over the course of 13 months, after the initial HBB/ECEB MT course in Santiago, local MTs taught HBB and ECEB courses to 178 and 171 newborn providers, respectively, in five hospital settings. HBB/ECEB courses were disseminated in four of five planned intervention sites. Fidelity to training course material was seen to be possible in a variety of formats depending on the needs and availability of the workforce at each intervention site. A QI tool was designed and implemented in intervention sites

by local MTs, allowing clinical behaviors outcome monitoring in addition to the cognitive and affective outcomes that are being measured through pre-/post-knowledge assessments and HBB/ECEB course evaluations, respectively, and the health status outcomes, which will be measured by regional neonatal mortality data. These data are currently being collected at all pilot sites for outcomes analysis such that the impact of the intervention will be comprehensively assessed, allowing the research team to better identify persistent gaps in training or clinical practice in order to adjust and improve the components of the intervention and strategically direct next steps of the initiative. Additionally, the data collection system established at the regional pediatric referral center will facilitate evaluation of program impact on neonatal transport outcomes. Assessing the motive for patient transfer, the vital signs and clinical status of the neonatal on arrival to the referral center, the short-term clinical interventions required after transfer, and 30-day mortality, we may indirectly evaluate the success of neonatal stabilization prior to transport, as is addressed in the ECEB curriculum.

Challenges

Despite consistent support from the Ministry of Health, thoughtful site selection and local champion identification, and strong international and multidisciplinary partnerships invested in program implementation and mentorship, there are a number of challenges that impeded the program's full potential progress. One of the five intervention sites was not able to conduct a provider HBB/ECEB course during the 12 months following the MT course, in spite of mentorship from international and regional partners and three site-specific MTs. Transitory nature of workforce at this site and waning motivation on the part of the MT who had been chosen to be the site representative for trainings may have determined these circumstances, although it is also worth noting that this particular site did not send the originally identified local champions to participate in the MT course, making an argument for the importance of early and consistent identification of local champions/MTs.

It has been challenging to maintain consistent QI monitoring in the intervention sites, despite the user-friendly nature of the checklist whose content was determined largely by the MTs themselves. Even when the QI book is found to be easily accessible within the delivery room of an intervention site, it is common for the providers to inconsistently enter the clinical practice data for each delivery. Only one of the five sites consistently records data at each delivery, which will be a limitation for early outcomes analysis. While mentoring seemed to be largely effective for programming of provider courses and continuing education sessions, it would appear that consistent local supervision of routine QI monitoring is needed. With a local Ministry of Health representative now responsible for program implementation and sustainability, there may be a more effective form of QI monitoring supervision available.

Next Steps

An outcome evaluation of the newborn resuscitation and essential care initiative will be conducted through analysis of program

data that is currently being collected. Continuing education in the form of additional HBB/ECEB provider courses at intervention sites and more structured skills refreshers is a priority and will be facilitated by local Ministry of Health supervision. Expansion of intervention sites is warranted and there is interest among local MTs to implement trainings in other secondary-level hospital centers, as well as the primary-level centers where deliveries are also attended.

The community needs of each intervention site drive the specific focus of training beyond the continuing education of HBB/ECEB curricula and QI monitoring. Two HBB/ECEB intervention sites have focused on utilizing ECEB program materials (MamaBreast simulator) to strengthen breastfeeding education and skills training programs for medical providers and patients. One of the sites has incorporated the breastfeeding education component into a prenatal education waiting room module in the obstetric clinic and the other site is planning a more comprehensive breastfeeding promotion project involving regular hospital-based provider and patient training and community breastfeeding support groups.

In addition to planned reinforcement and scale-up of combined HBB/ECEB throughout hospital facilities in the Cibao region, and ultimately on a national scale, steps have also been taken to make the scope of resuscitation training more comprehensive. In an effort to strengthen the continuum of maternal–infant health in the DR, where the maternal mortality ratio (92 per 100,000 births) is one of the highest in Latin America (22), a maternal resuscitation training program to reduce mortality associated with post-partum hemorrhage has been introduced alongside the newborn resuscitation and essential care programs. Helping Mothers Survive (HMS), a simulation-based maternal resuscitation training program aimed at managing obstetric emergencies in low-resource settings, was implemented alongside HBB in correlation with the one-year follow-up of the initial HBB/ECEB program rollout in Santiago. A 2-day HBB MT course was co-facilitated with six local MTs from the prior year and a multidisciplinary team of US-based clinicians to 33 physicians and nurses from 17 hospital facilities in the Cibao region. At the conclusion of the second day of HBB training, the local MT co-facilitators shared experiences, challenges, and lessons learned related to implementing provider courses in their home facilities during the first year following HBB/ECEB MT certification. This experience solidified the original MTs role as regional mentors to the newly trained HBB MTs. The HBB MT course was followed by a 2-day HMS MT course co-facilitated by a previously trained local MT and a multidisciplinary team of US-based clinicians to a group of 29 course participants from the same 17 hospital facilities in the Cibao region. Participants' prior training experiences and clinical roles were assessed, in addition to assessment of cognitive outcomes with standardized multiple-choice pre-/post-tests and affective outcomes with HMS course evaluations. The research team, representing multidisciplinary international partners, is in the process of adapting a monitoring system to record clinical behavior outcomes in the hospital sites where HMS will be implemented. The Ministry of Health is already working with its local and global partners to form a regional HMS training team responsible for co-facilitating HMS courses

with MTs in the 17 target hospitals, immediately assuming responsibility for workforce capacity building and sustainability of programs.

CONCLUSION

International, multidisciplinary partnerships, and in particular, close collaboration with the Ministry of Health, facilitated the regional implementation of newborn resuscitation and essential care programs in the DR, reinforcing workforce capacity and developing local infrastructure for program sustainability and scale-up. The power of identifying and unifying the efforts of various global health teams committed to similar projects within the same region cannot be understated. Use of a train-the-trainer model with subsequent international and regional mentoring of local champions and academic trainees has contributed to capacity building of local providers, establishment of local systems of mentoring and clinical supervision, first-year program sustainability, and individualized program expansion according to particular community needs, but was not sufficient to achieve consistent QI monitoring at all intervention sites. Designation of a local Ministry of Health representative to supervise program sustainability and growth will provide greater support for regional monitoring of clinical behavior outcomes. The establishment of a strong regional framework for newborn survival training and mentorship in the northern DR facilitated the subsequent coherent integration of maternal resuscitation training on a regional scale with corresponding development of a regional maternal training team to further enhance workforce capacity and strengthen local health care infrastructure.

Partnerships that foster collaborative training interventions may contribute essential clinical resources to local providers, empower providers to better care for their patients and promote the training and supervision of their colleagues, and strengthen the local health care system, ultimately improving the quality of care, supporting improved health outcomes, and upholding the dignity of all.

AUTHOR CONTRIBUTIONS

AL wrote the first draft; AL, LJ, and CC contributed revisions; and all the authors reviewed the final version, provided input into the research and program design, participated in data acquisition, and approved the final manuscript.

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Building Sustainable Partnerships to Strengthen Pediatric Capacity at a Government Hospital in Malawi

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Introduction: To achieve sustained reductions in child mortality in low- and middle-income countries, increased local capacity is necessary. One approach to capacity building is support offered via partnerships with institutions in high-income countries. However, lack of cooperation between institutions can create barriers to successful implementation of programs and may inadvertently weaken the health system they are striving to improve. A coordinated approach is necessary.

Background: Three U.S.-based institutions have separately supported various aspects of pediatric care at Kamuzu Central Hospital (KCH), the main government referral hospital in the central region of Malawi, for several years. Within each institution's experience, common themes were recognized, which required attention in order to sustain improvements in care. Each recognized that support of clinical care is a necessary cornerstone before initiating educational or training efforts. In particular, the support of emergency and acute care is paramount in order to decrease in-hospital mortality. Through the combined efforts of Malawian partners and the US-based institutions, the pediatric mortality rate has decreased from >10 to <4% since 2011, yet critical gaps remain. To achieve further improvements, representatives with expertise in pediatric emergency medicine (PEM) from each US-based institution hypothesized that coordinated efforts would be most effective, decrease duplication, improve communication, and ensure that investments in education and training are aligned with local priorities.

Call to action: Together with local stakeholders, the three US-based partners created a multi-institutional partnership, Pediatric Alliance for Child Health Improvement in Malawi at Kamuzu Central Hospital and Environs (PACHIMAKE). Representatives from each institution gathered in Malawi late 2016 and sought input and support from local partners at all levels to prioritize interventions, which could be collectively undertaken by this

consortium. Long- and short-term goals were identified and approved by local partners and will be implemented through a phased approach.

Conclusion: The development of a novel partnership between relevant stakeholders in Malawi and US-based partners with expertise in PEM should help to further decrease pediatric mortality through the coordinated provision of acute care expertise and training as well as investment in the development of educational, research, and clinical efforts in PEM at KCH.

Keywords: global health, multi-institution partnerships, low resource, resource-constrained, Africa, Malawi, pediatrics

INTRODUCTION

Over the past 15 years, major progress has been made in the fight against HIV, tuberculosis, and malaria in low- and middle-income countries (LMICs), resulting in decreased child mortality rates (1). Despite this, in 2015, 5.9 million children died before their fifth birthday (1, 2). The majority of these deaths were due to either preventable or treatable causes (1–5). Progress must accelerate if the proposed child survival target of the 2030 sustainable development goals (SDGs) is to be reached. The principle requirements for future success in decreasing child mortality will be improvements in local capacity in LMICs and sustained international cooperation through partnerships, both of which depend on training, infrastructure, political will, peace, and the absence of corruption (6).

The World Health Organization (WHO) (7) describes a partnership for health as a means to “bring together a set of actors for the common goal of improving the health of populations based on mutually agreed upon roles and principles.” Multifactorial health issues are ideally addressed through innovative, coordinated, and collaborative initiatives (8, 9) and during the past three decades, an exponential growth of global health partnerships has occurred. Some partnerships are borne of a joint interest, such as engaging in research or accomplishing a specific programmatic goal, while others evolve over time. An ideal partnership is borne from the collaboration of parties working toward a mutual goal. Once successfully established and effectively maintained, these initiatives can be of tremendous mutual benefit, be self-sustaining, and support development of much-needed training programs in resource-limited settings (10, 11).

While many partnerships exist between institutions in high-income countries (HICs) and those in LMICs, formal collaborations between US-based institutions are rare and our site

was no exception. We describe the evolution of a novel global health partnership from three distinct US-based institutional initiatives. Each program was focused on separate aspects of pediatric capacity building at Kamuzu Central Hospital (KCH), the main government referral hospital for the central region of Malawi, located in the capital city of Lilongwe. It is also the teaching hospital for Kamuzu College of Nursing, Malawi College of Health Sciences, and Malawi College of Medicine (COM). The COM, based in the southern city of Blantyre, has operated a satellite campus at KCH since 2012, which trains third year medical students and clinical officers. The parallel efforts of each institution began to overlap while providing clinical care in this busy inpatient setting with 300–450 pediatric inpatients. With open communication in an environment of mutual respect, our individual initiatives recognized that efforts to build capacity for pediatric care would develop best when working together, and that combining our resources would provide the foundation for collaborative action. We anticipate that long-term resource investment, sustained “on the ground” presence, ensuring that the partnership does not create undue burden on the system, and working cooperatively, with an emphasis on communication among institutions, will result in improved pediatric health systems. We outline the contributions and initial goals of each institution to date, the overlapping aspects of each program, which were collectively recognized, and the plans for moving forward as a multi-institution consortium.

BACKGROUND

Setting

Malawi is a low-income country in sub-Saharan Africa with approximately 17 million people and an average life expectancy of 55 years. It ranks 170 out of 188 countries with respect to its Human Development Index (2016), with an under five mortality rate in 2015 of 63/1,000 live births. HIV prevalence was 10.6% among adults aged 15–49 years (12) and an estimated 130,000 children are HIV-infected. Infections (malaria, respiratory illness, diarrhea, HIV) account for four of the top five causes of death in the country. The predominant local language in the central region, where KCH is located, is Chichewa.

Within KCH, the pediatric ward admits more than 27,000 patients per year and manages all medical emergencies. The department has approximately 215 beds spread over several wards, admitting patients based on acuity, condition, and age. In the

Abbreviations: LMICs, low- and middle-income countries; SDGs, sustainable development goals; WHO, world health organization; HICs, high-income countries; KCH, Kamuzu Central Hospital; COM, college of medicine; BCM, Baylor College of Medicine; COE, Baylor College of Medicine -Abbot Fund Children's Clinical Center of Excellence; ETAT, Emergency Triage Assessment and Treatment; PEM, Pediatric Emergency Medicine; CCHMC, Cincinnati Children's Hospital Medical Center; UNC, University of North Carolina; PMTCT, prevention of mother-to-child transmission; CDC, centers for disease control; GIZ, German Society for International Cooperation; PACHIMAKE, Pediatric Alliance for Child Health Improvement in Malawi at Kamuzu Central Hospital and Environs; MOH, Ministry of Health; MDGs, millennium development goals.

rainy (malaria) season, there may be greater than 100 pediatric admissions per day and over 400 inpatients, far more than the ward was built to accommodate. Limitations in various aspects of the system, such as access to supplies and medications, laboratory investigations, and adequate blood bank services provide additional challenges in managing pediatric patients.

In addition to infrastructure, resources, and pharmaceutical supplies, providing adequate care to pediatric patients relies on adequate human resources. In the pediatrics department, there are insufficient specialist pediatricians or generalist doctors to manage the volume of patients, and the burden of clinical care falls largely on mid-level clinical providers. The number of acutely ill patients also overwhelms nursing staff and it is not uncommon for a single nurse to cover a ward of 60 patients or more. In addition, staff often work additional overtime shifts to support the staffing needs of the wards, and these long hours in difficult conditions can lead to exhaustion and burn-out. Malawi has 0.02 doctors and 0.28 nurses per 1,000 population, far below the WHO's critical level of 2.5 health workers per 1,000 needed to provide adequate care to a population. Various efforts are in place to expand training of additional health workers in Malawi. Improving the staffing shortages at the hospital level will also depend on the ability of the Ministry of Health to employ and retain staff in the public system.

As each of our individual institutions became involved at KCH, it was recognized that the need for clinical capacity building is imperative to allow high-quality educational efforts to take place. All providers observed that the ability to adequately triage or stabilize new admissions was limited, due to both a lack of specific acute care training as well as staffing and resource shortages. Children would enter the ward with varying degrees of acuity and quickly overwhelm staff. Despite improvements, this overall problem persisted; no individual institution had been able to contribute enough resources to consistently change this situation. Therefore, our institutions collectively decided to prioritize pediatric emergency and acute care.

INSTITUTIONAL HISTORIES

Baylor College of Medicine (BCM)

The BCM-Abbott Fund Children's Clinical Center of Excellence (COE) in Lilongwe began providing care to children with HIV in 2005. The COE serves as the outpatient pediatric HIV clinic for KCH and is a pediatric HIV referral center for the country. While the primary focus of the COE is providing care for children with HIV, Baylor has also sought to build clinical capacity for non-HIV infected children, and provided a full-time pediatric hospitalist at KCH from 2006 to 2010. Additionally, BCM COE faculty led an initiative to improve inpatient emergency care utilizing the World Health Organization's Emergency Triage, Assessment, and Treatment (ETAT) program. This quality improvement effort resulted in decreased mortality in pediatric patients at KCH (13). From the beginning of the COE, Baylor was also involved in managing KCH's pediatric hematology-oncology program, and currently staffs the inpatient and outpatient pediatric oncology programs at KCH. In 2015, the section

of pediatric emergency medicine (PEM) began to send PEM fellows to work clinically at KCH. While primarily working clinically in the pediatric acute care areas alongside staff at KCH, PEM fellows and faculty have also provided bedside teaching for medical students and clinical officer interns from the Malawi COM, as well as participating in hospital initiatives to improve pediatric resuscitations.

Cincinnati Children's Hospital Medical Center

The initial relationship between Cincinnati Children's Hospital Medical Center (CCHMC) and KCH began in 2009 with individual resident trainees undertaking clinical rotations. CCHMC also recognized that there was a need to contribute to the clinical education of Malawian trainees as well as physically supervise our US-based trainees to decrease the strain on clinical operations at KCH and subsequently provided the sustained presence of a supervising pediatrician to KCH in exchange for the ability to continue rotations for US-based trainees. This relationship provided an opportunity for CCHMC, through the division of PEM, to establish specific goals focused on improving medical care and reducing mortality *via* clinical capacity building, enhancing medical education, and initiating collaborative research and quality improvement efforts. There was a specific focus on improved triage and emergency care of critically ill children within the pediatric ward and an improved process for blood transfusions for severely anemic children. In addition, capacity for point-of-care ultrasound was expanded with provision of an ultrasound machine residing on the pediatric ward and supplemental ETAT trainings were sponsored. CCHMC faculty was also integrated into medical student teaching.

University of North Carolina (UNC)

The UNC has been involved in pediatric research and programmatic endeavors through UNC Project Malawi since 1999, including the initiation of the first Prevention of Mother-To-Child Transmission (PMTCT) program in Malawi in 2001. Research studies have included the evaluation of the efficacy and safety of neonatal HIV prophylaxis, development of algorithms for inpatient pediatric HIV testing and treatment, malaria vaccine trials, and the management of Burkitt lymphoma. UNC physicians have supported pediatric inpatient clinical care at KCH since 2009, and a UNC pediatrician is currently part of the inpatient staff. The UNC pediatric residency program has been sending residents for short-term rotations since 2002 and supported 3 month-long rotations and the fellowship research of a PEM fellow from 2013 to 2016. In 2011, UNC in collaboration with KCH opened a pathology laboratory. This laboratory provides pathology services to all of Kamuzu Central Hospital and the Central Region of Malawi. From 2008 to 2013, UNC partnered with the KCH laboratory through a Centers for Disease Control (CDC) grant, in an effort to improve general laboratory services in the hospital. UNC developed a sickle-cell clinic at KCH in 2013 and has helped establish and maintain Malawian residency programs in Surgery and Obstetrics and Gynecology, and maintains a robust relationship with these departments.

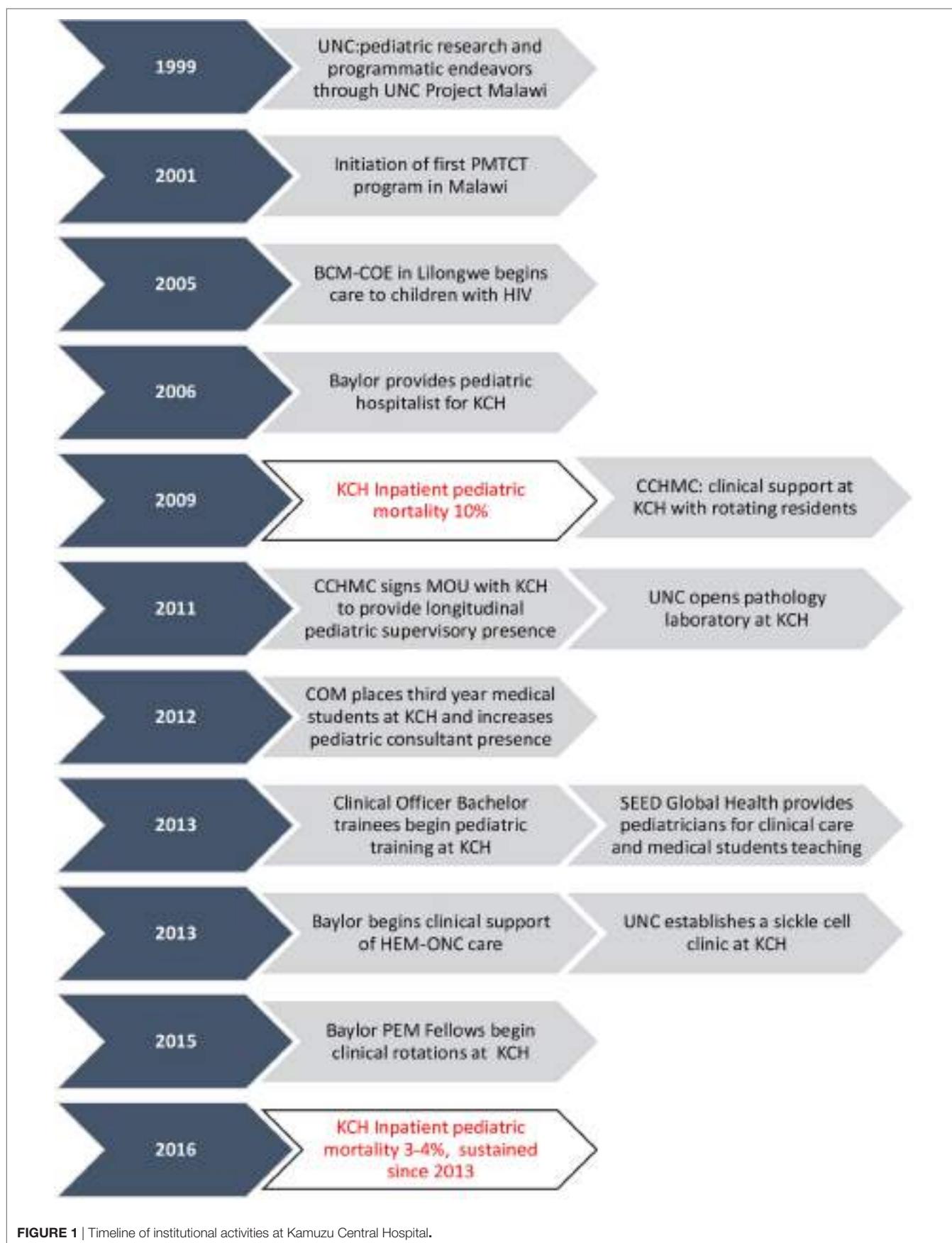


FIGURE 1 | Timeline of institutional activities at Kamuzu Central Hospital.

SIMULTANEOUS INITIATIVES AND THE OVERALL IMPACT OF PARALLEL EFFORTS

At the same time that the aforementioned institutions developed individual programs, multiple efforts at improving care were underway from both Malawian institutions and other international organizations. The COM placed third year medical students at KCH for their clinical attachments, including pediatrics. With this effort came increased pediatrician supervision supported by the COM through both the COM itself and other staff assigned from other organizations. To support training of clinical officers (middle level clinicians), another program was instituted to provide specialized pediatric training for experienced clinical officers, with the goal of supporting pediatric care at the district hospital level. Clinical rotations for these trainees were implemented at KCH as well, providing another cadre of trainees who also required bedside and didactic training. Program administration was supported through the COM with additional support from pediatricians allocated through the German Society for International Cooperation (GIZ). In addition, pediatricians placed at COM through the Global Health Service Partnership, a collaboration between Seed Global Health and the US Peace Corps, were instrumental in medical student and clinical officer education as well as clinical care. **Figure 1** shows the timeline of the various institutional contributions at KCH.

These programs and the support of outside institutions significantly improved the clinical care within the pediatric ward, supporting the fact that expansion of training programs offers benefits, which extend beyond the trainees themselves. Clinicians from each of the above programs worked alongside each other to develop specific initiatives, such as restructuring the space allocated for acute care to improve flow, instituting use of a tracking system for children needing blood transfusions, and providing the ancillary staff with training in the early identification of critically ill children. The combined efforts of local staff and foreign partners led to a dramatic decrease in inpatient mortality, from >10% in 2009 to the current rate of <4% in 2016.

COLLABORATION AS A WAY FORWARD: PEDIATRIC ALLIANCE FOR CHILD HEALTH IMPROVEMENT IN MALAWI AT KAMUZU CENTRAL HOSPITAL AND ENVIRONS (PACHIMAKE)

Despite these improvements, there was friction at times between the different stakeholders. Lack of coordination led to duplicative efforts. At this point, US stakeholders recognized that this lack of communication and coordination was affecting clinical care and outcomes and at times frustrating local providers. With the high acuity of illness and the high inpatient mortality, it was decided that a more collaborative approach would be required to further improve outcomes. Therefore, a cooperative effort was

embarked upon which elevated the care and survival of children above the priorities of individual institutions and demanded transparency and cooperative policies. In 2015, a working group was formed to begin discussions and outline future goals aimed at improving pediatric care at KCH. This group chose the name PACHIMAKE, a Chichewa word meaning “the heart of the matter.”

Once the working group from the three US institutions was formed, a site assessment was planned and then completed in November 2016. US and local stakeholders met multiple times to identify critical gaps that remained in pediatric care at KCH. Issues identified by local staff were given highest priority when determining the next steps for the consortium. Priority items identified for further work included reliable systematic data collection, adequate staff (specifically nurses and middle-level clinicians), coordination among institutions sponsoring rotating consultants and trainees, standardization of clinical care, and appropriate core infrastructure (**Table 1**). Of note, these priorities came directly from our Malawian partners. Solutions were proposed and short- and long-term goals were developed to collaboratively close the identified gaps in care. The past collaborative work between the US and local Malawian institutions had prepared us to begin work on mutually identified goals in a phased approach in the upcoming years.

TABLE 1 | Key consortium practices and goals.

Pediatric Alliance for Child Health Improvement in Malawi at Kamuzu Central Hospital and Environs Core Practices
Improving child survival at KCH is the overall goal, which all consortium actions serve, guided by principles of:

- Transparency
- Open respectful communication
- Shared code of conduct
- Mutual professionalism
- Joint recognition of successes/shared authorship with Malawian colleagues

Areas of focus identified by local partners	Proposed solutions
Reliable data system	Support implementation of electronic medical record, identify priority metrics for assessment of care based on local published standards (Council for Health Service Accreditation of Southern Africa)
Adequate staffing	Support staffing needs by leveraging resources from US-based institutions, provide consistent consultant presence year-round to support supervision and education of Malawian trainees
Coordination of US clinical rotators	Maintain open communication between institutions, guided by local needs and assuring outside rotators complement rather than burden the system
Standardization of clinical care	Support staff training in emergency care, develop and implement KCH-specific protocols for common conditions
Improvement of core infrastructure	Continue seeking funding opportunities to support acquisition and maintenance of equipment and medications and facilities

We believe that directing efforts toward locally identified goals is one of the strongest aspects of this partnership. Because each institution is deeply committed to clinical care at KCH, we recognize that these priorities must be accomplished in order to realize the goals of the PACHIMAKE partnership. This is also in alignment with best practices highlighted by existing global health partnerships supported by the US government (14). This required honest, transparent discussion, and logistical consideration. Given the time and effort invested by each individual institution, there were naturally some perceived threats to each one's investment as we moved toward collaboration. **Table 2** describes pitfalls encountered as the consortium has formed and the lessons learned and strategies used. We have prioritized transparency among all partners. We have developed a code of conduct to support professionalism and ensure the continued collegiality of the group. We maintain a database of ongoing research efforts and potential projects to foster open communication and collaboration. We have discussed authorship on future projects, with the intent to have a "working group" for all efforts and support the development of Malawian clinicians as primary investigators in consortium research. In addition, we have set as our benchmark the improvement of survival and health of the children at KCH to guide all of our collaborative efforts.

TABLE 2 | Pitfalls and lessons learned/strategies for partnership development.

Pitfall	Lessons learned/strategies
Past and Present US Institutional Agendas	Use PACHIMAKE formation to set new priorities guided by the host site and present this consortium and goals back to US-based leadership to support investment Leverage existing infrastructure in-country to expand scope of clinical services provided
Past history between institutions (US-based and local)	Develop memorandum of agreement Implement a formal code of conduct to guide inter-institutional endeavors Assemble a "working group" credited and named for any scholarly work Focus on shared goal of reducing child mortality
Burden on system created by US-based institutions	Provide a long term US faculty at the host site Commit to longer rotations at the host site for US-based faculty/trainees Standardize orientation for US-based rotators Coordinate consultant/faculty presence with local learners for increased shoulder-to-shoulder mentoring
Communication challenges	Lead with and maintain transparency in all activities Implement monthly calls/meetings including all partners Ongoing assessment of partnership benefits and burdens—honest communication about contribution of partnership to host site

While this partnership is in the early phase, we present our account of its formation as an example for US-based institutions who find themselves working alongside others at a common host site. We encourage a conversation of how individual goals intersect and whether those goals would be better achieved through collaboration. The global health funding climate is now more supportive of multi-institution partnerships; if this collaboration is successful, we anticipate scaling up collaboration among different sub-specialty service lines within pediatrics. As we progress, our outcome indicators of success will include ability to accomplish the goals set forth by KCH staff, coordinate support for a pediatric residency training program, provide continuous specialist (PEM) coverage at KCH, and document progress through presentations and publications.

Our vision is that the coordinated efforts of this multi-institutional consortium will significantly contribute to our overall goal, decreased morbidity, and mortality among children at KCH. Each partner has secured administrative support for this consortium from their respective institution and next steps now include identifying funding sources for the highest priority initiatives. We plan to prioritize reliable data collection and anticipate that this will direct the consortium's efforts in terms of prioritizing projects for initial funding, which will be pursued at both the individual institutional level and collaboratively through both foundations and government. We anticipate that this consortium could serve as a model of collaboration for HIC institutions striving to improve pediatric health-care systems in other LMICs.

CONCLUSION

In the absence of any other identifiable internal changes or external conditions, the improvements in care and decrease of mortality in pediatric patients at KCH can be attributed in large part to the clinical changes brought about by the training and educational initiatives resulting from the partnerships of the above US-based institutions with KCH, the Ministry of Health (MOH), and the COM. In order to sustain and improve upon these gains, investments focusing on advanced care of emergently ill children are needed, as the majority of childhood mortality still occurs in the first 48 h of hospital admission. The development of a partnership between relevant stakeholders in Lilongwe (KCH, MOH, and COM) and US-based partners with expertise in PEM (CCHMC, BCM, UNC) should help to further decrease mortality through the provision of acute care expertise and training as well as investment in the development of educational, research, and clinical efforts in PEM at KCH. In order to continue on the path of fulfilling the millennium development goals and to eventually reach the SDGs collaboration for the good of children and health for all people in general must become the norm and not the exception. Our demonstration of a collaboration that puts the goal of improved health and survival of children over individual institutional goals can stand as a model for others. The opportunities in child health to make the whole of our efforts when working together greater than the sum of our individual efforts are myriad. We must only align our priorities together. The health of the world's children depends on it.

AUTHOR CONTRIBUTIONS

All authors listed provided substantial contributions to the development of the partnership described in this manuscript, provided critical feedback on manuscript drafts, approved the final version of the manuscript, and agreed to be responsible for content.

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Increasing Regional Anesthesia Use in a Serbian Teaching Hospital through an International Collaboration

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Many low- and middle-income countries (LMICs) report low rates of regional anesthesia (RA) use for cesarean delivery (CD), despite its association with lower maternal major morbidity and mortality. Also, the prevalence of neuraxial analgesia for labor (NAL) is often low in LMICs. We report on the results of a collaboration in clinical education over a multi-year period between Kybele Inc., an international non-profit organization, and Klinicki Centar Vojvodine (CCV), a teaching hospital in Novi Sad, Serbia, to increase RA use for CD and NAL at CCV. From late 2011 through 2015, teams from Kybele participated in annual to biannual didactic conferences and week-long bedside teaching efforts involving obstetric and anesthesia staff from CCV and surrounding hospitals. Ongoing contact occurred at least weekly between Kybele and the host to discuss progress. De-identified quality improvement data on total deliveries, numbers of elective and non-elective CDs, number of vaginal deliveries, type of anesthesia for CD, and the number of NALs were collected. RA use for CD increased to 25% in year 2015 versus 14% in base year 2011 [odds ratio (OR): 2.05; 95% confidence interval (CI): 1.73, 2.42; $p < 0.001$]. NAL increased to 10.5% of laboring women in 2015 versus 1.2% in 2011 (OR: 9.6; 95% CI: 7.2, 12.8; $p < 0.001$). Greater increases for RA use during non-elective CD were observed between 2011 and 2015 (1.4 versus 7.5% of total CD; OR: 5.52; 95% CI: 2.63, 8.41; $p < 0.001$) relative to elective CD (12.5 versus 17.5% of total CD; OR: 1.48; 95% CI: 1.23, 1.77; $p < 0.001$). Overall, RA for CD increased during the 4 year collaboration but was not as great as reported in other countries with similar health-care demographics utilizing a similar program. Detailed descriptions of program interventions and barriers to change at CCV are presented.

Keywords: obstetric anesthesia, neuraxial anesthesia, cesarean delivery, labor analgesia, global health, regional anesthesia

INTRODUCTION

The use of regional anesthesia (RA) for cesarean delivery (CD) has become widespread in countries in the USA and in Western Europe (1, 2). RA is associated with a lower maternal mortality risk compared to general anesthesia (GA) in both high and low- and middle-income countries (LMICs) (3–7). Despite this recognition, many Eastern European countries report much lower rates of RA use for CD and neuraxial analgesia for labor (NAL) (8, 9). Barriers to implementation in such settings are varied. One report from Georgia cited lack of governmental funding for supplies, lack of familiarity of anesthesia staff with current techniques and evidence-based guidelines, and limited availability of appropriate local anesthetics as possible reasons (10). Another survey of RA use from the Czech Republic cited patient fear over the safety of RA and lack of acceptance by obstetric providers (9), similar to a report of an ongoing collaboration in China between Chinese and American anesthesia providers (11).

BACKGROUND AND RATIONALE

Collaborations between non-governmental global health organizations and host institutions in LMICs have been shown to be effective in increasing obstetric RA use (10–13). One report of a single, short-term effort to teach RA techniques in eight hospitals throughout Croatia reported a 50% increase in use of RA for CD and smaller increases in use of NAL (12). Whether these changes were sustained has not been reported. Although single, short-term educational efforts can improve anesthetic performance in some settings, longer collaborative commitments are most often necessary to achieve lasting change (10, 14). Rates of RA use both for CD and labor may regress without ongoing mentoring and support (14).

We report on the rates of RA use at the Klinicki Centar Vojvodine, Klinika za Ginekologiju i Akuserstvo in Novi Sad, Serbia from 2011 to 2015 as part of an ongoing collaboration with Kybele Inc., which began in late 2011. The Klinicki Centar (CCV) is a large tertiary referral obstetric hospital serving the Vojvodine region of Serbia with 6,500 annual births. Kybele, Inc. (www.kybeleworldwide.org) is a 501 (c) (3) non-profit humanitarian organization dedicated to improving childbirth safety through innovative partnerships that provide hands-on bedside and classroom teaching. This study evaluates changes in the rates of RA for CD and NAL before, during, and after expatriate visits and types of anesthesia for both elective and emergency CD over time. We describe our interventions to increase RA use and the barriers to practice change that we encountered.

MATERIALS AND METHODS

In September 2011, physicians representing Kybele were invited to participate in a medical conference in Novi Sad, Serbia consisting of 2 days of didactic instruction followed by 1 week of bedside instruction in obstetric anesthesia techniques. An ongoing collaboration was then established with one goal to increase the rate of RA use for CD and NAL. The anesthesia staff at CCV consisted of 13 certified specialists and two or three resident trainees

who were assigned as part of their residency rotations. Kybele teams consisted of obstetric anesthesiologists, obstetricians, and neonatologists. One anesthesia staff at CCV acted as the primary liaison between Kybele team members, CCV anesthesia and obstetric staff, and the hospital leadership. Annual visits occurred 2012–2014, with biannual visits in 2015, for six visits overall. Visits consisted of a 2-day didactic program of mutually determined topics and 1 week of hands-on clinical instruction for all anesthesia staff. In addition, CCV advertised the program to all certified specialists at hospitals throughout Serbia and the countries of Croatia, Bosnia, and Montenegro.

A curriculum in obstetric anesthesiology was developed over the 2nd and 3rd program years by the Kybele team to provide continuity of instruction material. The material was based on standard, evidence-based obstetric anesthesia practice in well-established training institutions in the USA. This material was available to CCV obstetricians and anesthesia staff both during and between visits. The didactic and clinical instruction programs were each altered from year to year based on anesthesia and obstetric staff input. In addition, informal presentations and discussions occurred frequently between small groups of Kybele team members and CCV obstetric and anesthesia staff during the week long visits. A model consisting of alternating layers of plastic foam of differing densities placed together in a wooden frame was made by members of the Kybele team. This allowed an operator to experience a tactile sensation similar to that encountered clinically when passing an epidural needle into the epidural space. The model was made available primarily to those program participants who had little previous experience in epidural catheter placement.

During each Kybele visit, at least one meeting with the chair of the obstetric department and members of the hospital administration at CCV was conducted to assess the program effectiveness and to suggest new approaches for education and systems change. Suggestions on how to more effectively utilize personnel and clinical resources that would facilitate the performance of RA were made. Upper-level leadership at the hospital expressed support of the ongoing collaboration during these meetings and to Kybele team members during individual encounters. Refinements in processes for best conducting RA were suggested.

During each visit, local media outlets interviewed both Kybele and CCV leaders, and the benefits of RA use in obstetrics were presented. The interviews, which were broadcast throughout Vojvodine, Serbia, stressed the collaboration between the host and Kybele teams. A patient information brochure, which explained anesthetic choices for CD, was made available to all patients upon admission to the hospital the night before elective cesarean section.

During the periods between visits, telephone conversations occurred weekly between one Kybele team leader and the principal liaison to discuss questions regarding patient management, administrative issues (most often, how best to increase RA use), and obstetrician questions on providing clinical anesthesia care. These discussions provided the basis for altering the approaches used by the Kybele team from visit to visit.

The Institutional Ethics Committee of Klinicki Centar Vojvodine gave permission for the collection of patient de-identified data for

a quality improvement assessment of the ongoing collaborative effort. To examine the shorter-term impact following each Kybele visit, data on the use of RA for CD were collected 1 week before a visit (R1), the week during (R2), and at one (R3) and two (R4) weeks, and two months (R5) following a Kybele visit.

Multiple logistic regression was used to estimate the relative changes in the odds of obstetric RA use in the week before, during, and after visitation by Kybele, adjusting for a visit. Thus, the fraction of CDs (during those weeks) in which RA was used was the dependent variable and week sequence and visit were treated as categorical independent variables.

A second pair of simple logistic regression analyzes was used to assess the odds ratios (ORs) of RA for CD and NAL with calendar year (2011–2015) as the categorical independent variable. This analysis included all CDs by calendar year, whereas the analysis above considered only those in the weeks before, during, and after a visit by study investigators. Long-term-sustained effects on RA use for CD for each year were assessed in the period 2012–2015 relative to year 2011 as the base year.

Finally, the association between elective versus non-elective CD and the rate of RA use was evaluated using a multiple logistic regression analysis adjusting for categorical calendar year and elective versus non-elective CD and their interaction. The interaction was used to assess whether the OR for RA use in 2015 versus 2011 varied by elective versus non-elective status. All ORs were summarized using Wald-type 95% confidence intervals (CIs) and *p*-values.

RESULTS

The mean annual number of deliveries was 6,382 (range 6,084–6,570) and mean yearly number of CDs was 1,964 (range 1,794–2,043) during the study period. The use of RA for CD increased significantly over time compared to 2011 (**Table 1**). In 2012 and 2013, the relative odds of RA use were greater by 18% (95% CI: −1, 41; *p* = 0.067) and 39% (95% CI: 16, 65; *p* < 0.001), respectively. In 2014 and 2015, the relative odds were greater by at least twofold (2014 OR: 2.20; 95% CI: 1.87, 2.60; *p* < 0.001. 2015 OR: 2.05; 95% CI: 1.73, 2.42; *p* < 0.001). For elective cases, RA for CD increased from 12.5% of total CD in 2011 to 17.5% in 2015 (OR: 1.48; 95% CI: 1.23, 1.77; *p* < 0.001). For non-elective cases, RA for CD increased from 1.4 to 7.5% of total CD from 2011 through 2015 (OR: 1.48; 95% CI: 1.23, 1.77; *p* < 0.001). Use of RA for non-elective cases increased more than for elective cases (interaction OR: 3.74; 95% CI: 2.36, 5.92; *p* < 0.001).

The use of NAL increased significantly over time compared to base year 2011 (**Table 1**). In 2012 and 2013, the relative odds of NAL use were greater by 2.7-fold (95% CI: 1.96, 3.72; *p* < 0.001) and 5.0-fold (95% CI: 3.7, 6.8; *p* < 0.001), respectively. In 2014 and 2015, the relative odds were greater by 7.1-fold (95% CI: 5.3, 9.5; *p* < 0.001) and 9.6-fold (95% CI: 7.2, 12.8; *p* < 0.001), respectively.

Effects of Kybele Visits 2012–2015

The immediate impact of a visit on the use of RA for CD showed a large positive effect that decreased over time. After adjusting for the visit sequence (one visit in 2012–2014 and two visits in 2015), the relative odds of RA use during the week of a Kybele visit were 2.57 times greater (OR: 2.57; 95% CI: 1.60, 4.14; *p* < 0.001) than the base week preceding a visit. Although use regressed over time, RA use was consistently higher than for the base comparison week: the OR was 1.96 (95% CI: 1.22, 3.16; *p* = 0.006) during the week after the visit, but by week two and eight, the ORs were 1.66 (95% CI: 1.01, 2.72; *p* = 0.046) and 1.70 (95% CI: 1.04, 2.79; *p* = 0.034), respectively. After adjusting for week, year was not significantly associated with the relative odds of RA use during those weeks (except for June, 2015 versus 2012) (**Tables 2** and **3**).

DISCUSSION

During the CCV-Kybele collaboration, the use of NAL increased from 1.2 to 10% and the use of RA for CD increased from 14% to approximately 25%, which plateaued over the last 2 years of the study period. Reports from both high and LMIC countries show that RA use is associated with significant reductions in anesthetic-related maternal morbidity and mortality compared to GA (3, 4, 6, 7). Accordingly, the 4 year on going collaboration between Kybele and CCV focused on increasing RA use and our results showed progress in achieving that goal, with significant increases in the use of RA for CD and NAL. These changes have been sustained over time despite decreases in use of RA that occurred in the immediate 2-month period following training visits. Kopic et al. reported increases in RA for CD and NAL following their program in Croatia, a neighboring Eastern European country similar in health-care demographics to Serbia (12). The use of RA for CD at the study institutions increased from 20% before their one time, country-wide, multi-institutional intervention to 34% following the program, a rate similar to that reported in year 2015 of the collaboration at CCV. Ninidze et al. (10) described better success in their collaboration of yearly program visits over

TABLE 1 | Yearly percentage of cesarean deliveries (CDs) performed under regional anesthesia (RA) and percentage of vaginal deliveries (VD) with neuraxial analgesia for labor (NAL) at Clinical Center Vojvodine.

Year	Percentage of CD under RA	Percentage of elective CD under RA	Percentage of non-elective CD under RA	Number of CDs	Percentage of VD under NAL	Number of VDs
2011	14.0	12.5	1.4	1,794	1.2	4,295
2012	16.1	13.7	2.4	2,043	3.2	4,312
2013	18.4	15.1	3.3	1,998	5.8	4,330
2014	26.4	19.0	7.4	2,004	8.0	4,500
2015	25.0	17.5	7.5	1,996	10.5	4,574

TABLE 2 | Number of cesarean deliveries (CDs) performed under regional anesthesia at Clinical Center Vojvodine around Kybele visits and overall, Calendar Years 2012–2015.

Interval	Visit year				
	2012	2013	2014	6/2015*	9/2015
R1 (%)	13	21	22	17	21
# C/D	38	33	45	35	33
R2 (%)	31	42	38	40	38
# C/D	29	36	37	42	39
R3 (%)	24	39	17	43	33
# C/D	33	38	36	44	45
R4 (%)	24	18	30	39	33
# C/D	34	38	33	36	36
R5 (%)	28	20	25	39	34
# C/D	32	41	36	31	38

**p* = 0.016 compared to the corresponding time intervals in 2012.

R1 = week before a Kybele visit.

R2 = week during a Kybele visit.

R3 = week after a Kybele visit.

R4 = two weeks after a Kybele visit.

R5 = two months after a Kybele visit.

TABLE 3 | OR for regional anesthesia for cesarean delivery (CD) adjusting for week around a Kybele visit.

	OR	95% CI	p-value
Visit: 2013	1.19	0.73, 1.94	0.475
Visit: 2014	1.15	0.71, 1.88	0.567
Visit: June, 2015	1.78	1.11, 2.85	0.016
Visit: Sept., 2015	1.51	0.94, 2.42	0.090
Week: R2	2.57	1.60, 4.14	<0.001
Week: R3	1.96	1.22, 3.16	0.006
Week: R4	1.66	1.01, 2.72	0.046
Week: R5	1.70	1.04, 2.79	0.034

The reference week is the week before a Kybele visit (R1), and the reference year/month is 2012.

OR, odds ratio; 95% CI, 95% confidence interval.

R2 = week during a Kybele visit.

R3 = week after a Kybele visit.

R4 = two weeks after a Kybele visit.

R5 = two months after a Kybele visit.

4 years to five participating hospitals in Georgia, another country with health-care demographics similar to Serbia. The importance of repeated visits over time was emphasized in this study, as the three hospitals who were visited four times reported increases in RA use for CD from approximately 20 to 80%, while the two hospitals visited only twice reported more modest increases from approximately 25 to 50%.

The present study sought to further define short-term variations in practice that occur temporally around a training intervention. During all visits, the use of RA for CD increased substantially compared to the baseline immediately before a visit, with less use of RA over time in the several weeks following an intervention. A diminishing effect of the shorter- and longer-term impact of interventions occurred; the results of the two visits in 2015 were similar to those in 2014. This outcome is not unexpected. Kybele team members provided additional patient care over that provided by CCV staff, and staff were enthusiastic in working with Kybele team members during the week visit.

However, by 2015, all of anesthesiologists had participated in at least one previous program, which might have diminished the effects of additional 1 week educational efforts. Further improvement would most likely require Kybele visits of greater than 1 week and more individually directed education efforts.

The unexpected finding of a larger percentage increase in the use of RA in non-elective CDs compared to a smaller overall increase in elective cases suggests that patient preference may be a significant factor in determining anesthetic choice. In cases of elective, repeat CD, patients will have most often experienced successful GA with a prior CD and will be familiar with it, versus lack of experience with RA. Stourac et al. (9), Kopic et al. (12), Olufolabi et al. (13), and Schnittger (15) all cited patient fear of being awake during a RA as a major factor in patient reluctance to choose RA. In year three of our effort (2013), a patient information card was made available to all patients who underwent elective CD, as they were admitted the night before an elective CD. Reference to it was made during the preoperative interview by those anesthesia personnel, who discussed anesthetic options immediately before CD. While this may have been an important factor in the increase in RA for CD between 2013 and 2014, its effectiveness may have been reduced if used by anesthesia personnel less than enthusiastic about performing RA.

While patient education regarding anesthesia for repeat CD in the immediate preoperative period is important in increasing RA use, such efforts should be considered during routine pre-delivery obstetric visits. Obstetricians often have a major influence over patient choice of anesthesia (10). Obstetrician preference may have a larger effect than that of the anesthesiologist in the choice of RA versus GA and efforts directed at obstetrician education to adequately answer patient questions concerning RA may be as important as those directed toward patients in increasing patient acceptance (10). An added benefit is that it may also overcome obstetrician reluctance to RA use (9, 11–13, 15). Ninidze et al. (10), Kopic et al. (12) Olufolabi et al. (13), and Schnittger (15) all cited obstetrician reluctance to operating on an awake patient as a potential barrier to use of RA for CD. We did not survey the obstetricians at CCV as to reasons why they might object to RA for CD. Our educational efforts were during conferences at which attendance was voluntary; many obstetricians did not participate.

We found that NAL use increased substantially during our multi-year program but is significantly less than the 60% rate cited for developed countries such as the USA (1). Our multi-year collaboration achieved greater success than that reported by Kopic et al. (12) following their one-time intervention (from 1.2 to 2.3%), but the overall rate of approximately 10% we saw in 2015 is considerably less than the 45% rate reported by Ninidze et al. (10) at the end of their multiyear intervention. However, the initial rate of NAL was considerably higher (20%) in the hospitals where Ninidze et al. worked than that at CCV, suggesting that the infrastructure for NAL (not described in their report) was already established before the training intervention.

Howell recently opined that the success of multi-national collaborative efforts is dependent on identifying a local partner in the host institution committed to change, presentation of new concepts in a way acceptable to recipients, team members who are committed to engage with local practitioners, and continuous

follow-up between educational visits (14). Reed et al. noted that technical training, carefully implemented in cooperation with the host, with repeated efforts during and in between site visits to overcome obstacles over a significant period of time are necessary for successful change (16). Our program incorporated most of these approaches. The program at CCV collaborated with a local host enthusiastic in achieving the mutually determined goals. Kybele, the host, and the senior leadership at CCV committed to a multi-year program. A curriculum that responded to the educational needs of the staff at CCV was developed. Kybele members worked closely with staff at CCV in uniformly positive ways and most expressed enthusiasm for the interventions. Kybele team members and the local liaison communicated regularly during the intervals between visits. The methods described in the multiyear effort reported by Ninidze et al. (10) employed these principles but with greater success.

The lack of significant increases in RA for CD from 2014 to 2015 and only modest absolute increases in NAL over the 4 year period are probably due to several structural and process factors unique to the practice setting at CCV. The principal liaison between Kybele and CCV was not the chief of the department of anesthesia. Although the chief of anesthesia at CCV supported the collaboration, the Kybele team did not meet with her regularly during visits or communicate with her between visits. Kybele's ability to approach anesthesia providers who did not increase RA use was thus limited. Also, we were unable to secure her permission to display de-identified charts of each anesthesiologist's RA use over time. This technique has been shown to be effective by others in implementing provider behavioral change in other health-care settings (17). In addition, anesthesia personnel felt obligated to continuously monitor NAL delivered by continuous infusion, thus limiting the availability of personnel to provide NAL, especially during call hours. We were unable to change this practice despite presenting that NAL by continuous infusion without continuous monitoring by anesthesia personnel is routine in the USA.

Early in the collaboration the Kybele team noted that all anesthesia department members were available for work during the day 8-h workday, with only a single staff person for call coverage beginning midafternoon. Thus, many persons were available for work during the regular 8-h workday, but very few after that time. This staffing model limits personnel available to perform NAL, especially since the call person performs all anesthesia for CD as well. We were unable to change this staffing model.

Finally, although the head of the hospital at CCV was enthusiastic about our collaborative effort, his enthusiasm may not have been shared by others. Some obstetricians were enthusiastic in interacting with Kybele members and welcoming of changes

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in anesthesia care for their patients, but others were not. We were unable to obtain the leadership's support for changing the anesthesia staffing model as noted above. We were also unable to obtain support for placing patient information brochures on choices of anesthesia for vaginal and CD in obstetricians' offices.

CONCLUSION

We report modest success of the Kybele CCV collaboration in increasing the use of RA for CD and for pain relief during labor. The increase in RA use was not as great as reported by others in other countries with similar health-care demographics but increases in the use of NAL are similar. Despite nearly weekly interaction between Kybele team members following 1-week interventions one and two times per year and a largely enthusiastic host, rates of RA use for CD at CCV are only 1/3 of those in Western European and North American practices (7, 9, 12).

Although barriers to change at CCV are similar to that reported by others (acceptance by anesthesia personnel, acceptance by obstetrical personnel, enthusiasm by hospital leadership that translate into staff enthusiasm, and improved patient education prior to delivery and in the immediate delivery period), factors unique to CCV (anesthesia staffing model, ability to target individual obstetrician and anesthesiologists for education efforts, better ways of providing education to patients) will need to be changed before further progress can be made. It is likely that Kybele team visits lasting greater than 1 week will be required.

ETHICS STATEMENT

Institutional Ethics Committee of Klinickog Centra Vojvodine gave permission for collection of patient de-identified data for a quality improvement assessment of the ongoing collaborative effort.

AUTHOR CONTRIBUTIONS

CB, BP, IV, MO, JS, MS, and FB, all made substantial contributions to the conceptual design of the work, in acquiring the data, and in its analysis. All helped draft the work and revised it critically. All approve this copy for publication. All agree to be accountable for all aspects of the work in ensuring its accuracy and integrity.

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The Need for Hematology Nurse Education in Low- and Middle-Income Countries: A Community Case Study in Tanzania

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Hematology-related diseases, such as anemia, malaria, sickle cell disease (SCD), and blood cancers, have differing rates of survival between high-income and low- and middle-income countries (LMICs). Nurses in LMICs have an unmet need for specialty training and education to address hematology and hemato-oncology disorders. A gap in the literature exists about hematology nurse education and clinical service demands in LMICs. This community case study documents a collaborative hematology and basic hemato-oncology education program to sustainably strengthen nurse capacity at a national referral hospital and university in Tanzania. The goal of the intervention was to provide culturally competent nurse training in pediatric and adult hematology. A certified pediatric nurse practitioner with hematology and oncology experience provided culturally competent training and staff development to nurses over two weeks to meet this goal. Prior to development of a training schedule, nurses confidentially identified five of their top learning needs. Main hematology and basic oncology educational needs identified by nurses were the management of anemia, safe handling of cytotoxic agents, and treatment of SCD. The format of the education varied from bedside teaching to formal presentations to one-on-one individual discussions. Overall, nurses expressed satisfaction with the education and verbalized appreciation for teaching and training activities tailored to meet their needs. Specialized training in hematology and hemato-oncology has the potential to increase nurses' confidence, respect, and participation in interprofessional team decision-making. Lessons learned from the impact of collaborative nurse education and partnership in Tanzania can be generalized to other LMICs. This community case study highlights the importance of specialty nurse education, interprofessional development, and global partnerships needed to improve patient outcomes.

Keywords: hematology nursing education, hemato-oncology nursing education, hematology nurses, low-income countries, middle-income countries, Tanzania

INTRODUCTION

Nurses play an important role in sustainably improving patient outcomes in low- and middle-income countries (LMICs). Nurse education in LMIC tends to focus on primary care topics. However, there is a growing need to manage chronic disease and reduce the burden of hematology-related diseases globally and improve public health. Nurses in LMICs have an unmet need for specialty training and

education to address hematology and hemato-oncology disorders. Nurses with adequate levels of specialty hematology nursing education will better meet the health-care needs of patients. The purpose of this community case study is to document a collaborative hematology and basic hemato-oncology education program to sustainably strengthen nurse capacity at a national referral hospital in Tanzania.

BACKGROUND AND RATIONALE

Hematology-related diseases such as anemia, malaria, sickle cell disease (SCD), and blood cancers have differing rates of survival between high-income and LMICs (1). Globally, anemia affects 1.62 billion people, which corresponds to 24.8% of the population (2). The highest prevalence is in preschool-age children (47.4%), and the group with the greatest number of individuals affected is non-pregnant women (468.4 million) (2). SCD is one of the most common diseases worldwide yet in many LMICs, basic facilities for management are lacking, systematic screening is not common practice, and diagnosis is made late (3). Leukemia and lymphomas occur in LMICs but it is difficult to estimate the burden of disease. However, we know lower-income families endure a double burden of communicable and non-communicable chronic illness, requiring a response well integrated into the health systems of LMICs (4). The practice of hematology is evolving in many countries in Africa to encompass the growing and changing demands in clinical and laboratory services as well as blood transfusion (5).

Globally, nurses comprise the largest group of health-care providers. In almost all countries, nursing and midwifery services are estimated to comprise over 80% of the health-care services (6). About 43% of World Health Organization (WHO) Member States report to have less than two nursing and midwifery personnel per 1,000 population (28% report to have less than 1) (6). The average nurse:population ratio in high-income countries is almost eight times greater than in low-income countries (7). In Tanzania, the density of nursing and midwifery personnel (total number per 1,000 population) in 2012 (last available year) was 0.436 (6). The low availability of nurses in many developing countries is exacerbated by geographical misdistribution—there are even fewer nurses available in rural and remote areas (7).

The strain of the nursing shortage on health-care systems is a worldwide concern. The need for specialty nurses is often overlooked in the face of this public health challenge. There is a gap in the literature about clinical service demands in relation to nursing and hematology in LMICs. It has yet to be demonstrated how nursing will evolve to meet public health demands. The lack of specialty training for nurses is being overlooked by the largest group of health-care providers. There are challenges associated with inadequately prepared nurses needed to care for the population suffering from hematology-related problems. Education and interprofessional collaboration should be used to meet the evolving service demands of specialty nursing in LMICs.

Description of the Case

The goal of the educational intervention was to provide hematolgy and basic hemato-oncology training and staff development to nurses with Muhimbili National Hospital (MNH) and nursing

students at Muhimbili University of Health and Allied Sciences (MUHAS) in the largest city in Tanzania, Dar es Salaam. The nurse educator observed inpatient pediatric and adult nurses had little training in how to care for patients with hematological and hemato-oncological disorders and recognized a definite need for improved nursing care. The hematology and basic hemato-oncology training and staff development for nurses was developed based on the self-identified needs of the nurses and by the nurse educator through observation of patient care.

Setting

MUHAS (8) aims to provide quality training, research, and services in health and related fields for attainment of equitable socioeconomic development for the Tanzanian community and beyond. The vision of the MUHAS School of Nursing (8) is to become a center of excellence in nursing education, research, consultancy, and public services responding to national, regional, and global challenges. MNH is a national referral hospital, research center, and university teaching hospital with a 1,500 bed facility, attending 1,000–1,200 outpatients per day, and admitting 1,000–1,200 inpatients per week (9). As the national referral center, MNH is responsible for providing specialized care for hematological disorders. The hospital operates inpatient wards for both children and adults with hematological conditions. Children under the age of eight years are treated in the pediatric division which consists of a sickle cell ward and a pediatric oncology ward. The hematolgy unit runs three outpatient clinics and also provides care to patients in obstetrics and gynecology, surgery, orthopedics and trauma, and otolaryngology (10).

COLLABORATIVE PARTNERSHIPS

The organization fostering inclusive partnerships in this community case study is Health Volunteers Overseas (HVO). They are a United States-based non-profit organization dedicated to improving the availability and quality of health care through the education, training, and professional development of the health workforce in resource-scarce countries (11). At HVO, nursing education is central to their work to improve the availability of nursing care around the world. Their projects plan for the next generation of nursing staff, providing essential information and skills to future nurse educators (HVO nurse partners). The aim is to create a sustainable solution to global nurse shortages, giving local health systems the capacity to teach and train the staff they need (11).

The American Society of Hematology (ASH) partners with HVO to bring consultation and training to hospitals in the developing world managing hematology patient cohorts with a wide range of disorders. Training takes the form of rounds in the clinics, bedside consultations, lectures in the classrooms, training in the laboratories, and more. The objective of the sponsorship is sustainable improvement of the management of hematology patients in the developing world (12).

Methodological Aspects

The format of the education at MNH varied from bedside teaching to formal presentations to one-on-one individual discussions.

Flexibility was key to meeting the scheduling demands of approximately 50 Tanzanian nurses caring for pediatric and adult hematology patients in both in- and outpatient settings. Group lectures were presented more than once to reach a wide audience. At MUHAS, lectures were presented to both undergraduate and postgraduate nursing students.

HVO NURSE PARTNER

Education sessions were delivered by a certified pediatric nurse practitioner with over 10 years' experience working in the fields of hematology and oncology along with clinical instruction at a large teaching hospital in the United States. The HVO nurse partner also has extensive experience working in LMICs with a major international medical humanitarian organization. The courses were delivered in English because nursing school, as with most tertiary education in Tanzania, is taught in English. At the national hospital, the HVO nurse partner participated in hematology department grand rounds, pediatric and adult hematology clinical rounds, outpatient pediatric and adult sickle cell clinics, as well as the new patient screening clinic and anti-coagulation clinic. **Table 1** shows some highlights of the HVO nurse partner's schedule while in Tanzania.

COLLABORATIVE APPROACH

Prior to the development of a training schedule, Tanzanian nurses were asked to confidentially prioritize five of their top learning needs related to hematology and basic oncology. Results of the prioritization survey were incorporated into the training schedule. The main educational needs identified by nurses were the management of anemia, safe handling of cytotoxic agents, and treatment of SCD. Specific goals of the nurse education program reached using the prioritization process are detailed in **Table 2**. Group lectures were held daily and lasted between 0.5–1 h and were repeated two to three times throughout the program so that as many nurses as possible could attend lectures. Groups averaged nine participants. The smallest was 5 and largest 21. The HVO nurse partner collaborated with Tanzanian nurses to arrange timing of group and individual education sessions.

EDUCATIONAL PROGRAM

A 2-week collaborative educational program was developed to provide hematology and basic hemato-oncology education to nurses in Tanzania. The education program included three main themes: (a) overview of hematologic and hemato-oncologic

TABLE 1 | Highlights of the Health Volunteers Overseas nurse partner's schedule in Tanzania.

Day 1	Day 3	Day 7	Day 9	Final day
Meeting with nurse managers, head nurses of peds/adult hematology/ oncology wards	Observe nurses in adult sickle cell follow-up clinic	Group lecture with nurses about safe handling of chemotherapy	Observe hematology grand rounds	Informal qualitative evaluations of educational program with nurses
Discussions with pediatric oncology nurses to review their learning objectives	Introduction to faculty at Muhimbili University of Health and Allied Sciences (MUHAS). Collaborative identification of teaching topics with students	Individual instruction with adult hematology nurses	Participate in pediatric hematology inpatient rounds with staff MDs and inpatient nurses	Review of experience with assistant director of volunteer program
Tour of all wards in pediatric hospital with hematology nurse	Visit clinical pathology/hematology lab offices	Observe nurses in new patient screening clinic	Attend hematology dept. MD research presentations	Lecture at MUHAS

TABLE 2 | Highlights of hematology nurse education program schedule in Tanzania.

Day 2	Day 4	Day 6	Day 8	Final day
Nurses self-identified education needs using anonymous survey	Cross-cultural discussions with individual nurses about differences in resource management between Tanzania and US	Group lecture: management of treatment side-effects, 0.5 h session, presented two times during program	Individual instruction with pediatric oncology nurses about safe chemotherapy administration	Informal qualitative interview evaluations of educational program with nurses
Cross-cultural discussions with individual nurses about differences in treatment options between Tanzania and US	Group lecture: overview of hematologic cancers, 1 h session, presented three times during program	Individual sessions at bedside with nurses to review sickle cell crisis pain management	Small group discussions about impact of cross-cultural hematology education program	Group lecture: management of nurse self-care/coping strategies, 45 min session, presented once during program
Group lecture: overview of hematology, 1 h session, presented three times during program	Individual sessions at bedside with nurses to review management of treatment side-effects	Lecture at Muhimbili University of Health and Allied Sciences (MUHAS) to 56 undergraduate third year nursing students about emergency management	Group lecture: anemia treatment, 0.5 h session, presented two times during program	Lecture at MUHAS to nine post-graduate second year students about transfusion medicine

disorders; (b) safe chemotherapy administration; and (c) supportive care. The education sessions included four components: (1) basic hematology and hemato-oncology group lectures; (2) individual instruction on self-identified needs; (3) direct observation of patient care in pediatric and adult inpatient wards and hematology outpatient clinics; and (4) group lectures to graduate and postgraduate nursing students. **Table 3** gives highlights of the hematology nurse education program schedule in Tanzania.

At MUHAS School of Nursing, at the request of nursing faculty, 56 undergraduate students received one 2-h presentation including an overview of hematologic disorders, blood product administration, and how to recognize blood transfusion reactions. Another 2-h presentation was given to nine graduate nursing students on the recognition and treatment of hematologic and basic oncologic emergencies such as neutropenic fever and unexplained bleeding.

EDUCATIONAL TOPICS

A summary of educational topics covered at MNH and MUHAS is presented in **Table 4**. For example, one topic identified by Tanzanian nurses as an area they wanted to learn more about were the principles of chemotherapy and safe handling of cytotoxic agents. The HVO nurse partner observed nurses in the chemotherapy preparation area and noted areas for improvement. The HVO nurse partner suggested ways to decrease surface contamination and encouraged the use of eye protection when preparing chemotherapy. After observation of nurses in the oncology ward, the educator proposed ways to reduce the potential for chemotherapy extravasation including the insertion of fresh IV catheters prior to vesicant administration and monitoring IV sites for brisk blood return and good flow during infusion.

EVALUATION

At the end of the hematology nurse education program, participants were asked in an informal survey to confidentially write the three things they liked most about the education sessions. They were also asked to verbally evaluate their experience during informal small group discussions on the final day of training. Nurses were asked to describe the potential outcomes of the educational program and to comment on any potential nursing practice outcomes after collaborating in the educational program. No quantitative data were collected as part of the evaluation.

THEORETICAL FRAMEWORK

The US-based HVO nurse partner used Leininger's (13) transcultural nursing movement in education research and practice as a framework for providing culturally competent hematology nurse education. Transcultural nursing focuses on comparative human-care (caring) differences and similarities of the beliefs, values, and patterned lifeways of cultures to provide culturally congruent, meaningful, and beneficial health care to people (13). Leininger's (13) Culture Care Diversity and Universality Theory served as a

TABLE 3 | Specific goals of hematology nurse education and professional development.

Nurse identified educational needs	Specific goals of educational sessions
Sickle cell disease	Review nursing care management of sickle cell, pain crisis and infection management, coping skills
Transfusion medicine	Increase understanding and knowledge of transfusion reactions, safe administration of blood
Hemato-oncology	Foster improved understanding of nursing care of patients with blood cancer
Chemotherapy	Provide details on safe administration and care, exchange transfusion, and home care
Bleeding and thrombosis	Monitor and detect signs of bleeding, clot formation
Anemia and other red cell disorders	Review nursing care implications and overview of pathophysiology for blood disorders

TABLE 4 | Nurse education at Muhimbili National Hospital and Muhimbili University of Health and Allied Sciences.

Topic	Content covered in lectures and individual education sessions with nurses and nursing students
Overview of hematology	
Origin of blood cells	PowerPoint presentation from American Society of Hematology Lecture Program: Blood Basics
Anemia	The role of red blood cells in anemia, common types of anemia, treatment for anemia, prevention of nutritional anemias
Neutropenia	Causes of neutropenia, infection prevention
Thrombocytopenia	Physical examination, symptom review
Hematologic disorders	
Sickle cell disease (SCD)	Overview of SCD and sickle cell trait, patterns of inheritance, risk factors, signs and symptoms, treatment, hydroxyurea
Thalassemia	Causes of thalassemia, patterns of inheritance
Hemophilia	Overview of bleeding disorders and hemophilia, patterns of inheritance, activity precautions
Emergency management	Treatment of acute bleeding events, sickle cell pain crisis, acute chest syndrome
Overview of hematologic cancers	
Leukemias, lymphomas	Overview of cancer cells, immune system impairment
Hematopoiesis and immune response	Creation of new blood cells, blood formation, response to antigens
Principles of chemotherapy	How chemotherapy works, medical treatment, dosage differences for pediatric and adult patients
Safe handling of cytotoxic agents	Safety considerations in preparation, administration, and disposal of chemotherapy
Supportive care	
Blood product components	Overview of red cells, white cells, platelets, and plasma
Blood product administration	Best practices for transfusion, transfusion reactions
Nutritional support	Health dietary options, importance of nutrition in healing process
Management of treatment side-effects	Treatment of nausea, vomiting, diarrhea, infection, fatigue, mucositis, neuropathy

guide for the selection of intervention elements keeping in mind every human culture has folk remedies, professional knowledge, and varying professional care practices. Using Leininger's model in Tanzania, the HVO nurse partner identified and addressed these factors consciously with each nurse to provide holistic and culturally congruent education.

TEACHING FRAMEWORK

The teaching framework used by the HVO nurse partner followed the approach outlined in "Educating Health Professionals in Low-Resource Countries: A Global Approach" (14). Three common principles of adult learning guided delivery of the intervention by the HVO nurse partner including (1) learners must be engaged by understanding the value and benefits of their learning; (2) outcomes and goals are clearly defined; and (3) teachers should use evidence-based teaching principles to facilitate learning (14). Active listening, observation, and culturally congruent communication were used in the bedside and classroom presentations. Individual and group training sessions fostered mutual respect, cultural competence, and exchange of ideas between the teacher and Tanzanian nurses and nursing students.

DISCUSSION

This community case study documents the collaborative hematology and basic hemato-oncology education intervention to sustainably strengthen nurse capacity at a national referral hospital in Tanzania. Overall, using informal qualitative surveys, nurses in the hematology and hemato-oncology areas expressed satisfaction with the education after the intervention was complete. The nurses ranked the following as what they liked most about the program: (1) opportunity for continuing education; (2) cross-cultural discussions; and (3) group lectures. The informal verbal feedback from participants following the educational intervention was extremely positive. Nurses verbalized appreciation that teaching and training activities were tailored to meet their needs. Some of the comments reflecting the nurses' evaluation of the training included:

I am so glad you came to talk to us. Nobody ever pays attention to us nurses. Only the doctors get educated over and over again.

I learned a lot about giving chemotherapy that I didn't know before. Now, I am not so scared to give treatment as I used be.

The presentations were very helpful.

Thanks for listening to our concerns and teaching about what's important for us to know.

Students in the School of Nursing at MUHAS also reported satisfaction with the presentations given by the HVO nurse partner. After class, students were each asked to write three of

their top take-home messages from the education intervention. Narrative comments from the nursing students included:

It's so nice to listen to international perspectives about nursing. We like to hear from experts in different subject areas. The best was about how to make sure blood types are compatible.

I will remember to talk to my patients about getting good nutrition for healing if they have cancer of the blood.

My best take home message is that sickle cell disease can stay in one family and hydroxyurea is a good medicine for those patients to take.

Specialized training in hematology and hemato-oncology has the potential to increase nurses' confidence, respect, and participation in interprofessional team decision-making. The WHO and its partners recognize interprofessional collaboration in education and practice as an innovative strategy playing an important role in mitigating the global health workforce crisis (15). Interprofessional education is a necessary step in preparing a "collaborative practice-ready" health workforce better prepared to respond to local health needs (15).

While there is little information regarding hematology nurse education programs in LMICs, there are a couple of programs reporting results of oncology nurse education. Recognizing oncology nurses in LMICs have limited access to specialized education and clinical training, the International Outreach Nursing Program at St. Jude Children's Research Hospital created the Latin American Center for Pediatric Oncology Nursing Education in Santiago, Chile to provide education, resources, and support to local nurse educators (16). In turn, these nurse educators educate the entire nursing staff at partner sites throughout Latin America. The educators provided pediatric oncology education to more than 1,000 nurses who can improve the quality of care and ultimately survival of patients throughout Latin America (16).

Recognizing there is no existing pediatric oncology nursing curriculum written specifically for LMICs, the International Society of Pediatric Oncology (SIOP) Pediatric Oncology in Developing Countries (PODC) conducted a survey of LMIC nurses in 2012 (17). A cross-sectional sample of LMIC nurses from Africa, Latin America, and Asia indicated a similar need for specialty training and curriculum development (17). The importance of education and learning is underscored by the development of an Education and Training Working Group in SIOP PODC which aims to facilitate training and education of health-care providers in LMICs (18). This case study adds to the growing body of evidence showcasing the importance of specialty nurse training in LMICs.

A team of Australian nursing and midwifery educators delivered evidence-based education in Tanzania and found with appropriate levels of cultural competence, international health professionals can be effective at providing ongoing professional development to colleagues in developing countries (19). Researchers suggest that in preparation for an international

teaching intervention, implementers should incorporate principles based on the work of Campinha-Bacote (20) when learning how to work in partnership with local health professionals to (1) assess learning needs; (2) understand and acknowledge differences in approach between educators and course participants; and (3) development of practical and relevant course content to suit local conditions (19).

Sustainable development calls for concerted efforts toward building an inclusive, sustainable, and resilient future for people and planet (21). Goal 17 of the recently launched United Nations Member Sustainable Development Goals (SDGs) encompasses revitalizing the global partnership for sustainable development to enhance international support for implementing effective and targeted capacity building in developing countries (21). The United Nations Member States recognize the importance of fostering inclusive partnerships built upon principles and values, a shared vision, and shared goals placing people and the planet at the center, are needed at the global, regional, national, and local level (21).

LESSONS LEARNED/ RECOMMENDATIONS

Urgent action is needed to educate nurses caring for patients with hematologic disorders such as anemia, SCD, blood cancers, and more in Tanzania and other LMICs. Nurses play an important role in achieving optimal care of patients with hematology-related problems yet there are large numbers of patients being cared for by nurses with no training in hematology. The work of HVO, in partnership with ASH, to improve the quality of health care in Tanzania through the education, training, and professional development of nurses in hematology is commendable. There is a definite need to advocate for other educational partnerships to increase the quality and supply of specialized nurses in LMICs.

Quality education is the foundation for developing competent health workers who are equipped with the knowledge, attitudes, and skills necessary to deliver quality care (22). In future intercultural exchanges, trainers should adopt the recently announced WHO Nurse Educator Core Competencies which were developed to help guide the educational preparation of nurse teachers, ensure educational quality and accountability, and, ultimately, contribute to improving the provision of nursing care and outcomes of health services (22).

The interdisciplinary collaboration barrier identified by nurses should not be ignored by team members in Tanzania. A great deal of effort should be focused on building a “collaborative practice-ready” health workplace at Muhimbili and at other nurse education sites. Collaborative practice strengthens health systems and improves health outcomes (15). Collaborative practice happens when multiple health workers from different professional backgrounds work together with patients, families, caregivers, and communities to deliver the highest quality of care. It allows health workers to engage any individual whose skills can help achieve local health goals (15).

The case study was time-limited because teaching strategies and cultural exposure took place over a period of two weeks. A longer period of immersion in the setting and culture would allow time for formal curriculum development and training to benefit

nurses providing care to patients with hematology-related problems in LMICs. Follow-up education sessions would allow for the reinforcement of material as would be creating sound or video recordings of sessions. Another limitation is some of the nurses expressed a lack of time to attend educational sessions. In the future, efforts should be made to schedule dedicated time to learn without the responsibility of providing patient care. Of course, this will be a challenge as the nursing workforce far too often experiences high patient to nurse staffing ratios. However, with proper advanced planning, a greater number of nurses should be able to benefit from training initiatives.

A limitation of the community case study is that it is written from only one side of the cultural exchange. Several unsuccessful attempts were made to contact lead nurses in the hematology department at MNH. The case study would no doubt be strengthened with the active input of Tanzanian participants in the writing process.

Future studies should evaluate the effect of hematologic and hemato-oncologic nurse education in LMICs. Recommendations for future research in LMICs would be to examine the effects of educating nurses in hematology and whether there is an associated improvement in patient outcomes. Another recommendation would be to examine the costs associated with educating nurses. Eventual research should investigate the cost-effectiveness of nursing education and impact on patient outcomes. The incorporation of a systematic evaluation process including both qualitative and quantitative measures would add richness and inform future collaborative efforts.

Lessons learned from the community case study experience in Tanzania can be generalized to other LMICs. Nurse educators and HVO nurse partners providing training in other settings must implement their programs with a willingness to provide culturally appropriate interventions in diverse settings. The education of hematology nurses should be scaled up in Tanzania and other LMICs settings. This community case study is the first one to document a hematology education intervention to sustainably strengthen nurse capacity in an LMIC and highlights the importance of specialty nurse education, interprofessional development, and global partnerships needed to improve patient outcomes.

AUTHOR CONTRIBUTIONS

JB, the sole author, made substantial contributions to the conception, design, and drafting of the work including final approval of the version to be published.

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Utilizing the “Plan, Do, Study, Act” Framework to Explore the Process of Curricular Assessment and Redesign in a Physical Therapy Education Program in Suriname

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Purpose: To describe how a multinational team worked together to transition a physical therapy (PT) educational program in Paramaribo, Suriname, from a Bachelor level to a Master of Science in Physical Therapy (MSPT) level. The team was made up of PT faculty from Anton De Kom Universiteit van Suriname (AdeKUS), the Flemish Interuniversity Council University Development Cooperation (VLIR-UOS) leadership, and Health Volunteers Overseas volunteers. In this case study, the process for curricular assessment, redesign, and upgrade is described retrospectively using a Plan, Do, Study, Act (PDSA) framework.

Method: PT educational programs in developing countries are eager for upgrade to meet international expectations and to better meet community health-care needs. An ongoing process which included baseline assessment of all aspects of the existing bachelor's program in PT, development of a plan for a MSPT, implementation of the master's program, and evaluation following implementation is described.

Conclusion: Curricular assessment and upgrade in resource-limited countries requires the implementation of process-oriented methods. The PDSA process is a useful tool to explore curricular development. The international collaboration described in this paper provides an example of the diligence, consistency, and dedication required to see a project through and achieve success while providing adequate support to the host site. This project might provide valuable insights for those involved in curricular redesign in similar settings.

Keywords: developing nation, physical therapy, education, curricular design, teaching

BACKGROUND

In developing nations around the world, the rehabilitation needs of persons with acute and long-term disability often go unmet. This problem is most often due to a combination of factors; (1) lack of understanding of rehabilitation professions, (2) inadequate numbers of rehabilitation providers, (3) inadequate infrastructure that limits access to care, (4) lack of education about the importance of

rehabilitation, and (5) social constructs that inhibit people from seeking services. Physical therapists (PTs) are key providers who can directly meet the unmet clinical needs and also influence the status of the profession and the community's understanding of physical rehabilitation. The purpose of this paper is to describe the process of curricular assessment, redesign, and upgrade of the Physical Therapy (PT) Program at Anton De Kom Universiteit van Suriname (AdeKUS) in Paramaribo, Suriname, through the retrospective lens of the Plan, Do, Study, Act (PDSA) framework.

Physical therapy curricular planning and evaluation play important roles in the advancement of the profession. This planning and assessment process is part of any PT educator's purview. However, educational programs in developing countries, eager to enhance their capacity for being able to meet community needs and to enhance the status of the PT profession, struggle in this area because of limited expertise, resources, infrastructure, and competing priorities. Various initiatives are underway around the world to empower PTs and educational programs that aspire to advancing the profession. This paper is an example of one such effort.

RATIONALE

In the recently released policy statement on PT education around the world, the World Confederation of Physical Therapy (WCPT) encourages and supports not only the implementation of appropriate entry-level education but also the development of "... processes that independently validate and assess the standards of entry-level education provision ..." (1). The WCPT states that these guidelines "provide a framework for internal quality assurance processes" but does not specifically address how to develop those processes (1). This WCPT document, along with the *WCPT Guidelines for Physical Therapist Professional Entry-Level Education* (2) and the *WCPT Guidelines for Qualifications of Faculty for Physical Therapist Professional Entry-Level Educational Programmes* (3), bring to the forefront the need for upgrading and equalizing PT education practices around the world.

Using a case report format, this paper utilizes Deming's PDSA process (4) to describe the activities and has undertaken to advance—from a Bachelor of Science level to a Master of Science in Physical Therapy (MSPT) level—of the PT education program at Anton de Kom Universiteit van Suriname (AdeKUS), an academic program providing entry-level PT education. The PDSA process reflects the reiterative and ongoing process by which the program was evaluated, redesigned, assessed, and reassessed, to achieve targeted outcomes. Outcomes of the process—rather than student outcomes—are described.

Suriname

The Republic of Suriname is the smallest country (63,037 square miles, population 543,000) in South America (5), and 45% of the population lives in Paramaribo, the capital city.

Suriname is one of the most ethnically and culturally diverse countries in the world with a population made up of several distinct ethnic and religious groups. Dutch is the official language of Suriname, but several other languages are spoken. Education is compulsory for ages 6–12 years and the literacy rate is nearly 95% (6).

Anton De Kom Universiteit van Suriname

Anton de Kom Universiteit van Suriname (AdeKUS), established in 1968, is the only university in Suriname and is located in the capital, Paramaribo. The medical sciences school was established in 1969 and the PT program in 1996. In 2006, AdeKUS sought funding and support from the Flemish Interuniversity Council University Development Cooperation (VLIR-UOS) (7) to enhance its medical and PT programs. Ultimately, in 2007, the PT Program was awarded funding for a 10-year project. The main goals of the grant were curriculum development and design, the upgrading of academic staff, and the upgrade of research and training facilities. In addition to those goals, it was expected that research and service areas and programs would also be enhanced in ways that would benefit the community and would promote PT in general and the MSPT program specifically.

AdeKUS, in consultation with the VLIR-UOS, determined that to best serve the changing health needs of the Surinamese population and elevate the presence and status of PTs and PT education—in the country and the Caribbean Region—the existing Bachelor program needed to be evaluated, updated, and transitioned to the MSPT level. This transition aligns with international recommendations put forth in the Bologna Process (8) and those adopted by the WCPT in the European Qualifications Framework (9). Further, AdeKUS was interested in pursuing accreditation. They realized that these efforts were necessary to increase the number of PTs, enhance the status of the profession, and meet the needs of underserved people in Paramaribo and those who live in remote areas of the country.

Multinational Collaboration

In 2008, a multinational, collaborative effort began with involvement and contributions from the AdeKUS administrators and PT faculty, representatives of the VLIR-UOS, and Health Volunteers Overseas (HVO) volunteers from the United States (US). The work group, referred to as Team 6, met regularly in Suriname from 2008 through 2013. This team was comprised of the following people who made the following contributions:

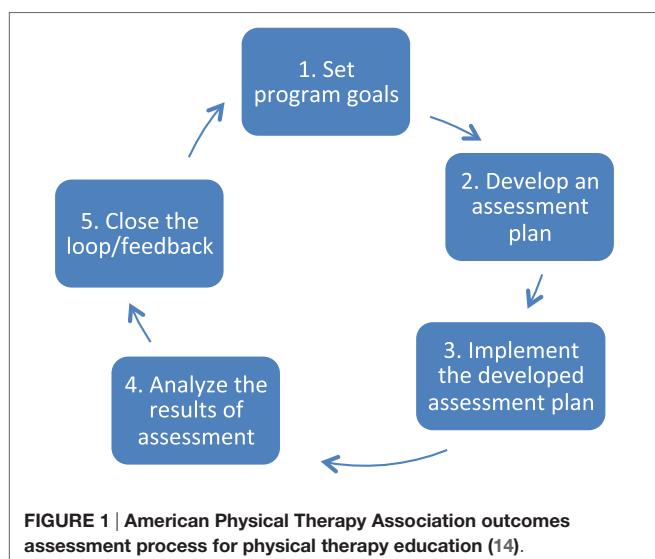
- (1) AdeKUS PT program faculty members provided information about the existing program and vision for future MSPT level program; described needs of the program, faculty, students, and community; provided ongoing feedback and program needs/outcome data; and were instrumental in implementing all aspects of the plan.
- (2) VLIR-UOS project leaders led and scheduled meetings; set strategic plan goals and objectives; and met and coordinated the exchange of information with AdeKUS leadership.
- (3) HVO volunteers provided knowledge and direction related to course planning, design, content, and teaching strategies to align with international guidelines; considered and communicated PT-specific accreditation expectations; instructed courses; provided clinical education training; and delivered continuing education to community therapists.

Performance Improvement Models

In the US, performance improvement models are routinely used in health-care organizations and PT professional education to measure, assess, and improve performance. This is likely due to the strong influence of standard setting bodies such as The Joint Commission on Hospital Accreditation (10) and the Commission on Accreditation of Physical Therapist Education (CAPTE) (11). These performance improvement models are intended to be evaluative, continuous, and reiterative. Various models have been suggested and utilized to assess PT education. One such model is the American Physical Therapy Association (APTA) model for outcomes assessment in PT education (12), based on the work of Donabedian (13). The purpose of this model is to improve the educational program through assessments of student learning and development, the curriculum, and alignment with the program's institutional mission. Key to this assessment process is its ongoing nature, which combines the analysis of results with continuous evaluation/re-evaluation and change, which provides direction for future assessment. With descriptions of expected outcomes, indicators of progress, targets, and thresholds established, the process uses a variety of stakeholder input and "authentic and available artifacts" to determine progress and direction for change. The APTA model consists of the following components (Figure 1): goal setting; assessment planning; developing and implementing the plan; analyzing the assessment results; and closing the loop with feedback and follow-up.

In the WCPT Guidelines for Physical Therapist professional entry-level education, this important international organization encourages and supports not only the implementation of appropriate entry-level education but also the development of processes to explore and validate what is done (2). The WCPT states that these guidelines "provide a framework for internal quality assurance processes" (Section 1.4: Application) but does not specifically address how to develop those processes.

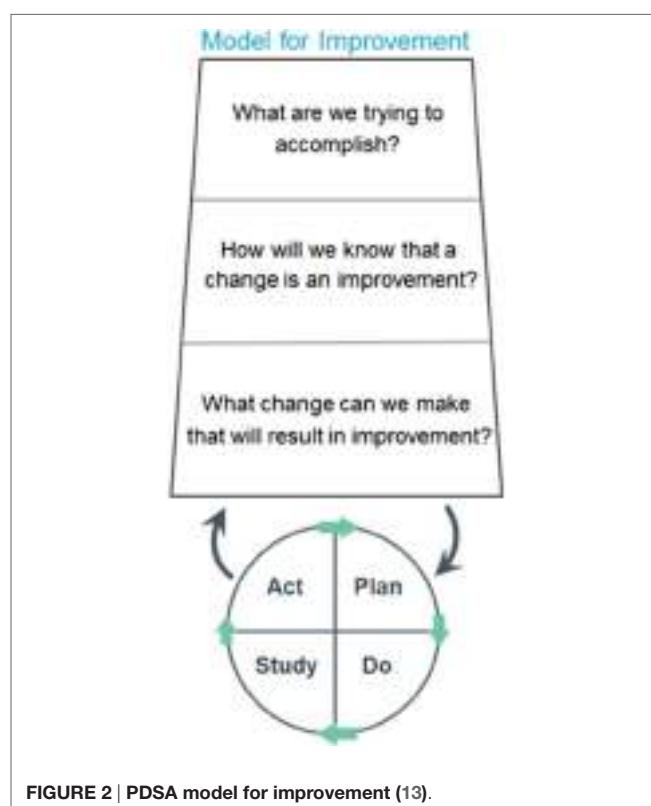
Versions of the Deming/Shewhart Cycle (Figure 1), such as the Plan-Do-Study-Act (PDSA) model, have been a part of business and industry's quality improvement tools for decades and are based primarily on the science of improvement (14). Although



the application of this model is less common for academic health-care programs, it mirrors the key aspects of the APTA model, meets the expectations put forth by WCPT, and was the model chosen to explore this particular project.

Implementing the PDSA model (see Figure 2) is useful because, when used properly, it results in an iterative process to explore the questions of: "What are we trying to accomplish?"; "What can be done that will result in improvement?"; and "How will we know there was an improvement?" Further, the model is based on taking action toward goals that are explored and assessed through the use of quantitative measures whenever possible. The involvement of those who are part of the system being improved is critical, as is the involvement of others possessing experience and expertise in the system/process being examined. In particular, the model has been used effectively in educational settings for planning, trying something, observing the results, and acting on what is learned. In essence, this is the scientific method adapted for action-oriented processes.

The cycle begins with the Plan step. This involves identifying a goal or purpose, formulating a theory, defining success metrics, and putting a plan into action. These activities are followed by the Do step in which the components of the plan are implemented. Next comes the Study step, where outcomes are monitored to test the validity of the plan for signs of progress and success or problems and areas for improvement. The Act step closes the cycle, integrating the information generated by the entire process. This can be also be used to reiteratively adjust the goals and the plan. These four steps can be repeated over and over as part of a cycle of continual improvement.



Using a case report format, this paper describes how the PDSA process was utilized during the evaluation of the AdeKUS PT program. Through a reiterative and ongoing process, the program was redesigned, assessed, and reassessed, with designated follow-up activities to achieve targeted program outcomes.

SUMMARY OF ACTIVITIES

In March of 2008, Team 6 met for the first time in Suriname. Over the next 5 years, Team 6 met regularly to address the goals of the VLIR-UOS grant to enhance the PT program by developing a MSPT curriculum, upgrading the academic staff, and upgrading the research and training facilities.

During the first meeting, the team was tasked with assessing and evaluating the structure, leadership, curriculum, and resources of the PT program and developing a general plan for upgrading the program to the MSPT level. **Table 1** provides an overview of the major areas of concern and specific needs identified during the initial Team 6 meeting. These areas of need drove the PDSA process and the activities that occurred during 1- to 2-week long, on-site meetings that took place in March 2008, October 2008, March 2009, September 2011, October 2012, and October 2013.

In January 2009, information exchange experiences occurred and selected AdeKUS PT faculty visited the academic, clinical, and research laboratories of the Belgian partner institutes for three main purposes: (1) to prepare for establishing a multidisciplinary training and research center at AdeKUS; (2) to discuss quality and outcome measurement strategies for curricular, professional, and course-related issues; and (3) to explore opportunities for additional Belgian collaboration.

Team 6 did not meet in Suriname during 2010; however, during that year, continued communication, support, and volunteer teaching took place. Various members of Team 6 visited AdeKUS individually to carry out a variety of supportive activities and consultation such as: teaching, document revision assistance, continuing education for faculty and community clinicians, and clinical instructor training.

During each Team 6 meeting a micro-level iterative process of planning, doing, studying, and acting on findings took place. Although providing specific details from each of those meetings is beyond the scope of this paper, **Table 2** provides a macro-level view of how the PDSA process worked over the 6 years. The table includes thematic categories of issues and activities that were identified, addressed, and accomplished. Information is included in relative chronological order. Several of the activities occurred a number of times because new need arose or the issue required exploration with a different focus or more depth. Certain items remain ongoing because they are vital to keeping the process fluid and dynamic. Those are discussed in the category specific narratives below. The items included in **Table 2** are included because they are likely pertinent to other programs planning or undertaking curricular upgrades. Some explanation for each of the major themes is provided below.

Program Structure and Leadership

The organizational structure of the program was examined in relation to PT education programs in Europe and the US. Guiding

TABLE 1 | Major areas of concern.

Area of concern	Specific needs
Program structure	Clarification of Vision and Mission. Improve clarity of program handbooks, policy and procedure manuals, syllabi and materials, and departmental reports. Assess and clarify faculty roles and administrative structure. Regular faculty meetings. Improved program coherence and coordination. Upgrade current faculty credentials to Master of Science (MS) and Ph.D. level. Increased number of qualified faculty. Define admission prerequisites and requirements.
Program management	Define clear and specific requirements for current, new, and prospective students (prerequisites, starting level of curriculum, admission criteria). Identify benchmarks for program goals and structure. Complete community/country needs assessment.
Quality and outcome measurement	Define the current student body (#, demographics, length of time in program, practice interests, admission issues, prerequisite work). Create program for measurement of student outcomes. Measure quantity, quality, and oversight of clinical education placements. Set quality standards for teaching and learning. Aggregate data and use for planning.
Curriculum content	Align course content with contact hours. Achieve appropriate balance of basic science content and application/physical therapy (PT) focused content. Connect instructional models with course content. Explore student assessment models and develop a cohesive plan for matching assessment types to course content and learning objectives. Integrate evidence-based practice concepts. Reduce student load (particularly in the basic sciences).
Curriculum organization	Implement PT basics earlier in the curriculum. Decrease reliance on medical school faculty and curriculum.

documents, program handbooks, policy and procedure manuals, committees, and meeting schedules were assessed for existence and quality. This resulted in the development, revision, and organization of the Mission and Vision statements, program handbooks, and policy and procedure documents. It also prompted the clarification of leadership roles and responsibilities, which was important for the day-to-day running of the program, but also served to empower those who had leadership expectations. This included the identification of a Program Director and gave him/her power and time to carry out leadership and administrative tasks. Importantly, this person had a direct supervision line to the Dean. A calendar of regular program, faculty, chair, and dean meetings was established.

A community/country needs assessment was carried out to determine PT service needs and the needs of community clinicians. This information led to the discussion and enhancement of program goals and expected outcomes. This included the identification of benchmarks for outcomes and performance, the development and revision of information about student admission prerequisites and requirements, and other informative documents for new and prospective students. It also led to the

TABLE 2 | Summative Overview of Plan, Do, Study, Act Issues, Activities, and Accomplishments.

Plan	Issues and activities	Accomplished							
		March 2008	October 2008	January 2009	March 2009	2010	September 2011	October 2012	October 2013
Do	Program structure and leadership Gather information about existing program structure and leadership	x	x						
	Curriculum Gather information about existing BS in PT curriculum Develop a framework for the new MS in PT program	x	x	x	x	x	x	x	x
	Faculty and Professional Development Admit MSPT students								
	Resources Provide professional development opportunities for faculty, students, and local clinicians	x	x	x	x	x	x	x	x
	Evaluation Evaluate existing and necessary resources (human, material, and space)	x	x	x	x	x	x	x	x
	Outcome assessment Establish an outcome measurement process			x					
	Establish Team 6 Determine membership and roles	x							
Study	Program structure and leadership Program guiding documents Program management Admission process and criteria for entry into MSPT part of the program Need for a PT education board Advising processes Leadership clarity, roles, and responsibilities	x	x	x	x	x	x	x	x
	Curriculum MSPT program development Curriculum content and organization First years of MSPT Plan for subsequent years of MSPT			x	x	x	x	x	x
	Faculty and professional development Faculty development needs Faculty job descriptions and curricular responsibilities Potential interest in Master of Science for Suriname physical therapists (PTs) Potential interest in Transitional Masters for previously trained PTs			x	x	x	x	x	x
	Resources Educational resource needs Space available for training and research			x	x	x	x	x	x

(Continued)

TABLE 2 | Continued

	Act	Program structure and leadership	Curriculum	Faculty and professional development	Resources	Outcome assessment	Accreditation	Team 6	Other
Outcome assessment									
Identify existing processes									
Create new process									
Program strengths and weaknesses on an initial and ongoing basis	x								
Program accreditation									
Potential for program accreditation	x								
Program structure and leadership									
Strengthen program structure	x								
Enhance program management	x								
Clarify and strengthen leadership	x								
Established an educational board and defined responsibilities	x								
Curriculum									
Assess existing and needed curricular resources	x	x	x						
Solidify MSPT curriculum content and organization	x	x	x						
Address student prerequisite issues	x	x	x						
Rectify imbalances in the curriculum	x	x	x						
Faculty and professional development									
Identify and interview current faculty and community therapists interested in pursuing advanced degrees abroad	x	x	x						
Solicit input from community clinicians about desire for t-MPT, continuing education courses, specialty certification	x	x	x						
Decide to continue to use MD faculty until PT department faculty can meet all program teaching and expertise needs	x	x	x						
Provide faculty training about pedagogy and student assessment	x	x	x						
Make MSPT available to community therapists	x	x	x						
Discuss involvement in international committees and organizations	x	x	x						
Resources									
Identify specific resource needs	x	x	x						
Identify space for a research center and laboratory	x	x	x						
Identify funding for equipment and operational costs	x	x	x						
Identify need and create a plan for utilizing international volunteer teachers	x	x	x						
Outcome assessment									
Institute outcome assessment and management program	x	x	x						
Assesses initial years of MSPT program	x	x	x						
Utilize data to plan for future	x	x	x						
Accreditation									
Address desire to seek accreditation for PT program	x	x	x						
Team 6									
Revise and adjust Team 6 member roles and involvement	x	x	x						
Other									
Meet with AdeKUS leadership to report findings, suggestions, plans	x	x	x						
Celebrate, share information, and enhance recognition of the program	x	x	x						

development of a transitional masters program for previously trained community therapists.

Initially the program was heavily reliant on medical school faculty who taught major aspects of the PT curriculum. This was problematic in two particularly important ways. First, the PT program had no autonomy or control over what was being taught and lacked the ability to hold those instructors accountable for what they did. Second, the students were learning from a medical perspective and not a PT perspective. Even within the PT program there was a need for clarification of roles and responsibilities. Some faculty had very heavy teaching loads while some had very light teaching loads. In some areas, expertise was lacking and the program had a reliance on international volunteers to come and teach courses. It was identified that many faculties would benefit from education and training to enhance pedagogical practice, teaching methods, and student assessment techniques.

These issues led to the development of a curriculum that was less reliant on the medical school faculty, a plan to progressively shift to more Master of Science (MS) and Ph.D. trained faculty, involvement of community PTs as lab and teaching assistants, a plan and schedule for regular faculty and committee meetings, continuing education to enhance teaching methods and strategies, and evaluation of teaching loads and expectations. Job descriptions were developed for all faculty and staff.

Later in the process, a Faculty Board was put in place. The Board would have responsibility and clout in addressing; curricular issues, outcome measurement results, student assessment, coordination, faculty performance, program evaluation, faculty assignments, research expectations, admission criteria, faculty recruitment, and space and resources. The Faculty Board was made up of PT program faculty and students, faculty associated with, but not a part of the PT program, and community PTs. The Board was tasked with establishing a regular meeting plan before start of each academic semester, run by the Program Director, where program faculty meet to discuss curriculum, send a consistent message to students about curriculum and course work, and stimulate collaboration. Importantly, the Board would also be responsible for the future management and approval of newly developed syllabi and course changes. This process would include syllabi acquisition, assessment, and revision. Subgroups of the Board would be responsible for specific didactic issues including specific faculty issues, course content, and incorporating evidence-based practice.

The development of leaders with the appropriate skills was and remains an ongoing challenge. There have been several changes in the leadership roles and responsibilities throughout the process.

Curriculum

Evaluation of program curriculum was carried out in relation to the Physical Therapy Normative Model, accreditation standards from CAPTE, and evaluative criteria from the Netherlands Flemish Accreditation Organization (NVAO) (15). Although the exact standards differ between the organizations, there are consistent themes and expectations that resonate across resources. Those themes were used to evaluate specific areas of the AdeKUS PT curriculum and to identify areas of strength, need, and opportunities for enhancement. Information was gathered from documents, AdeKUS faculty, recent graduates, administrators, community leaders, and current students.

At the initial meeting in 2008, the team was informed that it was taking students a very long time to complete the PT curriculum; the team thought this was the result of an inability to enlist international volunteer instructors in certain content areas. However, it also became clear that this problem was due to a couple of other things. These included (1) the use of a lottery system for admission to the program and (2) the common and chronic problem of students having to retake many courses because of failure were brought to light at this meeting. The use of a lottery system for admission to the program meant that students had not chosen PT and may or may not have knowledge of—or interest in—the profession. Low pass rates were felt to be due to the practice of student performance rarely being assessed during a course. Rather, a student's grade is dependent on one exam given 1–3 months after a course has been completed. Neither the lottery system nor the exam system could be changed, but there was opportunity to strengthen the teaching and student assessment practices and improve student advising within courses in the PT curriculum.

Based on all of these factors, several initiatives to assist students were implemented. These included a program-orientation process, an advising system, and professional development sessions. Contact hours and student workload were explored in depth, and the findings informed the development of the new curriculum. The importance of syllabi for guiding students was discussed and informative and thorough syllabi were developed. Access to important resources such as texts and other resources, Internet access, and lab space was enhanced.

A proposed “3 plus 2” MSPT curriculum, with the awarding of a bachelor’s degree after successful completion of the first 3 years, was developed (see **Figure 3**), and approval of that proposal was received from AdeKUS leadership. The curriculum was built on three main pillars: (1) musculoskeletal rehabilitation, (2) internal disorders, and (3) neuromotor rehabilitation that address domains across the lifespan, incorporate psychomotor learning topics, and integrate evidence-based practice. It was determined that in order for the new curriculum to be implemented properly and successfully several changes needed to be made. These included rectifying content imbalances in the curriculum; integrating the concept of evidence-based practice; comparing actual contact hours to US and Belgian models and proposing revised contact hours; providing faculty development opportunities related to instructional practices, student assessment practices, faculty leadership, and many other issues; involving community therapists in the curriculum and program activities; assessing and discussing overseas volunteer needs; and providing continuing education to faculty and students. A final version of the MSPT curriculum was completed following discussion and consideration of the above issues. **Table 3** provides a comparison of the BS in PT and MSPT curricula.

As with any academic program, the MSPT program and its content will continue to be evaluated and revised as indicated by analysis of stakeholder feedback.

Faculty and Professional Development

As part of the transition process, faculty development needs were evaluated and a plan to address them was developed. Initial activities to address faculty needs included the creation

of job descriptions based on program needs and the assignment of curriculum Pillar Coordinators to be responsible for related courses, syllabi development, and advising course instructors to coordinate and enhance the pillar they were responsible for.

Final Curriculum Proposed 3 + 2 Master of Science in Physical Therapy Curriculum		
Year One		
<i>Semester 1 Course</i>		<i>Contact Hours</i>
General Physiology	30	
General Chemistry	30	
Musculoskeletal Anatomy I	90	
Social Considerations	30	
Psychology and Behavioral Sciences	30	
Research I	45	
EHBO	15	
	270	
<i>Semester 2 Course</i>		<i>Contact Hours</i>
Musculoskeletal Physiology	30	
Musculoskeletal Anatomy II	45	
Internal Diseases Anatomy	15	
Internal Diseases Physiology	60	
Applied Physics	30	
General PT Assessment and Intervention I	45	
Massage I	30	
	255	
Year Two		
<i>Semester 1 Course</i>		<i>Contact Hours</i>
Basic Pathology	30	
Internal Diseases Pathology	45	
Neuromuscular Anatomy	45	
Biomechanics	45	
Psychology	30	
Teaching and Learning I	30	
Research II	45	
	270	
<i>Semester 2 Course</i>		<i>Contact Hours</i>
Musculoskeletal Pathology I	60	
Internal Diseases Assessment and Intervention	45	
Neuromuscular Physiology	30	
Kinesiology	75	
General PT Assessment and Intervention II	45	
Teaching and Learning II	30	
	285	
Year Three		
<i>Semester 1 Course</i>		<i>Contact Hours</i>
Musculoskeletal Pathology II	30	
Musculoskeletal Assessment and Intervention I	60	
Internal Diseases Assessment and Intervention II	45	
Neuromuscular Pathology	60	
Modalities	45	
Psychopathology	30	
Teaching and Learning III	30	
Therapeutic Massage	30	
	330	
<i>Semester 2 Course</i>		<i>Contact Hours</i>
Musculoskeletal Assessment and Intervention II	60	
Neuromuscular Assessment and Intervention I	75	
Motor Control and Motor Learning	30	
Pharmacology for PT	30	
Lifespan Considerations for PT	60	
Research III	30	
	285	
Year Four		
<i>Semester 1 Course</i>		<i>Contact Hours</i>
Musculoskeletal Assessment and Intervention III	75	
Neuromuscular Assessment and Intervention II	75	
Professional Practice	45	
Nutrition	30	
Orthotics and Prosthetics	30	
	255	

FIGURE 3 | Continued

<i>Semester 2 Course</i>	<i>Contact Hours</i>
Pain, Alternative Therapies, and Relaxation	60
Thesis I	20
Clinical I	480
	560
Year Five	
<i>Semester 1 Course</i>	<i>Contact Hours</i>
Management and Administration	60
Thesis II	110
Clinical II	480
	650
<i>Semester 2 Course</i>	<i>Contact Hours</i>
Thesis III	110
Clinical III	480
	590

FIGURE 3 | Master of Science in Physical Therapy curriculum.**TABLE 3 | BS and Master of Science in Physical Therapy (MSPT) curriculum comparison.**

Course	BS degree	MPT degree
	Existing contact hours	Proposed contact hours
Musculoskeletal pillar		
Course	Existing contact hours	Proposed contact hours
MS anatomy	155	135
MS physiology	In general physiology	30
Biomechanics	60	45
Kinesiology	95	75
MS assessment and treatment 1	180	60
MS assessment and treatment 2		60
MS assessment and treatment 3		75
Internal Disorders Pillar		
Course	Existing contact hours	Proposed contact hours
ID anatomy	20	15

(Continued)

TABLE 3 | Continued

Course	BS degree		MPT degree
	Existing contact hours	Proposed contact hours	
ID physiology	In general physiology	60	
Nutrition	20	30	
ID pathology	In general pathology	45	
ID assessment and intervention	Integrated in other courses	90	
Neuromotor Pillar			
Course	Existing contact hours	Proposed contact hours	
NM anatomy	45	45	
NM physiology	In general physiology	30	
Motor control and motor learning	In treatment and assessment	30	
NM pathology	In general pathology	60	
Life span course	Integrated into other courses	60	
NM assessment and treatment 1	105	75	
NM assessment and treatment 2		75	
Evidence-Based Practice Pillar			
Research methodology 1	0	45	
Research methodology 2	0	45	
Research methodology 3	0	50	
Thesis 1	0	110	
Thesis 2	0	110	
Total	About 1,370	2,190	

The development of the new curriculum—and the transition process itself—necessitated the upgradation of current faculty and the recruitment of additional faculty. A plan for faculty to travel abroad and earn advanced degrees was developed. Candidates interested in receiving scholarships to travel to Belgium to complete MS degrees were recruited and interviewed. Initially, candidates were chosen to study in the three curricular pillar areas mentioned previously. Once their degrees were completed, they would be hired as faculty in the new MSPT program. This opportunity was open to all PTs in Suriname. Over the years, three rounds of this process took place. The absence of the faculty who were earning degrees abroad had major detrimental impacts on the program. Various measures to alleviate the impact were put into place, including a plan for the increased use of international volunteer course instructors, long-term assistance from volunteers to assist with all aspects of the program, and the decision to not admit a class of students in 2009.

Community therapists were also included in the continuing education efforts. They too were eligible for opportunities to earn advanced degrees abroad. Locally they were included as lab assistants, attended continuing education sessions, and provided input about the program upgrade. A transitional MSPT was developed for them at their request.

Later in the process, opportunities for AdeKUS involvement in international committees and organizations and international collaborations for research and education were explored.

Current and future faculty will be encouraged to participate in professional development activities and attainment of advanced degrees in order to be able to meet the needs of the program and their own personal growth. Community clinicians will remain involved in the program in a variety of ways.

Outcome Assessment

The team determined that a variety of items needed assessment, and benchmarks were determined. An outcome measurement process was put in place to gather baseline data and explore programmatic outcomes, faculty outcomes, teaching and learning quality, student outcomes, quality of clinical education placements, reasons for delayed graduation, and composition of the student body.

In the fall of the 2011–2012 academic year, the outcome measurement initiative was implemented. A survey of faculty and students was carried out using a set of questionnaires from the Basic Quality Scan in the PROSE toolbox (16). PROSE is a toolbox with sets of standardized questionnaires validated by quality management experts in higher education. The application of PROSE was selected as an example of best practice at the 2013 Conference of the European Organization for Quality (17). This system allows respondents to evaluate items on a rating scale and also provide comments. Quantitative and qualitative data are available, and items for improvement can be identified and prioritized. The system generates indexes by questionnaire and by item, identifies weak and strong elements, and generates an overview of priorities based on participant responses. AdeKUS faculties were asked to complete 7-topic-specific questionnaires (20 items each) which included: program design; teaching and learning methods; assessment; study load and progress; organization; staff; and quality assurance. Students were asked to complete three of the questionnaires; teaching and learning methods; assessment; and organization. Three waves of program evaluation were organized for 2011, 2012, and 2013 in which the PROSE Online Diagnostics System (16) was used. The first wave of evaluation (2011) focused on the course quality, course difficulty, and study load. Ten faculty members and nine students completed the requested surveys. The performance indexes for faculty responses ranged from 50 to 76 (index interpretation: >60 sufficient, >70 good, >80 very good, >90 excellent). The students' ratings were substantially lower than the ratings of the faculty.

Discussion of PROSE results led to the clear identification of areas for improvement. An action plan that identified specific tasks and responsible persons was established. In an effort to limit the amount of change, it was decided that only minor changes would be made to the first year of the curriculum. In terms of the second year of the new program, the team established the following plans: continue to work to clarify faculty roles and responsibilities; attempt to improve communication between faculty members and between faculty and students; use HVO volunteers to teach courses as needed and as available; and consider evaluation of the first year and how it is relevant as the program moves through its second year.

In the two subsequent waves of evaluation (2012 and 2013), the team found many areas had improved and certain problems persisted. Strengths included overall improvement

in program delivery; an increase in quantity and quality of PT-specific instructors and content; and a student perception that the workload was acceptable. The response rates were low and too limited to extract significant results; however, some important areas for improvement were evident. The most serious problem was that students continued to have trouble moving through the curriculum. This seemed to be due to lack of faculty to teach certain courses, lack of non-PT faculty connection with—and dedication to—the PT curriculum, and poor examination results. Problems also included lack of clarity about organizational structure and coordination; lack of clarity in course materials and syllabi; problematic Internet access and reliability; and faculty shortages.

Based on the results, continued syllabi revision took place: supports for students were enacted; gaps in instructor expertise and availability were addressed; Internet system upgrades were requested; and faculty were reminded to keep to the course hours and workload specified in the curriculum. The aggregated data were used on an ongoing basis for planning in all aspects of the program.

Seeking and receiving adequate and useful feedback from stakeholders will continue to be a focus, as will designing a streamlined way of collecting and analyzing the data. Efforts will take place to enhance the number of respondents. The outcome measurement process will continue to evolve so that valid information is collected from a large number of stakeholders so that follow-up efforts can be maximized.

Resources

Educational resource needs were assessed. Necessary books, reference materials, computer access, lab space, materials, and equipment were identified, and a plan to acquire them was developed. Over the course of the project, efforts to improve Internet access were made, text books were purchased, and space and equipment for a research laboratory and a clinical laboratory/practice room was obtained. Grant funding for resources was identified.

Adequate Internet access continues to be problematic. Ongoing review of the adequacy and availability of resources will require ongoing attention as the program grows and changes and as research activities increase.

Accreditation

Toward the end of the process, AdeKUS decided to seek local accreditation, and preparation for that became a major priority for the PT program.

SUMMARY

The Suriname curriculum upgrade project has been exceedingly successful, although it was not without its challenges. The most notable of which were: a lack of clarity about leadership, the need to send faculty aboard to earn advanced degrees, reliance on the medical faculty, and cultural differences with regard to urgency and timeframes. Initially, it was difficult to identify who was responsible for various aspects of the program. Further, people outside of the PT program faculty had various leadership roles. This complicated matters and made it difficult for the program to be autonomous. When faculty members traveled to

Belgium to earn advanced degrees, this weakened the program structure while they were away and prevented some things from being accomplished in the most efficient ways. The reliance on the medical faculty to teach PT content was problematic. Those instructors did neither have adequate knowledge of PT content nor did they have an allegiance to the program. This created problems in terms of PT-specific curricular content, inadequate student support, and disenfranchising program leadership because they had no control over the medical faculty. Team 6 encountered cultural differences that needed to be addressed early on in the process. In particular, this included making the most beneficial use of the time the team had to work together and the expectations that tasks would be completed as assigned for subsequent meeting.

Despite these challenges, the AdeKUS PT program admitted the first class of MSPT students in November 2010. A new class of 10 to 15 students has been admitted every year since then. In the last 2 years, the program has grown in popularity so the lottery system is used to select 10 students, only after the 5 students with the top scores are admitted. Nine students have finished the MSPT.

As of now, six faculty members have completed their MS degrees in Belgium. Two faculty members plan to receive their Ph.D. degrees in 2017, while the third is planning to finish her Ph.D. in 2018. The other faculty members with MS degrees will start Ph.D. programs in the near future.

Clinical instructors are receiving continuous education to increase the quality of clinical education experiences. The program infrastructure (faculty, documents, space, resources, and expectations) has been upgraded in many ways to allow those things to occur. The most critical aspect of Team 6's success is related to the fact that the AdeKUS PT faculty was very involved in the process and receptive to the team's input and feedback—even when the comments were critical of past practices. The PT faculty were smart, eager, invested, and excited about the future of the program.

Evaluation of the success of the program transition is ongoing. Although Team 6 and HVO volunteers no longer meet in Suriname, members of the team continue to assess effectiveness and to make changes as needed. Once the basic needs of the program are met and running smoothly, plans include more sophisticated tracking of student demographics, qualifications, and success, which will allow for comparison with past students and other academic programs and provide rich data for ongoing programmatic evaluation. Future work will focus on coordinating and evaluating program expansion, exploring student outcomes, and consideration of the AdeKUS PT program's role at the international level.

In summary, AdeKUS, in consultation with the VLIR-UOS and HVO volunteers, determined that to best serve the changing health needs of the Surinamese population and elevate the presence and status of PTs and PT education in the country and the Caribbean Region, the existing Bachelor of Science program needed was thoroughly evaluated against current international expectations and practice. The program was then updated accordingly and, with constant examination and assessment, transitioned to the MSPT level. This curricular upgrade and transition

project aligns with international professional recommendations. The PDSA model provides a lens through which to explore the process and consider future curricular update projects in developing nations. In this case, it was used to explore how Team 6 was able to meet the initial goals of the VLIR-UOS grant. This multi-faceted, process-focused, international collaborative approach to implementing change was very successful; yet, it exemplifies the care with which such projects should be undertaken. Even with a strategic, process-oriented team of international colleagues, in a relatively controlled and stable national situation, with highly invested and motivated local faculty, some serious challenges existed and persist.

In this case, the PDSA process facilitated the identification of several important themes/issues and led to the upgrade and improvement of the AdeKUS PT program. Several of the problems identified and addressed through the process are likely relevant to most curricular upgrade initiatives. These themes and issues include thorough evaluation of existing organizational structure/practice; development of leadership skills and empowerment; consideration of the impact of student admission processes and academic readiness; deep assessment and analysis of curricular content; assessing and maximizing faculty capacity and needs for continuing education; seeking stakeholder buy-in; seeking, incorporating, and supporting the involvement of community clinicians; ensuring the availability of adequate resources; establishing outcome measurement processes; evaluating the need for outside support; and working toward a self-sustainable end. Entities interested in undertaking similar curricular development or upgrade projects—no matter the discipline—should be mindful of the many issues that might

complicate their efforts, the time needed for transition, and the importance of using an improvement model that will provide structure for the project.

The international collaboration described in this paper provides an example of the diligence, consistency, and dedication required to see a project through and achieve success while providing adequate support to the host site. Although this paper describes the upgrade of a PT education program, it can be used to inform curriculum development projects in developing nations in any of the health disciplines.

AUTHOR CONTRIBUTIONS

JA is the primary author. S-SB assisted with writing and editing. TC contributed with writing and editing. JdV contributed with writing and editing. NT assisted with writing and editing. JJ contributed with meeting content and development of paper. AV assisted with writing, editing, and PROSE content.

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Empowering the Physiotherapy Profession in Ethiopia through Leadership Development within the Doctoring Process

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Ethiopia recently introduced the Doctor of Physiotherapy (DPT) degree at Addis Ababa University as a mechanism to increase the work force capacity of primary care providers in the health sector. The DPT program was supported by an international academic partnership and was designed to empower physiotherapists as leaders to move the profession forward. The curriculum was framed by core pedagogical principles and strategies and was phased into two programs. First, the 4-year Advanced Standing DPT program focused on developing registered Ethiopian physiotherapists with Bachelor of Science degrees as academic faculty. Second, these new faculty would then sustain a 6-year Generic DPT program that would matriculate students upon graduation from high school. The curriculum represented depth and breadth of foundation and clinical sciences, evidence-based practice, clinical reasoning skills, and interprofessional education opportunities. A leadership thread provided opportunities to develop skills necessary to effectively navigate and manage the challenges faced by the profession. The main outcomes included (1) an 8-year international partnership, (2) the academic performance of students, and (3) leadership capabilities as demonstrated through activities and assignments. While the program has been criticized as an unnecessary extravagance for Ethiopia, the advantages of the DPT degree were revealed in a direct comparison to other academic physiotherapy programs in Ethiopia. In the end, because the DPT is new to the country, it will take time to fully understand the true impact within the Ethiopian health system.

Keywords: Ethiopia, Doctor of Physiotherapy, leadership development, academic partnership, empowerment

PHYSIOTHERAPY (PT) PROFESSION: HISTORICAL PERSPECTIVE

The PT profession in Ethiopia is relatively new when compared to the history of the profession in other countries (1). The modern era of the PT profession is thought to have begun in Europe toward the end of the nineteenth century. The early origins of physical therapy practice began in hospital-based settings to address the rehabilitation needs resulting from World War I causalities and for individuals impacted by disease epidemics, like poliomyelitis. Today, PTs manage patients

with a broad array of health conditions and practice in many different settings, including hospitals, rural health outposts, community-based rehabilitation homes and centers, private and public outpatient clinics, public K-12 schools, pediatric and geriatric settings, and specialized rehabilitation centers (2). The progression of responsibilities and educational standards for entry into the profession has paralleled this expansion. The profession has moved from teaching technical skills, like exercise and massage, to evidence-based strategies for examination, evaluation, diagnosis, prognosis, and intervention of individuals with multisystem health conditions. More than 100 years later, the profession has transformed its entry-level education from short technical-training programs with highly circumscribed knowledge and skill sets to more comprehensive and rigorous professional education programs that culminate in undergraduate and graduate degrees. While not all countries regulate curriculum, some national associations and the World Confederation for Physical Therapy (WCPT) have established guidelines for entry-level education requirements (3). Throughout the world, entry-level degrees span 2-year post-high school diplomas, to 3- and 4-year Bachelor of Science (BSc), 2-year Master of Science (MSc), and 3- and 4-year Doctor of Physiotherapy (DPT). Historically, African nations have offered primarily diplomas and have struggled to upgrade the diploma to a degree program (4). Ethiopia is an exception with the existence of BSc, MSc, and DPT degree options.

BSc AND MSc DEGREE PROGRAMS: GONDAR UNIVERSITY

At the beginning of the twenty-first century, Ethiopia had only 13 PTs registered to serve an estimated 15 million Ethiopians living with disabilities (5). In response to the critical shortage of PT workforce capacity, volunteers from the Netherlands and a team of Ethiopian physicians pioneered the Department of Physiotherapy at University of Gondar. The program sought “to be the best Physiotherapy Department in terms of education, health care and research in East Africa by the year 2020.” They defined their mission as, “committed to the sustainable socioeconomic development of the country achieving our goals through the provision of societal needs tailored education, conducting problem based research and delivering preventive, and rehabilitative services in the field of physiotherapy.” The 4-year BSc program continues to be supported by international faculty from India and the Netherlands. The first cohort of PTs graduated in 2006, with a total estimated graduation of 223 PTs as of 2016 (6).

The BSc curriculum (**Table 1**) integrates most of the basic foundational technical skill sets for entry-level education set forth by the WCPT (3). However, there is no apparent structure to support evidence-based practice, leadership development, critical thinking, problem solving, and professional judgment skill sets that are recognized as current best practices within the profession worldwide. As a mechanism to further advance the profession, Gondar University initiated a 2-year MSc in Physiotherapy degree in 2009. The MSc curriculum expanded the knowledge base in the content areas of neurologic, orthopedic,

pediatric PT, and research methods (**Table 1**). The MSc program generally accepts a maximum of four BSc prepared PTs each year. To date, the MSc program has graduated an estimated 25 PTs and is supported by international faculty from the University of South Australia and the Netherlands (6).

CHALLENGES FOR PTs IN ETHIOPIA

As with the introduction of any new health profession, Ethiopian PTs have met professional challenges within the health sector, which has impacted the general motivation by some to pursue or continue a career in PT. Thus, despite the development of the University of Gondar programs, Ethiopia continues to experience limitations in human resource capacity to meet the demand for rehabilitation services. There are a number of potential causes for the limitations.

First, there is a lack of overt public and government support for the physical therapists, possibly due to a limited understanding of this relatively new Ethiopian profession. Second, the Ministry of Education assigns post-high school students to the academic program based on their interests in health care and on their performance on the Ethiopian Higher Education Entrance Certificate Examination. It is perceived that some of those assigned to PT programs would prefer to seek opportunities in other health professions. Third, while Ethiopian physicians have opportunities for continued professional development, the PT profession has extremely limited opportunity in this area. Thus, the growth and development of individual practitioners and the profession as a whole is limited by this void. Fourth, poor salary compensation may cause PTs to seek additional ways to supplement their income, or they choose to leave the profession altogether. Fifth, a shortage of qualified local PT faculty limits the ability to sustain the academic programs without international support. In addition, local faculty may not be fully qualified for academic roles as they often receive little to no formal training in teaching pedagogy, nor advanced PT skill sets to optimally integrate into the academy. Finally, Ethiopia has a broad Scope of Practice for the PT profession that is dependent upon the level of academic preparation. This leads to disparities in the delivery of patient care among PT providers.

The sum of the limitations greatly impacts the profession throughout the country. Therefore, the focus of this special topic paper is to describe the development of the DPT program at Addis Ababa University (AAU) as a potential strategy to alleviate the impact of the many limitations on the PT work force capacity in Ethiopia.

DPT DEGREE PROGRAMS: AAU

The DPT was introduced to Ethiopia at AAU in 2008. The program defined the vision to “be recognized in Sub-Saharan Africa as a center of excellence for education and service provision by doctors of physiotherapy. These doctors will be physical medicine experts who deliver optimal patient care and contribute to the goals of the health sector.” The development of the DPT program was planned in a partnership between AAU, Regis University (Denver, CO, USA), the Jackson Clinics Foundation,

TABLE 1 | Gondar University 4-year BSc (152 CH/258 ECTS) and 2-year MSc curriculum (38 CH/65 ECTS).

BSc	Semester I	Semester II
Year 1	General anatomy Physiology Communication skill Biochemistry Civic education Introduction to physiotherapy Introduction to general psychology Introduction to sociology	Neuromusculoskeletal anatomy Orthopedic and general surgery Introduction to biomechanics Applied anatomy Pathology Therapeutic exercise I Exercise physiology Introduction to rehabilitation service
Year 2	Physiotherapy assessment and treatment I Clinical neurology Therapeutic exercise II Electrotherapy Physiotherapy clinical practice I Clinical pediatric conditions Introduction to general psychology	Physiotherapy assessment and treatment II Clinical cardiopulmonary condition Pediatric rehabilitation Neurological rehabilitation Massage therapy First aid Introduction to general psychology
Year 3	Cardiopulmonary pulmonary rehabilitation Physiotherapy in OBG conditions Pain management Prosthetics, orthotic and mobility aids Community-based rehabilitation Introduction to pharmacology Health ethics Sports physiotherapy Physiotherapy clinical practice II	Introduction to biostatistics Introduction to epidemiology Occupational and environmental science Introduction to health informatics Nutrition Radiology Physiotherapy clinical practice III
Year 4	Physiotherapy in geriatric Teaching skill (methodology) Health service management Research methodology Research project Physiotherapy clinical practice IV	Physiotherapy clinical practice V/internship practice Physiotherapy clinical practice VI/internship practice
MSc	Semester I	Semester II
Year 1	Library and information technology Basic biostatistics, evidence-based practice, and critical review Teaching skills Leadership, management, project planning Ethics, clinical governance, and audit Biostatistics II and research methods	Musculoskeletal physiotherapy Musculoskeletal physiotherapy clinical practice Physiotherapy trauma and orthopedics Trauma and orthopedics and clinical practice
Year 2	Neurological physiotherapy Neurological physiotherapy clinical practice Pediatric physiotherapy Pediatric physiotherapy clinical practice	Research dissertation

BSc, Bachelor of Science; MSc, Master of Science; ECTS, European Credit Transfer and Accumulation System.

LLC (Middleburg, VA, USA). Over the 6-year planning period, the partnership developed relationships with several Ethiopian stakeholders that played critical roles in the formation and approval of the DPT program at AAU (**Figure 1**). The partners encountered many challenges during this planning phase, mostly related to the frequent replacement of the AAU College of Health

Science and School of Medicine Deans and Directors and the accompanying breakdowns in communication between outgoing and incoming administrators. Despite the challenges, the AAU Senate ultimately approved the Advanced DPT Standing program in 2014 and matriculated the inaugural cohort of 17 registered PTs shortly thereafter.

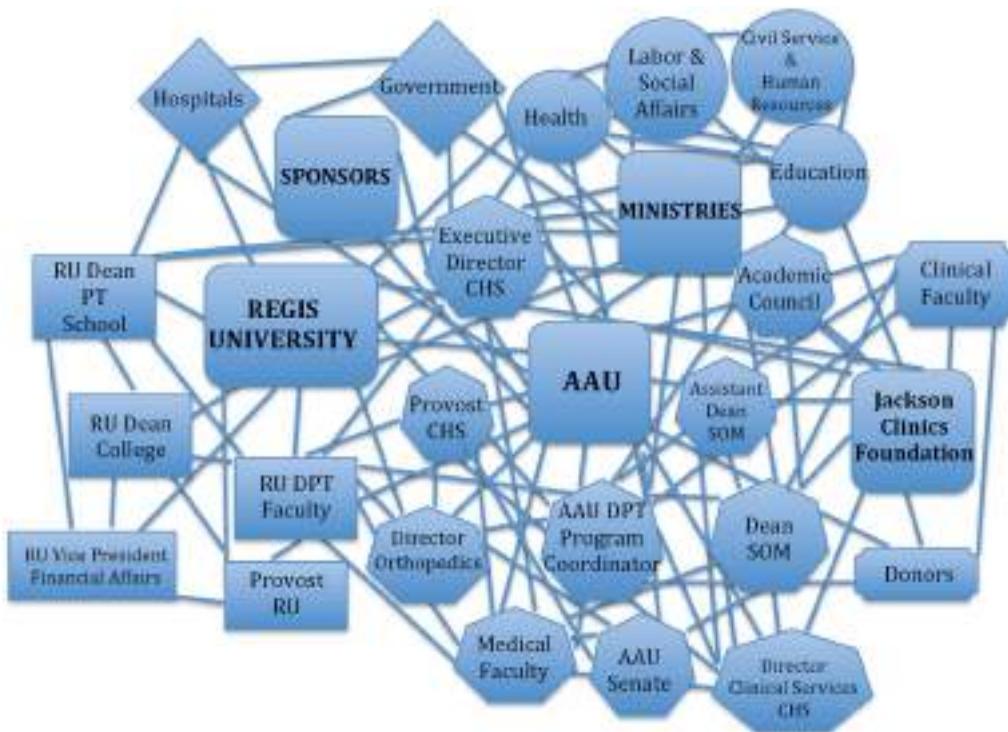


FIGURE 1 | Web of partner relationships for the development of the DPT program at AAU. DPT, Doctor of Physiotherapy; AAU, Addis Ababa University; CHS, AAU College of Health Sciences; SOM, AAU School of Medicine; RU, Regis University.

The introduction of the DPT at AAU was designed to occur in two phases as follows: (1) the Advanced Standing DPT Program and (2) the Generic DPT Program.

Phase 1: Advanced Standing DPT Program

The Advanced Standing DPT program was developed with consideration of the (1) social and economic development level of the country, (2) analysis of history, development, and present status of the PT profession in Ethiopia and in other countries, (3) educational sector development plan of Federal Democratic Republic of Ethiopia (FDRE), (4) health sector development plan of FDRE, (5) standards of admission, program design, licensing, and accreditation needs for the education of PT professionals, and (6) new developments in research within the profession of PT. The scope of the 4-year Advanced Standing curriculum (**Table 2**) was substantially greater than the Gondar BSc curriculum and was tailored to match the experience of the registered PTs and to specifically prepare them for professional roles as faculty of the Generic DPT program (see below). The graduation of the first cohort of Advanced Standing students is anticipated in May 2018. They will officially assume their roles as core and/or clinical faculty for the Generic DPT program in Fall 2018.

Phase 2: Generic DPT Program

The Generic DPT program was designed as a 6-year interprofessional (IPE) program within the AAU School of Medicine. The curriculum was expanded from the Advanced Standing program

by incorporating the first 2 years of the medical school foundational curriculum (**Table 3**).

In addition to the benefits cited for the Advanced Standing DPT program, the Generic DPT program will promote IPE collaboration in the classroom and in clinical practice and, thereby, expand potential for improved patient outcomes. Ultimately, the Generic DPT program will be fully sustained by PT faculty developed in the Advanced Standing program in coordination with the AAU medical school faculty. International faculty will not be needed to sustain the Generic DPT program. AAU plans to matriculate the first cohort of Generic DPT students in Fall 2017.

PEDAGOGICAL PRINCIPLES AND FRAMEWORK FOR THE DPT CURRICULUM

Core Pedagogy Principles

The development of the DPT curriculum was guided by six core pedagogical principles that emphasized empowerment, leadership, relationships, active engagement, reflection, and innovation.

Principle 1: empowerment through learning is the path to the future.

Principle 2: leaders dwell within everyone.

Principle 3: relationships form the basis of all learning.

TABLE 2 | Addis Ababa University 4-year Advanced Standing DPT curriculum (147 CH/249 ECTS).

	Semester I	Semester II
Year 1	Neuromusculoskeletal anatomy Human development Exercise physiology Kinesiology Clinical decision making	Exercise prescription Cardiovascular and pulmonary system management Pharmacology: cardiovascular and pulmonary Evidence-based practice: cardiovascular and pulmonary Clinical mentoring I: cardiovascular and pulmonary Movement science Movement analysis
Year 2	Qualitative and diagnostic EMG Neurological management I Neurological management II Pharmacology: neurology Evidence-based practice: neurology Clinical mentoring II: neurology	Radiology Musculoskeletal management I: LE Musculoskeletal management II: UE Evidence-based practice: orthopedics-extremities Orthopedic trauma medicine Clinical mentoring III: orthopedics-extremities
Year 3	Musculoskeletal management III spine Pharmacology: orthopedics Evidence-based practice: orthopedics-spine Therapeutic exercise Clinical mentoring IV: orthopedics: spine Physical medicine Sports medicine	Roles and responsibilities Practice management Health policy Community and rural health services Emergency medicine Clinical mentoring V: population health
Year 4	Endocrinology/integumentary Evidence-based practice: endocrin/integ Clinical mentoring VI: endocrin/integ OB/GYN Evidence-based practice: OB/GYN Clinical mentoring VII: OB/GYN Oncology Evidence-based practice: oncology Clinical mentoring VIII: oncology Research methods	Pediatrics Adult Geriatrics Clinical mentoring IX

DPT, Doctor of Physiotherapy; ECTS, European Credit Transfer and Accumulation System.

Principle 4: students achieve growth by challenging the process and modeling the way.

Principle 5: active engagement amplifies learning achievement.

Principle 6: reflective processes inspire innovation.

Pedagogy Framework Doctor of Physiotherapy

The pedagogical framework was designed to build upon the six core principles while acknowledging the local context of the physical medicine and rehabilitation needs of Ethiopia, the Scope of Practice, and the constraints of a resource-limited health environment (**Figure 2**). The DPT student was the primary focus of the framework, which aimed to empower, engage, motivate, inspire, transform, and develop leaders for the profession.

Scope of Practice

The framework required a thorough understanding of the vision of the PT profession in Ethiopia and was, thus, guided by the

Scope of Practice. The Ethiopian Physiotherapy Association and the Ethiopian Food, Medicine and Health Care Administration and Control Authority jointly wrote the Scope of Practice. The academic degree determines the scope of duties that a PT can perform, e.g., technician, BSc, MSc, and DPT. Ethiopian DPT practitioners have the highest capacity of all academic PT degrees to deliver primary care services.

Pedagogical Format and Curriculum

As previously stated, the Advanced Standing DPT and Generic DPT programs curricula were specifically designed to meet the unique needs of Ethiopia. Ethiopia aimed to increase the workforce capacity by including PTs as primary care providers in the health system. Thus, the DPT curriculum had to expand its scope beyond the BSc and MSc to meet the expectations and responsibilities that accompany the provision of primary care. For example, Ethiopian DPTs needed training to order medically relevant diagnostic tests, participate in the management

TABLE 3 | Addis Ababa University (AAU) 6-year Generic Doctor of Physiotherapy (DPT) curriculum (231 CH/393 ECTS).

	Semester I	Semester II
Pre-year 1	Medical psychology ^a Information technology/computer application ^a Medical sociology ^a Civics and ethical education ^a Communicative English skills ^a Basic English writing skills ^a	
Year 1	Body structure, organization and functions ^a Metabolic homeostasis/molecular genetics ^a Basic concepts of disease and therapy ^a	Blood and immunity ^a Neoplasia and molecular basis of cancer ^a Musculoskeletal, integumentary and craniofacial regions ^a Epidemiology and biostatistics ^a
Year 2	Cardiopulmonary ^a Excretion and toxicology ^a Nutrition metabolic diseases and GIT ^a Environmental health ^a	Endocrinology and reproduction ^a Neuroscience and behavior ^a Infectious diseases ^a Research methodology ^a
Year 3	Exercise physiology Kinesiology and biomechanics Physiotherapy skills ^b Physiotherapy examination ^b Clinical decision making	Exercise prescription Cardiovascular and pulmonary system management Pharmacology: cardiovascular and pulmonary Evidence-based practice: cardiovascular and pulmonary Clinical mentoring I: cardiovascular and pulmonary Movement science Movement analysis
Year 4	Qualitative and diagnostic EMG Neurological management I Neurological management II Pharmacology: neurology Evidence-based practice: neurology Clinical mentoring II: neurology	Radiology Musculoskeletal management: I Musculoskeletal management: II Evidence-based practice: orthopedics-extremities Orthopedic trauma medicine Clinical mentoring III: orthopedics-extremities
Year 5	Musculoskeletal management III Pharmacology: orthopedics Evidence-based practice: orthopedics-spine Therapeutic exercise Clinical mentoring IV: orthopedics: spine Physical medicine Sports medicine	Roles and responsibilities Practice management Health policy Community and rural health services Emergency medicine Clinical mentoring V: population health
Year 6	Endocrinology/integumentary Evidence-based practice: endocrin/integ OB/GYN Evidence-based practice: OB/GYN Oncology Evidence-based practice: oncology Research methods Prosthetics and orthotics ^b	Pediatrics Geriatrics Clinical mentoring VI: summative internship

^aCourses taught by AAU medical school faculty using an interprofessional model with medical students.

^bDPT only courses that were not included in the Advanced Standing program.

of medical/surgical emergencies or trauma, perform specialty interventions such as mechanical decompression, plastering techniques, joint and soft tissue injections, prescribe neuro-musculoskeletal medications, perform minor trauma suturing, reduce and stabilize minor fractures and dislocations, and

perform electromyography, lower extremity Doppler tests, and stress tests. The curriculum also included a leadership thread to cultivate and empower leaders for the PT profession. A teaching and learning thread was also woven throughout the curriculum to develop Ethiopian faculty that could independently sustain



the academic programs. Finally, the curriculum was taught with IPE collaboration among the faculty and students from other health professions to facilitate networking and teamwork among health professionals.

The curriculum was delivered in accordance with the guidelines for AAU College of Health Sciences, School of Medicine modular undergraduate curriculum. The Advanced Standing DPT program included 51 courses (**Table 2**) that were sectioned into 18 content modules (see below).

Modules

1. Human Anatomy and Development
2. Physiology and Kinesiology of Movement
3. Clinical Decision Making
4. Cardiovascular and Pulmonary System Management
5. Movement Sciences
6. Diagnosis—Electromyography Studies
7. Neurological Systems Management
8. Radiology
9. Musculoskeletal Management I—Extremities
10. Musculoskeletal Management II—Spine
11. Specialized Medical Management of the Musculoskeletal System
12. Professional Roles
13. Population Health
14. Integumentary and Endocrinology
15. Urogenital/OB-GYN

16. Oncology
17. Research Methods
18. Scope of Physiotherapy Practice

All courses were delivered in a blocked design, where students were required to take one course to completion before beginning the next course and subsequent module. The blocked design also accommodated the international faculty travel schedules.

The Generic program will also be taught with a modular system but will be taught with a traditional distributed delivery model rather than a blocked model. In addition, the Generic program will expand the curriculum to 6-years; thus 21 new courses (**Table 3**) will be sectioned into 12 new modules (see below).

Modules

1. Body Structure, Organization, and Function
2. Metabolic Homeostasis and Molecular Genetics
3. Basic Concepts of Disease and Therapy
4. Blood and Immunity
5. Neoplasia and the Molecular Basis of Cancer
6. Musculoskeletal and Integumentary Systems
7. Cardiopulmonary System
8. Nutrition, Metabolic Diseases and GIT
9. Excretion and Toxicology
10. Infectious Disease
11. Endocrinology and Reproduction
12. Neuroscience and Behavior

The additional 12 modules will be taught by AAU medical school faculty and represent the current foundational courses for medical students. The DPT students will take these courses alongside medical students during their first 2 years of the curriculum.

Pedagogical Strategies and Learning Environment

The Advanced Standing DPT program employed several pedagogical strategies throughout the curriculum to meet the needs of diverse learners and to expose the students to a variety of strategies that would be available to them as they prepared for their roles as future faculty.

Learning Environment

The curriculum was delivered with a hybrid model that utilized ground-based and distance-based delivery models to accommodate the availability of experienced international faculty. Ground-based instruction incorporated both didactic and practical (action-based) skill development and was delivered in a traditional classroom on the AAU School of Medical campus. Distance-based was primarily utilized for the delivery of didactic content and was delivered through a Skype connection into the AAU classroom.

Lecture

Traditional lecture formats were utilized throughout the curriculum, but with intentional efforts to actively engage the student in dialog. Non-traditional lecture formats that utilized technology

with audio-enhance lectures (flipped classroom concept) were also implemented when a faculty member could not be on-site or when students needed additional course review beyond the physical structure of the classroom.

Labs

Many of the courses incorporated lab experiences to teach, learn, demonstrate, and practice practical skills.

Small Group Instruction

Clinical mentoring courses for experiential patient management were performed in small groups of 3–4 students. The curriculum included a series of nine clinical mentoring courses. A similar model will be incorporated into the Generic program.

Student Demonstration/Instruction

Adopting the model, “See One. Do One. Teach One,” the students were frequently encouraged to assume the role of instructor to gain experience for their future roles as faculty.

Team-Based Learning (TBL)

Students completed individual readiness assurance tests and team readiness assurance tests on content assigned for specific days within selected courses. The TBL model encouraged learners to arrive to class fully prepared to engage in teamwork with other students.

Problem-Based Learning

Contextual-based case scenarios were adapted for various courses to promote thoughtful reflection, dialog, critical thinking, problem solving, and group process.

Assessment

The students were assessed with a variety of methods, including written examinations, quizzes, practical examinations, written assignments, and oral presentations.

Partnership

As stated earlier, academic instruction for the Advanced Standing program was supported by an international partnership. The partnership was manifested through a complex network of relationships (**Figure 1**) and a memorandum of understanding (MOU) that delineated the roles of each partner in supporting the program. In short, all partners had human resource commitments related to administrative roles and teaching responsibilities within the curriculum, as well as fiscal and physical resource commitments. The international partners also committed to providing mentorship to the newly formed faculty upon their graduation but do not plan to formally teach within the academic programs thereafter.

COMPETENCIES AND OBJECTIVES

The DPT curriculum represented depth and breadth of both foundational and clinical sciences and was accompanied by competencies and objectives reflective of an entry-level DPT

curriculum. In addition, a leadership thread was woven throughout the curriculum to develop leadership for the advancement of the profession in Ethiopia.

The leadership goals and objectives were unique to AAU’s DPT program and were not represented within the BSc program at the University of Gondar. They included the following:

1. Illustrate the social responsibilities of a doctoring profession.
2. Advocate for patient and community needs.
3. Commit to meet professional obligations.
4. Consider the determinants that impact societal health and wellness.
5. Adhere to high ethical principles and professional values and standards.
6. Accept responsibility for roles, obligations, and actions of the physiotherapist.
7. Consider social, emotional, and psychological components in patient care.
8. Acknowledge that effective health care depends on a mutual understanding and relationship between the health-care team, patient, and the family with respect for the patient’s welfare, culture, identity, beliefs, and autonomy.
9. Demonstrate patient-centered actions ahead of the self-interest of the physiotherapist by treating patients with politeness and consideration, respecting their dignity, privacy, and point of view without regard to background, culture, language, religion, race, and point of view.
10. Participate in lifelong learning to ensure ongoing high levels of knowledge and clinical competence.
11. Serve as leaders to elevate the standards of PT care in Ethiopia to best meet the needs of society.

CURRENT RESULTS AND OUTCOMES

Partnership

As stated previously, the partnership experienced significant turnover within the AAU academic administration. The Executive Director of the college of Health Sciences changed three times, the Academic Dean of the School of Medicine changed four times, the Associate Dean of the College of Health Sciences changed four times, the Director of Undergraduate Medical Education changed three times, and the Director of the Department of Orthopedics (where the Unit of Physiotherapy resides) changed five times. The instability and longevity of the higher education administration made the progression of the program difficult. Fortunately, the commitment of the DPT program Coordinator at AAU remained constant throughout all of the transitions in higher administration to sustain the partnership. All partners remain committed to the progression of the academic programs.

Generic DPT Program Development

The Generic DPT curriculum is currently in its final stage of development. The curriculum is scheduled for submission to the AAU Senate for review and approval in early 2017. Once it is approved, AAU will begin the process to matriculate post-high school students into the program in Fall 2017.

Advanced Standing DPT Students Survey

The 17 DPT students that matriculated into the Advanced Standing DPT program are currently completing the third year of the curriculum. To date, 36 courses have been taught by a total of 29 faculty, including 14 different AAU faculty for 18 courses, 7 different Regis University faculty for 15 courses, and 8 Jackson Clinics Foundation clinicians for 3 courses.

An extensive survey was administered to all students at the end of their first year. The survey addressed three primary areas and utilized a 4-point scale; 1 = novice: shows an understanding of the behavior but does not consistently act in this manner; 2 = competent: performs the behavior upon request, but not necessarily in every day activities; 3 = proficient: regularly acts in this manner and can provide recent examples; and 4 = expert: always behaves in this way and can illustrate with many recent examples.

1. Professional behaviors, roles, and responsibilities of the DPT profession: the domains with an average score in the proficiency range (mean = 3.07–3.14; SD = 0.57–61) were leadership, collaboration and relations building, communication, and altruism. The domains in the competency range (mean = 2.55–2.81; SD = 0.57–0.69) were professional roles and behaviors, advocacy, social responsibility, accountability/ethical/legal issues, self-assessment/peer-assessment, education, evidence-based practice, and critical thinking/clinical reasoning.
2. Principles for patient management: the domain with an average score in the proficiency range (mean = 3.01; SD = 0.44) was guiding principles for examination. The domains in the competency range (mean = 2.71–2.97; SD = 0.22–0.61) were guiding principles for diagnostic tests, evaluation, diagnosis, prognosis, plan of care, intervention, outcomes assessment, and education intervention.
3. System and patient-specific management: the domain with an average score in the proficiency range (mean = 3.05; SD = 0.56) was musculoskeletal examination. The domains in the competency range (mean = 2.13–2.99; SD = 0.51–0.88) were cardiopulmonary, integumentary (examination only), musculoskeletal, neuromuscular, orthotic/prosthetic/protective devices, and assistive/adaptive devices. The domains with an average score in the novice range (mean = 1.84–1.90; SD = 0.79–0.85) were integumentary procedural interventions and special populations.

The survey will be readministered at the completion of the 4-year Advanced Standing DPT program, and the results will be analyzed as a component of the overall assessment of the program.

Leadership Development

The critics of the AAU DPT degree argue that a change in academic degree will not resolve the challenges faced by the PT profession in Ethiopia. Indeed, they are probably right. Taken at face value, the expansion of the curriculum with the DPT degree is evident. However, less obvious was how the leadership thread

served as a potential mechanism to address the aforementioned limitations.

The leadership thread was an integral part of the Advanced Standing program and will continue with the Generic DPT program. The thread exposed students to a variety of leadership theories, models, and assessment tools. It offered opportunities to engage in reflective processes and gain perspectives on personal leadership styles as well as the leadership traits of others. Students individually and jointly reflected on their personal and professional values and future roles and responsibilities in the Ethiopian health-care environment. They also deliberated on leadership topics in groups to identify core professional values that they believed could lead the profession forward in Ethiopia. The current cohort identified the core PT values as professionalism, timeliness, accountability, knowledge and skills, and transparency and coupled them with their personal values of compassion, integrity, love, kindness, and honesty. Finally, the cohort worked as a team to develop action verbs to accompany the personal and professional values that would enable them to act upon the identified values. They chose to empower, promote, work, demonstrate, strive, pursue, and engage.

The thread required students to develop personal mission statements that could guide their journey as individual leaders in academia and clinical practice. General themes that emerged from the mission statements included statements to lead the PT profession forward through active involvement in policy making, to inspire and empower current and future PTs, to embrace altruism in practice, to advance the quality of patient care, and to be accountable to the profession and those that they served.

The culminating activity within the leadership thread was the development and implementation of personal leadership projects. The projects were a mechanism to motivate and empower them to address the challenges in Ethiopia by engaging as positive change agents. The leadership projects reflected the added value of the leadership thread within the curriculum. The leadership project themes ranged from being able to more fully integrate PTs as leaders within the Ministry of Health and improving the awareness of the profession in the country to improving PT work efficiencies and physical environments in hospitals and clinics to increase job satisfaction and retention of PTs in the work force. The general feedback about the leadership thread from the current cohort was extremely positive, as many of them believed they could be positive change agents and lead the profession forward as a result of the leadership development process.

DISCUSSION

Ethiopia has made great advances in developing academic programs to address the shortage of PTs in the workforce. Over the past 15 years, the contributions of Gondar University's BSc and MSc programs have contributed over 200 PTs to the physical medicine and rehabilitation sector. The DPT programs at AAU were designed to address the mounting challenges of the profession by increasing the scope of the curriculum for primary care and developing leaders to move the profession forward.

The DPT programs have been subjected to criticism, especially since the degree is new to Ethiopia and all of Africa. The harsh opinions have included statements such as:

- “Africa does not need doctoral education. They simply need basic training to meet the general growing needs of the population.” (USAID Representative)
- “Ethiopia does not need autonomous PTs, they need to work with the physicians as a team.” (European Physician)
- “The BSc degree works around the world. Does the world really need the American DPT?” (European PT)

To the critics, it can be argued that the challenges will only continue to grow if innovation is not pursued. Examination of the different curricular models in Ethiopia revealed the advantages of DPT degree compared to the BSc and MSc degree. Benefits to the profession included developing leaders; advancing clinical reasoning skills and application of evidence-based practice beyond the technical skill sets associated with the BSc and MSc programs; broadening the depth of foundational and clinical practice knowledge to fully address the professional scope of practice in primary care; promoting a culture of lifelong learning and service to others; envisioning positive change for the future of the profession; instituting IPE in educational curricula and clinical practice for optimization of patient outcomes; developing local faculty to sustain academic programs; increasing the potential for greater income, as the DPT will be compensated on a doctoral scale like physicians; and improving the potential for greater recognition and sustained increased in work force capacity within the profession. While preliminary data have been collected related to professional behaviors, roles, and responsibilities of the DPT profession, principles for patient management, and system and patient-specific management, future analysis of data from graduation surveys will serve as quantitative markers of the impact of the program.

LIMITATIONS AND RECOMMENDATIONS

The greatest limitation of the DPT program at AAU has been the inconsistencies of higher administration support due to the frequent turnover of personnel. It is strongly recommended that the primary coordinator/director of the program have a strong presence in the daily academic environment to ensure stability and sustainability of the program. Limitations were also noted in the availability of AAU medical school faculty and international PT faculty. The MOU designated courses to be taught by the AAU medical school faculty, but it was often difficult to secure the actual commitment of the faculty. The challenge was related to difficulties in communication and expectations between higher administration and the faculty. For almost all of the international faculty, they could only commit to teach in 2-week blocks due to ongoing responsibilities within their home institutions. Students reported that they would have preferred the courses to be taught over a 3- to 4-week timeframe to allow time to fully integrate the course materials. In addition, the expense to send international faculty to Ethiopia was quite high. The opportunities for external funding and grants were essentially non-existent for the DPT program, as most grants/funds directed to Africa targeted HIV/

AIDS, TB, malaria, and other medical student education programs. Advocacy for the PT education and profession grants in Africa would be strongly encouraged. Finally, the DPT program at AAU was specifically designed to meet the unique needs of Ethiopia and, thus, the curriculum may not be fully generalizable to other countries. However, the degree has many benefits that warrant careful consideration as a potential mechanism to upgrade the diploma to a degree in Africa. With this in mind, the process by which the DPT was developed in Ethiopia is, indeed, generalizable. The process involved a grassroots movement of Ethiopian PTs, a collaborative partnership for expertise (it would be difficult for any one person to have all the necessary expertise to develop a new academic model in any country), support of internal (academic institution) and external governing bodies (ministries, etc.), and students willing to commit to a pioneering academic program. The process requires time to navigate necessary systems to launch the program. It is very important to be patient. Due diligence to complete all requirements to launch a new program is the ultimate key to facilitating the sustainability and success of the DPT degree.

CONCLUSION

Since the program is still very new, it will take time to understand the impact of the DPT in Ethiopia. The only marker that exists at this time is the performance of the 17 students currently enrolled in the Advanced Standing program, all of who graduated from the BSc program at Gondar University. One particular student comment stands out to reflect the value of the DPT program:

I never knew what it was to be a PT until I started the DPT program.

So, the question to be asked is. “Can the DPT make a difference in Ethiopia?” If any credence is to be applied to the empowerment potential of the leaders being developed in the Advanced Standing DPT program, then the answer will hopefully emerge as, “Yes, the DPT can make a difference!”

AUTHOR CONTRIBUTIONS

CF, the lead instructor for the Doctor of Physiotherapy program at Addis Ababa University, contributed historical knowledge of program development at Addis Ababa University as one of the international partners and also provided specific details of the history of PT profession development, curriculum design, and pedagogy. AD, the lead instructor for the leadership development component of the Doctor of Physiotherapy program at Addis Ababa University, contributed key knowledge of the curriculum design and pedagogy. HT contributed valued perspective as a student in the doctoral program at Addis Ababa University and also contributed knowledge of the challenges within the Ethiopian health sector. TY, WM, and TS contributed valued perspective as students in the doctoral program at Addis Ababa University. EA provided a voice as the President of the Ethiopian Physiotherapy Association and contributed rich knowledge of the historical perspective and future direction of physiotherapy in Ethiopia.

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Leadership Development of Rehabilitation Professionals in a Low-Resource Country: A Transformational Leadership, Project-Based Model

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Background and rationale: This paper presents an overview of the activities and outcomes of the Leadership Institute (LI), a short-term leadership development professional development course offered to physiotherapists in a low-resource country. Previous studies have provided examples of the benefits of such programs in medicine and nursing, but this has yet to be documented in the rehabilitation literature. The prototype of leadership development presented may provide guidance for similar trainings in other low-resource countries and offer the rehabilitation community an opportunity to build on the model to construct a research agenda around rehabilitation leadership development.

Pedagogy: The course used a constructivist approach to integrate participants' experiences, background, beliefs, and prior knowledge into the content. Transformational leadership development theory was emphasized with the generation of active learning projects, a key component of the training.

Outcomes: Positive changes after the course included an increase in the number of community outreach activities completed by participants and increased involvement with their professional organization. Thirteen leadership projects were proposed and presented.

Discussion: The LI provided present and future leaders throughout Rwanda with exposure to transformative leadership concepts and offered them the opportunity to work together on projects that enhanced their profession and met the needs of underserved communities.

Constraints and challenges: Challenges included limited funding for physiotherapy positions allocated to hospitals in Rwanda, particularly in the rural areas. Participants experienced difficulties in carrying out leadership projects without additional funding to support them.

Lessons learned: While the emphasis on group projects to foster local advocacy and community education is highly recommended, the projects would benefit from a strong long-term mentorship program and further budgeting considerations.

Conclusion: The LI can serve as a model to develop leadership skills and spur professional growth in low-resource settings. Leadership development is necessary to address worldwide inequities in health care. The LI model presents a method to cultivate transformational leadership and work toward improvements in health care and delivery of service.

Keywords: physiotherapy, leadership development, professional development, rehabilitation, transformational leadership, constructivist approach, active learning, Rwanda

BACKGROUND AND RATIONALE

In low-resource countries, the impact of a few skilled and dedicated leaders is not only essential to ensure the success of short-term projects but also may be the central element in the development of sustainable health programs and systems. In countries with a more recent history of professional-level training, the number of experienced academic and clinical leaders is usually small (1–4). Talented and skilled leaders are promoted rapidly, asked to serve in multiple settings and administrative capacities, and are often over-extended, all factors that can result in burnout or departure from the health-care workforce (5). There is a need to develop leadership skills for those professionals already in leadership positions, and the next generation of leaders.

One of the primary methods of expanding impact is to disperse and disseminate new practices, including the development of leadership skills for both urban- and rural-based professionals. The geographic disparities of professionals in any low-resource country is high (6), and promoting leadership skills for individuals who are most likely to impact their own communities offers added benefits when seeking to transform professional standards and impact (4). The recommendations from a WHO Global Health Workforce Alliance taskforce on education and training included strategies to move learning into the community, expand teaching capacity, integrate training with service, and maximize impact through regional approaches (7). In the same report, the task force advocated developing leadership skills as a component of building health workforce capacity.

Ousman et al. (8) and Ferguson et al. (9) provided successful examples of leadership initiatives with benefits for the medical community. A longitudinal project designed to promote leadership development for nurses by the International Council for Nurses' Leadership for Change program has been implemented in more than 60 countries over the past two decades. In a review paper, Ferguson et al. (9) described how leadership initiatives resulted in new quality improvement systems, and training programs. They attributed new models of community partnerships along with professional association initiatives to improvements in health-care systems and policy (9). Ferguson et al. (9) also stated the belief that graduates of leadership training were less likely to emigrate, addressing the costly problem of "brain drain" that impacts the entire workforce (5, 7).

Ousman et al. (8) designed an interprofessional fellowship program with the goal of mentoring and training emerging leaders to improve HIV prevention and care in African countries. The initiative funded by the President's Emergency Program for AIDS Relief provided intensive mentorship and leadership training for physicians, nurses, and public health professionals (8). In addition to fostering partnerships between academic and government entities, a characteristic of this program was encouraging fellows to develop solutions to problems for workplace or community needs to strengthen systems. Ousman et al. (8) summed up these concepts by stating: "Leadership programs in Africa can have a profound effect on expanding a workforce of emerging transformational leaders capable of health systems reform."

These same types of projects are not firmly established in the rehabilitation literature for professional development in low-resource countries. While some programs have attempted to bolster professional associations and supported individuals to attend conferences or other professional activities (10–13), specific leadership training goals and methods have not been documented.

In 2015, Health Volunteers Overseas (HVO) initiated the Advancement of Rwandan Rehabilitation Services Project (ARRSP) funded by the United States Agency for International Development (USAID). HVO has a long history of developing and implementing capacity building projects to improve health-care provision in low resource settings. The ARRSP program goals included (1) provision of continuing professional development (CPD) courses to Rwandan physiotherapists in order to upgrade rehabilitation standards and (2) increase awareness of the profession of physiotherapy among the general public and other health-care professionals in order to increase utilization of rehabilitation services and reach under-served populations. The course materials and evaluation documents (14) are available through the USAID Clearing House. The full project details, results, and impact are discussed by Dunleavy et al. (15). By design, the ARRSP teaching and learning activities incorporated constructivist approaches as an underlying educational framework and the transformational leadership paradigm as an approach to providing professional development in the areas of leadership and advocacy to physiotherapists from both rural and urban settings in Rwanda. The purpose of this paper is to present an overview of the activities and outcomes of our leadership development module, The Leadership Institute (LI). We believe

this model of leadership development may provide guidance for similar trainings in other low-resource countries and that our reflections will offer the educational community an opportunity to build on our model and construct a research agenda around leadership development.

PEDAGOGICAL FRAMEWORK

Constructivist approaches allow learners to shape their learning based on their own experience, background, beliefs, and prior learning (16, 17). One of the major foundations of this approach is using activities to maximize the backgrounds and skills of participants. The use of constructivist approaches requires instructors to act as facilitators rather than delivering the material in a more passive manner (18). The learner drives instruction while instructors promote problem solving and provide guidance to achieve the desired objectives (19). In order to provide learning opportunities, questions and activities are designed to encourage students to discuss their ideas and solutions (17).

This broad educational philosophy extends into the use of (1) contextual learning concepts centered around application of learning in the learner's environment and (2) active learning methods that drive learning. Tessmer and Richey (20) suggest that it is essential to consider the surrounding context in order to maximize the relevance, acquisition, and application of knowledge and skills. Contextual learning is designed with specific elements related to the learner's environment. Active learning methods promote engagement through methods such as projects, discussion, and interaction. These concepts are considered essential for adult learning (19). Engaging in authentic activities in the actual setting or close to the setting in which the skills and information are to be applied is thought to link new concepts with the learner's strengths and existing knowledge, and promote transfer of skills into the real world. Since one of the goals of the ARRSP was to promote application of knowledge and skills gained in the content oriented courses, the inclusion of active learning assignments such as education and advocacy within the participant's community were used to promote sustainability and transfer (14).

The development of leaders and leadership development are essential for the growth and advancement of organizations and professions (21). Leadership is crucial to the improvement of health and health care (22). While leader development activities focus on the individual as a leader, leadership development enhances the leadership capacity of an organization (23). There are many theories and concepts used to examine and define leaders and leadership (22, 23). Burns (24) provided a conceptual approach to leadership defining two types of leaders, transactional and transformational. Transactional leaders emphasize the achievements of tasks and expect their followers to meet preset standards. Transformational leaders "stimulate and inspire followers to both achieve extraordinary outcomes and, in the process, develop their own leadership capacity" (25). Swanson et al. (26) suggested the use of transformational leadership will be an essential strategy to meet a global health agenda including the Sustainable Development Goals.

Transformational leadership development approaches are well suited to the advancement and development of a profession

since they focus on how a group can share leadership capacity. Bass and Riggio (27) provided examples of, and a context for, successful leadership training. This training can apply to leadership development at the professional association, academic, community, or individual level. Transformational leadership training and assessment has occurred across many cultures, in many professions (25, 27–29).

As the ARRSP grant activities progressed, expanding the emphasis to promote more extensive change as well as leadership development led to the idea of a LI. In this final course, an essential component to facilitate leadership development was the use of active learning projects driven by course participants. The identification and planning of the projects required thinking about needs from a broad perspective, beyond everyday practice. While active learning projects require real problem solving, learning is the primary goal, and often mistakes or early exploration can lead to vital analysis and reshaping of thought processes. These situations not only require leadership skills; the processes of identifying and meeting community needs create opportunities for discussion of ways to create and support change. Group or team learning is an ideal format to develop leadership skills. Kennedy (30) described a continuum of professional development models with the highest level characterized by a transformative purpose where groups include collaborative problem identification that drives exploring and understanding practice. The culminating course strove to challenge and stimulate established leaders and those with leadership potential, using these interactive approaches with the goal of promoting further development of transformative leadership.

Learning Environment

Physical therapy is a relatively new profession in Rwanda with the first cohort of diploma-trained physiotherapists graduating in 1999. While all physiotherapists now educated at the Bachelor's Degree level, at the start of the project in 2015, there were minimal opportunities for CPD in the country. Other medical professionals and the general public had a limited awareness or understanding of the scope of physical therapy, contributing to under-utilization of rehabilitative services for individuals with injuries and disabilities.

Physiotherapists in Rwanda work in health care at every level treating diagnoses across the lifespan. Hospitals employ the largest number of physiotherapists. Other practice settings include rehabilitation facilities, outpatient centers, and sports facilities. Physiotherapists can work independently as first-line practitioners, or in a health-care team.

ARRSP Courses Prior to the LI

The first five courses were taught by volunteer content experts from the United States who partnered with Rwandan co-teachers to offer skills-based courses to physiotherapists throughout Rwanda. The courses were offered in the two major academic settings in Rwanda, Kigali, and Butare, facilitating participation from a large geographic area (**Figure 1**). The didactic and practical courses were supported by clinical site mentoring to encourage application and dissemination of knowledge and skills (14).

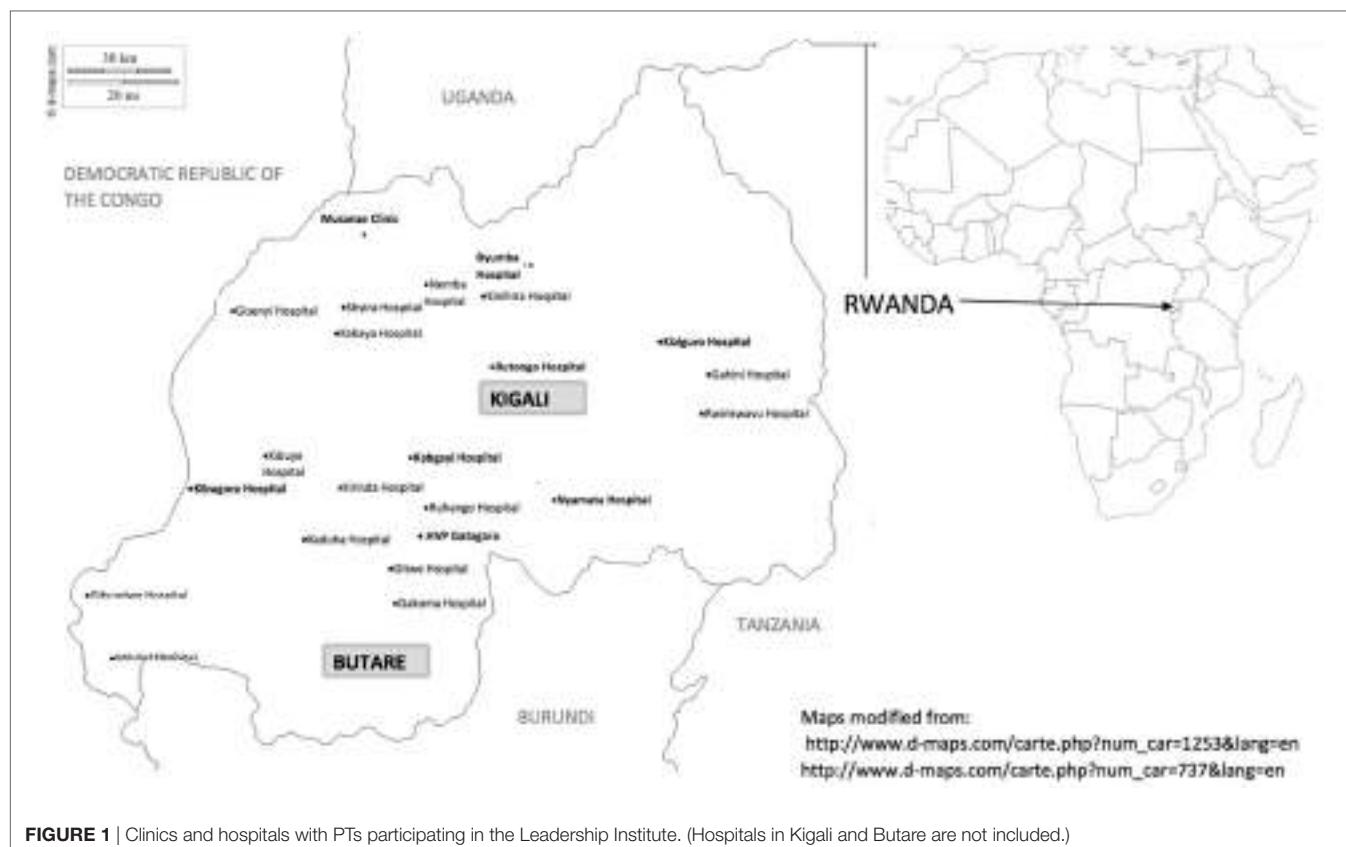


FIGURE 1 | Clinics and hospitals with PTs participating in the Leadership Institute. (Hospitals in Kigali and Butare are not included.)

Identification of Need, Development of the LI, and Overall Goals

While advocacy activities were included as part of active learning methods in the skills courses, many course participants expressed a lack of confidence when approaching other health professionals, and some requested guidance in carrying out campaigns to increase the understanding of physiotherapy among the general public. The Rwandan Steering Committee, who contributed to ongoing review of the grant activities, agreed that the focus of the final course would emphasize transformational leadership skills. The emphasis of the LI was to provide development opportunities for current and future leaders with the goal of expanding their impact within their communities.

LI Learning Objectives

Personal Leadership

1. Review and discuss leadership and follower styles.
2. Analyze personal leadership style and reflect on its effectiveness.

Professional Leadership

1. Define leadership in the context of physiotherapy.
2. Discuss success in terms of professional goals.
3. Write “SMART” professional goals.
4. Discuss the importance of using evidence in physiotherapy practice.

5. Describe how patient outcomes data can be used to demonstrate individual progress and effectiveness of physiotherapy.
6. Discuss the responsibilities of members of a professional association.

Collective Leadership

1. Develop a vision for the physiotherapy profession in Rwanda.
2. Discuss the main purposes of a professional association and its leadership.
3. Identify a challenge related to professional development, awareness of physiotherapy, or an unmet need in the area of physiotherapy.
4. Plan and present a project to meet the identified challenge, including a time frame and budget for implementing the project.

Pedagogical Format

Participants

Seventy-one Rwandan physiotherapists who had attended prior ARRSP CPD courses participated in the LI. Selection criteria included current involvement in a leadership role. Individuals who were heads of physiotherapy departments or private practices, and some more recent graduates who demonstrated leadership at their workplaces received recommendations from course instructors. Individuals from 18 urban and 25 rural settings were invited to participate, with some areas represented by more than one physiotherapist.

Organization, Instructional Design, and Implementation

The leadership initiatives were implemented using limited lecture material, interactive discussion, and explicit empowerment of leadership in small group community projects. Support and mentorship was provided for group activities, projects, and presentations. Two cohorts of the LI met on alternating weekends for a total of three sessions (Group A: 36 participants, Group B: 35 participants). All sessions were held at the University of Rwanda College of Medicine and Health Sciences in Kigali.

Content included definitions of leadership with a focus on transformative leadership, and leadership styles consistent with transformative theory. Participants engaged in discussions about qualities that contribute to effective leadership and professionalism. The topics regarding professionalism centered around strengthening the Rwanda physiotherapy association, known as the Association de Kinesitherapie Rwanda (AKR); developing a vision for the future of physiotherapy in Rwanda; developing personal and professional development plans; and the use of evidence-based practice and outcome measures to impact organizational development and clinical practice. Because the physiotherapy community in Rwanda is small, participants were able to use examples of styles and qualities of leadership to which almost everyone in the group could identify. The course instructors worked to facilitate productive analysis and sharing of ideas for improving leadership, asking participants to analyze their own leadership skills and qualities, along with developing plans for improving leadership ability.

Group projects were developed during the course with the intent of implementation after the completion of the LI, to encourage continued growth and development of the physiotherapy profession. Using a constructivist approach, participants identified topics relevant to their own environment and practice, and groups were established based on an area of interest and the needs. The user-defined topics served two goals: the participants developed projects that were important and relevant to their own practice and they were able to develop leadership and advocacy skills related to a real topic.

Feedback from course instructors and other volunteers from HVO was provided throughout the process of leadership project development.

Formative and Summative Evaluation

Participants completed a test before and after the course to assess knowledge of leadership concepts, attributes of leaders, and their ability to write goals and develop plans. Participants also completed an anonymous survey about the entire ARRSP project that included questions directly related to the goals of the LI.

As part of the project methods, the primary course instructor visited a total of 19 of the 43 participating clinics to mentor professional leadership. Qualitative interviews were completed with 39 physiotherapists. The visits provided information about the context for the projects, as well as opinions about the ARRSP overall. The information was threaded into the LI course activities and provided immediate and realistic feedback.

The primary course instructor conducted follow-up interviews 14 months after completion of the course. A total of 52 therapists

were interviewed using semi-structured interviews in several group and individual meetings at clinics, in-person, via phone interviews, and electronic interviews using email and mobile apps with chat functions.

Outcomes

Pre-Post Assessment and Participant Opinions of Growth

The proportion of participants who felt that “anyone could be a leader” increased from 60 to 88% at the end of the LI. Some of the most substantial areas of positive change noted were increased knowledge of the profession among other health-care professionals; increased utilization of PT services with a commensurate increase in staffing; and improved documentation standards, with notes for all visits and the use of outcome measures to demonstrate patient improvement.

Many physiotherapists stated the LI inspired and empowered them to be leaders in the field. One of the participants stated: “When I am the leader I have to be the first to influence others in achieving the goal.” Another stated: “Good leaders should give good examples. This sentence helped me a lot,” while a third reflected that: “One needs to be self-motivated, confident, and a role model to motivate others and show the way to the people he is leading.”

The increased sense of individual empowerment resulted in physiotherapists seeking referrals: “After the training, the way of approaching doctors increased … we appreciate it and we are proud of it” and including patients as part of the team: “LI has changed what I do as a physiotherapist by letting me know that my patients should participate in the planned activities by giving their points of view.”

One participant attributed the discussions as being the stimulus for starting a private practice: “Though we did not implement the project, we discussed some important issues, which led me to start a private clinical practice.”

Project Outcomes

Groups developed a leadership project proposal including objectives, goals, a timeline, and budget. Thirteen project proposals (**Table 1**) were presented in the final session to individuals from the community, professional association members, academic administrators, faculty, and students from the University of Rwanda.

Stakeholder Interviews—Advocacy and Awareness Outcomes

Overall, there was an increase in the number of community outreach activities completed by physiotherapists. The number of facilities involved in community outreach grew to 19, compared with only 7 facilities previously reporting such activities. Examples of outreach activities included talking to community health workers and visiting physicians. One therapist held an educational session at a meeting during her village’s “Umuganda” (monthly community service day). After the completion of the course, participants reported that many physiotherapy departments (74%) had provided educational programs to increase awareness of physiotherapy. Seven departments (37%)

TABLE 1 | Leadership institute projects and results.

Type of project	Project title	Project results
Promoting awareness of physiotherapy services in the community to improve utilization by individuals with disabilities and dysfunction	Increasing awareness of physiotherapy among health-care providers in Kayonza district	One physiotherapist in the Kiziguro district has visited a health center to raise awareness of physiotherapy and reports an increase in referrals to the hospital
	Increasing awareness of physiotherapy services among physicians through interprofessional training in Rwanda district hospitals	Met with physicians and community health workers. Physicians refer children with complicated birth history to physiotherapy before discharge from hospital. Community health workers refer children with suspected developmental delay
	Improvement of community utilization of physiotherapy services through interprofessional education	
	Establishment of online resources for physiotherapists and individuals seeking physiotherapy services	Website is up and running. Working with local web-hosting company. Applied for, but did not receive NGO grant. Secured some funding through a PT student club in the US
Community outreach for prevention and management of injury and disability	Community outreach to children with disabilities and their families	One physiotherapist provided an educational session about developmental delay at her village's Umganda. She has seen an increase in pediatric referrals to the district hospital
	Falls prevention programs for older adults	Not completed
	Physiotherapy intervention in fighting non-communicable diseases (NCDs) through sports and physical exercise in Gasabo district	Rwandan Association of Allied Health Professionals hosted an International Conference on NCDs
		Seven Rwandan physiotherapists presented at the conference. The conference chairperson is a physiotherapist
Improving standards of physiotherapy practice in Rwanda	Standardized physiotherapy assessment documentation	The AKR has organized healthy walks in Kigali City to raise awareness about NCDs. The walks conclude with stretching, during which physiotherapists discuss the importance of an active lifestyle
	Development and implementation of clinical guidelines in physiotherapy practice	The PT departments at the University Teaching Hospital of Butare (CHUB) and the University Teaching Hospital of Kigali (CHUK) are working on standardizing documentation, including outcome measures, to help with improved documentation of progress
	Recommendations for setting up private practice	The PT staff at CHUB is currently working on developing Rwanda-specific clinical guidelines for rehabilitation after shoulder and hip hemiarthroplasty surgeries
		In June 2016, the RPTO sponsored a continuing professional development program about entrepreneurship, which was attended by 42 physiotherapists
Prevention and management of workplace injury	Awareness of the role of physiotherapy for prevention and treatment of workplace injuries among public and private policymakers in Rwanda	Not completed
	Postural education and ergonomics assessment	
	Appropriate ergonomics in the working environment: case study—Rwanda Military Hospital, administrative staff	Several PTs mentioned difficulty with obtaining permission to perform these activities as a significant barrier to completion

provided information to physicians and other hospital staff and reported an increase in referrals and understanding of physiotherapy. Physiotherapists from one hospital met with nurses at health centers to discuss physiotherapy and also reported a subsequent increase in referrals. Several departments and facilities (16%) carried out other activities to raise awareness about physiotherapy.

Vision for the Future and Professional Association Involvement

Participants in the LI developed a draft vision statement for physiotherapy in Rwanda: "physiotherapists are recognized

throughout Rwanda as health professionals who provide quality care to patients in multiple settings."

One of the outcomes of the LI was motivation to contribute to the leadership of the physical therapy organization, the AKR. Participants resolved to increase their involvement in meetings and other activities planned by the AKR. The current leaders of the AKR participated in the LI and are applying skills fostered by their involvement in the program. AKR leaders report that there has been increased participation in AKR events. They have organized CPD courses and have petitioned the Rwandan Association of Allied Health Professions to become authorized providers for future continuing education.

DISCUSSION

The emphasis of the LI was to provide emerging leaders in rural and urban areas with exposure to transformative leadership concepts and opportunities to make a difference within their profession and communities. This final course was sequenced to facilitate sustainability and amplify clinical practice concepts gained in other ARRSP courses. The intention was to promote diffusion of ideas through empowerment and encouragement of advocacy to enhance the growth and visibility of the profession leading to increased accessibility and utilization of services by people with disabilities. The importance of developing a community of practice and a culture of sharing knowledge is a key attribute of professionalism and essential to growth of the profession. The Rwandan physiotherapists participating in the LI embraced this paradigm shift.

In comparison to the leadership projects cited from medicine and nursing (8, 9), this project had fewer participants and was of a shorter duration, making it difficult to equate results. The well-funded medical project related to HIV prevention and care (8) and the longstanding nursing leadership programs (9) concentrated mostly on leadership along with active learning projects. The LI is the first project to our knowledge focusing on rehabilitation leaders. The LI also followed a series of courses targeting practical skills and knowledge, creating a common platform for participants. One strength of this program was the inclusion of both experienced and emerging leaders, reaching 25% of the physiotherapists registered in the country. We believe this reach will contribute to further development of a strong critical mass for future professional initiatives.

The level of community outreach has increased, with physiotherapists taking a lead in internal and interprofessional education. They have advocated for better health outcomes and improvement of services. They have promoted team-based care to promote the quality and quantity of health care. Team-based care can optimize health resources, increase safety, and improve satisfaction among patients and health professionals (9, 31).

While the outcomes of the LI program cannot be separated from foundations laid in earlier ARRSP courses, participants believe that the advocacy and outreach work from the LI has led to an increase in physiotherapy referrals. They generally agreed that this increase in referrals has the potential to further demonstrate the value of physiotherapy, highlight the knowledge of the physiotherapy profession, and provide needed services to a large population of people living with disabilities. Outreach activities have mainly targeted other health-care professionals. Further outreach activities targeting the community at large would increase the awareness of the profession.

One of the characteristics of transformative leadership is the sharing of leadership responsibilities. This was one of the most successful aspects noted during activities. Participants worked together on projects and shared clinical problems and solutions through mobile communication applications such as WhatsApp. Often professionals in the district hospitals are isolated. The LI allowed for networking and discussion for individuals in the rural areas, which was a positive and important step toward upgrading the profession throughout the country. The commitment of the

group to expand and support professional association initiatives was also a positive outcome.

It was important to have the input of the Rwandan co-teachers in the design of the activities and the LI projects. The Rwandan course instructors provided valuable cultural insight and anticipated challenges for the projects and plans started during the LI. Many Rwandan physiotherapists have more than one job, working evenings, and weekends. This reduces time and resources available for professional activities. Regardless, the Rwandan course instructors served as role models for juggling professional duty and the need to earn a living. The growth of the co-instructors was notable during the course and when presenting at local and international professional association activities, including the World Confederation of Physical Therapy meeting. They have continued to be role models in community and academic endeavors.

Although not all the active learning projects were implemented, the process of developing group projects with other leaders promoted greater involvement of the participants in education and leadership in Rwandan health care. Even with partial completion, there was a sense of accomplishment, and those who were able to modify the proposals and complete components of the projects have inspired others to increase their professional involvement. These successes need to continue to be shared widely in the PT community.

Constraints and Challenges

One of the early challenges faced during the LI was the expectation of continued funding for projects and education. The influx of funding after the 1994 genocide may have contributed to this expectation; this challenge is not unusual with funded development activities carried out in low-resource countries. The course instructors discussed the importance of professionalism and volunteering as a component of professional duty, as well as the realistic limitations for financial support. A number of the projects were very ambitious and had to be scaled down. As noted by Ferguson et al. (9), projects developed during a leadership training program are more likely to be successfully implemented if they receive local financial support. Work on the majority of the projects continued despite little or no financial support, demonstrating the willingness of participants to serve as role models for change. The group working to develop a website attempted unsuccessfully to get grant funding, but did secure some funding through a student physical therapy club in the US. Future projects may need to establish expectations up front if there is no funding allocated for micro-grants. Other options are explicit objectives to investigate local resources, budget preparation, management, limits.

Despite the need for physical rehabilitation in Rwanda, there are limited physiotherapy positions allocated to hospitals, particularly in the rural areas. In the district hospitals, every physiotherapy department head reported requesting additional staff at least once in the past year, and being told either to wait, or that a position was not possible financially. Discussions during the LI also highlighted the need to be able to justify new positions. The use of outcomes had been introduced in the skills based courses and was reinforced as a tool to demonstrate the benefit of physiotherapy services. However, the use of outcomes and

documentation was a new concept for most of the participants and while there were improvements, this method may take more reinforcement and time to be consistent. Although six clinics reported an increase in staffing at follow-up, nearly all those interviewed felt staffing was insufficient, especially with increased referrals. It is also difficult to determine a causal relationship between staffing and documentation without more extensive study of all factors involved. Nevertheless, continued advocacy for physiotherapy as a necessary service for patient improvement would benefit from data to support patient progress. As discussed by Swanson et al. (26), this is an example of a situation in which transformational, systems level change is needed. The problem was discussed with the leadership of the AKR who agreed this is an issue that should be addressed at a national association level and began discussions of plans to address this through the Ministry of Health. Governmental approval of new positions is unlikely to be changed by the AKR only and will require advocacy from other health professions. Collaborative, interprofessional support will be contingent on physiotherapists continuing to work to increase awareness of their profession.

At the 14-month follow-up, most clinics were performing education about physiotherapy services and benefits within the hospital or clinic setting, but not all were performing outreach in the community. Therapists discussed the need for providing community outreach for both education and provision of direct care to underserved populations. The biggest barriers to community outreach were problems with permission to leave work for these activities and funding for transportation and time. These barriers will need to be addressed both at the institutional level and national association level.

While much progress has been accomplished within the short timeframe, there remain additional challenges to ensure improvement continues. The infrastructure for communication and transportation in Rwanda remains an impediment to having meetings electronically or in person. Although most people have cell phones, they must pay for calls and data on a regular basis. Some, but not all clinicians, have access to the internet and a computer at the workplace. Being able to meet to share successes and struggles will be essential for continued growth of the profession. As with patient care, data about successes and challenges in terms of outreach, staffing, and other management concerns need to be documented and disseminated. The AKR leadership has expressed interest in helping foster communication, a very appropriate and useful role for the organization. A strong professional organization will be paramount to continued progress and success. The use of Umuganda to educate community members about physiotherapy can help to increase access to services. There remains a large underserved population in Rwanda, and using community activities for education has the potential to begin to address this problem.

Lessons Learned and Suggestions for Future Projects

If a similar teaching and learning model for leadership development were to be implemented in the future, we suggest some important considerations. Introducing the leadership project

development earlier would allow more time for mentorship and for the development of in-country mentors. Early mentorship should help participants to narrow the scope of their projects to help ensure completion and to foster implementation with budget limitations. Organizing groups based on geographic proximity can reduce funds needed for meetings, is likely to facilitate more frequent communication, and could be beneficial for long-term support. Regular follow-up by mentors, with a transition to local mentoring by a university or professional organization may also help foster project completion. The projects were an innovative mechanism to promote sustainability and increased emphasis during grant planning might allow a longitudinal approach to amplify the benefits. Building interprofessional advocacy activities into the planning for future grants would be very beneficial, including consultation with other professional organizations. However, the platform of the skills-based courses is essential and the project needs assessment will need to identify the leaders who are most likely to benefit from this type of initiative. Finally, the integration of the emphasis on local advocacy and community education, professional organization development, and the individual development is highly recommended.

CONCLUSION

The LI conducted for physiotherapists in Rwanda can serve as a model for other countries with a young and developing profession such as physiotherapy. The series of classes and the development of a project fostered leadership skills empowered therapists to advocate for patients and their profession and spurred professional growth. The LI is an example of applying transformational leadership. The physiotherapists who participated in the classes report increased leadership in their work settings, in the professional association, and in the development and participation in CPD activities.

Leadership development in health-care disciplines is necessary to address worldwide inequities in health care. The LI model is one way to cultivate transformational leadership and work toward improvements in health care and delivery of services. The use of a constructivist approach allows direct and immediate application of skills and concepts and can be an important method to promote continued professional development and advocacy after a program has concluded.

ETHICS STATEMENT

The follow-up study was carried out in accordance with the recommendations of the Misericordia University Institutional Review Board with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Institutional Review Board.

AUTHOR CONTRIBUTIONS

MP, KD, MM, JC, LK, and AN contributed to the concept, original manuscript, and editing of the paper.

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Developing a Mentorship Program in Laos

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Skills strengthening and capacity building for maternal and newborn health (MNH) providers are essential to ensure quality care for mothers and newborns. There is, however, limited research regarding what constitutes an effective model in low-income countries. The Lao People's Democratic Republic (Laos) has some of the region's worst outcomes for neonatal and maternal mortality. Moreover, with a 23-year hiatus in midwifery training, which ended approximately 7 years ago, there is a cadre of new and inexperienced midwives in practice without support systems, skills, or continuing professional development opportunities. Traditional didactic teaching methodologies prevail in Laos, but with little evidence of efficacy. As an alternative model, Save the Children International has been implementing a mentorship approach for MNH providers in two provinces in northern Laos since January 2016, with technical guidance and funding from the United States Agency for International Development-supported global Maternal Child Survival Program. This community case study will describe and reflect on the approach by highlighting the need and rationale for mentorship, followed by a description of the program's core components and the results observed so far. Lessons learned and the application of the approach to different contexts and health-care professionals, considering both constraints and opportunities, will be discussed.

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INTRODUCTION

Laos is a landlocked country in Southeast Asia. The population of 6.8 million is made up of over 49 different ethnic groups. Seventy-one per cent of the population live in rural and remote areas with limited access to health services. Only approximately 41% of women give birth in a health facility (1). This is one of the lowest rates globally as cited in the United Nations Children's Fund database. According to national statistics, the current neonatal mortality rate is 32 per 1,000 live births and the maternal mortality rate is 357 per 100,000 live births (1). However, it is estimated that rates are much higher in rural areas where the majority of the population resides.

The Save the Children Primary Health Care program has been implemented in Laos since 1992. The program has achieved results by investing in strengthening the building blocks of an integrated health system, focusing on capacity building of district health managers, health staff, and

Abbreviations: AMTSL, active management of the third stage of labor; EENC, early essential newborn care; MCH, maternal and child health; MCQ, multiple choice question; MCSP, Maternal Child Survival Program; MNH, maternal and newborn health providers; MoH, Ministry of Health; OSCE, objective structured clinical exam; PDR, People's Democratic Republic; PHC, primary health care; RMNCH, Reproductive, Maternal, Newborn and Child Health; SCI, Save the Children International; SBA, skilled birth attendant; UNICEF, United Nations Child Fund; USAID, United States Agency for International Development; WHO, World Health Organization.

community volunteers (2). Strengthening of maternal and child health services has been an integral part of the Primary Health Care program since inception. In 2016, there was an opportunity to further this work with support from the United States Agency for International Development (USAID) Maternal Child Survival Program (MCSP). At the time, the Ministry of Health (MoH) was planning to develop supportive supervision for midwives, and it was hoped that learning from the mentorship approach could inform this model.

The MCSP is a global USAID initiative across 25 countries to reduce maternal, child, and neonatal deaths. In Laos, the MCSP implementation began in January 2016 as part of the Save the Children Primary Health Care program. The focus is on building skills for mentorship within the health system in order to develop the capacity of maternal and newborn health (MNH) providers. The international partnership affords technical expertise from a consortium of partners, including Jhpiego, an international non-profit organization affiliated to the John Hopkins University focused on women's health and well known for expertise in training.

The term "mentor" derives from Homer's *Odyssey* and differs from teacher-student relationships by way of the mentor being connected with a mentee in "both cognitive and affective domains" (3, 4). Mentorship is a feasible model of continuing professional development and supportive supervision for MNH providers. Mentorship in Laos involves participatory learning on the job and a reciprocal relationship between the mentor and the mentee encompassing coaching, demonstrating, providing constructive feedback, and planning for action. The approach in Laos is unlike formal mentorship whereby a senior mentor is selected by a junior colleague with a specific time-limited learning agenda. Instead, the approach focuses on peer to peer coaching in practice on a continuing basis as a model for supportive supervision. The evolution and development of the program thus far is described below and includes the following key activities in two distinct stages:

Stage one—developing Laos mentors and implementing mentoring visits to district facilities

Stage two—upgrading skills of select mentors to become trainer mentors through Training of Trainers and creating facility-based district mentors to ensure mentoring becomes part of sustainable daily practice, institutionalized in the district facility.

NATURE OF THE PROBLEM AND RATIONALE FOR DEVELOPING A MENTORSHIP APPROACH

For 23 years, there was no midwifery training in Laos. In 2008, there were only 100 midwives in the country. In response, the government created the *Skilled Birth Attendant (SBA) Development Plan (2008–2011)* (5), with the aim to develop 1,500 new midwives by 2015. As a 2014 review of the development plan noted, the rapid, didactic training produced a cadre of young, inexperienced, and unskilled midwives deployed to remote districts and health centers without support or supervision, unable

to provide quality care at the time of birth (6). A similar challenge was reported in Ethiopia, where rapid training produced midwives lacking competencies to deliver quality care (7). In Laos, the terms SBA and midwife are used interchangeably and refer to nurses who have completed a 1-year midwifery course as well as non-professionals completing a 2-year direct entry course. For the purposes of this article, the sole term "midwife" will be used.

The Laos government recognized the need to improve maternal and newborn care by developing capacity among MNH providers and developed two key strategies:

1. The Lao PDR MoH (2016) *National Reproductive, Maternal, Newborn and Child Health (RMNCH) Strategy and Action Plan 2016–2025* (8),
2. The Lao PDR MoH (2016) *Midwifery Improvement Plan 2016–2020* (9)

Save the Children International aims to support the MoH in achieving the objectives laid out in these key strategies by developing, implementing, and testing a capacity-building mentorship approach for MNH providers. There is a critical need to develop an effective model of capacity building and competency development for MNH providers in all levels of the system. A Cochrane review (2015) suggests in-service training improves outcomes for newborns but additional studies are required (10).

Traditional didactic models of pedagogy prevail in Laos but there is little evidence of their effectiveness (7, 11, 12). Didactic training focused on cognitive domains may not effectively prepare providers for the multidimensional complexity of clinical practice (13). A mentorship approach was developed that uses participatory learning through on-site coaching combining skill strengthening and support as a model of continuing professional development and supportive supervision within the facility, with the aim to improve the quality of care at the time of birth. Although mentorship has been implemented in other contexts, the Laos program focuses on full integration of maternal and newborn care, building skills and competencies through on-site coaching, and the removal of hierarchies to facilitate peer to peer learning which is new for this context. Furthermore, building the training capacity within the facility among a cadre of district mentors and ensuring continuing professional development and daily supportive supervision is a change from the traditional model of external trainers providing short courses.

METHODS

Stage One

Developing Mentors and Tools for Mentorship

An initial workshop was held in February 2016 to work with 15 government-selected MNH providers (11 provincial and 4 district staff) to design the mentoring approach and build capacity to become mentors. The 15 government employees comprised 3 pediatricians, 2 nurses, 1 midwifery teacher, 2 obstetrics/gynecology physicians, and 7 midwives. The workshop was led in a participatory way to ensure that the mentors were fully engaged in developing the program and that it was appropriate to context, feasible, and acceptable. Empowering the mentors to

shape the approach ensured their commitment and motivation. Despite many of the mentors being experienced educators in traditional didactic teaching methods, they very quickly took on board the participatory approach.

Initially the mentors' clinical skills for a normal delivery and when the baby is not breathing were standardized using the guideline for practice (outlined further below). From this foundation, mentoring skills were developed, including effective facilitation skills, coaching, demonstrating, providing feedback, and action planning. These skills were then field tested by the mentors and improved and finalized during the workshop. To support the implementation of the mentorship approach, a number of tools were created including two integrated in-service guidelines for normal delivery and when the baby is not breathing. The first draft of the guideline was based on global standard guidelines and fully aligned with the MoH/World Health Organization Essential Early Newborn Care (EENC) guidelines and policy (14). **Table 1** (below) highlights the nine key standards of the guideline for normal delivery when the baby is not breathing.

The draft guideline was shared with mentors for their input from practical experience. It was important to be realistic and understand contextual constraints. During the workshop, the guideline was reviewed and updated with input from the mentors. This process continued until a consensus was achieved and a practical, feasible clinical guideline created. A facility action plan tool was developed in line with global quality improvement tools which includes three domains; capability (knowledge and skills), opportunity (enabling environment), and motivation. The tool is used by staff to develop facility quality improvement action plans. The benefits of a combined mentoring and quality improvement approach have been demonstrated in similar programs in Rwanda (15). Due to the low number of facility deliveries and the need to develop skills, simulation using anatomical models Mamanatalie and Neonatalie are used for practice. These are simple and effective models that mentors and mentees learned to use quickly and successfully. Mentoring includes all four domains of simulation fidelity, namely, case study, role-play, focused task/skill practice, and full simulation (13).

Clinical Approach: Integrated and Comprehensive

An essential element of the program is the full integration of maternal and newborn care. To date, these have been separated under education, policy, and practice. For example, in Laos, the teaching of emergency obstetric care and EENC is disconnected and maternal and newborn care objectives are distinct under the

TABLE 1 | Nine key standards of the integrated in-service guideline for normal delivery when the baby is not breathing.

1. Monitor woman in labor using the partograph
2. Preparation just before birth
3. Assisting birth
4. Immediate essential newborn care
5. Newborn resuscitation—Airway and stimulation
6. Newborn resuscitation—Bag and mask ventilation
7. Active management of third stage of labor
8. Post-delivery tasks
9. Infection control and routine procedure after birth

new RMNCH Strategy (2016–2025) (8). In practice, a midwife may call a pediatrician to assist with newborn resuscitation if she is not confident, resulting in delays in life-saving care. Where mentorship differs is in the inclusion of both mother and newborn in the approach to care. The clinical guideline and standard of practice used in mentoring integrates maternal and newborn components equally, starting with the partograph (the vital sign tool for mother and newborn through labor and birth) and labor monitoring. The full integration of maternal and newborn care is an innovative and important development (16). The comprehensive clinical approach includes the following key components: respectful maternal care, ensuring good communication with the mother (an important part of patient perceived quality of care) (17), labor monitoring using the partograph, preparation before birth, safe delivery, early essential newborn care/newborn resuscitation, active management of the third stage of labor, skin to skin, early breast feeding, infection control, and correct disposal of waste.

Mentoring Visits to District Facilities

Following the workshop from March to July 2016, the 15 mentors provided mentoring visits to 10 district hospitals in two provinces to support skills strengthening as a model of collaborative education. Two mentors and one or two Save the Children staff spent 2 days in each facility. Mentoring activities were held in the delivery room with mothers during labor and delivery when possible, as evidence suggests the benefit of a real environment for practice (12, 18). Activities also involved demonstration and role-play practice in small groups (1 mentor:3 mentees) with coaching and feedback. The focus was on two clinical scenarios: normal delivery with baby breathing and normal delivery with baby not breathing. Strengthening foundational skills was the priority to ensure safe delivery and preventing complications of birth. Following clinical skill practice, a group feedback session and action plan to address issues and skills gaps was developed. Each facility was visited once every 2–3 months in a low-dose, high-frequency approach which is more effective than annual trainings (12, 19). The availability of mentors to undertake visits due to other commitments and responsibilities in their own facility was a challenge and catalyzed a review of how to successfully develop the mentoring approach going forward.

Stage Two

Institutionalizing Mentorship in the Facility and Building District Level Capacity

While quarterly mentoring visits with the original mentors (predominantly from the province) were well received, challenges of time and availability were noted. Thus, the opportunity was identified to fully institutionalize mentoring and build capacity in the district facility by developing district level mentors. Mentors within the facility further augment the low-dose, high-frequency approach by providing more opportunities for specific skills to be practiced frequently. District mentors also ensure on-site continuous support for mentees and quarterly practice drills for rare events, such as newborn resuscitation and management of postpartum hemorrhage. Criteria for selection and the roles and responsibilities of district mentors were developed in partnership

with district health managers and district hospital directors. Two staff from each facility were selected by district managers to be the new district level mentors. The priority was on midwives and MNH providers active in the delivery room who most often facilitate deliveries. **Figure 1** below shows the graph and distribution of mentors' profession from the first generation (February 2016 cohort) and the second generation of predominantly district level staff (August 2016 cohort).

Training of Trainer Mentors and Developing District Mentors

To ensure sustainability and Laos ownership, it was necessary to develop Laos trainers of new mentors. A specific training of trainers was convened for 5 days and included 8 of the original 15 mentors who showed particular strengths in their leadership and mentoring of others. The eight trainers include four midwives, one pediatrician, one obstetrics/gynecology physician, and one nurse. The 5-day trainers' workshop included standardizing the trainers' clinical skills, effective facilitation skills, and micro-teaching practice, which involved developing lessons plans and peer-teaching with feedback sessions and daily de-brief meetings. The trainers built competencies to develop a new generation of mentors. Focus was on interactive participatory learning consistent with the mentorship approach itself. Following the trainers' workshop, a second 5-day workshop was held to train the nominated district MNH providers to become new mentors. The workshop focused on clinical skills building and the mentoring skills of coaching, demonstrating, feedback, and action planning. The seven building blocks (skills) of mentoring are outlined in **Table 2**. From these seven building blocks, standards have been developed to measure progress in mentoring skills. Full competence in all seven standards will be developed with experience over time.

The duration of both workshops of only 5 days was a limitation. It is acknowledged the process of becoming a confident and competent mentor takes time, as Benner describes in the transition from novice to expert (20). While the workshop established foundational skills, further support and development of mentoring skills will be required. A majority of district level mentors had limited prior experience as teachers or educators and are, therefore, starting a new role. This differs from the original 15 mentors who were predominantly experienced provincial educators, regularly engaged in teaching or supervising others in their hospital and in the training school.

Continuous Mentoring in the District Facility

With two district mentors in every facility, mentoring and coaching is part of daily activities with mentors supporting their colleagues to build skills, using opportunities during real deliveries. District mentoring allows 1-1 or 1-2 coaching in practice rather than small group role-playing as before. Identification of skills gaps among mentees is based on the clinical guideline as the standard tool for practice. District level mentors ensure the institutionalization of mentoring and sustainability in the facility. Challenges will be garnering consistent support for the mentor role from the district hospital director, the district health manager, and staff.

Buddy System of Support and Capacity Building

A key element of the mentorship approach is ensuring systems and networks of support and continuous professional development. This is important not only for mentees but also for mentors and trainer mentors. Supervision can improve performance and facilitate retention of staff (21) but supervisors also require support to progress (22, 23). To address this need, a buddy system of support was developed whereby the trainer mentor is assigned as

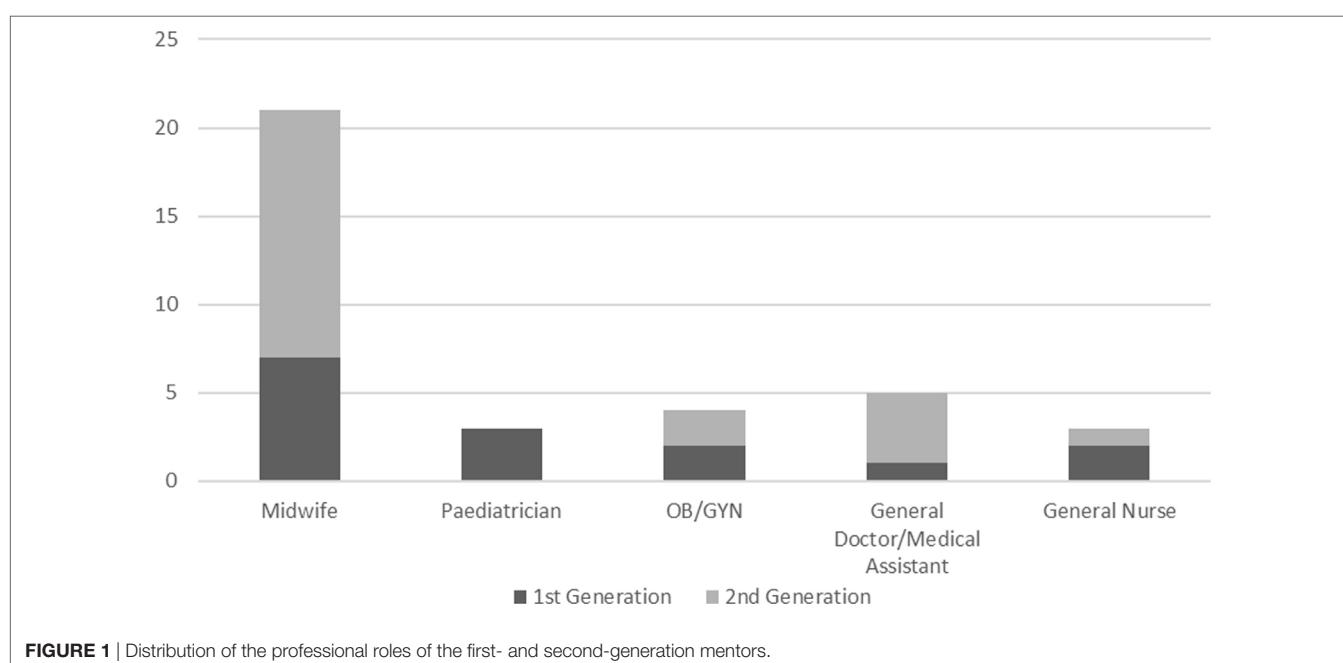


FIGURE 1 | Distribution of the professional roles of the first- and second-generation mentors.

TABLE 2 | Seven building blocks and standards of mentoring.

Create a good learning environment		
Coaching	Demonstrating	Feedback and assessment
Action planning	Reflect on own progress as a mentor	Safety of mother and newborn

a buddy mentor for two to four new mentors in the districts. The pairing was intentional to ensure continuity from the workshop through to ongoing buddy support.

The role of the buddy mentor includes making on-site visits to the district every quarter to assess progress and support the new district mentors in their roles. These visits provide the opportunity for the trainer mentors to support focused mentoring skills practice with the new mentors and to guide skills drills for rare events, for example newborn resuscitation. The importance of skills drills to build competencies in obstetric emergencies has been demonstrated (18). Finally, problems and challenges encountered by the new mentors are shared and solutions found collaboratively. Between on-site visits phone-calls are made to discuss progress or specific challenges. A quarterly mentor review meeting is held at the province which includes mentors and provincial and district leadership. The purpose of the meeting is to provide an opportunity for mentors to share feedback and lessons learned and to solve problems and challenges together with the district hospital directors. Results are presented and districts develop their facility action plans ensuring data are used for action.

Supervision in the form of on-site support can improve quality of care by improving the knowledge and skills of providers (24, 25). The system of support developed in the mentoring program can inform models of national supportive supervision, which have yet to be fully developed in Laos. In the current system, there are quarterly supervision and monitoring visits from the province to the districts, and the districts to the health centers. However, the focus tends to be observation and surveillance rather than support and capacity building, as has been noted elsewhere (25). Thus, there is an opportunity to incorporate a mentoring approach to these routine visits. The benefit of this approach has been documented in the mentoring and enhanced supervision of health centers program in Rwanda (15).

The two stages of the program, namely, developing the initial mentors and tools for implementation, followed by institutionalizing mentoring in the district facilities with a buddy system of support have been outlined above. As the approach is new for Laos, the importance of learning from implementation is the key. Together with key stakeholders and the MoH, the approach will be refined to develop a minimal package that can be replicated within the country context. **Table 3** summarizes the key elements of the program.

RESULTS

In Laos, the mentorship program has developed eight Laos trainer mentors through a training of trainers' workshop. The new trainer mentors have in turn developed 21 new mentors ensuring 2 mentors in every district facility. In total, the program has 36 mentors located in 14 facilities: two provincial hospitals,

TABLE 3 | Key program elements of mentorship.

Essential components	Laos mentorship examples
Pedagogical style	Participatory learning in practice
Method of implementation	During real delivery or simulation using anatomical model (Mamanatalie/Neonatalie)
Location	In the delivery room
Frequency	Low-dose high-frequency (Specific skills practised frequently)
Development and retention of skills	Skills drills for rare events, e.g., newborn resuscitation and continuous mentoring skills development with buddy support
Institutionalized and sustainable	District level mentors in the facility ensuring mentorship are part of everyday practice Laos trainer mentors equipped to train new mentors
Support	Buddy system of trainer mentor supporting district mentor. District mentor supporting facility staff (mentees). Model of supportive supervision
Integrated	Maternal and newborn together
Comprehensive	Includes respectful maternal care, labor monitoring using partograph, active management of the third stage of labor, skin to skin, early breast feeding and infection control, and disposal of waste
Reflective, adaptive, and reproducible	Process documentation, regular mentor feedback, and review meetings to share lessons learned, inform continuous revisions of the approach, develop concise model adapted to context for reproducibility/scalability

the training school, a provincial maternal child health center, and 10 district hospitals. Tools have been developed to support implementation of the approach including the clinical guideline, mentoring standards, and action planning tool. Development of the buddy system ensures support for trainer mentors, district mentors, and mentees. **Figure 2** below shows a diagram of the mentoring program.

A limitation was the delay in establishing the monitoring and evaluation framework, which resulted in an absence of an initial baseline from the first cohort of mentors. However, qualitative evidence of improvements has been noted through data, case-studies, and service delivery readiness. Indicators on service provision from exit interviews with mothers and patient chart reviews, including the partograph and service delivery readiness, are being tracked quarterly. Results obtained from the second mentor workshop demonstrated improvements in pre and post-test knowledge among mentors from 55 to 83%. Clinical skill attainment measured in an objective structured clinical exam verified that the new mentors had obtained at least 67% proficiency in normal delivery when the baby is not breathing. Our aim is for 80% proficiency, and we will work to ensure all new mentors reach this standard by the end of the year. Initial results of the mentees' clinical exam showed 14% were able to perform the steps of a normal delivery with the baby not breathing at a pass level of 80%. Three months later this figure has improved to 17%. Further incremental progress and skills development of mentees

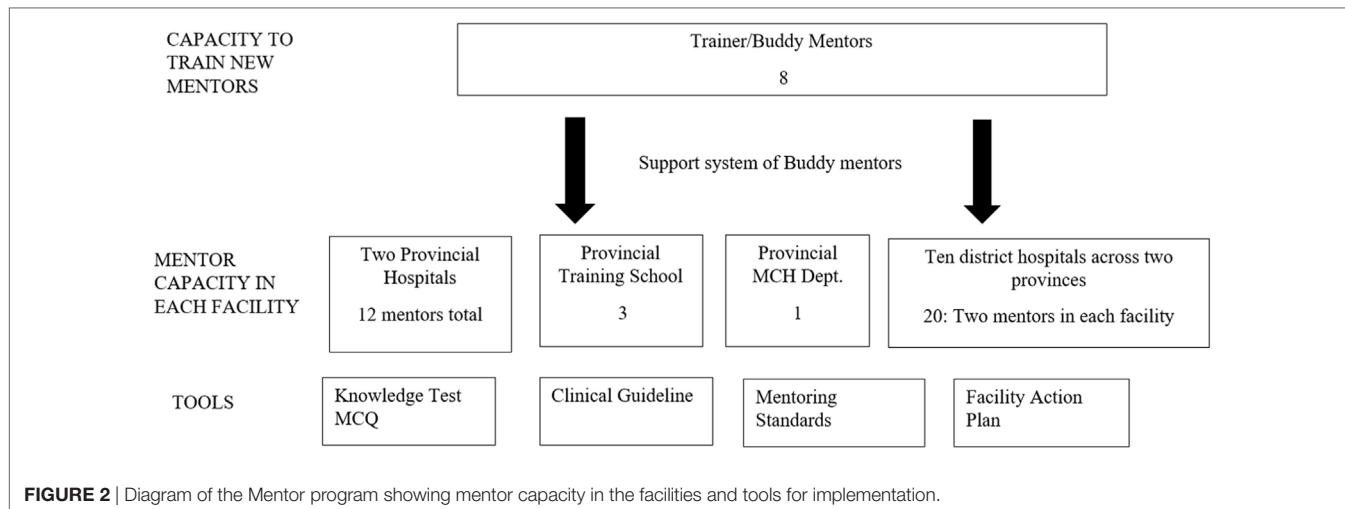


FIGURE 2 | Diagram of the Mentor program showing mentor capacity in the facilities and tools for implementation.

is predicted but will take time. An additional unanticipated challenge has been tracking a consistent cohort of mentees over time due to staff having numerous responsibilities both within the facility and externally. As a consequence, approximately 30% of the mentee cohort are taking the clinical exam for the first time each quarter, which results in the rate of progress being slower than would otherwise be expected. Positively, it means that more MNH providers have capacity-building opportunities and are engaged in the mentorship program. Encouragingly, mentoring skills of the mentors have shown greater progress. At baseline, 7% of new mentors gained a pass of 80% or more on their mentoring skills. However, with on-site coaching from the buddy mentor, 3 months later 72% were able to achieve 80% proficiency in their mentoring skills.

The institutionalization of mentoring in the facility with district mentors builds ownership and sustainability of the program. Furthermore, senior trainer mentors have independently taken mentorship to new districts as part of their capacity-building/training responsibilities under the provincial health department. At the central level, fifteen University of Health Sciences obstetrics/gynecology faculty underwent mentorship training to equip them to mentor residents using the approach and, in the longer term, build the residents' skills in mentoring to mentor medical students in pre-service education. Integration of mentorship into the provincial health system through the routine monitoring and supervision visits has been initiated and will be measured through supervision visit reports and skills outcome measures. This will include outcome measures on reach when mentors independently apply mentorship in new geographical areas.

DISCUSSION

Initial results from implementation in Laos have generated interest among provincial and national leadership for mentorship as a feasible, effective, and acceptable model of skills strengthening and capacity building for MNH providers. The study group is small in order to pilot and develop the intervention before moving it out more widely. Documentation of lessons learned

has informed adaptations and changes to the approach. Initial constraints included the lack of skills and experience in providing feedback and action planning among both mentors and facility staff. It was soon apparent that these skills are undeveloped in Laos. To overcome this, focused teaching was provided to mentors and mentees on feedback and action planning, which included problem identification, root cause analysis, and solution development. These sessions were subsequently included in all mentor workshops as core topics.

The availability of provincial level mentors to join mentoring visits due to work demands and other responsibilities was an initial constraint highlighted above. This has largely been overcome by the development of district level mentors. The abundance of programs and interventions both from the MoH and development partners results in a competitive programming climate. The simultaneous creation of new tools, guidelines, and checklists, rapidly developed and often later discarded, causes a guideline/checklist fatigue. This is often detrimental to effective implementation where programs overlap or staff are overwhelmed with numerous responsibilities.

The creation of district mentors was a key strategic decision which ensures institutionalization and sustainability of the mentorship approach in the facility. There are, however, new challenges to overcome including the acceptability among facility staff of peer learning where a tradition of being reliant on hierarchical systems and a provincial "expert" is the norm in Laos. This may be exacerbated by staff not being engaged or willing to change old practices or behavior. The mentorship program breaks the hierarchical mold but will require support from facility management for the mentors to perform their roles effectively. The long-term benefit of institutionalized facility-based mentoring, continuous professional development, and supportive supervision is significant and, therefore, perseverance with the model will be critical. Indeed, ineffective supervision has been found to be one factor influencing the lack of competent SBAs (26).

The loss of an initial baseline at the outset of the program due to delays in developing the monitoring and evaluation framework is a limitation. However, a baseline for 12 facilities has now been achieved. Furthermore, with multiple similar programs

occurring concurrently, for example, coaching in EENC, it is difficult to verify whether improvements are a result of mentorship exclusively. There is a blending of effects that needs to be accounted for in any summary of results. Recognition that district mentors will need further support to develop their proficiency in mentoring skills and gain experience in this role is important. Similarly, improvements in the skills and capacity of mentees will also take time as discussed above. Furthermore, ensuring skills developed using the Mamanatalie anatomical model are transferred to real deliveries will need support and encouragement. Changing behavior is challenging and improvements may not be evident immediately. The practical implications include MNH providers with the skills and capacity to provide quality care at the time of birth for mothers and newborns and an effective model that bridges the gap of rapid didactic training of midwives which has left many without skills, confidence, or experience.

Mentorship can inform the current quarterly MoH supervision and monitoring system and guide it to a supportive and capacity-building approach, moving away from surveillance and inspection. This will be beneficial for the new MNH providers who are frequently required to work alone in health centers and are often deployed to remote contexts after graduating, without sufficient follow-up. Mentorship can be applied in other contexts and with other health-care providers. For example, mentorship has been shown to be effective with physicians in the care of childhood illnesses using the integrated management of childhood illnesses in Rwanda (27). However, it is important to shape the model to the particular context. From our experience, this is achieved most effectively by ensuring the mentors themselves are partners in developing and modifying the approach relevant to local contextual constraints and opportunities. The program so far has implemented mentoring as part of in-service capacity building in provincial and district hospitals. In the future, we plan to expand to health centers to ensure all tiers of the health system are supported. While our focus has been on in-service training, mentorship is potentially relevant and beneficial to pre-service education both for students and their educators, as has been demonstrated through training University of Health Sciences faculty in the capital Vientiane in the mentorship approach.

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CONCLUSION

Mentorship in Laos has transformed traditional models of education and learning. The collaborative, participatory peer coaching method differs from traditional hierarchical training models that have been shown to be ineffective (12). The clinically integrated and comprehensive approach in Laos ensures equal care for the mother and newborn at the time of birth. In essence, having mentors in every facility to support learning and skills development of mentees through low-dose, high-frequency coaching is effective and sustainable in the long term. Ensuring the approach is locally owned, developed by the mentors themselves, and is reflective and adaptive to context and constraints will ensure its longevity and sustainability in a competitive program climate.

The benefits of mentorship as a model of effective capacity building and supportive supervision relevant to both in-service and pre-service education are evident. Future research is needed to evaluate improvements in confidence and satisfaction of mentees and to understand how capacity building through mentorship translates into improved quality of care for mothers and newborns. The ultimate aim being to support the MoH reduce maternal and newborn mortality in Laos.

AUTHOR CONTRIBUTIONS

The author confirms to be the sole author and writer of this work and approves it for publication.

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Telehealth to Expand Community Health Nurse Education in Rural Guatemala: A Pilot Feasibility and Acceptability Evaluation

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Telehealth education has the potential to serve as an important, low-cost method of expanding healthcare worker education and support, especially in rural settings of low- and middle-income countries. We describe an innovative educational strategy to strengthen a long-term health professional capacity building partnership between Guatemalan and US-based partners. In this pilot evaluation, community health nurses in rural Guatemala received customized, interactive education via telehealth from faculty at the supporting US-based institution. Program evaluation of this 10 lecture series demonstrated high levels of satisfaction among learners and instructors as well as knowledge gain by learners. An average of 5.5 learners and 2 instructors attended the 10 lectures and completed surveys using a Likert scale to rate statements regarding lecture content, technology, and personal connection. Positive statements about lecture content and the applicability to daily work had 98% or greater agreement as did statements regarding ease of technology and convenience. The learners agreed with feeling connected to the instructors 100% of the time, while instructors had 86.4% agreement with connection related statements. Instructors, joining at their respective work locations, rated convenience statements at 100% agreement. This evaluation also demonstrated effectiveness with an average 10.7% increase in pre- to posttest knowledge scores by learners. As the global health community considers efficiency in time, money, and our environment, telehealth education is a critical method to consider and develop for health worker education. Our pilot program evaluation shows that telehealth may be an effective method of delivering education to frontline health workers in rural Guatemala. While larger studies are needed to quantify the duration and benefits of specific knowledge gains and to perform a cost-effectiveness analysis of the program, our initial pilot results are encouraging and show that a telehealth program between a US-based university and a rural community health program in a low- and middle-income country is both feasible and acceptable.

Keywords: community health nursing, child health, telehealth, education, medical, rural health services, Guatemala

INTRODUCTION

Over one billion people globally have limited access to health services, with many living in rural areas in low- and middle-income countries (LMICs) (1). One important way to reduce this growing burden is to increase training of frontline health workers worldwide. In particular, community health nurses (CHNs) are vital health-care workers who can extend healthcare in rural areas, especially in LMICs. These nurses are trained health workers based in central health centers who meet the needs of local people by visiting and providing care at individual homes and community group visits. The importance of community health workers and CHNs has been widely recognized on an international scale. In 2008, the World Health Organization and the Global Workforce Alliance challenged the international community “to make sure that everyone has access to a suitable, trained and motivated health worker as part of a functioning health system” (1). In order to ensure the ongoing effectiveness of CHNs, organizations must provide continuing education to health workers.

Telehealth is defined as “the use of electronic information and telecommunications technologies to support long distance healthcare, patient and professional health-related education, public health and health administration” (2). This technology has proven to be a promising method of providing continuing education for healthcare providers (3) as well as supporting clinical services for patients (4). Multiple studies demonstrate effective distance education to rural locations in the United States using telehealth (5–7). However, there remains limited evidence of the cost-effectiveness and the acceptability by both patients and health-care providers of using this technology, and most research to date has been conducted within higher income countries. Recent studies have begun to show promise in addressing the disparity of medical specialists in LMICs by expanding access to sub-specialty training through telehealth (8, 9). Several organizations link multiple groups across geographical and cultural boundaries to provide educational videoconferencing, including the Reseau en Afrique Francophone pour la Telemedicine (10–12), the KwaZulu-Natal Experience (13), and the Global Educational Toxicology Uniting Project (14). Additionally, several programs have explored collaborations between academic institutions/hospitals in higher income countries and LMICs to provide medical education *via* teleconference, including in specialties such as obstetrics and gynecology (15), emergency and trauma care (16), anesthesia (17), and surgical skills training (18). While much of the rapidly expanding research for Internet-based remote education in LMICs is focused on the continuing medical education of physicians and trainees, a study in Malaysia showed that nurses and their remote lecturers responded positively to e-learning, noting that communication and interaction are key components to a teleconferencing format of teaching (19). Furthermore, during the recent Ebola epidemic, a tablet computer tutorial application was successfully used to train frontline health workers by improving knowledge and attitudes surrounding the virus (20). While telehealth technology holds great promise in educating health professionals in LMICs, very few studies have assessed the feasibility and acceptability of this teaching method with frontline health workers such as CHNs.

BACKGROUND AND RATIONALE

Our organization, the Center for Global Health at the Colorado School of Public Health, has partnered with a local agricultural company, AgroAmerica, in the coastal lowlands of southwest Guatemala to create a health center and community health program that improve general health and access to healthcare to several small communities that make up a rural population of approximately 30,000 people (21). This area in Guatemala is cultivated with crops for export, primarily bananas and palm oil, owned by large agro-business enterprises, and the rural population struggles with poverty and lack of access to health, education, and reliable clean water. Our partnership is a unique relationship between a university, a private business, and a community. The program is largely funded by the Guatemalan agricultural company with our university establishing and supporting medical services through a Guatemalan-staffed clinic, laboratory, and pharmacy as well as community-based health programs for maternal and early childhood health. The CHNs in our program conduct home and group visits for pregnant women and children up to 3 years of age. They follow women throughout pregnancy, monitoring expectant mothers and providing interventions that improve prenatal care and delivery. Once the baby is born, the mother and child transition to an early childhood health and development segment of the program that combines a series of neonatal home visits, community education sessions, and mother-child interactive group visits to enhance the health and development of children from birth to 3 years of age. CHNs travel throughout the communities performing assessments of general health, child development and anthropometrics, and providing anticipatory guidance and basic health advice.

In the summers of 2014 and 2015, a general lack of lactation knowledge and support was identified within our program. As a result, team members from our institution provided in-person breastfeeding training to the CHNs while present in Guatemala as baseline education. Following the 2015 program, both the CHNs and the instructors wanted to continue the breastfeeding educational program. However, as in many rural health-center locations in LMICs, a great deal of time and resources are needed to send instructors to the local site for in-person trainings. As many rural health centers reach communities outside of main cities and common thoroughfares, travel to these sites frequently involves extended time and costs, limiting teaching faculty to a few longer trips and limiting teaching to short periods of intense training. From our organization, it costs approximately 3000 USD to send one faculty member to Guatemala for 2 weeks, which includes airfare, room and board, and local transportation but does not even include faculty salary, which varies considerably. In the initial years of program development and implementation, our institution would spend around 50,000 USD annually to send faculty members to our rural site, which quickly became a financial limitation. For programs using local faculty, instructors can provide sustained regular contact with CHNs allowing for interactive discussions over time, including case reviews related to the teaching. For distance programs and partnerships such as ours, however, regular training of CHNs creates the need for a more innovative and cost-effective education delivery method

using information and communication technology such as telehealth.

For this reason, continuation of the initial breastfeeding curriculum was initiated *via* a videoconferencing software program at our institution. Developed in response to the expressed needs of the CHNs, topics then expanded to more generalized child health topics in rotation with breastfeeding lectures. The initial pilot period of July–November 2015 demonstrated general feasibility and satisfaction among team members and CHNs, and the team proceeded with a planned curriculum that included knowledge assessments and formal evaluations. The current program evaluation for this telehealth curriculum aimed to prove knowledge gains in child health topics, assess satisfaction and convenience with telehealth technology, demonstrate connection between learners and instructors, and identify challenges in delivery.

METHODS

This pilot was considered to be program evaluation rather than human subject research by the Colorado Multiple Institutional Review Board, and therefore, informed consent was not required. The CHNs were aware of the evaluation process during the program. The program evaluation took place between February and May 2016. Child health lectures were organized into two blocks of five topics each and were selected based on CHN preferences and instructor ability. Lectures covered the following topics: anemia, ear infections, zinc, urinary tract infections, antibiotics, vaccines, obesity, vitamin A, injury prevention, and burns. We used the videoconferencing software program Vidyo® (22), licensed by the Telehealth Department at our institution and available free of charge to our program. Vidyo® is a high-definition videoconferencing platform with an encrypted signal between several computers or mobile devices. The system has smoothing capabilities due to an iterative signal to allow for more natural communication. The platform runs on our institution's secure network. One of the team members acted as lead instructor by using the Vidyo® platform and sharing the screen with supplementary documents or slides on the topic. Other team members joined lectures as assistant instructors or observers. The lectures consisted of approximately 30 min of didactic teaching with an additional 15 min for questions, case presentations, and discussions of current cases and experiences in the community, providing a total time of approximately 45 min connected *via* telehealth. Learners viewed the shared supplementary teaching materials and the instructors simultaneously on their screen. The lead instructor viewed the learners as well as the instructor's home screen with supplementary teaching materials (Figure 1). Lectures were given in Spanish, the native language of the learners, but there was intermittent discussion among instructors in English for clarification. Learners were able to access the teaching documents after the lecture. The educational sessions were not recorded due to the need to maximize bandwidth availability at the Guatemala location.

Internet connection for the instructors was home or office Wi-Fi or cellular network on their personal or work computers, tablets, or phones. The devices connected securely to our institution's network through Vidyo®. The CHNs used an established Wi-Fi



FIGURE 1 | Example of lead instructor's Vidyo® screen.

connection at the clinic campus in Guatemala freely available to employees. The Internet at the clinic costs 5,300 Guatemalan Quetzales or approximately 700 USD per month for connection speeds of 6 mbps, which is paid by the Guatemalan agricultural company. This Internet connection is used for maintaining electronic medical records at the clinic and data downloads for multiple ongoing research studies. There were no additional costs to our program for the use of the clinic Internet. No evaluation of specific bandwidth usage was done for this assessment.

Evaluation Instruments

Evaluation of the program consisted of pre- and post-knowledge assessments by the learners as well as quality and satisfaction evaluations by both learners and instructors. All testing and evaluations were done through Google Forms® (Google Docs, RRID:SCR_005886). The anonymous survey data were collected and stored in Google Docs and then further processed in Microsoft Excel®. Two blocks of five lectures were given. Each block was preceded by a pre-test, consisted of one lecture per week for 5 weeks and was followed by a posttest after the last lecture was given. Pre- and posttests assessed knowledge of each of the five topics per block, with 20 points available per topic and an overall 100 points per test for each of the two blocks. Each lecture was followed by a quality and satisfaction evaluation assessing content, technology, and connection between instructors and learners on a 4-point Likert scale. Instructors completed a separate evaluation assessing technology, convenience, and connection. Both evaluations requested details on technology difficulties and general feedback on the teaching. As technical problems can affect the students' perceptions of quality (23), technical quality (e.g., audio, video, and time to connect) was measured with each lecture. All surveys and tests were completed anonymously to allow for candid responses.

Analysis

Survey responses from instructors and learners were combined across 10 lectures for mean Likert scores (1–4 range) with population SD. Percent of "agree" responses (scores 3 and 4) was also calculated per survey question. Survey questions were grouped into assessments of lecture content, technology, and connection among instructors and learners. Knowledge gain was measured

by percent improvement per subject and overall pre- to posttest scores. Due to the small number of students, instructors, and lectures, correlation among survey responses per lecture was not performed.

RESULTS

Demographics

The seven CHN learners in this program had completed either auxiliary nursing school ($n = 4$, 1 year post high school) or professional nursing school ($n = 3$, 3 years post high school). All CHNs were female, averaging 25 years of age and 5 years post-completion of nursing school. The lead instructor was a pediatrician at our institution (Kelly A. McConnell). Additional instructors were pediatricians (Maya Bunik and Gretchen J. Domek), a pediatric nurse practitioner (Maureen Lenssen), and a recent medical school graduate from Guatemala (Saskia Bunge Montes). All instructors had been to the site in rural Guatemala and had been involved with the implementation of the community health program.

Knowledge Gain

The percent increase of the mean for each lecture ranged from 1.4 to 19.9% (Figure 2) with an overall average increase of 10.7% among all topics. Overall, the correct score for each lecture improved from a mean of 13.9 to 15.4 out of 20 possible points. Test responses were not paired or adjusted for non-attendance of certain lectures as surveys and tests remained anonymous.

Learners' Evaluation

There was an average of 5.5 learners present per lecture. Responses from the learners were overall positive, especially regarding lecture content with 98% or greater agreement with each positive statement (Table 1). The technology questions regarding ease of use and convenience were also strongly positive with at least 98% agreement. The ability to hear the instructor (94.5% agreement) was greater than the ability to see the instructor (87.3% agreement), likely due to greater signal strength required for video compared to audio delivery. Statements related to the connection to the instructor were agreed upon 100% of the time except when asked if the lecture *via* telehealth was as good as in person (94.5% agreement). The amount of time to connect to the system was most frequently 5–10 min but took up to 15 min. Three lectures were rescheduled due to a lack of Internet connection at the site in Guatemala; two were done later in the same day and one was rescheduled to a different day. Overall, the CHNs were extremely satisfied with the lecture delivery *via* telehealth as well as the direct teaching.

Instructors' Evaluation

An average of two instructors was present for each lecture, one lead instructor and generally one additional team member. Audio quality was again reported to be better than video quality with “I could see the learners well” agreed upon only 59.1% of responses compared to 86.4% for audio (Table 1). Ease and convenience statements were 100% agreed upon, reflective of the system in which instructors joined from their personal or work computers or phones at their convenience if available. The amount of time to connect was nearly immediate in all reports from the

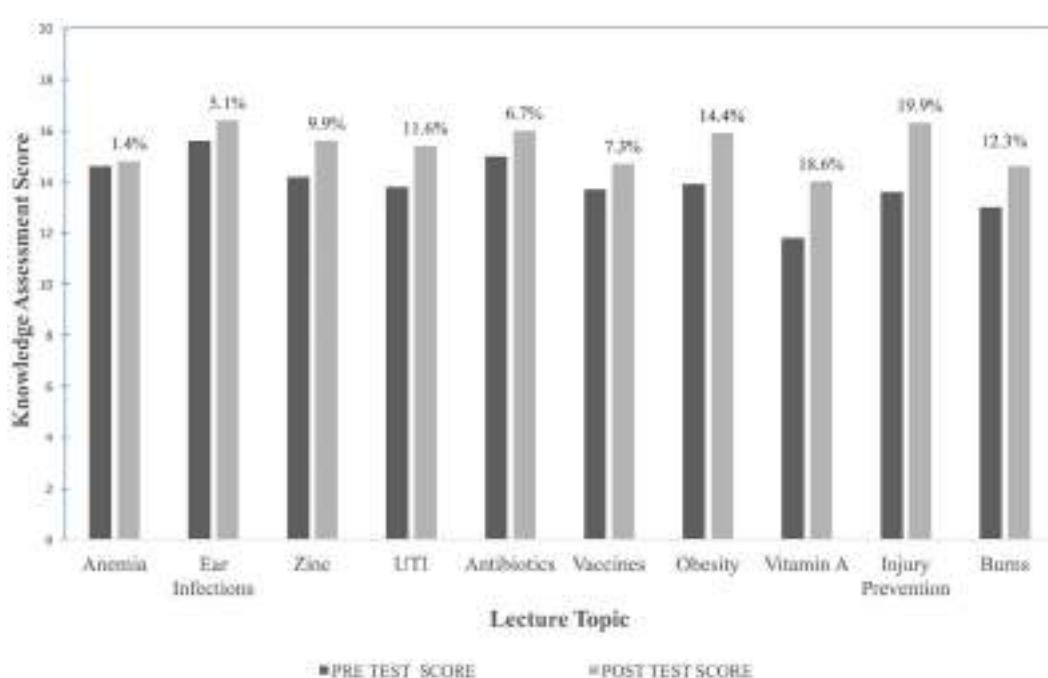


FIGURE 2 | Pre- to posttest knowledge gain and percent improvement.

TABLE 1 | Learner and instructor evaluation responses.

	Mean Likert score ^a	SD (population)	Number of "disagree" responses (Likert score 1 or 2)	Number of "agree" responses (Likert score 3 or 4)	Percent with an "agree" response
Learners: lecture content					
I learned the stated objectives	3.76	0.43	0	55	100
This topic and content are useful to my daily work	3.83	0.36	0	55	100
My work in the community is going to change/improve through this lecture	3.75	0.48	1	54	98.2
This lecture improves my knowledge of this topic	3.83	0.37	0	55	100
The quantity of the information included in this teaching was appropriate	3.74	0.44	0	55	100
The quantity of material in this lecture is appropriate for teaching via telehealth	3.67	0.47	0	55	100
Learners: technology					
I could hear the instructor well	3.67	0.58	3	52	94.5
I could see the instructor well	3.43	0.76	7	48	87.3
The system is easy to use	3.67	0.51	1	54	98.2
This teaching was convenient in my schedule of daily work	3.72	0.45	0	55	100
Learners: connection to instructor					
This mode of teaching maintained my interest	3.74	0.44	0	55	100
I feel connected to the instructor	3.70	0.46	0	55	100
I believe the instructor cared about my learning	3.83	0.37	0	55	100
This lecture was as good via telehealth as in person	3.46	0.60	3	52	94.5
Instructors: technology					
I could see the learners well	2.86	1.01	9	13	59.1
I could hear the learners well	3.36	0.71	3	19	86.4
The system is easy to use	3.73	0.45	0	22	100
This format was convenient for me	3.95	0.21	0	22	100
Instructors: connection to the learners					
I feel connected to the learners	3.09	0.60	3	19	86.4

^aAnswered on a 4-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree.

instructors except two instances in which an observer was not able to connect. Feelings of connection to the learners by the instructors were lower at 86.4% than was reported from learners who reported 100% agreement.

DISCUSSION

Our pilot evaluation contributes important results on the feasibility and acceptability of using telehealth technology to train CHNs in a rural LMIC, an area where very little research currently exists. In fact, we are not aware of another study using telehealth to train CHNs in a LMIC via an academic partnership. Our study shows that with an overall improvement of more than 10% in pre- to posttest knowledge scores, teaching CHNs through telehealth was effective for knowledge gain specific to the 10 topics taught. CHNs also reported that these teachings were useful and would be impactful for their daily work in the community. Some lectures had a greater improvement than others, which may be related to the difficulty of the test questions, baseline knowledge, quality of the technology, and lecture content. Knowledge gain did not seem to be influenced by the amount of time between each lecture and the final posttest.

High rates of satisfaction and convenience with the telehealth system were demonstrated in our surveys from both learners and instructors. This is a critical component of feasibility and program evaluation, enabling continued investment from both parties. As telehealth involves remote interaction, connection is both difficult and important to maintain. Our instructors are

culturally much more experienced with in-person teaching, while the CHNs have less experience with typical classroom didactic education, possibly reducing expectations. This may explain the higher satisfaction from the CHNs compared to the instructors. Overall, a sense of personal connection in regards to the teaching was felt by both parties, and importantly, the CHNs felt that the instructors cared about their learning. We think that there is likely a correlation between video quality and feelings of connection, but our dataset is not large enough for this analysis.

Strengths

A major strength of our study was the low start-up costs and minimal resources needed to develop and implement a telehealth program. We used existing institutional computer equipment, Internet connections, teleconferencing software, and office space, including a well-established videoconferencing system, Vidyo® (22), as well as Internet access readily available to each participant. This substantially reduced the costs of initiation. While Vidyo® is provided free-of-charge at our institution, other videoconferencing software programs, such as Skype, have basic software packages that are easily accessible, free, and have been used by other e-learning programs (15, 17). Our team also had access and support from the Telehealth Department at our institution, providing infrastructure, technical expertise, and connection troubleshooting, all of which are critical elements to any e-learning programs. In general, Internet connectivity was strong during our study with few failed connections or technical difficulties experienced. Additionally, our educational sessions

were all scheduled during protected academic time for our faculty and regular working hours for our CHNs, adding no further salary costs.

Another major strength to our program was the interactive, repetitive, and case-based learning style that we incorporated into each educational session. Research has shown the importance of active-learning exercises, personal interactions and feedback, intensive practice and repetition, and peer discussion in improving learning outcomes (24–26). A major advantage to using telehealth technology over web-based e-learning is the ability to have real-time interaction and active participation that facilitates asking questions, receiving clarifications, and discussing case presentations. In a review of e-learning in LMICs (27), lack of face-to-face interaction is discussed as a challenge to educational effectiveness. Additionally, all members of our team have traveled to the site in Guatemala, met the CHNs in-person, and been involved in multiple elements of the project, allowing a stronger connection, we believe, compared to telehealth contact alone. This participation with and knowledge of the community health program also allowed the team to create content directly applicable to the situations in which the CHNs worked daily.

While not assessed in our small pilot evaluation, there are likely to be significant economic, environmental, and personal benefits to such a program. We believe that increased education will improve the work of the nurses within the community since the lectures were targeted to improve CHN identification of common illnesses, determination of referral needs, and education of families for home treatments and health maintenance. Additional economic benefits include reduced travel of university faculty to the site, including lost work (clinical or teaching) time and travel and accommodation costs. A concept of planetary health linking human health, flourishing civilizations and the environment, described in the Lancet commission on planetary health (28), must be considered in our global health work to ensure the health of the environment as well as populations. This is especially true as the people most hurt by climate change are likely to be the communities we are working to help. Using telehealth to provide education allows for reduced carbon emissions related to travel, and if used on a large scale could have a positive effect on the environment. Additionally, this program evaluation started as Zika virus concerns were raised resulting in reduction in travel to endemic locations, including our site where Zika transmission is reported. The ability to deliver education remotely has far reaching benefits from direct costs to planetary health to personal health.

Limitations

A major limitation to this study was that a specific cost-effectiveness analysis was not performed as the set-up of equipment, bandwidth, licensing of software, and faculty and CHN salaries were all included free-of-charge to our program. While most economic evaluations of telemedicine have failed to show significant cost savings (29), there is a paucity of data overall and especially in the educational (non-direct patient care) usage of telehealth. This is likely due to the fact that equipment, time, and software used are typically shared among projects in an academic setting, and there is no clear tracking of costs spent or

saved with the specific telehealth program. Additionally, instructor and learner time commitments were not calculated for our evaluation. While further research exploring cost-effectiveness will be critical to future program expansion and replication, such studies remain a challenge to conduct. This is especially true in the academic setting where the actual costs of shared university resources and faculty time commitments for a specific telehealth program are hard to quantify, making it particularly difficult to estimate the future costs of scale-up, to generalize any findings and to replicate the study results in other non-academic settings.

Another limitation of our study was that the CHNs completed the surveys and tests anonymously, preventing pairing of pre- and posttest scores or the ability to adjust for lecture attendance. This was, however, done to encourage full participation and to remove concerns about job performance, which we feel aided in more candid survey responses. Furthermore, our dataset of surveys and tests was small, as it was designed as a pilot program evaluation, limiting our ability to calculate further correlation or data beyond central tendency. We do not know from our small pilot study whether the knowledge gain by the CHNs translated into better work performance and for what duration of time the knowledge gain persisted. This will be another important area of future exploration.

We are limited in the sustainability of this project which could provide additional quality improvement cycles as well as more detailed data collection, especially as these additional research questions arise. As this program developed in response to an expressed need, our team had several champions for CHN education. This is the main project of a Global Health postdoctoral fellow, who has moved to a different practice location. The program would benefit from an assigned hub of responsibility such as each oncoming fellow, a resident in our global health program or another long-term champion. The project is likely to continue but not necessarily with the same structure or data collection.

Lessons Learned

Several lectures were followed by informal discussions regarding the overall telehealth experience. These discussions informed the following lectures in an unofficial improvement cycle. Throughout our experience with telehealth for education, we observed that the learners were much more engaged if the didactic portion was limited to 30 min and interspersed with interactive questions supplied by the instructor and real patient cases brought by the CHNs. Engagement was not specifically measured by the instructors but was discussed after lectures among team members. Also, limiting the use of video and audio transmission for those instructors not directly teaching improved the clarity and focus of the lead instructor and allowed the lead instructor to see and hear the learners better. This allowed for reengagement, questions, and breaks as necessary, similar to the way a live teacher can respond to a class. The CHNs reported preference for a larger screen for viewing, especially compared to a small laptop screen as was most commonly used. In the future, it will be important to provide a larger screen and speakers to allow for better video conferencing at the rural LMIC site. Flexibility and patience from both the learners and instructors were also important since some lectures had to be delayed or postponed due to poor connectivity,

although this was rare. Anecdotally, the instructors noted that experience with telehealth, especially in understanding the delay in videoconferencing, allowed for better interactions and stronger feelings of connection.

CONCLUSION

Our program evaluation shows that telehealth may be an effective and low-cost method of delivering education to frontline health workers, specifically CHNs in rural Guatemala. Post graduate nursing education targeted to current fieldwork was delivered using existing technology systems and easily available resources during work hours with high satisfaction among instructors and learners as well as knowledge improvement among learners from pre- to posttest scores. There are likely to be significant economic benefits to such a telehealth program, including improved fieldwork by CHNs and decreased travel costs by faculty. While larger studies are needed to quantify the duration and benefits of specific knowledge gains and to perform a cost-effectiveness analysis of the program, our initial pilot results are encouraging and show that a telehealth program between an academic university in a high-income country and a rural community health program in a LMIC is both feasible and acceptable. The relationship between the faculty at the US-based Center for Global Health and the frontline health workers at the rural LMIC site in Guatemala is integral to the continued success of this international partnership and community health program, which provides critical health-care access to a rural and impoverished population. The frequent interactions and time and effort given to these educational sessions provide ongoing CHN training in support of the community health program goals and display concern and support for

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the daily work of the CHNs, contributing to the continuation and longevity of this important partnership.

AUTHOR CONTRIBUTIONS

All authors participated in multiple meetings regarding the design of the educational program and the program evaluation. KM was the instructor for all teaching sessions in this program evaluation, with supervision and approval of materials by GD. All authors participated in teaching, primarily MB and ML, prior to this specific program evaluation. LK coordinated educational sessions and analyzed the data with KM. SM, a Guatemala native, assisted with translation and creation of educational materials as well as communication with CHNs. KM did the primary writing, closely working with author GD. All authors reviewed the manuscript and gave final approval.

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Crisis Team Management in a Scarce Resource Setting: Angkor Hospital for Children in Siem Reap, Cambodia

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Introduction: A crisis team management (CTM) simulation course was developed by volunteers from Health Volunteers Overseas for physicians and nurses at Angkor Hospital for Children (AHC) in Siem Reap, Cambodia. The framework for the course was adapted from crisis resource management (1, 2), crisis team training (3), and TeamSTEPPS® models (4). The CTM course focused on teaching physicians and nurses on the development of team performance knowledge, skills, and attitudes. Challenges to providing this course at AHC included availability of simulation equipment, cultural differences in learning, and language barriers. The purpose of this project was to evaluate the impact of a CTM simulation course at AHC on attitudes and perceptions of participants on concepts related to team performance.

Methods: Each of the CTM courses consisted of three lectures, including team performance concepts, communication, and debriefing followed by rotation through four simulation scenarios. The evaluation instrument used to evaluate the AHC CTM course was developed for Cambodian staff at AHC based on TeamSTEPPS® instruments evaluating attitude and perceptions of team performance (5). CTM team performance concepts included in lectures, debriefing sessions, and the evaluation instrument were: team structure, leadership, situation monitoring, mutual support, and communication. The Wilcoxon signed-rank test was used to analyze pre- and post-test paired data from participants in the course.

Results: Of the 54 participants completing the three CTM courses at AHC, 27 were nurses, 6 were anesthetists, and 21 were physicians. Attitude and perception scores were found to significantly improve ($p < 0.05$) for team structure, leadership, situation monitoring, and communication. Team performance areas that improved the most were: discussion of team performance, communication, and exchange of information.

Conclusion: Teaching of non-technical skills can be effective in a setting with scarce resources in a Southeastern Asian country.

Keywords: simulation, crisis team management, non-technical skills, cambodia, health volunteers overseas

INTRODUCTION

The development of non-technical skills has been shown to improve patient outcomes during crisis situations in high acuity clinical settings (6, 7). Team performance is a concern in health-care settings around the world, not just for clinicians in countries that have resources to provide simulation education using computerized mannequins (often termed high-fidelity simulators) and other technology-intense equipment. Simulation technology is expensive and requires technical support that is often not available in low- and middle-income countries. Improving team performance is a priority for health-care providers in low- and middle-income countries that realize the impact of non-technical skills on patient outcomes. Angkor Hospital for Children (AHC) in Siem Reap, Cambodia, provides health care for children in one of the poorer areas of Cambodia. AHC focuses on improving clinical care by advancing the education of the Cambodian nurses and physicians at AHC (8).

Crisis team management (CTM) focuses on team performance skills during an emergent situation that occurs when a patient has a clinical event that requires immediate intervention. Team work during a crisis situation impacts outcome no matter the setting (6, 7). The focus of this article is to describe the implementation and evaluation of a CTM course supported by volunteers from Health Volunteers Overseas (HVO) in a setting with scarce resources and strong cultural differences from Western settings using simulation education to improve non-technical skills.

ANGKOR HOSPITAL FOR CHILDREN

Angkor Hospital for Children is a non-government organization (NGO) hospital that provides free high-quality compassionate care to Cambodian children. The outpatient department at AHC sees 400–500 patients per day. The inpatient department includes a 40-bed inpatient unit, a 10-bed low acuity unit, a 11-bed surgical unit, and a 16-bed combined emergency/ICU unit. Surgical procedures are performed in a main operating theater, minor procedure room, and ophthalmology operating theater. An AHC satellite provides pediatric and neonatal service located at a government referral hospital in Sotnikum, 35 km from AHC. Travel is a major obstacle for many families to have their children receive health care in rural Cambodia, the satellite hospital provides access to care for those families that cannot afford to travel to or stay in Siem Reap. Although AHC is an NGO, funding from the World Health Organization and USAID provides support for programs provided in conjunction with the Ministry of Health (9). Support for the CTM course was provided by HVO volunteers and Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand.

Angkor Hospital for Children has been designated as a teaching hospital by the Ministry of Health. Pediatric clinical rotations are provided for nursing students from all five government schools of nursing. Medical students from Phnom Penh and international sites participate in clinical educational experiences provided by AHC physicians and nurses. A pediatric residency program was established at AHC in 2003. Educational programs such as Advanced Pediatric Life Support (APLS) were initially

provided by an Australian team of certified APLS instructors but train the trainer courses led to the development of an independent AHC-delivered Khmer language APLS course, which mirrors the international one. Training of physicians and nurses when using APLS focuses more on application of protocols for treatment in emergency situation, whereas CTM focuses on team performance and communication during emergency situations.

Health Volunteers Overseas has been sending volunteers to AHC to support their Nurse Anesthesia program since 2004. The guiding principles of HVO are to improve care by teaching health-care providers in resource scarce settings (10). In addition, HVO volunteers teach existing health-care providers how to educate others. The CTM course follows the HVO model. The role of HVO volunteers expanded when the executive director of AHC in 2012 identified a need for focus on clinical communication skills. In collaboration with the staff at AHC, the CTM course focusing on team performance was adapted to meet the needs to improve clinical communication. The development of a CTM train the trainer course has led to direction of simulation scenarios and debriefing by Khmer nurses and physicians.

The CTM course was first taught by HVO volunteers from University of Pittsburgh and faculty from the Department of Anesthesiology, Siriraj Hospital, Mahidol University School of Medicine, in August of 2015. The goal of the CTM project is to develop instructors at AHC to assume the teaching of the CTM course in Khmer. Train the trainer courses have been conducted in October 2016 and March of 2017. Additional train the trainer courses have been scheduled in 2017 to reinforce previous training of instructors and to train new instructors as needed (see Table 1).

DOES HIGH-FIDELITY SIMULATION EDUCATION IMPROVE PATIENT OUTCOMES?

Simulation education has been found to be beneficial in improving outcomes in the clinical setting. In a meta-analysis of 609 studies done by Cook and colleagues (11), technology-enhanced simulation training in health professionals was found to have a large effect for participants in terms of knowledge, skills, and behaviors and a moderate effect on patient outcomes.

Although simulation has been shown to be effective, many assume that high-fidelity simulation is more effective than low-fidelity simulation. The cost of the technology to support

TABLE 1 | Crisis team management (CTM) courses offered and planned for Angkor Hospital for Children.

Date of CTM course	Instructor trainer course	Health Volunteers Overseas volunteer instructors	International instructors
August 2015	Not offered	2	5
March 2016	Not offered	3	0
October 2016	6	3	0
March 2017	6	2	2
July 2017	Yes	2	2
October 2017	Yes	0	2

simulation can quickly become prohibitive in a scarce resource setting such as AHC. High-technology simulators can cost over \$60,000 (personal communication, John O'Donnell). In a meta-analysis, Norman and colleagues (12) compared the effectiveness of high-fidelity versus low-fidelity simulation teaching. Outcomes of the 24 studies included in the meta-analysis were auscultation skills, surgical techniques, and complex management skills. There was no difference in high-fidelity versus low-fidelity methods of teaching on outcomes. Norman and colleagues (12) suggest that more complex skills do not require more complex simulators. Although high-fidelity simulation methods were considered at AHC, cost could not justify the purchase of high-tech simulators. Thus, low-fidelity simulation was used to support the teaching of non-technical skills at AHC.

Authenticity is considered a key concept when using simulation (12). Is the simulation setting close to real life? Norman and colleagues (12) describe fidelity to support the authenticity of a simulation setting in two ways. Engineering fidelity has been described by "does the setting look real?" Psychological fidelity has been described as, "does the setting elicit the required behaviors?" A dedicated simulation laboratory with a high-tech simulator is not required to improve competencies related to non-technical skills. At AHC, two or three classrooms, depending upon the size of the class, were used to run simulation scenarios and conduct debriefing sessions.

HOW SHOULD WE TEACH NON-TECHNICAL SKILLS?

Education for high acuity crisis situations in clinical setting is often associated with the development of task-oriented education that focuses on skills and knowledge. Advanced Cardiac Life support is an example of a course that provides this knowledge and skills with some focus on team performance (13–15). As health-care providers learn more about the importance of team performance during acute care crisis situation, there is increased demand for team performance and non-technical skill training. The development of non-technical skills is associated with improved knowledge, confidence, and skills among health-care providers (16). Additionally some studies suggest that good team performance is associated with improved patient outcomes (6, 7).

WHAT CRISIS TEAM PERFORMANCE MODELS WERE USED AT AHC?

The CTM course at AHC was developed based upon various models for crisis team performance also known as non-technical skills. Crisis Team Training (CTT) developed by DeVita et al. (3) at the Winter Institute for Simulation Education and Research focused on completion of team tasks, and directed communication. A key concept in the CTT course was a flattening of the power hierarchy (doctor versus nurse) that promoted communication between team members. Gaba (2) developed an Anesthesia Crisis Resource Management course that utilized concepts used in the air-line industry. The course focused on communication including, situation, background, assessment and recommendations

(SBAR) used during handoffs. SBAR has been incorporated into CTM at AHC. TeamSTEPPs® (4) provided concepts that were incorporated during teaching of non-technical skills, team structure, leadership, mutual support, situational awareness, and communication.

HOW IS LEARNING DIFFERENT IN CAMBODIA?

Communication during the CTM course is an important concept for the success of team performance. CTM courses at AHC have been taught in English. Although participants speak English relatively well, the language typically used during crisis events at AHC is Khmer. The first three times the CTM course was offered in August 2015, March 2016, and October of 2016, the course was taught in English. Lectures for the fourth course in March of 2017, were taught in English but scenarios and debriefing were conducted mostly in Khmer. Instructor trainers directed scenarios and led debriefing. HVO volunteers and international faculty initially directed scenarios and led debriefing sessions. Future courses to be offered in 2017 will be led by AHC faculty, and volunteer faculty will serve as consultants for the CTM course. See **Table 1** for a timeline of the CTM course that have been offered and are planned. The goal for the CTM course is that it will be coordinated and taught by AHC faculty with little support by HVO volunteers and international faculty.

Learning styles by students in Cambodia are rapidly changing from the use of a more traditional classroom environment to frequent use of the internet and other less traditional methods of learning. In the past, the learning environment focused more on memorization and less on critical thinking (17). Students feared asking questions in class or answering questions posed by the instructor incorrectly (18). Students in Asian cultures were more likely to ask questions during individual meetings with instructors rather than group sessions. Facilitating classroom discussion and using less traditional teaching methods is strongly emphasized at AHC. The goal at AHC is to have considerable discussion and promote participation in the classroom and less pure lecture style of teaching. During the first CTM course, discussion during debriefing sessions were very lively and often went past the allotted time due to the rich discussion by the more senior participants enrolled in the first course.

Advanced Pediatric Life Support is mandatory at AHC and for pediatricians in countries such as the UK. The knowledge from APLS is known to saves lives. However, APLS focuses on the individual's performance during scenarios—particularly memorization and application of evidence-based protocols. Participants called on to assist in a scenario may only do what the individual being tested asks of them and cannot contribute their own knowledge or observations. As such, it does not focus on team performance skills. During the CTM course, Khmer instructor trainers would sometimes focus upon discussion of the APLS protocol alone with less emphasis on team performance concepts. HVO volunteer instructors would assist by refocusing debriefing on concepts related to team performance. Gaining expertise with protocols is much more comfortable with learners

and Khmer instructor trainers well versed in APLS than applying team performance concepts in a crisis situation. The introduction of non-technical skills that is new to health-care providers at AHC was difficult at times and required critical thinking skills but by the end of the course participants seemed to be enthusiastic about learning related to team performance skills.

METHODS

Institutional Review Board approval was provided for this project by AHC. Physicians and nurses employed at AHC and its Satellite Clinic in Sotnikum participated in three CTM courses offered in August of 2015, March of 2016, and October of 2016. Instructor trainer courses were offered in October of 2016 and March of 2017.

Faculty

Instructors for the course were from Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand, and Graduate School of Public Health and School of Nursing at the University of Pittsburgh, USA. In addition to stating their role and unit at AHC, participants completed a pre- and post-course questionnaire regarding perceptions and attitudes associated with team performance.

Components of the Course

The 8-h CTM course comprised of three lectures and rotation through four simulation scenarios. Course concepts were based on the Crisis Resource Management model (2) CTT (3) and TeamSTEPPs® (4). Development of scenarios, debriefing points and evaluation were based on the concepts of (1) team structure, (2) leadership, (3) situational awareness, (4) mutual support, and (5) communication. Lectures covered CTM principles, communication skills, and debriefing. Initially, lectures, simulation scenarios, and debriefing sessions were conducted in English. Simulation scenarios were developed and directed by simulation instructors from Thailand (Tachawan Jiravivanont), US (Richard Alynn Henker), and Japan (Hiroko Henker).

Crisis scenarios included anaphylaxis, hemorrhagic shock, postoperative bleeding after tonsillectomy, hypoxemia, and opioid-induced respiratory depression. A scenario template from Siriraj Hospital included setup instructions, flow of the scenario, and debriefing points. Although there may be some discussion during the CTM debriefings about appropriate treatment, the focus of debriefing was on concepts related to team performance. Instructors for the third courses included nurses and physicians from AHC who had been enrolled in the train the trainer course. Confederates, playing the roles of patient family members for simulation scenarios included nurse anesthetists from Siriraj Hospital and nurse anesthesia students from the University of Pittsburgh, School of Nursing.

Low-tech pediatric manikins that could be intubated were available at AHC for the CTM course. These manikins were typically used for the APLS course at AHC and do not have the technological capabilities of manikins used in simulation lab settings in the US. Ipads (Apple, Cupertino, CA, USA) were configured as physiologic monitors to provide heart rate, oxygen saturation,

blood pressure, and respiratory rate during simulation scenarios. The app used to configure the Ipads as physiologic monitors was Sim Mon version 1.5.3 (Castle + Andersen Aps, Denmark). Airway equipment including oral airways, endotracheal tubes, and laryngoscopes were available from the APLS course at AHC. Intravenous infusions were attached to manikins and medications were labeled and available.

Debriefing Techniques

Debriefing methods used for the CTM course were based upon experiential learning by Kolb (19) and focused on providing a concrete experience with an emphasis on reflective observation. Other models influencing our debriefing approach included (1) plus delta and (2) gather, analyze and summarize (20). During the train the trainer course, debriefing concepts were reviewed based on categories from the Debriefing Assessment for Simulation in Healthcare instrument emphasizing: (1) having participants describe their thoughts on how they performed, i.e., reflection, (2) providing a structured debriefing format including a review of the concepts of team performance, and (3) having participants summarize team performance by describing aspects of the simulation scenario that went well and those that needed improvement (21). These principles were used to guide debriefing of CTM participants immediately after scenarios. Duration of debriefing sessions was 20–30 min.

Course Evaluation

Attitudes and perceptions of team performance including team structure, leadership, mutual support, situational awareness, and communication were evaluated in participants before and after the course. The 18-item evaluation instrument with responses of 1 (agree) to 5 (disagree) was used to evaluate the AHC CTM course concepts of team performance. The instrument was developed based on TeamSTEPPs® perception and attitude instruments by BunRum Ly and R. Henker (5). The instrument used for the course was in English at a level appropriate for Cambodia staff at AHC. Subscales in the instrument match the concepts used when teaching the course, i.e., team structure, leadership, situation monitoring, mutual support, and communication. The instrument focused on attitudes and perceptions of course participants. Data for statistical analysis were entered into SPSS Version 24 (2016). Pre and post scores were compared using Wilcoxon signed-rank test for participants in the simulation workshop.

RESULTS

Twenty-seven nurses, 6 anesthetists, and 21 physicians participated in three CTM courses offered August of 2015, March of 2016, and October of 2016. Pre- and post-course questionnaire data were collected on 54 course participants. Of the 54, 21 were from the operating theater and 13 were from the emergency department/intensive care unit. The remaining participants were from a wide variety of units at AHC including the inpatient department, outpatient department, satellite, eye clinic, and external programs.

Comparison of pre and post perception and attitude scores demonstrated statistically significant improvement for team

structure ($p = 0.00$), leadership ($p = 0.00$), situation monitoring ($p = 0.00$), and communication ($p = 0.00$). Although not statistically significant, the p -value for mutual support was $p = 0.09$. See **Tables 2** and **3** for changes in by team performance concept category.

The survey question areas that had the greatest and least change for each team performance concept topic are listed in **Table 4**. The areas associated with the greatest changes in the perception and attitude scores; (1) discussion of team performance, (2) exchange of information by the team, and, (3) good communication is associated with better team performance.

DISCUSSION

Participant evaluations at the end of the course indicated that the scenarios were realistic and that it was important for them

TABLE 2 | Wilcoxon signed-ranks test results by team performance category.

Team performance	Post minus pre-negative ranks	Post minus pre-positive ranks	Ties	p-Value
Team structure	26	7	18	0.00
Leadership	31	6	16	0.00
Situation monitoring	26	6	20	0.00
Mutual support	23	12	16	0.08
Communication	30	8	15	0.00

TABLE 3 | Average scores by team performance category.

Team performance	Pre-course mean score	Post-course mean score	Paired differences	Paired difference SD
Team structure	6.47	5.47	0.71	1.7
Leadership	6.51	5.53	0.98	1.4
Situation monitoring	5.35	4.56	0.79	1.4
Mutual support	6.55	6.04	0.51	2.0
Communication	5.74	4.13	1.60	2.7

TABLE 4 | Survey questions with the greatest and least change for each team performance category.

Team performance concepts	Significance by team performance concept	Pre-post negative ranks	Pre-post positive ranks	Ties	p-Value
Team structure					
Team goals more important than individual goals	Greatest change	7	0	46	0.01
Staff share information to improve team performance	Least change	16	7	29	0.08
Leadership					
Leader provides opportunity to discuss team performance	Greatest change	25	3	25	0.00
Leader views mistakes as learning opportunity	Least change	14	7	32	0.13
Situation monitoring					
Staff exchange of important information	Greatest change	22	3	27	0.00
Monitor stress of team members and assist if needed	Least change	14	8	31	0.13
Mutual support					
Help other team members is part of good team performance	Greatest change	15	4	34	0.03
Communicate during stressful times in positive way	Least change	14	11	26	0.92
Communication					
Poor communication common cause of error	Greatest change	21	3	29	0.00
Staff share information in timely manner	Least change	18	8	27	0.28

to reflect on their performance during debriefing. Participants would have liked readings assigned prior to the course to help prepare. Participants also indicated that they would prefer less lecture and more scenarios. The course offered in March of 2017 included six scenarios instead of four that had been previously used in prior courses. Additional scenarios for the March 2017 course were developed during the instructor trainer course that was held prior to the CTM course. Khmer instructors noted that a team work exercise early in the course engaged learners. Khmer instructors also noted that learning took place despite the low tech manikins used to support the course. International faculty noted that organizing the course was difficult due to instructors being from the US and Thailand.

Similar simulation courses have been offered in countries such as Ghana. In the Bulletin of the American College of Surgeons (22) the development of a simulation-based Advanced Trauma Operative Management course was reported. It was noted that the success of the course required substantial support from Johnson and Johnson for course implementation and in resourcing the simulation center. "Is the cost of a simulation center worth the benefits?" is a frequent question asked in low- and middle-income countries with scarce resources; although, the time commitments of instructors and participants needs to be considered in the cost.

Partnerships

The partnership between the HVO nurse anesthesia program and AHC has been in place since 2004. This relationship has progressed from clinical teaching of basic skills for the anesthetists at AHC to the development of a CTM course to teach team performance knowledge and skills to nurses and physicians. The focus of initial volunteers was to assist AHC staff with support for the day-to-day function of the operating theater. As the partnership of HVO and AHC has grown, plans for volunteers have become more sophisticated with well-developed goals for projects. The development of the CTM course with specific goals and objectives is an example of the growth of the partnership between AHC and HVO and well-planned use of volunteers by AHC.

Sustainability

The model of educational development used by HVO contributed to the successful implementation and sustainability of this project. The need for improved clinical communication was identified by AHC and conveyed to HVO volunteers. A CTM Course that had been developed for Siriraj Hospital was adapted to AHC. Initially participants were taught in the CTM course that was developed with input from AHC educators. The next stage was the development of instructors from AHC to continue to have this course offered with little assistance from international and HVO volunteers.

Capacity Building

Although this specific project focuses on improving the quality of care at AHC through the development of the CTM course, it should be noted that the teaching by HVO nurse anesthesia volunteers has led to an increase in the anesthesia work force. The number of anesthesia providers at AHC has increased from three in 2006 to six in 2017. This increase in the number of anesthesia providers has led to opening of a minor procedure room and ophthalmology operating theater. In addition, HVO volunteers have assisted with the coordination of clinical experiences for AHC anesthesia providers at the National Pediatric Hospital in Phenom Penh, Siriraj Hospital in Bangkok and UPMC-Children's Hospital of Pittsburgh in the US. Currently, the nurse anesthetists at AHC are not only teaching in the CTM course but are also providing a clinical rotation for nurses from Lao Friends Hospital for Children that are learning to be nurse anesthetists.

CONCLUSION

The development of a CTM course at AHC provides an example of how to advance a sustainable education project that improves

the quality of care in a resource scarce setting. The timing of this project was effective not only because of the need for improvement of clinical communication but also the ability of the AHC educators and administration to understand how to utilize HVO volunteers effectively. This project was driven by the HVO model to develop sustainable programs to educate health-care providers in a resource scarce environment then increase the likelihood of sustainability by developing a train the trainer course.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of "Angkor Hospital for Children Institutional Review Board." The protocol was approved by the "Angkor Hospital for Children Institutional Review Board."

AUTHOR CONTRIBUTIONS

RH co-coordinated the course, developed scenarios, conducted the analysis, wrote the manuscript, and taught in the course. HH co-coordinated the course, developed simulation scenarios, assisted with the analysis, and taught in the course. TJ co-coordinated the course, developed simulation scenarios, and taught in the course. HE taught in the course and assisted with the development of the manuscript. JO assisted with analysis and development of the manuscript.

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Editorial: International Partnerships for Strengthening Health Care Workforce Capacity: Models of Collaborative Education Part II

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Keywords: partnerships, collaboration, education, sustainability, health workforce capacity, global health

Editorial on the Research Topic

International Partnerships for Strengthening Health Care Workforce Capacity: Models of Collaborative Education

Part II of the e-book, *International Partnerships for Strengthening Health Care Workforce Capacity: Models of Collaborative Education*, offers significant examples of key elements for international collaborative education to build health workforce capacity to improve health care outcomes, and provide guidance for building or maintaining partnerships. While Part I includes 18 manuscripts that focus extensively on long term partnership development or programs, Part II offers 13 more examples of those partnership elements or short term educational programs. As noted in the Editorial by Leffers and Audette that precedes Part I of this e-book, the manuscripts represent geographic and professional diversity and range from those that address partnership elements, program development, multifaceted offerings of university partnerships, and short-term educational offerings to strengthen health care workforce capacity.

The entire collection of 31 published manuscripts from the Research Topic (RT) represent perspectives, community case study, curriculum, instruction and pedagogy, and evaluation types across academic, non-governmental organization and other global partnership forms. While every manuscript included in this RT addresses partnerships, the 18 manuscripts published as Part I of this e-book strongly exemplify partnership elements of collaboration, mutual planning, and capacity building (1–3) while those in Part II are more specific to programs and short term educational offerings.

In Part II of this e-book are 13 manuscripts that offer examples of comprehensive assessment for collaborative program planning, program development, effective short-term educational offerings, and academic partnerships with multifaceted activities with several global host settings. While these 13 manuscripts do not address all partnership and sustainability aspects of the RT for long-term programs that are described in Part I, they do address important elements of partnerships that address workforce capacity. Part II offerings address projects that focus upon both health and partner priorities such as capacity building for midwives, occupational and physical therapists, nurses, anesthesiologists, and nurse anesthetists and medical specialties in trauma, orthopedics, and infectious disease. Collaboration, partnership building and meeting host setting needs feature strongly in the manuscripts in both Part I and Part II of this e-book. Canizares et al. discuss an extensive needs assessment to build health promotion programs for children with upper limb differences that extended on-going work in a long-term partnership. The assessment can serve as a model of stakeholder engagement that looked at a wide range of factors such as

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demographics, environment, socioeconomics, individual behaviors, and biologic factors to discover the most important priorities for families [1]. Five of the manuscripts in Part II highlight program development: Cunningham et al. for a physical therapy program in Kenya, Persaud et al. for an infectious disease program in Guyana, Manske for a pediatrics hand and upper extremity surgical program in Nicaragua, while Potisek et al. conducted a survey of 93 graduates of a nurse anesthesia training school in Cunningham and McFelea and McFelea assess knowledge, clinical reasoning, and psychomotor skills for physical therapists in a post-graduate orthopedic manual therapy program. Two authors describe university partnerships with multifaceted offerings. Brzoska et al. highlight the International Public Health partnership between a university in Germany and universities in India, Nigeria, and Turkey. Conway et al. explain the four strategic areas for the Institute for Global Orthopedics and Traumatology (IGOT) in the US and teaching hospital partners in Ghana, Malawi, Nepal, Nicaragua, and Tanzania. The final five manuscripts describe short term educational offerings for physical therapy in Malawi (Beling and Chisati); a short, intensive course on fundamental aspects of clinical research for orthopedic surgeons in Cuba (Miclau et al.); education for midwives in Sudan (Downes et al.) and in Guatemala (Hernandez et al.); and a two day continuing education program for musculoskeletal disorders in Guyana (Ferreira).

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As we state in the conclusion of the editorial preceding Part I of this e-book, we “are pleased to be able to share so many creative, interesting, and diverse models of global health initiatives. We applaud the authors for their contributions that demonstrate how educational international partnerships can strengthen health care workforce capacity globally.” The manuscripts from the authors for Part II of this e-book highlight important elements and aspects of global health collaboration. This e-book adds to the body of literature to advance equitable, ethical and sustainable global health partnerships. Collectively the e-book offers strong exemplars of the processes noted by Pinner and Kelly to move equitable partnerships to provide sustainable programs that strengthen health workforce capacity.

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The author confirms being the sole contributor of this work and approved it for publication.

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Assessment of Health Needs in Children with Congenital Upper Limb Differences in Nicaragua: Community Case Study

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Congenital anomalies are prevalent in Nicaragua, and disability is estimated to be 10% in the general population. We studied children with congenital upper limb differences, as they are vulnerable to disability. This case study documents a collaborative effort between American and Nicaraguan orthopedic surgeons to determine unmet health needs of children with congenital upper limb differences at Hospital Manuel de Jesus Rivera ("La Mascota" Hospital) in Nicaragua, with the goal of developing programs that successfully address these needs within the context of the priorities of the community. Participants were recruited during one of the biannual pediatric hand specialty clinics held by a partnership of pediatric hand surgeons and occupational therapists under the auspices of Health Volunteers Overseas (La Brigada de las Manos, or "La Brigada") and Nicaraguan orthopedic surgeons. Structured interviews were performed with 34 parents or caregivers of patients with the diagnosis of a congenital upper limb difference. Parents were asked to rank the social, economic, environmental, and biological factors that determine health according to priority. Using the Hanlon Method for prioritizing health problems, in consultation with local providers and the program director of La Brigada, five needs were identified: (1) improvements in access to specialized care from hand surgeons and (2) rehabilitation specialists; (3) improvements in upper extremity function; (4) access to transportation; and (5) improvement in physical activity and sports participation. Based on the results of this needs assessment, we learned that some of the needs were already part of the ongoing work of the partnership, but in addition, more needs became evident; for that reason, local health care providers and members of La Brigada identified potential solutions to these needs and are currently working to translate these in future interventions.

Keywords: global health, partnership, community, case study, needs assessment, congenital differences, upper limb, Nicaragua

INTRODUCTION

Partnerships between local health-care professionals with international allies can improve health in developing countries, especially when they are based on equal participation, knowledge contribution, and focus on important community health issues (1). The challenge remains that collaborative alliances do not have clear roles and responsibilities when starting new programs. To that end,

in order to establish and sustain a successful partnership with long-lasting results, developing a clear and common purpose among all stakeholders, including the community, is paramount when designing new interventions. One of the goals of global health partnerships is to prevent disability (2), especially in high-risk populations such as children. The purpose of this case study is to document a collaborative effort between American and Nicaraguan orthopedic surgeons to determine the unmet health needs of children with congenital upper limb differences, with the goal of developing a plan of action that successfully addresses these needs within the context of the priorities of the community.

BACKGROUND AND RATIONALE

According to the World Health Organization (WHO), "Health is a state of complete physical, psychological, and social well-being and not simply the absence of disease or infirmity" (3). Based on this model, public health practitioners assess the needs of a population to identify biological, socioeconomic, and environmental risk factors and their relationship with disease. As health needs are identified, the next step is to plan comprehensive interventions to meet these needs and improve health as result.

Disability is a current public health concern in national and international agendas, which arises from the disturbance of anatomical structure or function and is highly influenced by social environment (4). As a result, people with disabilities require more health-care resources and may have more unmet needs than those without limitations (5). In developing countries, negative interactions between an individual with a health condition and their contextual environment aggravate the risk of disability. Children with congenital anomalies are particularly vulnerable to disability when their physical impairment is compounded by low socioeconomic status and lack of health-care resources.

According to WHO, congenital anomalies are prevalent in Nicaragua (6), and rates of disability of 10.2% are reported by the Pan American Health Organization (7). Unfortunately, relevant data about congenital musculoskeletal conditions are lacking. However, we know that children and adolescents with congenital upper limb differences experience variable degrees of physical impairment that can limit their ability to perform physical activity and disrupt of their emotional and social functioning (8). Depending on the level of involvement, a congenital difference can range from conditions that cause minimal impact on functioning to more complex conditions with potentially more disability (9). To begin identifying strategic priorities, the author was invited to participate as a volunteer to conduct a needs assessment of patients with congenital upper limb differences, as they are considered at high risk of disability. By recognizing their needs in the context of broader social, economic, and environmental determinants of health, this assessment will guide the development of future interventions.

COLLABORATIVE PARTNERSHIP

Under the auspices Health Volunteers Overseas (HVO), a non-profit organization dedicated to improving the availability

and quality of health care through the education, training, and professional development of the health workforce in resource-scarce countries (10), a partnership developed in 2009 between an American team of hand surgeons and occupational therapists called "La Brigada de las Manos" with a team of Nicaraguan orthopedic surgeons from Fernando Velez Paiz Hospital. In 2014 after an earthquake destroyed this hospital, all personnel were transferred to Manuel Jesus Rivera "La Mascota" Hospital where La Brigada has continued to provide care on a biannual basis. Since the first Brigada de las Manos trip, the need to do more than just providing surgical care twice a year was evident, so the Brigada also undertook training of a local orthopedic surgeon to provide surgical treatment to simple upper extremity pathologies independently between Brigada trips and serve as local hand surgeon. This training is still underway (11). Pediatric hand specialty clinics are still held twice a year with help of La Brigada de las Manos and the hand surgeon in training, in order to address more complex hand pathology.

SETTING

The needs assessment was conducted in Hospital Infantil Manuel de Jesus Rivera "La Mascota" located in Bo. Ariel Darce, Distrito V, Managua, Nicaragua. This pediatric hospital was established in 1982 in Nicaragua's capital as a teaching governmental hospital that offers services free of charge and is administered by the Ministry of Health (Ministerio de Salud, or MINSA). The hospital not only offers services to the city but also receives referrals from the entire country making this institution the main referral center for children and adolescents less than 15 years of age. The Department of Orthopedic Surgery, where the need assessment took place, was recently transferred to "La Mascota" as above, and currently includes six staff surgeons, one of whom is dedicated to the treatment of upper limb conditions as above.

METHODS

This needs assessment evaluation employed structured interviews to obtain insight from families of children from 0 to 15 years of age with the diagnosis of a congenital upper limb difference, who sought care in La Mascota Hospital during the La Brigada visit in October 2016. Parents were questioned using a non-validated interview created for the purpose of this needs assessment. The interview was structured in five sections related to (1) demographic variables; (2) environmental factors such as water sanitation, housing, transportation, security, and access to health care services; (3) socioeconomic factors including education, employment, and income; (4) individual behavioral factors as nutrition, physical activity, and habits; and (5) biological factors such as the presence of a medical condition or history of genetic diseases. These sections were developed to have three possible responses: a positive outcome, a neutral outcome, and a negative outcome. For example, when asking about family monthly income, the possible responses included positive incomes (allowed savings), neutral (expenses equal income), or negative (expenses surpassed income). At the end of the interview, parents were asked to enumerate the most important needs

for their family, and when more than one need was designated, they were asked to rank the need according to priority in the context of their life.

In addition to the interview, Spanish translations of Patient Reported Outcome Measurement Information System (PROMIS) questionnaire Pediatric Item Bank short form of upper extremity function were used for this assessment (12). Parent proxy-reported health measures were collected from patients older than 5 years of age and self-reports from children older than 8 years. PROMIS questionnaires were scored using the Assessment Center Scoring Manuals (13). Data collection was performed by a fluent Spanish speaking researcher to avoid language barriers. Informed consent was obtained from all participants prior to the interview. This study received approval from the University of Massachusetts IRB board and La Mascota Hospital authorities.

Demographic characteristics, determinants of health, and PROMIS scores were summarized for all patients and parents using descriptive statistics. The sections from the interview, related to both environmental and socioeconomic factors as well as individual behaviors and biological determinants of health were ranked according to the percentage of negative outcomes. If the average for PROMIS scores was less than 50 for peer upper extremity function domains, they were considered areas of need. A list of needs was created based on responses from interviews and questionnaires. In order to select the most important need, a Hanlon's priority matrix method was used similar to previous program planning strategies (14). This prioritization technique requires rating each health problem identified on a scale from 0 to 10 on the following criteria: size of health problem (A), magnitude or seriousness of health problem (B), and effectiveness of potential interventions (C) (see **Table 1**). The size of the problem was assigned based of the percentage of negative outcomes obtained from the interviews; the seriousness of the problem was calculated taking into consideration the demand from parents when they were asked to rank the needs according to priority; and the effectiveness rating was assigned by consensus expert opinion of collaborators from La Brigada. A feasibility "PEARL" test was performed before calculating the total score; this test assigns a score of 1 if all the components of feasibility have a favorable response; however, if a response is negative, then a 0 is assigned. Finally, based on the three criteria rankings assigned to each health problem and the PEARL test, scores were calculated using the following formula: priority score = [A + (2 × B)] × C × PEARL.

TABLE 1 | Criteria rating of the Hanlon method.

Rating	Size problem % of negative outcome	Magnitude % parental demand	Effectiveness of current La Brigada interventions (%)
9 or 10	>25	>25	80–100
7 or 8	10–24.9	10–24.9	60–80
5 or 6	1–9.99	1–9.99	40–60
3 or 4	0.1–0.99	0.1–0.99	20–40
2 or 1	0.01–0.09	0.01–0.09	5–20
0	<0.01	<0.01	<5

RESULTS

Demographics

Thirty-four patients with a diagnosis of an upper limb difference were screened for this study, (19 males, 15 females). Patient median age was 30 months (IQR 18–63). The right side was most commonly affected, and unilateral conditions accounted for 68%. According to the Oberg–Manske–Tonkin classification for congenital differences, malformations in the hand were the most numerous group (41%) with radial polydactyly as the most common condition screened (15%). Parents of six patients did not complete the interview due to lack of time availability, and one parent did not want to provide socioeconomic information. Parents of 27 patients consented to participate and provided information centered about needs, including environmental, socioeconomic, behavioral, and biological factors determining health.

Determinants of Health

Environmental Factors

Access to sources of water was limited; three (11%) families had to walk a considerable distance to obtain water from wells. While more families reported they had access to electricity, there was still one family (4%) without this service and instead used coal, biofuels, or candles to light their house. All respondents used public transportation, but seven (26%) of the parents reported having difficulties traveling to La Mascota Hospital. Finally, none of the families had insurance coverage, and all received medical attention in public institutions funded by the Nicaraguan government. The provision of basic health-care services was considered by the majority to be accessible and efficient; however, half of the respondents complained that prescribed drugs were only partially covered by the public health system. In addition, 22 (82%) parents reported difficulty accessing specialized care; in particular, this group was concerned that it was difficult to obtain access to a pediatric hand surgeon between La Brigada visits.

Socioeconomic Factors

A total of 19 (70%) of the respondents reported that the father economically supported the family; of those, 13 (68%) were full-time employees. Parents complained that monthly income varied under several circumstances, and nine (33%) respondents reported an unstable income. Regarding the highest level of education in the household, 19 (70%) of parents had completed primary education and started high school, and in one household, none of the parents (4%) had finished primary education.

Individual Behavioral Factors

According to five (19%) of the parents, nutrition in the family was not balanced and included a low proportion of fruit and vegetables. Similarly, 15 (56%) families mentioned that at least 1 member of the household had over or underweight. When asked about physical activity in children, seven (25%) of parents stated that their child performed moderate physical activity for less than 3 h per week.

Biological Factors

History of genetic diseases was reported in four families, two of them similar to the child's pathology. Relatives of three

subjects were diagnosed with radial polydactyly and one with arthrogryposis. Finally, 10 (37%) of the parents mentioned that at least 1 member of the household suffers of chronic conditions (i.e., diabetes mellitus, hypertension). **Table 2** shows a detailed description of factors that are known to be determinants of health.

Health Needs Prioritization

Parents were asked to prioritize the following needs: access to specialized orthopedic care and hand surgeons, improvement of basic health services, family income, employment opportunities, and improvement of child's upper extremity function. In addition to what parents considered important, the process of

prioritization included the input of other stakeholders, in this case health-care providers from La Brigada and local physicians from La Mascota Hospital. They rated the needs considering the internal capacity to develop potential interventions, in such a way that needs were relevant for the community and attainable by La Brigada. **Table 3** shows the variables of the prioritization based on the Hanlon method and the final ranking of needs.

DISCUSSION

La Brigada, under the auspices of HVO, established continuity in volunteering efforts for children with hand problems in Managua,

TABLE 2 | Factors determinants of health derived from interviews to 27 parents of children with congenital upper limb differences in La Mascota Hospital.

Environmental factors	N	%	Economic factors	N	%	Individual factors	N	%
Water for consumption								
Accessible	19	70	Person in charge of expenses			Nutrition		
Less accessible	5	19	Father	19		Balanced	13	48
Inaccessible	3	11	Full-time employee	13	68	Regular	9	33
			Half-time/ <i>per diem</i>	6	32	Not balanced	5	19
Electricity								
Possess electricity	24	89	Household monthly income			Weight		
Irregular service	2	7	Stable	13	48	Normal weight	12	44
No electricity	1	4	Regular stability	5	19	High or low weight	15	56
			Unstable	9	33	Obesity or desnutrion	0	0.0
Housing								
Adequate materials	22	82	Balance of monthly income			Vigorous physical activity		
Regular materials	3	11	Positive (savings)	4	15	Adequate 3 h/week	20	74
Bad housing materials	2	7	Neutral	12	44	Regular 1–2 h/week	4	15
			Negative (debt)	11	41	Low or none: <1–0 h/week	3	11
Transportation								
Accessible	14	52	Social factors			Smoking in household		
Somewhat accessible	6	22	Highest level of education			Nobody smokes	22	82
Not accessible	7	26	Superior studies	7	26	Smoke outside	2	7
Km Distance from La Mascota (median, IQR)	28	8–100	Primary complete secondary	19	70	Smokes inside	3	11
						Alcohol in household		
Security								
Secure neighborhood	18	67	Primary incomplete or no education	1	4	Nobody consumes alcohol	16	60
Minor crimes	7	26	Family time together			Socially 1 day a week	9	33
			Share time together	23	85	Consumption several days a week	2	7
Major crimes	2	7	Busy, little time together	3	11	Personal factors		
Health coverage								
Private insurance covers expenses	0	0	Very little or no time together	1	4	Genetic diseases		
Public institution covers all expenses	10	37	Culture and tradition			No family history of genetic disease	23	86
Public partially covered expenses	15	56	Highly involved	8	30	Family history but not direct family	2	7
Pays out of pocket most expenses	2	7	Sometimes involved	10	37	Family history of genetic condition	2	7
			Not involved	9	33			
Accessibility to basic health services								
Accessible and efficient	19	70	Religion			Medical conditions in household		
Less accessible with delays	6	23	Important and practiced	16	59	Only minor conditions	14	52
Inaccessible	2	7	Sometimes practiced	8	30	Acute diseases (viral diseases)	3	11
			Not practiced	3	11	Chronic conditions	10	37
Access to hand surgeons								
Accessible	1	4						
Less accessible	4	15						
Not accessible	22	81						

Managua, Nicaragua, 2016.

TABLE 3 | Prioritization of needs according to Hanlon method.

Most important perceived need (order in interview)	Size	% negative outcome	Seriousness	% parent priority	Effectiveness	PEARL	Priority score	Rank
Access to specialists	10	81.5	8	21.7	8	1	208	1
Access to rehabilitation	6	7.4	5	2.2	8	1	128	2
Improve UE function.	5	7.7	6	7.6	5	1	85	3
Transportation	9	25.9	6	6.5	3	1	63	4
Physical activity	7	11.1	5	3.3	3	1	51	5
Family support	5	3.7	5	1.1	3	1	45	6
Employment	9	31	6	9.8	2	1	42	7
Diseases in the family	9	37	5	2.2	2	1	38	8
Weight	0	0	5	4.4	2	1	20	9
Access to basic health care	6	7.4	7	13	2	0	0	10
Culture, traditions, and religion	9	33.9	0	0	1	0	0	10
Education	5	3.7	6	7.6	2	0	0	10
Habits: smoke, alcohol	7	11.1	5	1.1	2	0	0	10
Housing	6	7.4	6	6.5	0	0	0	10
Money expenses	9	40.7	5	1.1	0	0	0	10
Money income	9	33.3	7	10.8	0	0	0	10
Nutrition	8	22.	6	5.4	2	0	0	10
Security	6	7.4	5	1.1	0	0	0	10
Water, electricity	7	11.1	5	2.2	0	0	0	10

Nicaragua, in 2009. Through 16 biannual trips, La Brigada has not only provided specialized health-care services to patients with upper limb pathology but also has formed a partnership with Nicaraguan colleagues which has proven to be effective strengthening local health-care efforts of delivering surgical care to children with hand pathologies. By training a local surgeon, the partnership aims to cover a gap in the shortage of specialists in Nicaragua, addressing one of the major problems in low- and middle-income countries.

Due to this collaborative alliance, La Brigada has gained the confidence of La Mascota Hospital administration to extend efforts beyond volunteering and training, by exploring health promotion opportunities through research endeavors that improve other aspects of health. In order to promote health, however, the first step is to gain a deeper understanding of what the patient needs and to determine if health-care professionals have the capacity to make the improvements the patient and the family request. In addition, this analysis also made clear the role of social determinants of health in relationship with access to health-care services. Children with congenital upper limb differences are more susceptible to long-term disability due to physical impairments (9), but in addition, their development might be more under the influence of their socioeconomic environment (8). For that reason, the partnership aims to improve health care for children by determining the unmet health needs of children with congenital upper limb differences and the understanding of social determinants of health with the goal of developing a plan of action that successfully addresses factors within the context of the priorities of the community. Considering the opinion of all stakeholders (parents, patients, and members of la Brigada de las Manos as well as Nicaraguan colleagues), the assessment revealed the most important needs that are relevant for children with congenital differences and are considered achievable to the health-care team, which are as follows:

Health Need 1: Improving Access to Orthopedic Surgeons and Hand Surgeons

Respondents uniformly expressed that the most important health need is related to their child's condition, ranking first the need for hand surgeons who specialize in the treatment of congenital upper limb differences. Parents favorably viewed visiting surgeons from La Brigada and were very appreciative of their services; however, the priority of this need reinforces the importance of training local surgeon(s) who can serve these patients throughout the year. To that end, La Brigada has prioritized training a local orthopedic surgeon the necessary skills to perform pediatric hand surgical procedures independently. This training strategy to date has proved to be successful, as this physician has carried out hand surgeries in children with congenital pathologies such as polydactyly and syndactyly when La Brigada is not present with favorable results. Although this training will make specialized care more available at La Mascota Hospital, it does not meet the needs of communities that are distant to Managua.

Health Need 2: Improving Access to Rehabilitation and Therapists

The second need derived from the analysis is that patients perceived the need to increase in the capacity of rehabilitation services, especially the ability to fabricate splints with thermoplastic materials. Since La Brigada started recurrent trips to La Mascota, the fabrication of splints has relied on donations of splint material from volunteers and requires the guidance of U.S. therapists. Through continuous skills training, a pool of local therapists has been able to gain proficiency in splint fabrication to cover the basic needs of patients in La Mascota Hospital. While this method has proven effective for training purposes, donated materials do not meet the local demand of the locally trained hand surgeon and therapists. This area of need requires more institutional

compromise to extend the partnership to areas beyond training of local therapists; with institutional negotiations an agreement could be reached with industry that can provide materials at low cost. There is the need to establish a local institutional mechanism that guarantees the provision of resources instead of relying in donations.

Health Need 3: Improving Upper Extremity Function

As result of the examination of PROMIS questionnaires, patients and parents acting as their proxy expressed the importance of improving child's upper extremity function. It is not surprising that upper extremity function is affected in this patient's population. Prior research has shown a wide spectrum of outcomes depending on the type of congenital difference and the level of involvement. For example, patients with unilateral below-the-elbow deficiency exhibit deficits in upper extremity function when compared with controls (8, 15, 16). Parents believed that improving function would optimize performance for future employment opportunities. A congenital condition is sometimes stigmatized (17), and if children are perceived as unable to perform a manual task, they are at a relative disadvantage compared with same age peers.

Health Need 4: Improve Access to Transportation

Parents frequently complained of the difficulty accessing surgical services due to several factors related to distance, poor roads, lack of suitable transport, and cost related to accessing the hospital. The first inconvenience is the distance they have to travel from their communities, as on average, families traveled 57 km to get to La Mascota Hospital. Second is the cost, because public transportation is infrequent in rural areas, a round trip to the hospital is lengthy, and some families have to travel 1 day in advance and stay overnight in a hotel in order to arrive in time for their child's appointment, which increases the cost of the trip. Parents may also have to take unpaid time off to travel with their child to the appointment.

Health Need 5: Increase physical activity

Overall, parents expressed that their children were active; however, 25% of them are not getting the necessary physical activity recommended by WHO of 3 h of moderate to intense physical activity per week. In addition, parents expressed that patients were not involved in many sports that required upper limb involvement due to the perceived physical limitation. There were several reasons for this, but the most important were their fear of rejection by other children, and they felt unable to practice certain sports because of their physical impairment.

Lessons Learned

After analyzing the needs of families and considering the capacities of La Brigada, the next steps this partnership between American and Nicaraguan health providers became apparent. Based on the findings, possible interventions were outlined to improve health of patients with congenital upper limb differences. La Brigada is already addressing the most important need by providing

pediatric hand surgery training to a local orthopedic surgeon who will care for patients with congenital differences between la Brigada visits, increasing access to specialists. This surgeon, in turn, works with Nicaraguan orthopedic surgery residents from three local training programs. Similar "train the trainer" strategies have proved effective in orthopedic surgery. One example of the initiatives on non-surgical care has been physician education in the Ponseti method to treat clubfeet in developing countries (18). Similarly, private non-profit organizations have improved the availability and quality of health care in developing countries through the education of local health-care workers—from general surgeons to clinical officers to orthopedic assistants—in musculoskeletal conditions (19).

In a similar effort, the need for physical therapists has also been addressed as part of the ongoing efforts of La Brigada. Physical therapists in La Mascota hospital are being trained in the fabrication of splints due to the high demand of services for patients with congenital differences and neuromuscular problems. However, the need to make splint materials more available to local therapists in La Mascota persists. Local therapists currently rely on donated material, but this is not sustainable in the long term. In response to results from this needs assessment, La Brigada's therapy director will work to engage the hospital's administration and local institutions to develop purchase mechanisms that will allow the acquisition of a steady supply of thermoplastic materials, thus making splints more available for the community.

In response to the need for increased access to orthopedic services in remote locations, La Brigada plans to initiate an outreach clinic in Leon, a large population center 75 km from Managua, so that only patients who need surgical care (20–25% of those seen in the La Brigada clinics) will have to travel to La Mascota Hospital. Similar strategies to deliver care in rural areas have been implemented in other areas of medicine with promising results, as is the case of mobile clinics dedicated to cancer screening (20), dental care (21), and maternal and child services (22).

Finally, in an effort to improve upper extremity function, physical activity, and sports participation, La Brigada will work to develop an intervention for skills training focused in promoting function enhancement and activity performance that will lead to increased physical capacities of patients with congenital upper limb differences. Several young adults with congenital hand differences have recently joined La Brigada as volunteers; the development of skills training programs may be a possible role for them on future trips as they have shown to be successful in people with disabilities (23, 24).

CONCLUSION

The purpose of this health needs assessment was to discover the most important health needs of children with congenital upper limb differences and to propose interventions to address their needs, considering the opinions of the community. An approach that takes into account social determinants of health and considers the opinion of families is important to develop effective and long-lasting interventions that suit the social and economic environment of the family. In addition, the case study highlighted the importance of having organized partnerships that have built

a long-standing relationship of trust with local authorities and community members and have committed resources to the improvement of health of this vulnerable population. An assessment of health needs should be considered one of the first activities of global health partnerships, because this process guides the efficient allocation of resources and maximizes results, taking in account what the community needs. As result of this case study, we learned that the most important need for patients and families is improving access to specialized care for their child's condition, including hand surgeons and rehabilitation services that will improve child's upper extremity function. In addition, parents expressed difficulty accessing the hospital from distant places and they will benefit from strategies that address this problem. Finally, there was the need to improve physical activity and sport participation as means to increase social inclusion and acceptance in their community. Health-care providers from La Brigada and Nicaraguan partners in response to this assessment have identified potential solutions to these needs and are currently working in future interventions.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the Human Research Protection Office with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the University of Massachusetts—Amherst Institutional Review Board and La Mascota Hospital Director.

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The Development of a Postgraduate Orthopaedic Manual Therapy Residency Program in Nairobi, Kenya

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Introduction: There are very few opportunities for long-term, comprehensive post-graduate education in developing countries because of fiscal and human resource constraints. Therefore, physiotherapists have little opportunity following graduation to advance their skills through the improvement of clinical reasoning and treatment planning and application.

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Background: To address the need for sustainable advanced instruction in physiotherapy within the country, a postgraduate Residency program was initiated in Nairobi, Kenya in 2012. The mission of the program is to graduate advanced orthopedic practitioners who can lead their communities and local profession in the advancement of clinical care and education. Since its inception, six cohorts have been initiated for a total of 90 resident participants. In addition, six program graduates are being trained to continue the Residency program and are serving as teaching assistants for the on campus modules. This training will result in a self-sustaining program by 2020.

Discussion: The manual therapy Residency education model allowed for advancement of the participating physiotherapists professional development utilizing evidence-based practice. This was done without altering the current education system within the country, or accessing expensive equipment.

Concluding remarks: The Residency program was developed and established with the cooperation of a local education institution and a non-profit corporation in the United States. This collaboration has facilitated the advancement of orthopedic clinical standards in the country and will, hopefully, one day serve as a template for future programs.

Keywords: Residency program, Kenya, clinical reasoning, physiotherapy, manual therapy

INTRODUCTION

In the year 2000, it was estimated that there were 234 million moderately or severely disabled people living in developing countries (1). This number is projected to grow to 525 million in 2035 (1). Although there are limited numbers of physiotherapists available to provide services in these countries, there is a possibility to maximize the potential and skills of the physiotherapists who do exist for

the benefit of those in need of services. However, there are very few opportunities for long-term, comprehensive postgraduate clinical education in developing countries because of fiscal and human resource constraints. Therefore, physiotherapists have little opportunity to improve clinical reasoning and treatment skills (2). To promote the profession of physiotherapy in Kenya, an orthopaedic Residency program was developed in Nairobi, Kenya.

BACKGROUND

Physiotherapists in Kenya currently have the opportunity to earn a 3-year diploma or a Bachelor of Science degree in the field of physiotherapy (3). According to the World Confederation for Physical Therapy, education for entry-level therapists should include a minimum of 4 years of university level courses (4). In addition, physiotherapists should be committed to pursuing educational opportunities following entry-level education to promote the development of the profession (4). Access to advanced instruction, fundamental to promoting educational development, is limited in Kenya. One factor restricting advanced instruction has been the shortage of physiotherapists with advanced degrees and specialty training to offer educational opportunities following entry-level education (2).

Development of the Residency Program

To assist with the progression of clinical reasoning and skill development, an Orthopaedic Manual Therapy Residency (Residency) program was introduced in Nairobi, Kenya in 2012 (5). The Residency is a partnership between the Jackson Clinics Foundation (Foundation) in the United States (US) and Kenya Medical Training College (KMTC) in Nairobi. The Foundation is a non-governmental organization formed for the purpose of funding humanitarian efforts in Africa (5). The Foundation provides the recruitment and transportation of qualified instructors from universities and clinics throughout the US to Nairobi, Kenya. KMTC secures housing for instructors, provides teaching space for the program, and grants a Higher Diploma in Orthopaedic Manual Therapy to successful graduates of the Residency program. The mission of the Higher Diploma Program is to graduate advanced orthopedic practitioners who can lead their communities and local profession in the advancement of clinical care and education.

Multiple steps were taken to establish a long-term educational program, including comprehensive didactic education and clinical mentoring, to improve clinical practice and health-care delivery by physiotherapists in Kenya. During the development of the program, meetings were held with key stakeholders; the Foundation, the director of the KMTC, and the head of the department of physiotherapy education. Discussions centered on a shared vision and mission for the program. Common goals for the program were agreed upon. In addition, details regarding what each stakeholder could provide to ensure the success of the program were examined. Following the development of the mission for the program and drafting of a Memorandum of Understanding, the goals and scope of the program were shared with the University of Nairobi and Kenyatta University to ensure

that misunderstandings did not ensue. In addition, the program was presented to the Ministry of Health. Once the program was accepted by all parties, the development of the content was addressed by the Foundation and physiotherapy faculty at KMTC.

Program Content

The physiotherapists participating in the Orthopaedic Manual Therapy Residency program have a 3-year technical diploma in physiotherapy and have reported no previous access to continuing education throughout their careers. The residents complete six modules over 18 months. The online didactic portion of the program utilizes the Clinical Practice Guidelines and Current Concepts in Orthopedics, 3rd edition (American Physical Therapy Association) as background reading and preparation for participation in onsite modules (6). Each module takes place during 10 days of onsite education and mentoring provided by physical therapy instructors from the US. Instructor qualifications include currently a faculty member teaching in the area of orthopedics within an accredited physical therapy program or having an advanced certification in both orthopedics and manual therapy. The purpose of each module is to provide the residents with the didactic education and clinical skills consistent with the orthopedic curriculum provided by professional doctorate in physical therapy programs in the US.

In addition to onsite modules and online resources, residents receive clinical mentoring focused on integrating the knowledge and skills learned during the Residency program into clinical practice. Although 90% of residents work within the Nairobi area, 10% work outside of the city. To allow for mentoring of these residents, KMTC contracts with providers to allow the residents to practice as students within local facilities. To progress in the program, residents must achieve adequate performance on written and practical examinations provided at the completion of each module. Following completion of the 18-month Residency program, residents must successfully pass a comprehensive written examination and a live patient practical examination to earn the Higher Diploma.

Participants

Since 2012, 51 volunteers from the US have provided instruction in the Residency program as didactic instructors and clinical mentors to the Residents. The first cohort of the program graduated in December 2014, and the second cohort graduated in December 2015. Currently, four additional cohorts are in progress of completing the Residency program for a total of 90 Residents. Although significant support has been provided through the Foundation to institute the program, a train-the-trainer program has been established. Six graduates are currently being trained to continue the Residency program and are serving as teaching assistants for the on campus modules. Mentoring is being provided to the teaching assistants to allow progression of their understanding of the content and effective delivery skills for teaching both didactic and procedural knowledge. The training of graduates to provide ongoing education will result in a self-sustaining program by 2020.

Costs

The estimated cost of the Residency program over 6 years is \$600,000. The Foundation has provided the costs associated with airfare from the US to Kenya for volunteers. Furthermore, the Foundation has sought professionals with specialty training in manual therapy to provide mentoring for the residents in their current clinical setting focused. This mentoring focuses on integrating the knowledge and skills learned during the Residency program into clinical practice. KMTC provides the resources and facilities needed for the onsite modules. These include a large gym space with standard treatment tables and exercise equipment and audiovisual equipment. KMTC also arranges lodging and transportation for the volunteer instructors and mentors. Residents pay \$1,100 in tuition for the program (the equivalent of three months salary) to offset some of the local costs. As a gift from the Foundation to successful graduates, a messenger bag with an inclinometer, two goniometers, pinwheel, reflex hammer, exercise band, stethoscope, pulse oximeter, and blood pressure cuff is provided at graduation. This provides the graduates with some tools for providing treatment to patients.

DISCUSSION

Even though residents verbally relayed their gratitude for the education, a formal program evaluation was initiated to begin to explore the outcomes of the Residency program and discover any facilitators and/or barriers for participation in the program. In addition, the Foundation hoped to determine obstacles to the integration the newly acquired knowledge and skills gained through the Residency into clinical practice. Outcomes were explored through a mixed methods approach with interviews and a paper survey.

Outcomes

All 15 residents in the first (2012) cohort of the Residency program consented to participate in the outcome measurement process.

Interviews

Individual interviews with residents were conducted following completion of their final live patient practical examination. Interviews were audio recorded and transcribed by an independent transcriptionist to ensure accuracy. The descriptive phenomenology approach was utilized to describe the data. The information from the interviews was coded using the constant comparative method by two investigators, and general themes were identified specifically addressing facilitators and barriers for participation in the Residency program and the implementation of new skills in clinical practice. Thick descriptions and narrative of the participants were provided to inform the themes. The following themes were identified: (1) there was an initial discontent expressed by colleagues regarding participation in the Residency and the required time away from the clinic to participate in onsite modules; (2) patients' required education regarding manual therapy treatment techniques to be comfortable with the new approach to care; (3) residents

experienced a decrease in productivity as they were practicing new skills and assessment techniques in the clinic; (4) there was a positive impact on the ability to utilize clinical reasoning to determine multiple hypotheses for the patient's diagnosis and then effectively determine a working diagnosis for which to choose evidence-based treatment techniques; and (5) mentoring in the clinic was the most effective method for integrating knowledge into practice.

Survey

The primary researcher developed a 19-item written survey to determine the impact of the Residency program on professional development and career advancement. The survey was adapted from a tool that had been used previously in studies related to outcomes of residency training in the US (7, 8). The survey contained 12 questions related to professional development. Each question had six possible responses: "major positive," "some positive," "no effect," "some negative," "major negative," and "unable to assess." Cronbach's alpha for the 12 questions related to professional development was 0.884. The survey also contained seven questions related to the influence of the Residency program on career advancement. Because the alpha for the seven items calculated at 0.672, two items related to career fulfillment and research opportunities were removed from the questionnaire based on this assessment. The responses two items were consistent for all 15 residents. Alpha for the five remaining questions related to career advancement was 0.713. Similar to the results found in the US (7, 8), the graduates reported a positive influence of the Residency training on their professional development including their ability to: perform a thorough clinical examination; use a logical clinical reasoning process; determine the nature of a patient's problem; treat complex patients; treat effectively to achieve projected outcomes; perform overall patient management; use scientific literature to provide rationale for interventions; critically read and evaluate scientific literature; communicate with patients; and communicate with other health professionals. In addition, graduates reported an increase in the number of patient referrals and the number of professionals referring patients to them. However, in regard to career advancement; the residents reported no change in salary, job promotion, or access to research opportunities related to participation in the program.

CONCLUDING REMARKS

Residency programs emphasizing clinical reasoning and manual therapy could provide a means to optimize the effects of physiotherapy (minimize pain, normalize movement, and maximize function) without the need for or access to expensive equipment. The Residency format provided in Kenya could allow physiotherapists with technical degrees access to specialty training and ongoing mentorship without a substantial change to educational infrastructure for entry-level education currently provided at higher education institutions within developing countries. The outcomes from the first cohort of the Residency program and the continued positive collaboration between institutions in the US and Kenya suggest that the program is positioned for a

sustainable impact on patient care. The success of this program may provide a template for the future development of similar long-term programs in countries with limited resources.

ETHICS STATEMENT

This research was approved by the Kenya Medical Training College Ethics and Research Committee and the University of Evansville Institutional Review Board. Residents were made aware of the upcoming study by the residency coordinator in Kenya through verbal communication in June 2014. In September 2014, the primary investigator traveled to Kenya. She discussed the purpose of the study, procedures associated with the study (survey completion and one-on-one interviews), and requirements for time involvement up to 50 min. Written consent was obtained. Instructors in the Residency program were not aware of which residents consented to participate in the study, and participation did not affect the residents performance or standing within the program.

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AUTHOR CONTRIBUTIONS

SC: developed the methodology for surveys and qualitative research performed to investigate outcomes associated with the Residency program; analyzed the results of the quantitative and qualitative data. RJ: instrumental in developing the curriculum for the Residency program in Kenya; collaborated with the Kenya Media Training College for develop and initiate the Residency program; and assisted with writing information regarding the development of the program. DM: instrumental in coordinating efforts with administrators from both the United States and Kenya; coordinated data collection in Kenya. JM: assisted with methodology development for the outcomes research associated with the Residency program.

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Conflict of Interest Statement: RJ is the founder of the Jackson Clinics Foundation. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Internal Medicine Residency Program in Guyana: A Collaborative Model for Sustainable Graduate Medical Education in Resource-Limited Settings

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The Georgetown Public Hospital Corporation (GPHC) started the Internal Medicine/ Infectious Diseases residency program in 2013. It was a collaborative initiative between GPHC and University of Maryland. Since that time the program has gone through many trials and developed new partnerships and collaboration and emerged as a young successful program with close international links that have worked and persevered in developing the successful academic and professional careers of its residents. International collaborations have resulted in applying innovative methods of teaching to deliver the curriculum in a sustainable manner in a resource-limited setting. The article discusses in detail the history of the program and the roles that the collaborative partners have played in the evolution of the program.

Keywords: global health, Medical Education, Collaborations, Collaborative Learning, Collaborative Research, Internal Medicine, residency training, residency program

A LITTLE ABOUT GUYANA

The Cooperative Republic of Guyana [(Figure 1), (1)] is a small country on the northeastern coast of South America. Its population of approximately 750,000 is multiethnic and multicultural, with 43% Indo-Guyanese, 30% Afro-Guyanese, 17% mixed and the Indigenous Peoples, known as Amerindians, contribute to less than 10% of the populace. In contrast to most of its South American counterparts, where the overwhelming majority of the population lives in large cities with the average urban population for the Continent being close to 80% (2), presently only one in four Guyanese lives in a city or town (3). This difference being largely due to the lack of industrialization in urban centers in Guyana (4).

Over the past five decades, Guyana's population annual growth rate has fluctuated widely due to the influence of multiple factors, such as the political establishment and socioeconomic conditions of the day, on the degree of outward migration. For example, during the 1980s when Guyana's economy became heavily indebted and its currency was significantly devalued, the population declined to its lowest in modern times, due to an increased rate of emigration (5). Differences in earnings among countries and the availability of the labor market in other Caricom member states are also certainly factors that encourage migration (6). The largest numbers migrate from urban areas and include many well-educated professionals. In fact, Guyana has the highest rate of emigration of individuals with tertiary education in the world, where nine out of every 10 tertiary educated persons are migrating (7).

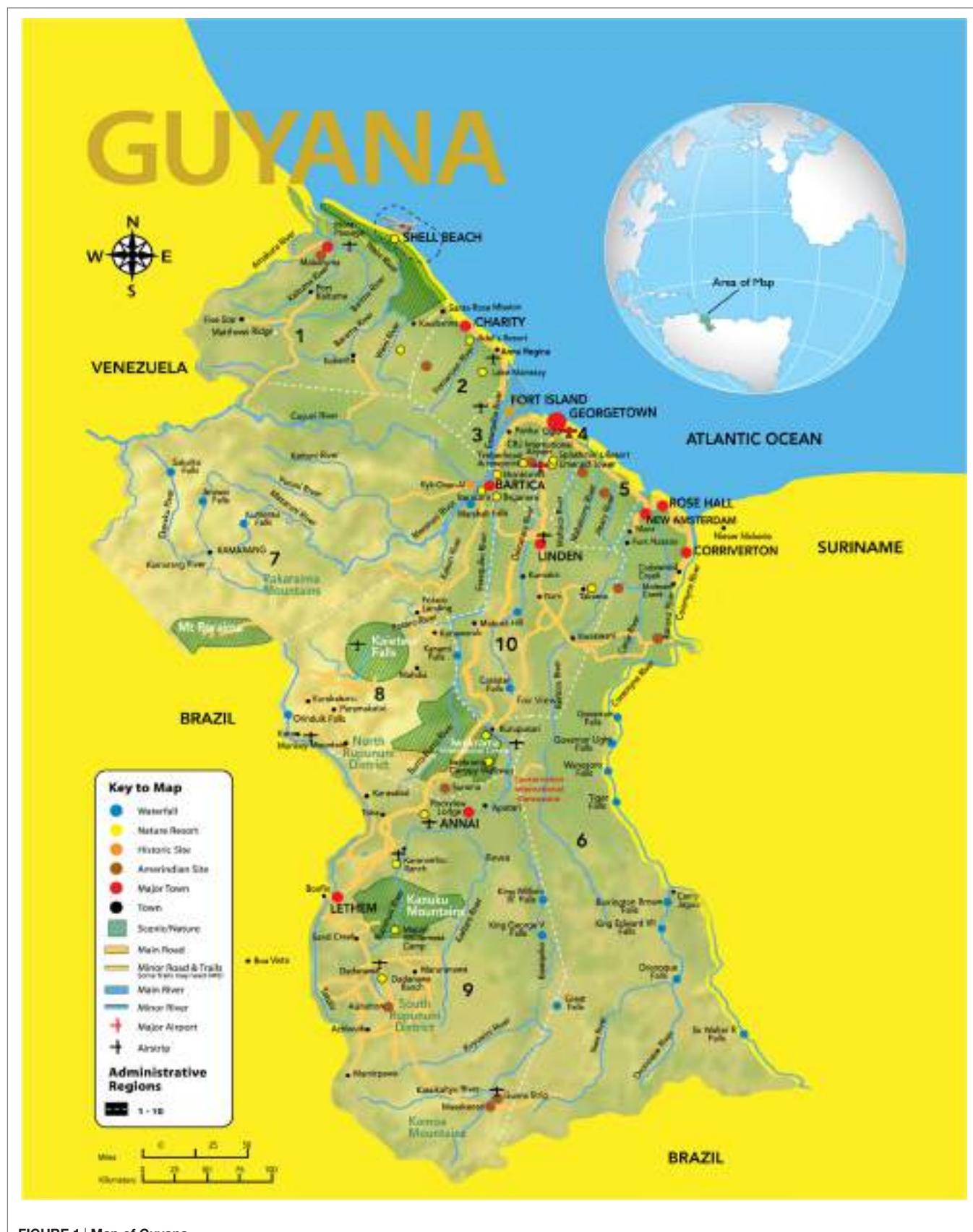


FIGURE 1 | Map of Guyana.

THE NEED FOR IN-COUNTRY GRADUATE MEDICAL EDUCATION PROGRAMS

Like many of its Caribbean counterparts, Guyana is experiencing an epidemiologic transition with the highest burden of morbidity and mortality now being due to non-communicable diseases, such as ischemic heart disease and diabetes mellitus, while some communicable diseases still present formidable challenges. Human immunodeficiency virus (HIV) infection/AIDS is also a significant contributor to morbidity and mortality and is in fact the leading cause of mortality in both males and females in the 25–44 years age group (8). The vast majority of doctors and nurses who serve population through a network of regional and district hospitals, health centers, and health outposts only have basic training.

Before the establishment of the University of Guyana Medical School and its 5-year Bachelor of Medicine; Bachelor of Surgery program in 1985 (9), all doctors in Guyana were trained outside the country in places such as the United Kingdom, India, Cuba, and the Soviet Union. However, it was not until the initiation of a diploma in Surgery, diploma in Orthopedics, and diploma in Nursing Anesthesia programs in 2006 at the Georgetown Public Hospital Corporation (GPHC), Guyana's main referral and teaching hospital, that access to Graduate Medical Education became available locally. As such, with no opportunities for further training locally after internship, combined with poor income opportunity and uncertainty created by political instability, many health-care workers, in particular doctors and nurses, have migrated over the years (10). As a result, Guyana has had a shortage of health-care professionals, resulting in reduced access to basic health care in the country. The World Health Organization notes that in Guyana in 2005, there were only 2.1 physicians and 5.3 nurses and midwives per 10,000 population compared to regional figures of 20.4 and 71.5, respectively (11). Anecdotal information provided by the Medical Council of Guyana indicates that as of March 2017, there are 900 fully registered physicians and 400 institutionally registered physicians in Guyana.

Subsequent to the introduction of the above mentioned programs, several other graduate medical education programs including residencies in Emergency Medicine, Obstetrics and Gynecology, Pediatrics, Internal Medicine, and Family Practice were established at the GPHC in the 2011–2015 period, through the Institute of Health Science Education (IHSE) in collaboration with the University of Guyana and a multitude of international partners. These programs would not only provide opportunities for medical professionals to get specialist training locally but potentially be cost effective, having a holistic curriculum, teaching effective and relevant patient care skills and forming a pool of candidates to make the programs a sustainable venture.

BEGINNINGS OF GPHC INTERNAL MEDICINE/INFECTIOUS DISEASE (IM/ID) RESIDENCY AND JOURNEY TO GRADUATION OF FIRST COHORT

Through a joint initiative by the IHSE, GPHC, and the Institute of Human Virology, University of Maryland and with support

by a new 5-year grant from the US Centers for Disease Control and Prevention (CDC) as part of the President's Emergency Plan for AIDS Relief, a 3-year Masters in Internal Medicine Degree program, accredited through the University of Guyana, was designed. The first batch of six residents started on January 14, 2013.

It was envisioned that the program would be supervised under the continuous presence of faculty from the University of Maryland, with the support of local faculty. The latter proved difficult with very few local IM specialists and none that were able to champion the program in leadership capacity. In August 2013, the University of Maryland hired an ID-trained physician to be the full-time in-country program director and to serve as the local champion. Somewhat unexpectedly, the funding support for the program was terminated early, creating a new challenge for the program. At this point, the program had not yet graduated its first class and had enrolled more participants. As notable gains in patient care and education had been shown, the Ministry of Health and IHSE recruited the program director to stay beyond the end of grant funding period. The primary goals during the extension were for the director to facilitate the graduation of students who would become faculty and to form new academic partnerships for curriculum development and integrity. Over the past 3 years, much progress has been made in this respect and the curriculum, in its present form, is the result of collaboration with faculty from many internationally recognized institutions of learning. This is further discussed in the sections below.

In the past more than 500-odd inpatients per month were managed by one consultant and a few general medical officers and interns, with no morning handover and rounds lasting from morning till evening. Now, a similar number of patients are managed by more than 30 doctors divided into six teams, headed, respectively, by graduates from the first cohort of students, 10 residents (3 PGY-1, 5 PGY-2, and 2 PGY-3s), several general medical officers, and interns. In terms of the resident demography, there are nine female residents and seven male residents (this includes the graduates as well), and among them nine graduated from medical school in Cuba, two in Russia, and five from the University of Guyana. The increase in the number of physicians has also been augmented by an influx of Cuban consultants hired by the Ministry of Health (who also supervise some of the teams) and large numbers of Cuban-trained Guyanese medical graduates who are returning home for further clinical training.

THE CURRICULUM

The stated goal of the IM residency program is to provide specialty training in IM with special focus on IDs in order to develop high-quality IM physicians who will enhance the quality of the health care and well-being of the people of Guyana. To achieve this goal, the curriculum encompasses both academic and clinical training components.

Academic activities are compulsory and are not only intended to improve the knowledge-base of residents but also to improve their scholarship, encourage the application of the best available evidence in clinical practice, and develop skills in root cause analysis and approaches to quality improvement. These activities

are conducted utilizing a variety of learning modalities which include the following:

1. Modular systems-based didactic series—each module is accompanied by a study guide and it usually takes 1–2 months to complete the specific lecture series. Didactic lectures are conducted once or twice weekly either (a) in a classroom by resident or visiting faculty using slideshows, whiteboard, and bedside demonstrations where applicable or (b) via teleconference (**Figure 2**) with non-resident faculty or residents from other programs with whom there is collaboration. As the lecture series for each module progresses, residents simultaneously engage in a senior resident-moderated group study to cover specific objectives and practice and discuss board review questions. Each module usually concludes with a multiple choice question exam.
2. Resident case presentations—case-based discussions on diseases and their management.
3. Journal club—occurs once to twice monthly. Articles on topics of interest are chosen and reviewed with registrars and then recommended to be critically analyzed and presented in a specified format by the residents (12).
4. Morbidity and mortality rounds—these are held monthly and the medicine department meets to discuss the morbidity and mortality statistics for the previous month and two or three cases of interest. These cases are not just presented, but analyzed using a health-care matrix (13), and the points needing clarification or improvement are noted by a designated resident, who is responsible for following up for the next meeting. The points noted in these discussions also serve as starting points for potential quality improvement projects.

The clinical training component of the curriculum spans the 3 years of the program and allows residents to work and learn on rotations in a variety of clinical settings. Each rotation block usually lasts 4 weeks. The rationale behind—and expectation of residents in—these rotations are highlighted below:

1. Inpatient medicine: the inpatient IM rotations form the bulk of the rotations and serve as the foundation of the inpatient general medicine/IDs experience with an emphasis being placed on cost containment, medical ethics, and preventive medicine when applicable.



FIGURE 2 | Teleconference lectures.

Residents are expected to function as team leaders, supervising all members of the team and guiding the clinical care of the patients and educational development of the interns and students. They also attend and guide discussions at daily morning handover, which ensures continuity of care and provides teaching opportunities. At least once a week, senior residents and registrars “run the whiteboard” and conduct hands-on resuscitation demonstrations (low fidelity simulation using resuscitation mannequins) during the morning conference.

2. ID ward: this is dedicated to the investigation and treatment of tuberculosis. Residents rotate on this service at least once per year, and this entails interacting with unique patient populations and collaborating with the National Public Health Reference Laboratory and Georgetown Chest Clinic. Students are exposed to the use of modern technologies such as GeneXpert and plan and organize long-term care for patients.
3. General cardiology and cardiac intensive care unit: this inpatient service and unit were recently established by professors from the Libin Cardiovascular Institute, University of Calgary—presently one of the major collaborators with our IM/ID residency program. Residents work at least one block a year on this service under the guidance of visiting cardiologists and fellows, and a resident registrar, being exposed to a wide range of cardiovascular pathologies in stable and critically ill patients.
4. Outpatient medicine: weekly clinics are included as part of all inpatient rotations which provide residents with an experience in outpatient management and allow them to appreciate the natural history of disease and become familiar with common problems encountered in the practice of general IM. There is a focus on preventive medicine, cost containment, and psychosocial/behavioral issues. They are also taught how and when to seek subspecialty consultation and how to provide general medicine consults to other clinical specialties.
5. HIV outpatient clinic: this rotation occurs once per year at the National Care and Treatment Institute under the guidance of its director and provides interaction with various populations including prisoners, pregnant women, members of the LGBT community and these are patients with both newly diagnosed HIV and its complications. On this rotation, residents are also exposed and involved in the diagnosis and treatment of other sexually transmitted infections.
6. Emergency room (ER): this is an intense one block rotation, the goals of which are twofold: to provide an opportunity for residents to care for patients in an acute setting with a broad spectrum of medical, surgical, and gynecological diagnoses and to expose them to a full range of acuity—from trauma and medical resuscitations to ambulatory care.
7. Intensive care unit: the intensive care unit receives patients primarily from the medical wards, ER, and transfers from other hospitals. The main goal of this rotation is to provide a milieu for residents to learn the basic principles of critical care medicine. Residents work one block per year in this unit, where they care for critically ill patients with a broad variety of medical illnesses under the guidance of a faculty member and in conjunction with the anesthesia program at GPHC.

8. Senior regional service rotations: this is a two block rotation done by senior residents at a regional hospital, such as the West Demerara Regional Hospital, in their third year of the program. The goals of this rotation are to provide the experience of more independent clinical practice, increase awareness of the systems outside of GPHC, the challenges, and advantages of practicing in such a setting. Residents are also required to provide a service to the regional hospital in either a quality improvement, educational, or research project.
9. International rotations: in collaboration with international partners from McMaster University and the University of Calgary, senior residents in their third year are able to do a two-block elective in nephrology, general IM, or cardiology at teaching hospitals associated with these institutions. International electives are an essential part of the program and not only expose residents to advanced diagnostics and treatments, and increase their depth of knowledge, but they also see what it is to practice in a highly efficient system, and inspire ideas for quality improvement back home.

In the future, there is also plan to take the residents on outreach programs to the rural areas to screen and assess for chronic medical diseases such as diabetes and hypertension and to do patient education regarding these diseases.

ASSESSMENTS

In addition to actively taking part in the academic and clinical training aspects outlined in the curriculum, residents undergo several assessments that serve a variety of purposes for both the resident and the program:

1. Clinical evaluations: residents receive clinical evaluations for each rotation based on the six-core competencies outlined by the Accreditation Council for Graduate Medical Education: Patient Care, Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills, Professionalism, and Systems-Based Practice (14). In addition to the assessments performed by supervisors, resident-to-resident peer assessments are also performed, which are used solely for formative feedback purposes.
2. Subject exams: at the end of a lecture series of a particular module, residents are assessed in a multiple choice question exam with case-based questions.
3. American College of Physicians (ACP) In-training exam: once a year, second- and third-year residents do the ACP In-training computer-based residency exam. Residents receive individualized reports and assessment of knowledge based on content areas for the purposes of directing their study efforts. The in-training exam is not used for purposes of promotion.
4. Annual written examination: the annual exam is written by program faculty and assesses content covered during the year. A passing score is required for promotion.
5. Final examination: at the end of the program, residents undergo a final exam to determine their competence to practice as Internists. This is both a written and oral examination. The oral portion is administered as an Objective Structured

Clinical Examination designed to test communication, procedural, and clinical reasoning skills. The examination is written by program faculty in collaboration with external examiners from partners at Caribbean and/or North American Universities.

Our first cohort of six residents passed their final examinations successfully in November 2016. They started as registrars in the hospital and remain an integral part of the residency program. Since the program started, four residents left the program; one had to leave after repeatedly failing remediation courses and three left due to other personal commitments.

NEED FOR COLLABORATION

A young residency program needs a lot of nurturing to bloom to its full potential. A resource-limited setting with just one resident faculty member can lead to a challenging environment in which to make this feasible. Although GPHC had other residency programs that could mentor the medicine program—partnerships and collaborations became a necessity to develop further on the foundation of the residency program and help develop and sustain the program at international standards. Collaborations with academic leaders in the field foster a process of self-appraisal and improvement and provide networking opportunities that broaden the horizon of medical education and academic scholarship far beyond the local boundaries.

INTERNATIONAL COLLABORATION

At present the GPHC program collaborates with the following universities: McMaster University, University of Calgary, University of Pittsburgh, and a recently expanded collaboration with Health Volunteer Overseas (HVO). The collaborations have been developed with an open, trusting, and negotiable memorandum of understanding. The goals of the collaboration are to focus on the following:

1. Clinical teaching and supervision

Visiting faculty from each of the universities volunteer their academic and clinical time at GPHC and are provided medical licensure by the Guyana Medical Council. They provide clinical supervision, mentorship, and bedside teaching to the residents, medical students, medical officers, and interns participating in patient care. Having experts from different specialty areas and academic backgrounds provides the learners at GPHC ongoing dynamic perspectives by which to discuss different approaches to the clinical cases that they see everyday. It also gives them an opportunity to discuss evidence-based medicine and understand the application to their local surroundings and resources.

Visiting faculty also fill in the gaps in the delivery of the formal curriculum—i.e., delivery of lectures, case discussions, and supervision of journal clubs. Didactic lectures and case-based discussions are not only facilitated in person but also via teleconference on a fixed schedule by faculty and residents from partner universities.

2. Curriculum development and assessment

Although a formal curriculum has been developed by the program director and has been adapted to the local health-care needs and to the requirements of the academic program, fresh perspectives, critical appraisal, and assessment are essential. Faculty in partner universities have been recruited to collaborate on further development and delivery of the curriculum. Assessment (summative and formative) tools are being adapted and implemented to allow for more well-rounded assessment of the residents. Simulation (**Figure 3**) has been incorporated as part of the curriculum to teach clinical reasoning skills, resuscitation skills, and communication skills. An ultrasound curriculum (**Figure 4**) has been developed and implemented to assist learners in bedside clinical assessment and for improving the safety of bedside procedural skills.

Recently, 10 residents and 6 recent graduates of the IM residency program were surveyed to get their feedback on the current curriculum. This included formative feedback and summative feedback using a Likert scale (from 1 to 10 with 10 being excellent) to rate the different modalities of teaching employed in the curriculum. Ninety percentage scored the simulation-based teaching above 7, and 70% scored the didactic teaching above 7.



FIGURE 3 | Acute resuscitation course using simulation.



FIGURE 4 | Use of bedside ultrasound by resident.

Morbidity and mortality teaching and journal clubs were scored above 7, 80% of the time. The formative feedback included the following—the residents enjoy the simulation-based teaching as it is practical and engaging and they found they can apply the teaching to the cases that they see. As long as the didactic sessions are high quality and delivered by engaging and experienced physicians, they find the sessions relevant and informative. They did find that since the didactic sessions are done by faculty who also have to manage the patient load, some sessions were rushed. Due to the paucity of visiting faculty, it is recognized that there is a lack of diversity in subspecialty teaching. The teleconferences are useful if they are interactive and use local cases as points of discussion. The ECG teaching is repeatedly reported as being of very high quality and very applicable to their clinical practice. Although the mortality and morbidity rounds and journal clubs are scheduled regularly, the residents feel that the discussions and presentations do not always facilitate learner engagement and discussion. The point of care ultrasound was particularly identified as adding value to their clinical teaching and practice as they felt more comfortable doing bedside procedures such as thoracentesis, central line insertion, and paracentesis and are now also able to use the ultrasound for bedside assessments to help in making clinical decisions given the lack of portable chest X-rays for critically sick patients.

3. Electives

One two-block international elective in subspecialties (nephrology, general IM, or cardiology) has been organized where GPHC residents gain experience and exposure to different medical settings and practices. They are encouraged to reflect and implement some of the learned practices in their local medical environment. Residents and medical students from US and Canadian Universities are also given the opportunity to do supervised elective rotations in GPHC and participate in the academic rounds, as well as be involved in resident and medical student teaching that enriches their global health experience.

4. Research

As the residency program develops a sound foundation, research projects are being fostered with supervision and collaboration from partner universities. An online quality improvement course was taken by all the residents through the Institute of Health Improvement website, and project plans are on their way to being implemented. Small, locally applicable projects are a good way to start to garner understanding of the process and make it more feasible.

5. Mentorship and training the trainer programs

The first residents graduated in November 2016 and are now part of the local resident faculty. There is a need for ongoing mentorship as these graduates move into leadership and clinical educator roles. And collaborative partners are vital. Online sessions are organized for the graduates to meet with their mentors for debriefing and regular reflection and self-evaluation. Online

and local courses are being organized for training the trainer initiatives that build on their teaching and leadership skills.

6. Resource support

In the public health-care system in Guyana (which includes teaching hospitals such as the GPHC), select essential medications and health-care services are free to all patients. Some of the collaborators have participated in improving public health care in Guyana by donating medical equipment and hard to obtain medications. Partner universities have also assisted in providing resources such as partial task trainers and mannequins for simulation training, portable ultrasound machines, learning materials, online resources, etc.

LESSONS LEARNED

1. The need for strong support from local leadership

While the need for specialists in IM and IDs is evident based on the number of health-care personnel in the country and the trends in the morbidity and mortality statistics, developing credible and sustainable programs to have specialist doctors trained locally is a paradigm shift in policy in Guyana. The success of such efforts is multifaceted and depends on collaboration and the continued support of a number of vital partners locally and internationally. In the case of the Guyana IM/ID residency program, the necessary local support was provided from the Ministry of Health, with favorable opinions of post-graduate medical education from the Minister and other political entities; the IHSE, which provided the platform for the program to be delivered; GPHC, which provided the clinical teaching site; and the University of Guyana, which confers the degree offered on completion of the program. As noted, the presence of a local “champion of the program” also proved to be an essential component. The local “champion” provided necessary representation to local leadership, assisted in developing bidirectional partnerships, and advocated for the specific needs of the program with international partners.

2. Diversified funding

Through engagement with multiple local and international stakeholders, funding for various aspects of the program has become diversified. The benefit of such support became evident, when the success of the program was threatened by a loss of funding from the CDC in its first year.

3. Balance and adaptation to local educational system

The curriculum was initially based on typical course work of a US-based residency program, with the addition of a focus on IDs, because of its relevance in Guyana. However, the curriculum had to be adapted within the first year for several reasons: (1) there were differences in baseline knowledge from medical school, which meant more basic science and background knowledge needed to be targeted; (2) many of the program participants

had several years of clinical experience as general medical officers, so the clinical teaching needed to be targeted to a higher level; (3) similar to many resource-limited health-care settings, there are significant deficits in efficiencies and processes, so a sharper focus on system-based practice, high-quality care, and principles of quality improvement were needed in the educational program.

4. Using a variety of learning platforms

Traditional specialist training has revolved around the combined learning platforms of bedside teaching, didactic lectures, and group learning sessions. Technology is increasingly being used to diversify learning experiences and optimize use of face-to-face time between learners and experts. With the globalization of technology, programs with limited access to faculty and expertise can capitalize on the use of technology to maximize learning. The IM/ID program adopted several of these alternatives and routinely uses: teleconferencing, virtual libraries, social media, online modules for didactic teaching and interactive case discussions, and simulation-based education. These teaching modes have not only enhanced the learning experience for residents in the program, but have expanded access to expertise and clinical teaching in a way that is flexible and feasible for our international partners.

FUTURE DIRECTIONS

1. Transition of leadership and ongoing mentorship of junior faculty

As the program produces graduates, the reins of leadership will be gradually transferred to these new locally trained specialists who will not be just clinicians but will add to the pool of “program champions” and take on the responsibility of moving the program forward. This will be another phase in the process of ensuring the program remains sustainable and is envisioned to require ongoing mentorship over the next few years. Of note, selection of residents for admission to the program, delegation of duties throughout the years of residency, implementation of resident-initiated quality improvement projects, etc. are all done in consideration of this larger picture.

2. Formal quality improvement training and collaborative QI projects based at GPHC

One of the major goals of the IM/ID residency program is to improve the standard of care for patients with conditions falling under the care of internists. While having specialists trained locally is an excellent step toward this end, implementation of best practices at a systemic level is also necessary. With all IM residents initiating various quality improvement projects during their residency years, the intellectual environment created is one that is conducive to fostering projects that will result in positive tangible changes in the delivery of care. Having basic, formal training in quality improvement can strengthen this process and help build capacity for even larger projects.

3. Expansion of subspecialty services

As part of the collaboration with various internationally recognized institutions of learning, the possibility of having graduates of the GPHC Internal Medicine Residency pursue fellowships in subspecialties such as nephrology and cardiology is being considered. Several of the international partners have already made strides in establishing subspecialty services at the GPHC so that these ventures can be sustainable. Having a local specialist is important. This would not only be an opportunity for further professional development for the new graduates but also on a larger scale it will enhance the capacity of both the health-care and educational workforce. It will also advance the cause of improved health care for the citizens of Guyana.

4. Research collaborations

To improve both clinical and academic standards, it is vital that research should be part of the GPHC residency program. Further collaborations with partner universities are planned to encourage residents to ask, enquire, and then answer their research questions with mentorship to foster the development of adequate methodology. Ideally, the residents and medical officers at GPHC will take the lead on such research projects and then disseminate it by presenting at local and international conferences and submitting for publication in peer reviewed journals. Balancing research responsibilities with heavy clinical loads will be challenging and, therefore, priority will be given to research on quality improvement projects around medical education and patient care and safety.

5. Assessment of programs and interventions to identify what does/does not work in the setting

Ongoing external and internal, local and international assessment and appraisal of the program are vital for ongoing success, preservation, and sustainability. A memorandum of understanding outlining roles and responsibilities is vital to partnership development and enrichment of the global health curriculum and experience. Committees involving local and international stakeholders are needed to meet and review all aspects of the program. These committees will make recommendations to evolve the program and build on local and international partnerships and continue to be innovative in the field of global health.

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CONCLUSION

The GPHC program has come a long way since its implementation in 2013. Much of its success is attributed to the dedication and perseverance of the program director and the residents who have worked on local and international collaborations to weave a strong mesh on which to support and build this program. Barriers related to limited financial and human resources continue, and the program is working hard to be more self-sustaining and self-preserving by training the program graduates to be leaders in clinical care, education, and research. Ultimately, they will take on independent leadership of the residency program. The future definitely is not free of bumpy (yet interesting) rides but does promise new horizons for developing the program and its partnerships. The program leaders hope to move toward a competency-based design that provides a standard of assessment for graduating physicians and providing more holistic, evidence-based health care to the Guyanese population.

AUTHOR NOTES

Dr. Dev Persaud is a current third year resident in the GPHC IM/ID residency program. Dr. Joanna Cole is the current program director for the IM/ID residency program and works as an Infectious Disease specialist at V.A. Medical Centre, Spokane, WA. Dr. Ramdeo Jainarine is a 2016 graduate of the IM/ID program and now the assistant program director for the residency program and the on site program director for the HVO volunteer program. Dr. Zahira Khalid is associate professor at McMaster University, Volunteer Assistant Program Director for the GPHC IM/ID residency program and external site director for the HVO volunteer program.

AUTHOR CONTRIBUTIONS

DP is the first author and contributed to 40% of the writing and gathering of the information for the article. JC is the second author and contributed to 30% of the material in the article. RJ contributed to 10% of the article in terms of material and writing. ZK supervised and mentored DP in the writing and editing of this manuscript and contributed to 20% of the material in the script.

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Pediatric Hand Surgery Training in Nicaragua: A Sustainable Model of Surgical Education in a Resource-Poor Environment

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Recent reports have demonstrated that nearly two-thirds of the world's population do not have access to adequate surgical care, a burden that is borne disproportionately by residents of resource-poor countries. Although the reasons for limited access to surgical care are complex and multi-factorial, among the most substantial barriers is the lack of trained surgical providers. This is particularly true in surgical subspecialties that focus on life-improving, rather than life-saving, treatments, such as pediatric hand and upper extremity surgery, which manages such conditions as congenital malformations, trauma and post-traumatic deformities including burns, and neuromuscular conditions (brachial plexus birth palsy, spinal cord injury, and cerebral palsy). Many models of providing surgical care in resource-limited environments have been described and implemented, but few result in sustainable models of health-care delivery. We present our experience developing a pediatric hand and upper extremity surgery training program in Nicaragua, a resource-limited nation, that grew out of a collaboration of American and Nicaraguan orthopedic surgeons. We compare this experience to that of surgeons undergoing subspecialty training in pediatric upper limb surgery in the US, highlighting the similarities and differences of these training programs. Finally, we assess the results of this training program and identify areas for further growth and development.

Keywords: pediatric hand surgery, orthopedic surgery training, Nicaragua, resource-poor environment, surgical education

INTRODUCTION

Although the origin of the adage "Give a man a fish, and you feed him for a day. Teach a man to fish, and you feed him for a lifetime," is debated, the principle it conveys, that the acquisition of skills promotes self-sufficiency, can be found in numerous diverse philosophies. The ubiquity of this concept suggests that it is applicable to the acquisition of any scarce resource, including medical and surgical care.

BACKGROUND AND RATIONALE

In 2015, the *Lancet* Commission on Global Surgery estimates that nearly 5 billion people, approximately two-thirds of the world population, do not have access to adequate surgical care (1). Not surprisingly, this burden is borne disproportionately by people in resource-poor nations (1), with the poorest third of the world population receiving only 3.5% of all surgical procedures (2). Given

that an estimated 30% of global diseases are treatable with surgical intervention, the lack of access to safe, timely, and appropriate surgical care results in substantial morbidity, mortality, and disability. Additionally, although the relationship between health and socioeconomic status is complex, several studies have established an association between poor health (especially in childhood) and poor socioeconomic status in both developed and developing nations (3, 4). Consequently, in addition to a moral imperative to address disparities in access to adequate surgical care, the dedication of resources to improve surgical care in resource-poor environments will likely have economic benefits at both the individual and societal level, the ramifications of which are likely to be far reaching.

The reasons for inadequate surgical care in resource-poor environments are multi-factorial, including inadequate infrastructure (facilities, electricity, water), limited physical resources (surgical and anesthesia supplies and equipment), lack of adequately trained anesthesia and surgical providers, and under-utilization of surgical services for financial, cultural, and religious reasons (5, 6). Moreover, strategies to improve global health often focus on infectious and communicable diseases, rather than surgically treated diseases, which are often characterized as expensive and technologically demanding to treat, despite emerging evidence that suggest that surgical care is cost effective (7). Although there are many reasons for lack of surgical care, the shortage of trained surgical providers is among the most significant barriers to essential surgical care worldwide (8).

If we accept the wisdom of the “teach a man to fish” philosophy, part of the solution to limited access to surgical care may be to increase the number of qualified surgeons by providing training experiences in surgical disciplines in which there are currently inadequate numbers of trained local providers. The goal of such a training program would be to develop surgeons who are not only capable to delivering surgical care but who are also able to mentor and train additional surgeons (residents, colleagues) to create a sustainable supply of knowledgeable, competent surgical providers. We describe our experience developing collaboration between American and Nicaraguan surgeons to provide pediatric hand and upper extremity surgery in Nicaragua.

COMPETENCIES AND STANDARDS

In the US, hand surgery fellowship training is available to graduates of ACGME-accredited residencies in orthopedic surgery, plastic surgery, and general surgery, and pediatric orthopedic training is available to orthopedic surgery residency graduates. Following hand surgery or pediatric orthopedic fellowship training, approximately five US surgeons each year elect to obtain an additional 6 months of training in pediatric hand surgery, to prepare them to care for children with congenital hand malformations, neuromuscular conditions such as brachial plexus birth palsy, spinal cord injury, cerebral palsy, and post-traumatic deformities. These highly specialized surgeons acquire the diagnostic skill set of pediatric orthopedists by gaining an understanding of the impact of growth on musculoskeletal deformities, the treatment of syndromes, and the technical skill set of hand

surgeons (training in complex reconstructive procedures that treat pediatric hand conditions).

While no formal accreditation of pediatric hand surgery exists, this discipline, a hybrid subset of pediatric orthopedic surgery and hand surgery, has become well established in the US. Most children's hospitals now include a pediatric hand surgeon on their staff and the Pediatric Hand Study Group (PHSG), established in 1995, meets twice-yearly, performs multicenter research projects, and presents an international award each year for the best pediatric hand article (9–14). The senior author (Michelle A. James) is a founding member of the PHSG and has directed a pediatric hand fellowship training program at Shriners Hospital for Children Northern California since 2009, training eight pediatric hand fellows (<http://shrinerschildrens.org/pediatric-hand-upper-extremity-surgery-fellowship>). In this training program, pediatric hand fellows typically perform approximately 100 cases in a 6-month period (Table 1).

LEARNING ENVIRONMENT

Nicaragua and the Nicaraguan Health System

Nicaragua is the largest country in Central America by land mass area, approximately the size of the state of New York in the US, and has a population of 6.1 million people. The majority of the population lives in the Pacific region of the country, along the western coast, with 25% of the total population in the capital city Managua (15). Nicaragua also is the poorest country in Central America and the second poorest country in the Western Hemisphere (16) with nearly 50% of the population living under the poverty line and a per capita gross national income of US \$2,720 (17).

The Nicaraguan health-care system has three tiers with both private and public components. The private health-care sector serves Nicaraguans with the financial resources to pay for care, approximately 10% of the population. The public sector includes the Nicaraguan Social Security Institute (Instituto Nicaraguense de Seguridad Social or INSS), which covers salaried government workers (10–20% of the population) and the Ministry of Health (Ministerio de Salud or MINSA), which provides health-care services for the remainder (approximately 70–80% of the population). In addition to being the predominant health-care provider in Nicaragua, MINSA is also the health-care regulatory agency and is responsible for all matters related to the provision of healthcare, from establishing health-care policy and government priorities to the salary schedule for providers (16).

Medical Education and Orthopedic Surgery Residency in Nicaragua

There are both public and private medical schools in Nicaragua. Admission to public medical school is based on the results of a standardized admissions test, and tuition is covered by the government. Medical education in public medical schools lasts 8 years after high school (5 years of medical studies, 1 intern year, 2 years of social service). By contrast, private medical schools (American University, Catholic University, Military School)

TABLE 1 | Shriners Hospitals for Children Northern California pediatric hand fellow experience.

Diagnosis (average number of cases per fellow)	Procedures performed
Brachial plexus birth palsy (12)	Brachial plexus exploration and reconstruction with sural nerve autograft or nerve transfers Open subscapularis/pectoralis major release; teres major/latissimus dorsi tendon transfer Arthroscopic anterior shoulder capsule and subscapularis release; teres major/latissimus dorsi tendon transfer Botox injection for shoulder internal rotation contracture Biceps re-routing for supination contracture Distal humerus external rotation osteotomy FCU to ECRB tendon transfer
Retained hardware (7)	Removal of deep implant Syndactyly release with/without full thickness skin graft
Syndactyly/sybrachydactyly (6)	
Trigger thumb (6)	Trigger thumb release
Elbow trauma/sequela of elbow trauma (6)	Lateral or medial condyle fracture non-union repair LUCL or MCL ligament reconstruction for elbow instability Elbow arthroscopy Corrective osteotomy of distal humerus malunion Elbow contracture release Elbow arthroscopy, excision of loose bodies, interposition arthroplasty LUCL reconstruction secondary to traumatic elbow instability ORIF lateral or medial condyle fracture Ulnar nerve decompression, transposition Closed reduction, percutaneous pinning supracondylar humerus fracture Distal humerus epiphysiodesis ORIF scaphoid fracture or non-union
Hand trauma/sequela of hand trauma (6)	Extensor tendon repair, central slip repair Flexor tendon repair or reconstruction, pulley reconstruction Centralization of extensor tendons for tendon subluxation Revision amputation of finger Interphalangeal joint fusion Phalanx osteotomy Digital nerve repair ORIF or percutaneous pinning of phalanx or metacarpal fracture Corrective osteotomy of radius and/or ulna Skin grafting for fasciotomies for compartment syndrome Forearm fasciotomy for compartment syndrome
Sequa of forearm trauma (5)	Polydactyly reconstruction Ganglion cyst excision Hypoplastic thumb (4) Epiphysiodesis for pollicization overgrowth Wrist/finger contracture release Burn excision and skin grafting PIP arthrodesis
Radial polydactyly (4)	
Ganglion cyst (4)	
Hypoplastic thumb (4)	
Burn injury (3)	
Arthrogryposis (4)	First web space deepening Posterior elbow capsulotomy, triceps lengthening

(Continued)

TABLE 1 | Continued

Diagnosis (average number of cases per fellow)	Procedures performed
Osteochondroma/multiple hereditary exostosis (3)	Index proximal phalanx rotational osteotomy Fractional lengthening flexor tendons Thumb MCP arthrodesis Osteochondroma excision
Ulnar polydactyly (3)	Forearm osteotomy Radius hemiepiphiodesis Polydactyly reconstruction
Constriction band syndrome (3)	Constriction band release
Cerebral palsy (3)	Revision amputation of finger for bony overgrowth Acrosyndactyly release First web space deepening Lateral band re-routing Thumb MCP arthrodesis Wrist arthrodesis Pronator release Adductor pollicis, thenar release FCU to ECRB tendon transfer Wrist centralization (bony or soft tissue)
Radial longitudinal deficiency/TAR (2)	
Apert syndrome (1)	Complex syndactyly release with full thickness skin graft OATS procedure
Osteochondritis dissecans lesion of capitellum (1)	
Hand/finger bone or soft tissue mass other than ganglion (2)	Excisional biopsy, curette, ORIF
Brachymetacarpia (1)	Metacarpal lengthening
Retained foreign body (1)	Removal of foreign body
Tetraplegia (1)	Forearm rotational osteotomy Tendon transfer
Soft tissue abscess (1)	Irrigation, debridement
Clasp thumbs (1)	Index dorsal rotation flap
Flexor tenosynovitis (1)	Irrigation debridement flexor sheath
Shoulder instability (1)	Capsular shift and stabilization wrist arthroscopy and TFCC repair
TFCC injury (1)	Stump amputation for overgrowth
Transverse deficiency (1)	
Clinodactyly (1)	Excision of bracketed epiphysis
Osteogenesis imperfecta (1)	Humerus, radius, ulna osteotomies
Cleft hand (1)	Cleft reconstruction
Trigger finger (1)	Trigger finger release, synovectomy, FDP slip excision
Carpal tunnel syndrome (1)	Carpal tunnel release
Camptodactyly (1)	PIP contracture release
Shaken baby, L hemiplegia (1)	Fractional lengthening flexor tendons
Radioulnar synostosis (1)	Forearm osteotomy

charge tuition and last 6 years (2 years of social service are not required). Following medical school, physicians wishing to become orthopedic surgeons must be accepted into an orthopedic surgery residency. These are administered by either MINSA or the National Autonomous University of Nicaragua (Universidad

Nacional Autónoma de Nicaragua or UNAN). Most programs last 4 years. In 2015, 55 residents (including 10 women) were enrolled in orthopedic surgery residency in Nicaragua (18). In contrast to the US, where nearly 90% of graduating orthopedic surgery residents matriculate into an orthopedic subspecialty fellowship (19), there are no subspecialty orthopedic fellowships available in Nicaragua, although some residents complete an additional year of residency focusing on a particular subspecialty, and a small number seek subspecialty training in other countries, but due to financial and regulatory barriers, few surgeons pursue fellowship training.

According to the Asociación Nicaragüense Orthopaedia y Traumatología (ANOT), there were 210 actively practicing orthopedic surgeons in Nicaragua, about half of whom practice in Managua [3.5 orthopedic surgeons for every 100,000 people, compared with 8.5 per 100,000 in the US (19)]. However, not all Nicaraguan orthopedic surgeons belong to ANOT, so this estimate may not be accurate. Few Nicaraguan orthopedic surgeons have subspecialty training in pediatric orthopedic surgery or hand surgery, and no surgeons are trained specifically in pediatric hand surgery, a unique discipline that includes some of the most intricate and complex surgery in orthopedics. Other than service trips of surgeons from developed countries, pediatric hand surgeons are not available to treat congenital hand malformations, neuromuscular disorders (spinal cord injury, cerebral palsy, brachial plexus palsy), and post-traumatic deformities.

La Brigada de las Manos

In 2009, under the auspices of Health Volunteers Overseas (20), a relationship was forged between three of the authors (Jairo J. Rios Roque, Gabriel Ramos Zelaya, and Michelle A. James), along with two additional members of the orthopedic and traumatology physician staff of a pediatric hospital in Managua, Nicaragua (Hospital Fernando Velez Paiz). In 2014, Hospital Velez Paiz was damaged by an earthquake, and the orthopedic staff and the pediatric hand surgery program (La Brigada de las Manos) transferred their services to Hospital Infantil Manuel de Jesus Rivera (Hospital “La Mascota”), the largest public children’s hospital in Nicaragua. Both Hospital Velez Paiz and Hospital La Mascota are administered by MINSA.

At the time of the first Brigada de las Manos trip in 2009, it was apparent that there existed in Nicaragua a large population of children with hand conditions, with little treatment available. The orthopedic surgeon sub-director of the children’s hospital (Gabriel Ramos Zelaya) requested that the Brigada provide hand surgery training to one of the junior orthopedic surgeons (Jairo J. Rios Roque), so that he could provide ongoing care between Brigada trips, and eventually gain expertise to care for complex pediatric hand problems independently. Jairo J. Rios Roque’s practice has been based at a public children’s hospital since 2009 and he has extensive experience, although no formal training, in pediatric orthopedic surgery, and a strong interest in hand surgery. The senior author (Michelle A. James) investigated various options for international hand fellowships in the US, and discovered that licensing and credentialing requirements virtually precluded hands-on training in the US for Jairo J. Rios Roque. Together,

the sub-director and senior author developed a model of training that includes:

- (1) Twice-yearly week-long Brigada visits. The Brigada includes two experienced pediatric hand surgeons (Michelle A. James and another member of the PHSG), a pediatric orthopedic occupational therapist, and additional volunteers. During these visits, the Brigada surgeons work with Jairo J. Rios Roque and the La Mascota staff to see approximately 100 children in clinic and to schedule and perform 20–25 operations (see **Table 2**). Jairo J. Rios Roque functions as a pediatric hand fellow, performing at least half of the cases together with a Brigada surgeon (**Figure 1**). The Brigada surgeons also train Nicaraguan residents. Jairo J. Rios Roque provides post-operative care for patients, communicating with Brigada surgeons by email as indicated. In addition, based on his performance in clinic and surgery, he is credentialed by the Brigada members to perform certain pediatric hand operations between trips.
- (2) Nicaraguan surgeon visits to the US. As part of the planned training curriculum, Jairo J. Rios Roque visits the senior author every 1–2 years for 2–3 weeks (three visits between 2009 and 2016) where he observes clinic and surgery. He obtained a Pediatric Orthopaedic Society of North America international scholarship to attend a pediatric orthopedic meeting and visit two centers, in addition to attending the World Symposium on Congenital Hand Surgery in Dallas, TX, USA. At each Brigada visit, Jairo J. Rios Roque presents patients whom he has operated on since the previous visit to the visiting surgeons, who critique his results and provide feedback.

RESULTS TO DATE/ASSESSMENT

Comparison to SHCNC Pediatric Hand Surgery Training Experience

Although Jairo J. Rios Roque’s experience is not a consolidated period of six contiguous months, but is rather occurring over years in a series of 1 week intervals, it is similar in number of cases and types of cases to a typical pediatric hand surgery training fellowship in the US (see **Tables 1** and **2**). There is substantial overlap in the most frequent diagnoses and procedures, with surgeries for polydactyly, syndactyly, sequelae of upper extremity trauma, and neuromuscular conditions (arthrogryposis, cerebral palsy) being among the most common procedures performed (**Figures 2–6**). Moreover, the volume of operative cases performed by Jairo J. Rios Roque is comparable to those of the typical US pediatric hand surgery fellow during his or her 6-month fellowship. SHCNC pediatric hand surgery fellows typically perform 100 surgical cases during their 6-month training experience and, after 7 years, Jairo J. Rios Roque has performed approximately half of the 220 cases with the Brigada during that time, and observed many of the other cases. Finally, the Nicaraguan training experience employs the concepts of graduated responsibility, such that Jairo J. Rios Roque’s responsibility and ability to independently care for patients in clinic and the operating room increases,

TABLE 2 | Operative cases performed by La Brigada de las Manos 2009–2016.

Diagnosis (total number of operative cases) ^a	Procedures (number)
Arthrogryposis (38) (Figure 2)	First web space deepening/dorsal index finger rotational flap/thenar release (16) Finger contracture release/flexor tendon lengthening (6) Dorsal carpal wedge osteotomy (5) Posterior elbow release and triceps lengthening (5) Thumb MCP arthrodesis (3) Radius and ulnar osteotomy (2) ECU to ECRB tendon transfer (1) Polydactyly reconstruction Syndactyly release Repair of phalanx malunion/non-union (5) Tenolysis/tendon reconstruction (5) Revision finger amputation/ray resection (4) MCP capsule release, Z plasty, skin graft (1) Kutler advancement flaps (1)
Radial polydactyly (27) (Figure 3)	Acrosyndactyly release with full thickness skin graft (8) Band excision (3) First web space deepening (1)
Syndactyly (25) (Figure 4)	Corrective forearm osteotomy for forearm malunion or missed Monteggia fracture (6) Ulnar shortening osteotomy for distal radius physeal arrest (2) Flexor tendon repair/reconstruction with median nerve reconstruction with sural nerve autograft (2) Distal radius/ulna epiphysiodesis (1) Polydactyly reconstruction (10) Ulnar nerve transposition for tardy ulnar nerve palsy secondary to lateral condyle fracture (4) Ligament reconstruction for chronic elbow instability (3) Flexor tendon release/tendon transfer for Volkmann's ischemic contracture (2) Teres major/latissimus dorsi tendon transfer (3) Wrist arthrodesis (1) Biceps transfer (1) Radial derotational osteotomy (1) Pectoralis major and subscapularis release (2) FCU to ECRB tendon transfer (1) Pollicization (4)
Sequa of hand/finger trauma (16)	Thumb reconstruction (2) Wrist centralization (1) Mass excision Osteochondroma excision (5) Radius hemiepiphysiodesis (1) Syndactyly release (2) Thumb osteotomy (2) First web space deepening (1)
Constriction band syndrome (12) (Figure 5)	Trigger thumb release DIP arthrodesis (2) Contracture release (3) Dome osteotomy distal radius (3) Ulnar shortening osteotomy (2)
Sequa of forearm trauma (11)	
Ulnar polydactyly (10)	
Sequa of elbow trauma (9)	
Brachial plexus birth palsy (9)	
Radial longitudinal deficiency/hypoplastic thumb (7) (Figure 6)	
Hand/finger mass (6)	
Multiple hereditary exostosis (6)	
Apert's syndrome (6)	
Trigger thumb (5)	
Sequa of burn injury (5)	
Madelung (5)	

(Continued)

TABLE 2 | Continued

Diagnosis (total number of operative cases) ^a	Procedures (number)
Cerebral palsy (5)	Tendon transfer (3) Wrist arthrodesis (2) Syndactyly release
Poland syndrome/ sybrachydactyly (3)	PIP arthrodesis for finger contractures secondary to ulnar nerve palsy (1) Tendon transfers for radial nerve palsy (1) Carpal tunnel release (1) Corrective forearm osteotomy Removal of deep implant
Nerve palsy (3)	Cleft closure Juvenile arthritis (2) Macrodactyly (1) Marfan's syndrome (1) Clinodactyly (1) Total number of cases (220) ^a

^aRecords of cases performed on two trips were lost, so this list represents 13 La Brigada trips.

**FIGURE 1 |** Jairo J. Rios Roque, MD and Michelle A. James, MD following a syndactyly release procedure performed at Hospital "La Mascota" in Managua, Nicaragua.

commensurate with his experience, skills and core competencies, benchmarks for determining Jairo J. Rios Roque's progress, and ability to practice pediatric hand surgery independently.

Nevertheless, there are differences between the Nicaragua training experience and the SHCNC experience. The biggest difference is the lack of availability of hand fellowship training for Jairo J. Rios Roque as a prerequisite to pediatric hand surgeon training. Although hand fellowships focus on the care of adult hand problems, they provide training in the basic hand surgical skills needed to perform most pediatric hand surgical procedures. For this reason, Jairo J. Rios Roque's training is prolonged, and will likely not ultimately include the most complex procedures, especially those that require microsurgical skills. **Table 2** does not include brachial plexus exploration and reconstruction surgeries, due in part to the fact that the hospital lacks a surgical microscope,



FIGURE 2 | A patient with arthrogryposis, limited elbow flexion, and wrist extension. Note the flexed position of the wrists pre-operatively (image on the left). The patient was treated with a dorsal carpal wedge osteotomy to improve the position the wrist to neutral (image on the right).

which is required for brachial plexus reconstructions, and also due to the fact that Nicaraguan patient with brachial plexus birth palsy Brigada may present in a delayed fashion. In the US, brachial plexus surgeries are often performed around 6 months of age in the US, and the Nicaraguan patients present to hand clinic at an older age, making them less likely to benefit from brachial plexus reconstruction and more likely to require other procedures to minimize the sequelae of brachial plexus birth palsies (e.g., tendon transfers and contracture releases). Another difference is that Nicaraguan patients with syndromic congenital anomalies may be less likely to undergo surgery, as these patients may have a greater risk of anesthesia that precludes their ability to undergo surgery safely without the advanced monitoring and critical care technology available in the US. Several such patients in need of surgical intervention have been transferred to hospitals in the US where PHSG surgeons are able to care for them safely. Finally, surgeries requiring advanced technology, such as corrective forearm osteotomies using Materialise (Materialise NV, Leuven, Belgium), which utilizes 3D CT scanning, 3D printing, and advanced software technology to plan complex forearm reconstructions, are unable to be performed in Nicaragua due to the limited or absent availability of these resources.



FIGURE 3 | Radial (thumb) polydactyly treated with reconstruction of the thumb to form a single stable thumb.



FIGURE 4 | Syndactyly (webbed digits) affecting the ring and long fingers treated with syndactyly release and skin grafting.

DISCUSSION

Sustainability

In addition to the mentor model of surgical education we have described here, several other methods to improve the availability and capacity of surgical providers in resource-poor environments have been utilized, including: direct provision of surgical services (mission trips of visiting surgeons to resource-poor countries); fellowships (medical providers from resource-poor countries travel to the US to obtain experience and training not available in their home country); and attendance at international conferences and courses (which provide learning opportunities in the form of lectures and surgical simulations) (21). Each of these strategies, while beneficial, has certain limitations. Direct provision of surgical services (i.e., “parachute trips”) does not



FIGURE 5 | Constriction band syndrome resulting in a complex syndactyly of the fingers.

expand the skills or ability of local providers. Most US fellowships for foreign medical providers are limited to observerships, which do not allow hands-on training, and the provision of surgical services is not conducted in the context of their local resources, often relying on expensive technology that is not available in their home institution. Finally, international conferences and courses, like observerships, require substantial commitment of both time and resources, which is not feasible for many providers.

In contrast to the above surgical experiences, the training model we have implemented in Nicaragua results in sustainable delivery of health-care services to children with hand conditions. As Jairo J. Rios Roque's responsibility and ability to independently care for patients in clinic and the operating room increase, patients with congenital and acquired hand conditions will be able to receive appropriate care from Jairo J. Rios Roque directly, throughout the year, without the services of the Brigada. Moreover, he will be able to educate and train the Nicaraguan residents and orthopedic surgeons in the care of patients with these conditions. Finally, the next step in sustainable surgical education is to establish research initiatives that investigate the outcomes of the treatment provided, to publish the results of these investigations, and allow the study findings to inform surgical decision making. Currently, we are planning to include Hospital La Mascota in the development of registry of congenital hand differences, which would ultimately be used to determine the outcomes and effectiveness of surgical treatments for these conditions. Because Hospital La Mascota is the sole provider of surgical services for these complex conditions, a registry of the patients treated here will provide unique and comprehensive perspective into the incidence of these conditions, the need for surgical treatment, and outcomes of operative interventions; this could then be compared to similar registries in the US, enhancing our understanding of how to best improve the hands and lives of patients with these conditions.

CONCLUSION

The disparity between the need for surgical care and its availability in resource-poor countries is substantial, which has far-reaching consequences for individual, social, political, and economic



FIGURE 6 | Bilateral thumb hypoplasia with a severely underdeveloped thumb on the left hand and an absent thumb on the right hand. This patient was treated with pollicization on both hands, in a staged fashion, which involves reconstructing and repositioning the index finger to function in the position of a thumb.

development. Although the reasons for this disparity are complex, solutions should focus on sustainable ways to increase the supply of scarce resources. In Nicaragua, as in other developing nations, there is an unmet need for surgeons adequately trained in the management of pediatric upper extremity surgery. We believe that the model of education and training presented here is a self-sustaining solution to lack of adequately trained pediatric hand and upper extremity surgeon in Nicaragua, which can be applied to other surgical specialties in other environments. We are hopeful that the establishment of such training models improves surgical education, enables and empowers surgeons in resource-poor environments to provide of desperately needed surgical care, and improves both the health and the lives of the patients treated.

AUTHOR CONTRIBUTIONS

MM: primary author, responsible for data collection and analysis, drafting the work, approval of final work for submission and

publication, and agreed to be accountable for all aspects of the work. JR: contributed substantially to the data collection and interpretation, made important intellectual contributions through the writing and revision processes, approved the final work for submission and publication, and agreed to be accountable for all aspects of the work. GZ: made considerable contributions to the conception and design of the training program and the written manuscript describing this program, participated in data interpretation and in critical analysis of the written work in the revising processes, approved the final work for submission and publication, and agreed to be accountable for all aspects of the work. MJ: responsible for initiation and design of the training program, conceived the idea for the written manuscript describing this program, participated in data interpretation and in critical analysis of the written work in the revising processes, approved the final work for submission and publication, and agreed to be accountable for all aspects of the work.

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Where Are They Now? Evolution of a Nurse Anesthesia Training School in Ghana and a Survey of Graduates

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Ghana, like other countries in sub-Saharan Africa, has limited access to surgery. One contributing factor is the inadequate number of anesthesia providers. To address this need, Kybele, Inc., a US-based non-governmental organization, partnered with the Ghana Health Service to establish the third nurse anesthesia training school (NATS) in Ghana. The school, based at Ridge Regional Hospital (RRH) in Accra, opened in October 2009. This paper describes the evolution of the training program and presents the curriculum. Second, the results of a voluntary survey conducted among the first four classes of graduates (2011–2014) are presented to determine their perceived strengths and gaps in training and to identify employment locations and equipment availability. Seventy-five of 93 graduates (81%) responded to the survey. The graduates reported working in 39 hospitals across 7 of the 10 regions in Ghana. Six providers (8%) worked alone and 16 (21%) were one of only two providers. Fifty-three providers (71%) had no physician anesthesiologist at their facility. Most providers had access to basic anesthesia equipment; however, there was limited access to emergency airway equipment. While most graduates felt that their training had prepared them for their current positions, 21% reported experiencing a patient death during anesthesia. The NATS at RRH has been sustained and most of the graduates are working in Ghana, filling an important void. Quality improvement and continuing education must be emphasized in an effort to reduce surgical morbidity and mortality in Ghana.

Keywords: anesthesia training program, low income country, capacity building, anesthesia workforce

INTRODUCTION

Globally, an estimated two billion people have limited or no access to surgery and anesthesia (1, 2). Sub-Saharan Africa (SSA) has 25% of the global disease burden but only 3% of the world's health care workers (3). Challenges to improving surgical capacity are many, including insufficient equipment and supplies, improper distribution of staff, and migration of health-care workers to more developed countries (3, 4). One report found that half of the countries in SSA lost over 30% of the physicians they trained to migration, leaving a tremendous void (3). The number of anesthesia providers, specifically, is well below what is required to provide safe surgery (4, 5). Many low-income

countries (LIC) have between 0.1 and 1.4 anesthesia providers per 100,000 citizens, approximately 1/100th of the ratio found in most developed countries (6, 7).

Ghana is a country in SSA with a population of 24 million, yet in 2007 there were only 20 consultant-level anesthesiologists and 200 nurse anesthetists providing surgical anesthesia for the entire country (8, 9). The lack of providers was due, in part, to the paucity of training programs (10). In 2007, there were only three anesthesia training programs (one for physicians and two for nurse anesthetists). The existing nurse anesthesia training programs, Komfo Anokye Teaching Hospital in Kumasi and 37 Military Hospital in Accra, were longstanding and successful, yet the number of graduates were insufficient for the needs of the population. Both required 3 years of prior nursing experience for admission and were designed as 18-month training programs. Following training, most physician and nurse anesthesia providers were concentrated in urban areas working in small private or large referral and teaching hospitals (11). The smaller district hospitals in Ghana were often unable to provide surgery, a fact which was compounded by the lack of anesthesia providers (4, 11). The large hospitals received a high volume of obstetric and surgical cases and were plagued by delay resulting from too many patients and too few resources. This in turn led to high mortality rates (8, 12, 13).

BACKGROUND AND RATIONALE

In 2007, Kybele, Inc., a US-based humanitarian organization, began a 5-year partnership with the Ghana Health Service (GHS) to reduce maternal and newborn mortality (13). Ridge Regional Hospital (RRH) in Accra was selected as the primary target facility, because it was the largest GHS hospital in the country. At the project's onset, there were three anesthesia physicians and six nurse anesthetists for four operating rooms dedicated to both general and obstetric surgery. The hospital had 6,000 annual deliveries and a 36% cesarean delivery rate. Most cesareans were deemed emergencies (13). Patients for emergency cesarean delivery often waited hours and anesthesia personnel availability was a frequent limitation. Access to emergency obstetric surgery has been cited as an indicator of the overall surgical capacity of a health system (14, 15).

In 2009, leaders of RRH and Kybele opened the third nurse anesthesia school in Ghana. Inter-country collaborations, particularly between academic institutions, have proven effective in building local capacity (4). Collaboration to produce a quality education and adequately trained personnel is paramount to the goal of reducing surgical, maternal, and neonatal morbidity and mortality in LIC. In addition, the overall shortage of physicians, such as anesthesiologists, has led to the need to task shift to less specialized providers to increase manpower (2, 4). This paper will primarily describe the evolution of the nurse anesthesia training program and present the curriculum. The secondary aim was to conduct a survey among graduates to determine their perceptions of the strengths and gaps in training as related to their varied work environments and to examine the retention and location of graduates across Ghana.

METHODS

Program Implementation

In November 2008, an action plan was developed for the establishment of a nurse anesthesia training school (NATS) at RRH. Key meetings were held with stakeholders including the Greater Accra Regional Director, members of the Health Ministry, the GHS human resource director, and Kybele and RRH leaders. By March 2009, a curriculum was created with input from faculty of the existing Ghanaian nurse anesthesia schools, anesthesia educators from among Kybele leaders, and RRH anesthesia providers. To create the school's curriculum, the Ghanaian faculty obtained the curriculum used at other local schools in Ghana. The US-based faculty brought curriculum from the Duke and Wake Forest Nurse anesthesia programs and curriculum were compared. The local faculty ultimately determined what their curriculum would be. They then went through the arduous task of getting the curriculum approved by the various local governing authorities. When final approval was given by the Health Ministry to open the school, students were recruited via notifications sent to hospitals throughout the country and advertisements in the print media. On September 9, 2009, the first student applicant was interviewed. From September 9 through September 21, 2009, the Ministry of Health and Education provided training for lecturers. On October 6, 2009, the 18-month nurse anesthesia training program was opened. The admission prerequisites and training duration were modeled after existing programs for continuity.

Kybele volunteers serving as guest faculty included practicing academic anesthesiologists, nurse anesthetists, nurse anesthesia students, obstetric anesthesia fellows, and selected anesthesiology residents in their final year of training. These providers came primarily from the following academic medical centers: Wake Forest University, Duke University, Dalhousie University, Vanderbilt University, the University of Pennsylvania, and Yale University. Kybele volunteers traveled to Ghana in small groups each January, May, and September to support the training program. Volunteers provided 1–2 weeks of didactic, small group and clinically oriented teaching in the operating room and classroom. The clinical teaching by the visiting team covered topics such as preoperative assessment, pharmacology, anesthesia delivery systems, patient monitoring, case scenarios, and subspecialty-specific topics. Kybele members helped in preparing students for examinations, served as oral examiners, and participated in matriculation and graduation ceremonies. The students received regular written, oral, and practical examinations throughout the training period to assess knowledge and practical skills. If the Ghanaian faculty assessed a student as inadequately prepared, they were not allowed to graduate, but were retained for additional training and experience.

Survey

A 39-question survey was developed for program graduates with input from faculty at RRH and Kybele. The survey gathered information about the graduates' current work environments, locations of employment, and perceived training preparedness. Questions were designed to assess scope of clinical practice, anesthesia-related mortality, and resource and equipment limitations in the

facilities where they worked. Graduates received an e-mail or WhatsApp message detailing the purpose of the survey and were then called by a member of Kybele experienced with the conduct of anesthesia but not previously affiliated with the training program. A short introductory script was used to reiterate the purpose of the 10–15 min voluntary survey, to ensure confidentiality and to obtain verbal consent. Calls were made from May 2014 to September 2015 to graduates of four classes (2011, 2012, 2013, and 2014). At least two attempts were made by phone to contact graduates. If unavailable by phone, graduates attending a September 2015 refresher course in Accra were given a paper survey.

RESULTS

The third NATS in Ghana at RRH has enrolled 165 students since 2009. One hundred forty have graduated from the program. The curriculum is presented in **Table 1**. Forty-seven guest lecturers traveled to Ghana with Kybele from 11 institutions in the USA and Canada from January 2009 through September 2015. Fourteen lectures traveled multiple times to provide educational support for the school (**Figure 1**). Three educators (one physician and two nurse anesthetists) from RRH were sponsored by Kybele to visit US-based training programs and observe clinical sites of Kybele coordinators.

TABLE 1 | Nurse anesthesia training school curriculum.

Course title	Total credits
First semester curriculum	
Applied anatomy	3
Applied physiology	3
Applied physics and equipment	3
Introduction to research methods and biostatistics	2
Health sociology	2
Applied pharmacology	3
Practicum	3
Total credits	21
Second semester curriculum	
Case conference/seminar	2
Principles and practice of anesthesia	4
Principles and practice of intensive care	4
Health psychology	2
Project work/research	4
Practicum	3
Total credits	19

Third semester internship

This final part of the program covers a period of 6 months in which the student will work in accordance with his/her work schedule as planned by the facility to which the intern is attached. The intern will ultimately be responsible to the specialist/consultant anesthetist and shall take instructions from him/her. Interns should be responsible for perioperative assessment, intraoperative monitoring of all categories of patients in the theater, postoperative management and monitoring of patients in the recovery ward, postoperative pain management, and the transfer of patients to the wards following surgery. Interns should attend and participate in all clinical presentations in their departments and report back to the school with a written report from the institutions where they underwent internship training

Bold indicates different sections/semesters.

Ninety-three students graduating between 2011 and 2014 were surveyed and 75 surveys (81%) were completed. Graduates worked in 39 hospitals across 7 of Ghana's 10 regions (**Figure 2**); however, 46% remained in Accra. Regions with no representative graduate included Upper West, Upper East, and Brong-Ahafo (**Figure 2**). Fifty-three graduates (80%) reported working in government facilities while seven (10%) and four (6%) reported working in private and mission hospitals, respectively. Twenty-three graduates classified their workplace as a regional hospital (34%), 33 reported working in a district hospital (50%), and 3 reported working in a municipal hospital (4%). The average number of nurse anesthetists in a given hospital was 5.4 (range 1–24) with a median of 3. Six providers (8%) reported working alone and 16 (21%) reported working with only one peer. The average number of anesthesiologists per hospital was only 0.4 (range 0–3). Fifty-three providers (71%) reported that no anesthesiologist worked at their facility.

Essential equipment availability varied considerably as shown in **Figure 3**. Notably, 95% of surveyed graduates had access to pulse oximetry and an anesthesia machine but only 58% had capnography. Access to emergency airway equipment was extremely limited, with less than 15% having a videoscope or fiberoptic bronchoscope. Fifteen graduates (21%) had experienced a patient death during anesthesia. Of these deaths, two (13%) were associated with a difficult intubation and five (33%) were within 30 min of spinal anesthesia. The exact cause of the other deaths was unspecified. For cesarean deliveries, 6/61 (10%) reported maternal death during general anesthesia and 10/63 (16%) reported it following spinal anesthesia; however, spinal anesthesia was used more frequently. Graduates reported doing an average of seven cesarean deliveries per month under general anesthesia with a median of six.

With regard to their perception of preparedness for their current jobs, 64 (85%) felt "definitely" prepared, 8 (11%) felt "somewhat" prepared, 1 (1%) felt "neutral," 1 (1%) felt "poorly" prepared, and none felt unprepared. Graduates were asked to rate their preparedness to perform specific types of anesthetics on a scale of 1–10 (with 10 being the most prepared). They rated their



FIGURE 1 | Nurse anesthesia students at Ridge Regional Hospital with Kybele lecturers.



FIGURE 2 | Map of Ghana with working locations of Nurse Anesthesia Training School graduates.

preparedness highly in all areas, with the highest values assigned to obstetric anesthesia. Responses are displayed in **Figure 4**.

DISCUSSION

Anesthesia training programs in LICs should focus on quality, safety, and professionalism while striving for sustainable change that is supported primarily by local resources (10). The development of a locally based NATS to improve capacity is likely to be more cost-effective and viable than reliance on outside resources to meet surgical and healthcare needs. Established as only the third nurse anesthesia school in Ghana, the training program at RRH is addressing a severe shortage of anesthesia providers. The school's administration is based entirely in Ghana, thus supporting the goal of independence and sustainability. Kybele, as a multinational and interdisciplinary organization, provides mentoring in curriculum design, evidence-based standards, quality improvement, and systems development (13). Kybele volunteers continue to visit for 1–2 weeks at three times per year, serving as guest faculty and supplementing educational topics that are

assigned by the Ghanaian administrators. The survey results represent an initiative to evaluate the strengths and weaknesses of the curriculum and to identify barriers in the implementation of safe anesthesia practice in Ghana. The limitations of this survey include incomplete responses, variable interpretation of questions, and recall error, but the results are valuable for program improvement and optimization. It also underscores the importance of partnership in addressing extreme global health anesthesia shortages.

The survey found that over 80% of the first four classes of NATS graduates work in Ghana. This helps fill an important healthcare gap, especially in areas without other providers. The provider retention that the survey demonstrated is encouraging given that health-care emigration has been so problematic in SSA. Furthermore, we found that half of the graduates reported working in district hospitals, which is valuable given that many such facilities have limited medical staff (7). District hospitals, in particular, need adequately trained anesthetists because many procedures in these facilities are emergent and high perioperative mortality rates have been attributed to an

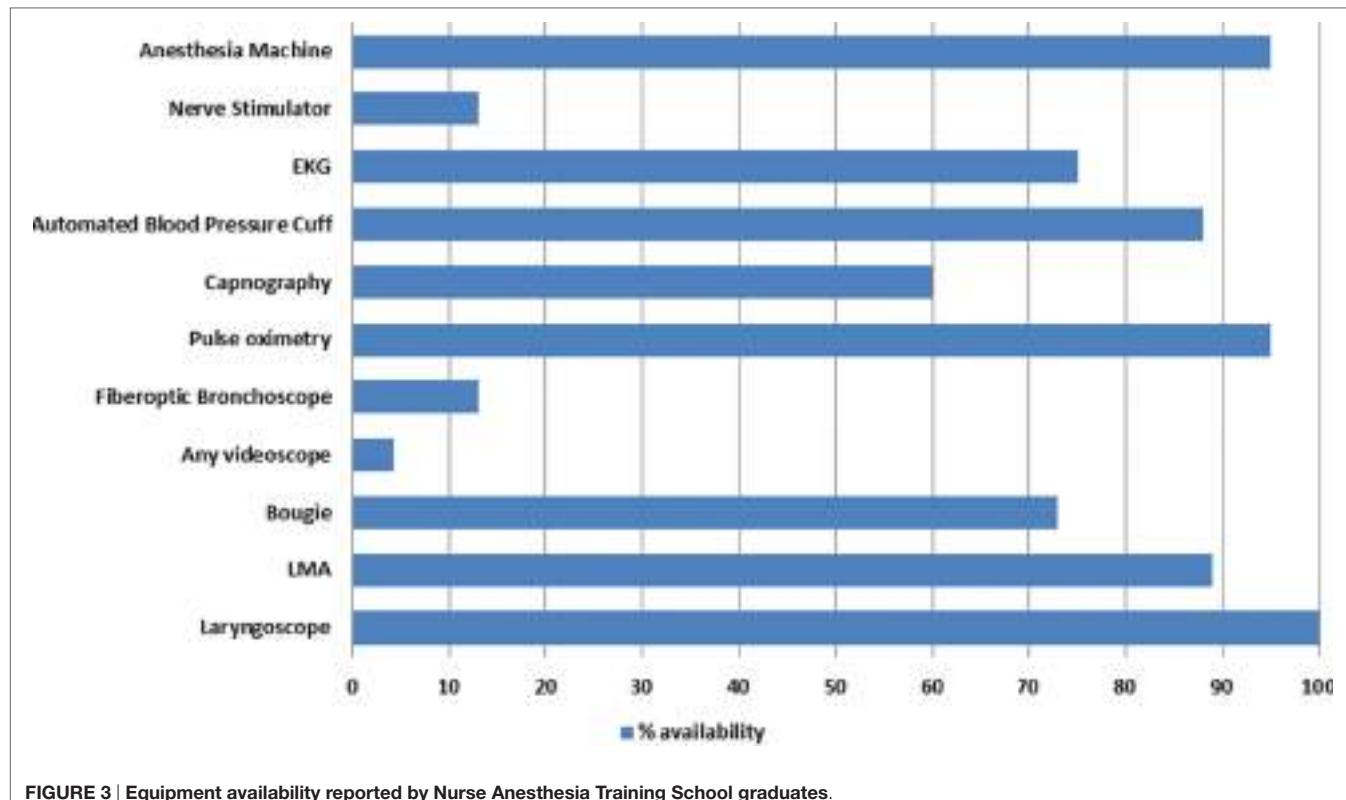


FIGURE 3 | Equipment availability reported by Nurse Anesthesia Training School graduates.

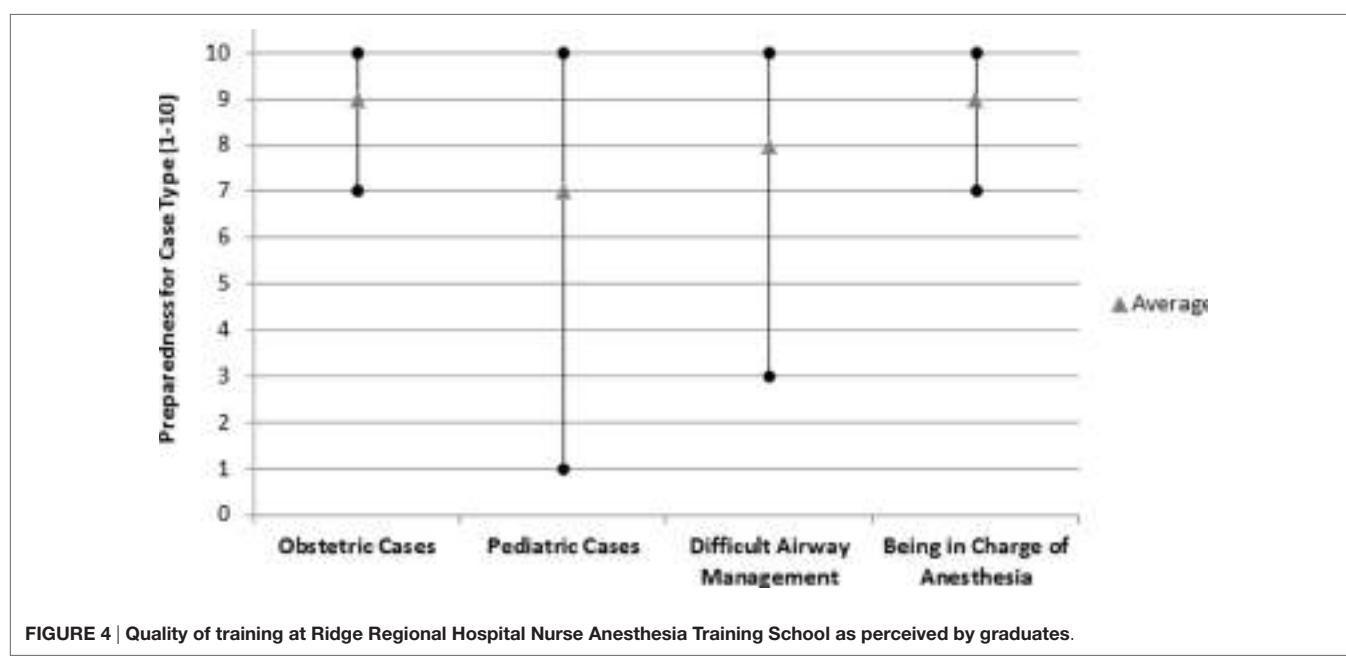


FIGURE 4 | Quality of training at Ridge Regional Hospital Nurse Anesthesia Training School as perceived by graduates.

insufficient supply and education level of providers (7, 11, 16). Other successful training programs in LICs have developed strategies to retain providers. A NATS in Kenya, for example, has students “sent” to training from rural communities to which they return with a binding work agreement following graduation (17). This was also true for some of the graduates of the NATS in Ghana. Other students were hired by the hospitals

to which they were deployed for their internships or posted by the GHS.

The safe provision of anesthesia is limited when essential equipment and monitors are unavailable or poorly functioning. It is reassuring to note that basic equipment availability reported by our graduates is better than what has been shown in other settings (5, 17). For instance, a 2012 survey of 22 LICs reported

that only 50% of facilities had an anesthesia machine and pulse oximeter (18). Another report estimated that 40–80% of equipment in LICs is out of service and that 70% of operating rooms in SSA lack pulse oximetry (19). Our survey, conversely, found that 95% of graduates had access to an anesthesia machine and pulse oximeter. The availability of biomedical technical assistance for the repair of broken equipment was not addressed; however, it is likely that equipment maintenance in a tropical climate with frequent electrical fluctuations remains a significant challenge (18). Despite the availability of basic anesthesia equipment, access to emergency airway supplies was variable. While graduates did report almost universal availability of a laryngoscope and nearly 90% availability of the laryngeal mask airway, only 73% had access to a bougie and less than 15% had access to any sort of videoscope. Poor access to proper medication, equipment, and blood products can limit anesthesia practice, compromise patient safety, and can undermine training, thus contributing to provider frustration and job dissatisfaction (6). Kybele has donated emergency airway and other necessary equipment to providers. However, some of the graduates are located remotely and until the survey was conducted, conditions and equipment availability were not known. Other governmental and non-governmental organizations such as Lifebox and Gadian Health Systems are also providing necessary monitoring equipment, ventilators, and anesthesia machines.

It is unclear from this survey if the lack of airway equipment contributed to maternal morbidity or mortality, but the number of deaths reported during anesthesia is troubling. At least 1 maternal death was said to have resulted from a difficult intubation, and 16 other deaths occurred during either spinal or general anesthesia, though the causes are not known. Evaluating safety is beyond the scope of this study. Providing safe care and optimal outcome depends on a multitude of factors, some of which are outside the parameters of anesthesia administration and can include things such as the availability of blood products and emergency medication, electricity, the initial disease state of the patient, timeliness of care, and the availability of backup personnel. The reported number of deaths, however, underscores the need to reinforce safe practice and vigilance while also improving access to emergency equipment and supplies. The risk of anesthesia-related maternal death is estimated to be the highest in SSA (1.5 per 1000) compared to other LICs (19). This highlights the need for better data and root cause analysis to maximize training and quality-improvement efforts (19). Future queries might seek clarification into the specific causes of maternal mortality in the experience of graduates in order to more appropriately allocate resources and direct didactics on sentinel events.

Despite the limitations, most of the surveyed graduates felt prepared for their roles as anesthetists in Ghana. There are multiple ways to assess preparedness after training, such as oral or written examinations, faculty appraisal, and student self-evaluation. These are utilized in well-resourced training programs and were also utilized in Ghana. The inter-cultural aspect of this program is valuable because it exposed the students to a broader range of topics they might not have otherwise learned about. Given the different hospital settings the graduates would be practicing in, we felt a personalized self-assessment was a valuable starting point

to assess their perception of training preparedness as it applied to their new work environments. Furthermore, their sense of preparedness might also have been, in part, due to the selection criteria for admission which requires nursing training and 3 years of work experience (20). It is concerning, however, that many providers reported working alone without an anesthesiologist or other colleagues for support. The lack of appropriate collaboration is a contributing factor to the inconsistent quality of care that has been documented in SSA (5, 12). The NATS went through a rigorous approval process by the Health Ministry and policies in Ghana do allow nurse anesthetists from approved programs to practice independently.

However, having the support of colleagues for problem solving, technical assistance, and capacity building is a goal for many hospitals in Ghana and throughout SSA and could increase job satisfaction and the quality of care (21).

Another strategy to offset provider isolation is continuing education and support. Nurse anesthetists worldwide have called for better access to continuing education in order to improve their skills, knowledge, and practice (22). The International Federation of Nurse Anesthetists has recently published a model curriculum for an 18- to 24-month certificate (non-degree) program as well as applications for program recognition and accreditation (23). In addition, the website (www.ifna.site) contains a wealth of teaching material, practice standards, and guidelines available for download. Health Volunteers Overseas has developed an online curriculum that could be a useful adjunct to graduates in the future (24). In addition, we hope to continue a recently debuted annual refresher course for continuing education attended by 74 NATS graduates and maintain regular communication. Future refresher topics should include pediatric anesthesia and difficult airway management. Based on the survey's results, the school's curriculum has been changed to include emergency management, including advanced airway management techniques and cardiopulmonary resuscitation. Furthermore, the school recently expanded the class size from 25 to 38 and the length of training from 18 to 24 months while also advancing from a diploma to a degree program that is being supported by the University of Cape Coast. In addition, practicing nurse anesthetists now have the opportunity to return to school for 6 months to "top-up" their previous training and receive their degrees. Hopefully, this will enhance the clout of nurse anesthetists in Ghana to further improve job satisfaction and provider retention (10).

There are few publications regarding the outcomes of global health collaborations to increase the number of anesthesia providers in LICs, though various organizations are working in this capacity (10, 17). Notably, work is being done by the American Society of Anesthesiologists, the Canadian Society of Anaesthesia, and the World Federation Societies of Anesthesiology to increase physician anesthesia provision and by the International Federation of Nurse Anesthetists to guide nurse anesthesia program development. We hope that by sharing our experience with establishing the third NATS in Ghana, others can refine or develop their own partnerships to increase the capacity of anesthesia care. NATS is a success in that it has been entirely locally sustained and is expanding based on its success. We aim to continue following graduates of the NATS, working with the local administration to improve

the curriculum, the capacity to provide quality patient care, and to ultimately reduce surgical morbidity and mortality in Ghana.

CONCLUSION

A global health partnership recognized a gap in the provision of anesthesia care in Ghana. Through joint collaboration, the third NATS in Ghana was established at RRH in Accra. The school has been locally sustained and most of the graduates are working in Ghana, filling an important void. Quality improvement and continuing education must be ongoing in an effort to maximize surgical safety in Ghana.

ETHICS STATEMENT

Institutional approval to conduct the survey was granted by Wake Forest University Health Sciences and the Ghana Health Service.

AUTHOR CONTRIBUTIONS

MP analyzed and interpreted the survey results and drafted the manuscript; DH co-designed and oversaw survey execution and assisted with data analysis and interpretation; EA-N developed and executed the curriculum, and co-designed the survey; JA developed and executed the curriculum and co-designed the

survey; AO co-designed and assisted with survey execution, coordinated and oversaw lecturers, and developed educational content; MR co-developed the curriculum and co-designed the survey; HM co-developed the curriculum, coordinated lecturers; MO co-designed the survey, analyzed, and interpreted the survey results and drafted the manuscript. All authors have reviewed the manuscript and are accountable to the accuracy and integrity of this work. All authors give final approval for publication.

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The Influence of an Orthopedic, Manual Therapy Residency Program on Improved Knowledge, Psychomotor Skills, and Clinical Reasoning in Nairobi, Kenya

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Introduction: The purpose of this study was to describe the influence of a post-graduate orthopedic manual therapy residency program in Kenya on the development of physical therapists' (PTs) knowledge and clinical reasoning related to the performance of a musculoskeletal examination and evaluation as compared to an experience-matched control group of PTs waiting to enter the program.

Methods: A cross-sectional design was utilized in which 12 graduating residents and 10 PTs entering the residency program completed a live-patient practical examination to assess the knowledge, clinical reasoning, and psychomotor skills related to the examination and evaluation of musculoskeletal conditions. The assessment utilized was based on the tasks, procedures, and knowledge areas identified as important to advanced clinicians in the US as outlined by the Orthopaedic Description of Specialty Practice. Inclusion criteria included participation in or acceptance to the residency program, practice as a PT between 3 and 25 years, and 50% of workday being involved in direct patient care. Overall pass rates were analyzed using the Pearson chi-square and Fisher's exact tests to determine if the graduating residents achieved significantly higher scores than experience-matched controls consisting of PTs entering the residency program.

Results: PTs completing a post-graduate orthopedic manual therapy residency in Nairobi, Kenya, achieved higher scores and passing rates compared to their colleagues who had not completed a residency program as determined by a live-patient practical examination. Graduating residents demonstrated statistically significant higher scores in the categories of examination, evaluation, and diagnosis. The average live-patient practical examination score for PTs without residency training was 38.2%, and their pass rate was 0.0%. The average live-patient practical examination score for residency-trained PTs was 83.4%, and their pass rate was 92.3%. These findings are statistically significant ($p < 0.001$).

Discussion: The study results suggest that the residency program had a positive influence on the residents' ability to perform musculoskeletal examination and evaluation and to determine a treatment diagnosis. Future studies should be performed to determine if the improvements in assessment have a positive impact on clinical practice.

Keywords: global health, physical therapy, residency program, manual therapy, Kenya

INTRODUCTION

Kenya is a developing nation in eastern Africa with approximately 600 registered physical therapists (PTs) delivering care to a population of 44 million people (1). PTs in Kenya currently have the opportunity to earn a 3-year diploma or a Bachelor of Science degree in the field of physical therapy (2). According to the World Confederation for Physical Therapy, education for entry-level therapists should include 4 years of university-level courses. In addition, PTs should be committed to pursuing educational opportunities following entry-level education to promote the development of the profession (3). Access to advanced instruction, fundamental to promoting educational development, is limited throughout the country of Kenya. One restricting factor has been the shortage of PTs with advanced degrees and specialty training to offer educational opportunities (4). To assist with promotion of skill advancement, clinical reasoning, and use of current evidence in practice, the Kenya Medical Training College Higher Diploma Program offered the first post-graduate residency program, which was administered by the Jackson Clinics, in 2012. The degree of Higher Diploma corresponds to the current educational structure of the region and denotes advanced training beyond the entry-level PT. The program is focused on a long-term commitment to the region and initiated a train-the-trainer program to transit the administration of the residency program to local administrators.

Similar to the medical model, a clinical residency program is a structured experience for PTs following entry-level education that is designed to advance the therapist's knowledge, skills, clinical reasoning, and attributes in a specific area of practice (5). The residency experience combines opportunities for ongoing mentoring to the resident, including required written and practical examinations, with a foundation of evidence-based practice and course work designed to provide a theoretical basis for advanced practice (5). Several key activities have been noted for promoting the success of continuing education in effecting clinical practice and improving patient outcomes (6). Many of these activities have been incorporated into the residency program: a needs assessment, interactive education, multiple methods of instruction, multiple exposures to the material, and case-based learning. In addition, the program emphasizes and provides clinical mentoring within the resident's current place of employment. This allows for the incorporation of deliberate practice into learning activities and feedback for performance correction (7). In addition, active reflection on the outcome of the treatment, as compared to previous experience, is encouraged to facilitate the transfer of knowledge from the program to clinical practice.

Current published literature suggests that graduate residents subjectively value residency education for its influence on clinical reasoning and professional development. Utilizing survey

methodology, graduates of a residency program in California reported a positive impact of the program on the ability to perform a comprehensive evaluation, utilize clinical reasoning in treatment decisions, and implement an effective treatment plan employing scientific literature (8). In addition, graduates reported career advancement through promotions and increases in salary (8). A second study expanded on the survey by introducing a comparison group. It demonstrated that residency graduates are more likely to become board certified physical therapy specialists and to participate in providing educational instruction than non-residency graduates (9). Likewise, the residency graduates earn a higher income when compared to non-residency-trained PTs with similar experience (9).

Despite the positive subjective reports of improvement in knowledge and clinical reasoning, residency programs in the US have not been shown to improve patient outcomes (8). Utilizing the Focus on Therapeutic Outcomes (FOTO) database, patient outcomes have been compared between PTs without residency or fellowship education to PTs who have completed an orthopedic residency program accredited by the American Board of Physical Therapy Residency and Fellowship Education. There was no difference in functional outcomes between the two groups. Furthermore, the non-residency-trained PTs achieved functional outcomes in fewer treatment visits (10).

The study was limited, however, by the use of retrospective data collected from commercial databases. These drawbacks were outlined by Resnik and Hart when they attempted to utilize the FOTO database to identify expert clinicians (11). There is no process, when one accesses such a database, to determine how patients were selected. If a patient did not complete an episode of care due to failure to improve or worsening of the condition, their information would not be captured by the database as a discharge outcome would not be completed. Patients with poor outcomes may not have been encouraged to complete the discharge outcome tool. These scenarios may have led to bias in the clinical database. Furthermore, there was no ability to adjust the data analysis for covariates, such as comorbid conditions and complexity of the patient presentation. Residency-trained therapists have reported an increased comfort level in assessing and treating complex patients, which may result in a patient population with difficult clinical presentations and, therefore, poorer prognosis. Classification of patients to improve homogeneity may provide additional insight into outcomes. Last, the outcome measures may not reflect factors considered important to both the patient and therapist. These factors make classifying therapists as expert versus average in assessment and treatment skills difficult with the utilization outcomes measures alone.

In all health-care professions, the development and progression of clinical reasoning skills is perceived as a key factor in

distinguishing expert from novice clinicians (12). It has been shown that clinical reasoning has three distinct areas of development. These areas include declarative knowledge or content specific knowledge, practical knowledge requiring multiple approaches for an identifiable clinical problem, and reflective practice (13). Due to its complex nature, clinical reasoning is difficult to objectively assess. Three areas of clinical reasoning are reportedly observable and measureable. These areas include collection of important of key information, diagnosis outcomes, and how clinicians integrate new patient information into their existing knowledge organization to gain an improved understanding of the clinical problem (13–15).

Insufficient research is available to evaluate the effectiveness of residency programs to progress the development of clinical reasoning. Clinical reasoning development has been associated with declarative knowledge, practical knowledge, and reflective practice (14, 15). Each of these distinct areas is addressed in the current post-graduate residency education model utilized in the US through the instruction of content-specific didactic information, clinical mentoring, and self-assessment (5). In addition, several key aspects of effective continuing medical education have been incorporated into residency programs. The accepted theory that residency training assists with the development of clinical reasoning associated with expert practice has not been established in the literature. An attempt to measure this construct may provide additional insight into the ability of residency training to improve patient care provided. The purpose of this study was to determine the influence of a post-graduate, orthopedic residency program on the participant's knowledge, clinical reasoning, and psychomotor skills related to the examination and evaluation of musculoskeletal conditions.

MATERIALS AND METHODS

A cross-sectional design was utilized in which 12 graduating residents and 10 experienced matched PTs entering the residency program completed a live-patient practical examination to assess their knowledge, clinical reasoning, and psychomotor skills related to the examination and evaluation of patients with musculoskeletal conditions. The examinations were performed over a 5-day period in Nairobi, Kenya, at the Kenya Medical Training College. The assessment tool utilized was based on the American Board of Physical Therapy Specialties Dimensions of Specialty Practice in Orthopedics. The assessment tool was comprised of 58 items within four categories of performance: examination, evaluation, diagnosis, and prognosis. Cronbach's alpha was calculated to determine internal consistency for items in each of the categories and were 0.871 for examination, 0.818 for evaluation, 0.836 for diagnosis, and 0.603 for prognosis.

The study participants completed the live-patient practical examination with no information about their patient's current condition, signs and symptoms, and reason for referral. The study participants were asked to complete the live-patient practical examination and evaluation and to determine a clinical musculoskeletal diagnosis. The assessment form that was utilized assessed the collection of key information and psychomotor skills. Following the examination and evaluation,

interviews were performed with the participants to assess the mental processes associated with their clinical reasoning. This included how the PT integrated information into their existing knowledge framework to gain an improved understanding of the clinical problem. Participants were asked to describe the nature of the patient's symptoms, the anatomical structures involved in the dysfunction, and probable causes of the patient's condition. Furthermore, discussion occurred regarding how they prioritized functional limitations, interpreted data regarding the irritability of the condition, and identified psychosocial factors that may influence rehabilitation.

Two examiners who were well versed in the use of the assessment form performed the assessments. The examiners were blinded to the participants. Descriptive statistics, including frequency counts for each of the 58 items assessed during the examination, were calculated via IBM SPSS 22. In addition, overall pass rates were analyzed using the Pearson chi-square and Fisher's exact tests to determine if the graduating residents achieved significantly higher scores than PTs entering the residency program.

RESULTS

Demographic information of the two groups is listed in **Table 1**. The graduating residents completed a significantly greater number of outpatient visits during an 8-h day than the entering residents ($F = 9.041$, with a significance level of 0.006). Graduating residents reported a positive shift in patient care load toward more outpatient care as they developed new skills through the residency program.

The live-patient examination assessment results were analyzed for significant differences between the two groups. The assessment category of examination focused on the ability to collect key information regarding the patient in order to make deductions regarding the patient's diagnosis and prognosis. Behaviors listed under evaluation, diagnosis, and prognosis best describe how clinicians integrate patient information into their existing knowledge organization to gain an improved understanding of the clinical problem. In addition to considering each individual behavior, the categories of examination, evaluation, diagnosis, and prognosis were assessed for significant differences between the graduating and incoming residents using the chi-square analysis and Fisher's exact test. **Table 2** includes a summary of

TABLE 1 | Participant demographic information.

	Residents	Mean	SD	SEM	Levene's test	
					F	Sig
Age	Entering	33.30	9.627	3.044	1.607	0.219
	Graduating	35.54	5.811	1.612		
Years practicing as a physical therapist	Entering	9.40	8.708	1.754	0.230	0.637
	Graduating	11.08	6.589	1.827		
Percent time in patient care	Entering	75.50	12.994	7.904	1.036	0.320
	Graduating	80.77	15.525	4.306		
Number of outpatient visits in an 8-h day	Entering	5.60	3.098	0.980	9.401	0.006
	Graduating	8.38	5.839	1.619		

TABLE 2 | Live-patient examination category assessment.

Behavior category	Graduating satisfactory performance	Entering satisfactory performance	Chi square	Fisher's exact two sided
Examination	277	162	69.811	<0.001
Evaluation	160	86	59.262	<0.001
Diagnosis	20	7	12.564	<0.001
Prognosis	17	15	7.628	–

the category analysis. There was no significant difference in the category of prognosis between the cohorts.

The average live-patient practical examination score for PTs without residency training was 38.2%, and their pass rate was 0.0%. The average live-patient practical examination score for residency-trained PTs was 83.4%, and their pass rate was 92.3%. These findings are statistically significant ($p < 0.001$). Utilizing a live-patient examination allowed for the assessment of performance in addition to competence (knowledge). These results demonstrate the effectiveness of the training on knowledge, skill development, and most importantly, the clinical reasoning associated with expert practice.

DISCUSSION

This study represents a novel attempt to objectively measure clinical reasoning of PTs with residency education. PTs completing a post-graduate orthopedic manual therapy residency in Nairobi, Kenya, achieved higher scores and passing rates compared to their colleagues who had not completed a residency program as determined by their performance of a live-patient practical examination. In three of the four assessment categories, the residents demonstrated statistically significant higher scores compared to the experienced matched controls. The residency graduates were able to more effectively collect necessary key information and collectively interpret this information to determine a definitive diagnosis. There was no difference between the two groups with regard to prognosis. The ability of the residents to determine a prognosis was measured by their (1) proficiency in choosing reassessment measures to determine initial and long-term responses to intervention and (2) prioritization of interventions based on the impairments noted during their examination. Assessment of this category was done through an interview with the resident and with limited cues to the participant. The assessment tool has been revised to provide additional cues to assist the participant in understanding the information being requested.

Results from this pilot study suggest the residency program was successful in promoting clinical reasoning. These results are similar to the documented subjective perceptions of residency graduates in the US. In addition, residency graduates noted a shift in their clinical practice toward an orthopedic population as their skills improved through participation in the residency. This change in clinical practice may reflect the perception of these PTs as experts in the field.

The residency program incorporated many of the aspects of continuing education associated with improved performance and clinical outcomes in medicine. The utilization of an

authentic patient assessment, through the live-patient practical examination, provided a measure of not only competence but also performance. Although the theoretical link between expert practice and patient outcomes has not been substantiated, the residency program was successful in promoting clinical reasoning associated with expert practice. This program may provide the framework for the development of additional residency programs in countries with limited educational resources. The development of residency programs that can influence the ability of PTs to provide treatment efficiently and effectively may ultimately assist in serving community physical therapy needs. According to the United Nations, 80% of all disabled persons live in rural areas within developing countries without access to adequate medical treatment (16). PTs in these countries have an important role in the treatment of disability and maintenance of quality of life.

Limited medical documentation in Kenya prohibited a prospective study using outcome measures to quantify changes in treatment results and clinical practice. Future studies should be performed to determine if the improvements in clinical reasoning have a positive impact on clinical practice.

ETHICS STATEMENT

The Kenya Medical Training College Ethics and Research Committee and the University of Evansville Institutional Review Board approved this research. Current residents and entering residents were informed about the upcoming study by the residency program coordinator in August 2014. In September 2014, the primary investigator traveled to Kenya to visit each cohort and discuss the purpose of the study, procedures associated with the study (access to practical examination results), and requirements for time involvement. Informed consent was explained and the investigator was present for questions regarding the project. The residents' examiners and instructors did not have access to a list of residents consenting for the study. All residents completed the practical examination as a required by the residency program. Additional time to complete demographic information was approximately 5 min.

AUTHOR CONTRIBUTIONS

SC developed the research methodology and performed the data analysis for the study. JM assisted with the methodology development and manuscript.

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Enhancing an International Perspective in Public Health Teaching through Formalized University Partnerships

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Teaching in the field of public health needs to employ a global perspective to account for the fact that public health problems and solutions have global determinants and implications as well. International university partnerships can promote such a perspective through the strengthening of cooperation, exchange, and communication between academic institutions across national boundaries. As an example for such an academic network in the field of public health, we introduce the International Public Health Partnership—a collaboration between a university in Germany and universities in India, Turkey, and Nigeria. Formed in 2005, it facilitated the exchange of information, fostered discussion about the transferability of public health concepts, contributed to the structural development of the universities involved, and promoted an intercultural dialog through a combination of local and distance learning activities. Although well accepted by students and staff, different obstacles were encountered; these included limited external funding, scarce own financial, time and personnel resources, and diverging regulations and structures of degree programs at the partnership sites. In the present article, we share several lessons that we learned during our joint collaboration and provide recommendations for other universities that are involved in partnerships with institutions of higher education or are interested to initiate such collaborations.

Keywords: International Public Health, university partnership, developing countries, virtual classroom, collaboration

INTRODUCTION

Public health challenges, such as epidemics of communicable and non-communicable diseases as well as questions of inequality, of health care reform and of financing have global dimensions and determinants. Solutions to public health problems, therefore, also require a global perspective and international cooperation in teaching students who are the future specialists in these fields (1, 2).

Health inequalities would be an example of one such public health challenge. Even though at different absolute levels, health inequalities exist worldwide, both in industrialized and in

developing countries (3). To a significant degree, they are caused by economic and social factors affecting health through multiple pathways on the psychosocial, behavioral, and material level (4). These economic and social determinants comprise a differential distribution of resources, such as income, education, employment and housing, and environmental factors, such as climate and air, water, and food quality (5, 6). In addition, access to health-care services and quality of care vary across socioeconomic groups, adding to differentials in morbidity and mortality. Also, risk factors, such as tobacco use, tend to have a higher prevalence among poor population groups, while the uptake of preventive interventions against such risk factors is often higher among the well-off than the poor, leading to a further increase in health inequalities (7).

Avoidable or remediable health inequalities between groups of people, whether those groups are defined socially, economically, demographically, or geographically, are unfair and should be reduced (unfair inequalities are often termed inequities). Maintaining and promoting the health of populations and reducing health inequalities are key goals of all national health systems (7). Because societies differ in their approaches to defining, investigating, and tackling inequalities, as well as in their respective success in this socially important endeavor, researchers and policymakers can learn from their experiences (8). A global approach, incorporating the perspective of both developing and developed countries, thus, is indispensable in teaching inequalities in health. The same is true for many other aspects of public health and the health sciences (9, 10).

For several reasons, however, an international perspective in teaching is often limited: existing public or community health courses often focus on national or regional problems than on international aspects of public health (11). Although degree programs that contain coursework in global and international health can convey an international perspective, these programs can benefit strongly from the direct exchange of public health students and lecturers between developing and developed countries with differing cultural and political background. This exchange, however, is often constrained by limited financial and personnel resources. Current approaches to electronic distance learning that could potentially reduce these barriers do not always succeed in overcoming the reservations of lecturers, e.g., with respect to perceived time commitment and inadequate instructor training. They may also make it difficult to maintain the interest and motivation of students (12).

Formalized international university partnerships that foster exchange and cooperation can help tackle these challenges by providing a structural and organizational framework for respective activities (13, 14). They can also be a competitive edge for universities in terms of international visibility and attractiveness for international students and researchers. Such collaborations, however, make huge demands on financial resources, individual commitment of the persons involved, and available infrastructure. They are also challenged by geographical distance as well as cultural, political, and economic diversity (15, 16). In this article, we introduce the International Public Health Partnership between a university in Germany and universities in India, Turkey, and Nigeria as an example

for such an academic collaboration in the field of public health. We illustrate the benefits of international cooperation in public health education and describe the use of different teaching instruments as well as the potential obstacles that need to be overcome in order to achieve a sustainable cooperation. This may provide helpful information for other universities that are involved in partnerships with institutions of higher education or are interested to initiate such collaborations.

COLLABORATION ON EQUAL TERMS: THE INTERNATIONAL PUBLIC HEALTH PARTNERSHIP

The International Public Health Partnership was founded by the School of Public Health at Bielefeld University, Germany; the Centre of Social Medicine and Community Health at the Jawaharlal Nehru University in New Delhi, India; and the Department of Public Health at the Başkent University in Ankara, Turkey in 2005. The initiative was a response to the increasing need for a global perspective in public health research and practice. Later, the Achutha Menon Centre for Health Science Studies of the Sree Chitra Tirunal Institute for Medical Sciences and Technology in Trivandrum, India, and the Department of Languages and Linguistics at the University of Maiduguri in Maiduguri, Nigeria, joined.

The academic collaboration originated from informal personal and professional contacts and was financially supported for the first 8 years with a total budget of between 25,000€ and 35,000€ per year by the German Academic Exchange Service [*Deutscher Akademischer Austausch Dienst (DAAD)*] through its “Subject-related Partnerships with Institutions of Higher Education in Developing Countries” program (17). Afterward, German–Indian activities received funding through the government program “A New Passage to India,” administered via DAAD.

Rationale and Concept

The overall goal of the International Public Health Partnership was to improve the structural basis of teaching in international public health, to broaden understanding of the multi- and interdisciplinary foundations of scholarship and initiatives in international public health, to facilitate exchange of information, and to initiate discussion around the transferability of public health concepts between the institutes involved. The diverse activities of the partnership aimed to offer a possibility for students and lecturers to experience and jointly analyze international aspects of public health, its ethical implications, the responsibilities of stakeholders, and the effectiveness of policies and strategies to reduce global and local public health problems. Students from Nigeria, India, and Turkey could benefit from a first-hand experience of public health problems and constraints the German health system is facing, thus informing the debate on public health priorities. On the other hand, German students could benefit from a practical exposure to issues in health care in a less-affluent setting, with such an experience serving as an eye-opener and facilitating a better understanding of public health. Additionally, the collaboration sensitized staff and students

toward issues of developmental policy and offered an opportunity to all persons involved to increase their flexibility as well as to improve their cross-cultural competencies and their mutual respect for other cultures and their respective world views (18, 19). These goals were achieved through a number of modalities: innovative electronic media, annual summer schools, workshops and seminars, international exchange of lecturers, and students who then acted as local multipliers of knowledge and experiences garnered at their universities (see below).

The collaboration between the institutes was based on equal terms. It comprised not only a unidirectional exchange between a developed country (Germany) and developing regions (Turkey, Nigeria, India), e.g., in the development and strengthening of teaching innovative methods. Of equal importance was an exchange in the other direction, e.g., in terms of the teaching of political economy of health, comparative studies in health systems, and language issues in health care delivery, where the other partners have particular expertise. The countries involved represent majority population segments belonging to the three large world religions (Hinduism, Islam, and Christianity) and numerous minority groups. The collaboration, therefore, contributed toward promoting an intercultural dialog and preventing cross-cultural conflicts (20).

Combining Local and Distance Learning Activities

The partnership combined local and distance learning activities in order to promote collaboration in teaching and joint learning. Local activities included summer schools, workshops, and seminars, involving exchange and face-to-face contact of students and lecturers. These activities were complemented by electronic media serving as a platform for distance learning and electronic communication between students and lecturers. As is well known, distance learning has, as far back as the first half of the nineteenth century, allowed students to take part in lectures without the need to be physically present (21). In order to implement and promote distance learning facilities, the partnership used web-based communication technologies, such as a wiki-based website for communication and interaction (22, 23).

For distance learning purposes, podcasts of selected lectures given during local activities were uploaded to the website to be streamed by interested individuals unable to attend a course in person. In addition, the website served as a repository for course materials, such as publications discussed in classes and for documents produced in regular courses at all partnership institutions, such as reports written as part of student assignments. In this way, a virtual classroom was created, assisting students in experiencing how their opinions on a public health topic fare with peers in other settings who may be more directly involved with the particular problem under discussion (24). These asynchronous communication tools were well received by students and lecturers. The virtual classroom was, therefore, quite consistent with the partnership's goal of promoting an international perspective and understanding of public health. Aside from its distance learning focus, the website facilitated communication and bridged the gap between different cultural, political, and economic backgrounds. For this purpose, it

offered a set of basic social networking facilities for interested users. The technologies utilized were elements of web 2.0, a way to make use of the worldwide web through a variety of tools aiming to facilitate interaction, cooperation, and creativity (25–27). Comparable to the Wikipedia project, the website could be regarded as a dynamically and democratically formed platform cooperatively maintained and further developed by students and staff from all partnership institutions. While the tools utilized provided possibilities for synchronous (i.e., real-time) communication in the form of text and video chats, these were seldom utilized because of technical constraints and diverging course schedules.

The activities of the partnership gave opportunity to all the participants to get in touch with each other and to exchange experiences. Moreover, they brought together participants who have different backgrounds and come from countries with different economic situations and offered a direct face-to-face setting for cross-cultural understanding and respect. While, as in other disciplines also, much of the factual knowledge relevant to that field can be learned from books, (cross-cultural) social and communication skills—which are particularly important for international public health—can only be acquired through exchange with people from different countries and cultures (20).

Initiating Structural Development through Joint Action

As far as possible, given the respective examination regulations governing modification of the curriculum, the partnership initiated structural development with regard to teaching at all institutions involved. International aspects of public health have been integrated into undergraduate, graduate, and postgraduate courses regularly taught at all universities. In addition, a procedure for recognizing course work was developed, following the idea of the European Credit Transfer System (28). The summer schools on international public health that originated at Bielefeld University have been successfully transferred to other partnership institutions. In addition, possibilities for joint tutoring of M.Sc. and Ph.D. candidates have been established, and international partners have served as examiners of the respective theses. Collaboration has also tried to work together in research resulting in joint publications (29–34).

CHALLENGES AND REQUIREMENTS FOR SUCCESSFUL PARTNERSHIPS: LESSONS LEARNED

Developing and maintaining successful academic collaborations across national boundaries can be difficult. Challenges may result from the diversity of collaborations in terms of cultural, political, geographical, and economic context. Therefore, several requirements must be met. We could learn some lessons from the International Public Health Partnership in this respect.

1. The collaboration must be based on trust, open communication, equity, and commitment. Likewise, each partner's expectations must be clear to the others. Specific and measurable

- objectives of the partnerships and the responsibilities of each partner must be documented in a written memorandum of understanding. Both are necessary to evaluate the partnership activities and are key factors for a continuous quality management.
- 2. Regular direct or online project meetings are necessary for coordinative and planning purposes to ensure that partnership activities are not neglected and to keep all individuals involved focused at the partnership goals.
 - 3. Partnerships that plan to establish distance learning activities need to consider the high demand with regard to IT infrastructure, including broadband internet connections, which sometimes are not reliable even in developed countries. Our experiences show that particularly distance learning activities based on real-time exchange, such as lectures simultaneously broadcast in several universities, can, therefore, quickly result in a frustrating experience. Asynchronous activities instead, e.g., implemented by means of podcasts, are more flexible and can also be easily adjusted to the specific conditions and course structures at each partnership site. Continuous IT support, e.g., for administering a partnership website, however, is indispensable.
 - 4. Distance learning activities need to follow a low-threshold approach in order to be accepted by both lecturers and students. Also, both need to be actively included in the development of the partnership to increase motivation and commitment. In the International Public Health Partnership, students had an active role in developing and maintaining the partnership website, in organizing onsite activities, and in hosting exchange students.
 - 5. An important aim of teaching-oriented partnerships is to initiate structural development in terms of joint degree programs and mutual acceptance of course work. Often, administrative obstacles as well as diverging regulations and structures of degree programs, e.g., regarding the length of the term or mandatory course work, can complicate this process. In addition, they can make it problematic to integrate partnership activities into regular courses. Sometimes, diverging grading systems can also make it difficult to transfer completed assignments between partnership sites (35, 36). Experiences with the International Public Health Partnership show that structural development is a time-consuming process, which also requires adjustments in existing regulations to new conditions. Therefore, sustainability of the partnership is even more necessary to render changes implemented into established structures worthwhile. Until formal agreements regarding the acceptance of course work are reached, our experiences show that, in most situations, it will be possible to decide on a case-by-case basis. It is also advisable to be as flexible as possible in recognizing coursework and examinations in order to not create additional barriers for students who plan to pursue courses abroad (37).
 - 6. Structural development is also necessary to prevent the partnership from being dependent on the individual commitment of selected faculty members. A high staff turnover is common at institutions of higher education. Actions and outcomes of joint activities, therefore, must be thoroughly documented in

order to smooth the handover of responsibilities and to ensure the continuity and sustainability of the collaboration. In this respect, also continuous institutional and administrative support is necessary. Experiences with the International Public Health Partnerships have shown that the demand in project management, e.g., in terms of accounting, can be high.

- 7. Each of the institutions involved has to invest a considerable amount of financial, time, and personnel resources to actively contribute to activities and to the further development of the collaboration. Otherwise, the collaboration will be hardly able to go beyond a set of intentions documented in a cooperation agreement—a situation faced by many academic partnerships (15, 35, 38). In case of the International Public Health Partnership, the partners had to contribute almost 30,000€ per year out of own resources for funding of expenses for personnel, travels, IT infrastructure, rooms, materials, accommodations, and catering not covered by DAAD. The budget situation of many universities is tight. This is also the case in Germany with resources from state general funds available for research and teaching declining for some years now (39). Financial resources of universities in low- and middle-income countries also tend to be scarce. Teaching-related partnerships with universities in developing countries, consequently, depend on continued external funding to cover expenditures for coordination, administration, infrastructure, and staff and student exchange. In case of the International Public Health Partnership, funding by the German Academic Exchange Service made it possible to cover expenses for a period of 8 years and to develop an informal cooperation between four professors into a well-functioning, successful, internationally visible formal collaboration on the institutional level. Unfortunately, as financial support ended in 2012, many of the activities of the partnership, predominantly those involving exchange of students and lecturers, can now be offered only on a restricted basis (Germany–India). This is particularly disappointing in light of the partnership's success, the reliable structures developed, and the experiences gained. Whereas external funding agencies and foundations in most cases will only be willing to provide resources for initiating partnerships, in the long run, it must be the institutions of higher education themselves which invest resources into maintaining successful collaborations. The relevance of such collaborations for research and teaching must be acknowledged and state general funds need to be increased accordingly for this purpose. Still, expensive activities, such as transnational travels, will have to be additionally supported by other sources. In this regard, external funding agencies and foundations such as the DAAD and the European Commission (e.g., through its ERASMUS+ program) need to extend possibilities for the acquisition of complementary financial resources.

CONCLUSION

As health concerns do not recognize national boundaries, the importance of international perspectives and cooperation in the teaching of public health cannot be overemphasized. By means

of the International Public Health Partnership, we developed a concept for an academic collaboration that is able to meet the needs in public health education with an international perspective which also respects contextual specificities. Experiences gained with the partnership show that collaborations in the field of academic education involving mobility of students and staff face different challenges and are particularly difficult to maintain, unless sufficient financial resources are available. As the budget of many academic institutions gets increasingly tight, sustainability becomes a crucial issue. Given the relevance of international partnerships for research and teaching, more resources need to be made available for universities through general state funds to ensure long-term financial support. In addition, external funding agencies must extend possibilities for the acquisition of complementary resources.

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The Institute for Global Orthopedics and Traumatology: A Model for Academic Collaboration in Orthopedic Surgery

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In 2006, surgeons at the University of California, San Francisco (UCSF) established the Institute for Global Orthopedics and Traumatology (IGOT), an initiative within the department of orthopedic surgery. The principal aim of IGOT is to create long-term, sustainable solutions to the growing burden of musculoskeletal injury in low- and middle-income countries (LMICs) through academic partnership. IGOT currently has relationships with teaching hospitals in Ghana, Malawi, Tanzania, Nicaragua, and Nepal. The organizational structure of IGOT is built on four pillars: Global Surgical Education (GSE), Global Knowledge Exchange (GKE), Global Research Initiative (GRI), and Global Leadership and Advocacy. GSE focuses on increasing surgical knowledge and technical proficiency through hands-on educational courses. The GKE facilitates the mutual exchange of surgeons and trainees among IGOT and its partners. This includes a global resident elective that allows UCSF residents to complete an international rotation at one of IGOT's partner sites. The GRI strives to build research capacity and sponsor high-quality clinical research projects that address questions relevant to local partners. The fourth pillar, Global Leadership and Advocacy aims to increase awareness of the global impact of musculoskeletal injury through national and international courses and events, such as the Bay Area Global Health Film Festival. At the core of each tenet is the collaboration among IGOT and its international partners. Over the last decade, IGOT has experienced tremendous growth and maturation in its partnership model based on cumulative experience and the needs of its partners.

Keywords: Institute for Global Orthopedics and Traumatology, global health, orthopedic surgery, collaboration, musculoskeletal burden, international orthopedics

INTRODUCTION

Over the last several decades the contributors to global burden of disease have shifted. Injuries as a result of trauma are becoming increasingly common and are now a source of more global DALYs than HIV/AIDS, malaria, and tuberculosis combined. Based on data from the 2013 Global Burden of Disease Study, road injuries alone went from 10th in 2005 to the 7th most common cause of DALYs worldwide (1). There are an estimated 1.3 million deaths from road traffic injuries every year (2), and injuries are the most common cause of death between the ages of 15 and 29 (3). More than 90% of injury-related mortality occurs in low- and middle-income countries (LMICs). While these

mortality statistics are staggering, it only begins to address the scope of this problem, as it has been estimated that an additional 20 to 50 million people are disabled by road traffic injuries every year (3). Musculoskeletal injuries, such as femur fractures and open tibia fractures, are substantial but understudied contributor to this burden. In addition, a number of other orthopedic diseases, including osteomyelitis, congenital and acquired limb deformity, and degenerative joint disease are major public health issues that fall within the domain of orthopedic surgeons.

Unfortunately, many developing nations lack the capacity to manage the growing burden of musculoskeletal disease and injury. While models of international collaboration have been effective in other medical specialties, orthopedic surgery has lagged behind its counterparts. Thus, novel frameworks for improving orthopedic capacity in low-resource settings are needed, focusing on long-term sustainability and partner-driven goals. The organizational structure for the Institute for Global Orthopedics and Traumatology (IGOT), an initiative within the Department of Orthopedic Surgery at the University of California, San Francisco (UCSF), is presented here as an academic model that may be replicated at other institutions to improve musculoskeletal care abroad.

BACKGROUND AND RATIONALE

While global health has traditionally focused on reducing the burden of infectious disease, there is increasing recognition of the global impact of trauma, including musculoskeletal injuries (4). Primary prevention is commonly touted as the most effective and cost conscious method to reduce disease, and trauma is no exception. Programs aimed to reduce the burden of trauma through increased road traffic safety and regulations have shown some success in LMICs (5, 6). However, even in Europe and the United States, where resources for traffic enforcement, safer roads and vehicles, and other injury prevention programs are immense, emergency medical transport systems and trauma centers play a crucial role in the secondary and tertiary prevention of death and disability from injury. Within trauma centers, orthopedic surgeons have the expertise to maximize function and reduce disability from fractures and dislocations involving the spine, pelvis, and extremities, thereby improving quality of life and helping victims of trauma return to being productive members of society. In addition, a variety of more chronic conditions may benefit from access to musculoskeletal specialists, ranging from pediatric deformities to musculoskeletal infection to degenerative arthritis. Unfortunately, access to high-quality orthopedic care in developing settings is limited by lack of specialist providers and training programs as well as limited infrastructure and material resources, including operating rooms and surgical implants. For example, in 2008, Uganda reported only 23 orthopedic surgeons in the country, 1 for every 1.3 million people (7). At the same time, research to quantify the unmet burden created by these deficiencies and evaluating potential strategies to address them is sorely lacking. A sustainable approach to addressing these barriers is desperately needed.

Orthopedic surgeons have long recognized the need for their expertise in LMICs. There is a rich history of volunteerism in

orthopedic surgery, primarily through short-term surgical missions (8). While this model may be effective for a limited number of patients, the bigger picture impact and sustainability are limited once surgeons return to their home institutions. Thankfully this strategy has begun to adapt based on lessons learned from other medical and surgical specialties.

The model of international academic collaboration to address global issues has been well established in many fields of modern medicine. Infectious disease has long been a specialty of medicine associated with overseas collaboration, treating diseases, such as AIDS, malaria, and tuberculosis (9–12). Access to surgery is being increasingly recognized as a global health issue, as the poorest countries in the world—representing a third of the global population—only account for a small percentage of operations performed annually (13, 14). Despite these staggering statistics, academic models of collaboration in surgical fields lag behind their counterparts in medicine. There are a few exceptional models, particularly in pediatric surgery (15–17). However, these programs are almost exclusively within the realm of general surgery. The role of orthopedic surgeons in the broader picture of global health is likely to be unique and has not been well established. While the global need for orthopedics is clear to its practitioners, there is no clear model to address this need, and data supporting one approach relative to another are wholly lacking. Adding to the challenge is that no all-encompassing innovation will be universally adaptable. Rather, each initiative will need to be unique and malleable to fit the needs and locations being addressed (14). Given the need for increased global orthopedic presence without a consensus on effective strategies, IGOT serves an important purpose in both the orthopedic and public health communities. The framework represents a decade of trial and error through frequent communication with international partners to best address the needs they deem most critical. The purpose of this article is to present IGOT and its organizational structure as a potential model for other academic institutions, particularly in orthopedics and other surgical subspecialties, to develop an organized, scalable, and realistic approach to global outreach through collaborative partnerships.

CASE DESCRIPTION

In the summer of 2006, IGOT was founded as an initiative within the department of orthopedic surgery at UCSF (18). The professionals involved in its inception all shared a passion for global health in addition to orthopedics. IGOT's founders were three orthopedic surgeons with a long track-record of international work, including leadership roles in such organizations as Orthopedic Overseas, the International Committee of the Red Cross, and Médecins sans Frontières. They shared a vision of an organization dedicated to creating long-term, sustainable solutions to the growing burden of musculoskeletal injury. By focusing on collaboration with institutions around the world—rather than the simple provision of short-term services—the founders hoped to promote a culture of training and investigation to be shared equally among all partners. IGOT was one of the first academic organizations created to address the need for comprehensive orthopedic care on a global scale (18). By fostering

academic partnerships in LMICs, IGOT aims to build local capacity for research, education, and clinical care. By focusing on academic centers, impact is maximized through a “train the trainers” model.

METHODOLOGICAL ASPECTS

International collaboration is a proven, effective tool for developing health-care capacity in LMICs. However, the framework that comprises these collaborative efforts can be widely variable among different fields of medicine. Moreover, there is little experience with global partnerships in orthopedic surgery. IGOT is one of the first academic organizations to address the global need in orthopedic surgery. Thus, we believe the organizational framework described below represents an adaptable model that can be utilized by other institutions to improve global outreach in orthopedics.

Institute for Global Orthopedics and Traumatology utilizes a four “pillar” structure that categorizes the various modes of successful academic partnership. The four pillars are Global Surgical Education (GSE), Global Knowledge Exchange (GKE), Global Research Initiative (GRI), and Global Leadership and Advocacy. The GSE pillar aims to disseminate knowledge and enhance surgical technique in all fields of orthopedic surgery with an emphasis in orthopedic trauma. This is accomplished through courses—exemplified by the Surgical Management and Reconstructive Training (SMART) course—and online training. The GKE pillar facilitates the bilateral exchange of surgeons and trainees between UCSF and LMICs. This is accomplished through a resident global elective and international fellowships and observerships. The GRI focuses on building capacity to conduct clinical research. By addressing many of the common barriers to conducting research in low-resource settings, the GRI makes high-quality clinical research feasible and thereby facilitates research that addresses locally relevant clinical questions. Finally, the Global Leadership and Advocacy pillar strives to establish the role of orthopedic surgery as a key component of international health. Numerous publications, conferences, and events, such as the Bay Area Global Film Festival, help to increase awareness of this growing problem. Through these four pillars, IGOT aims to have a positive impact on the burden of orthopedic trauma worldwide.

Currently, IGOT has active partnerships with five different hospitals around the world. While some sites function only in the resident exchange program, others feature active and productive collaborative research efforts and recurring educational courses. In Central America, IGOT partners with the El Antonio Lenin Fonseca Hospital in Managua, Nicaragua. In Asia, the only formal partnership is with the Rehabilitation Hospital for Disabled Children in Kathmandu, Nepal. Finally, IGOT has three partnerships in Africa: Komfo Anoye Teaching Hospital in Kumasi, Ghana, Queen Elizabeth University Teaching Hospital in Blantyre, Malawi, and the Muhimbili Orthopedic Institute (MOI) in Dar es Salaam, Tanzania. IGOT works with surgeons from numerous other sites across the world in the absence of a formal partnership. While the current network is broad, IGOT continues to grow and expand its partnership

opportunities. A key tenet in IGOT’s philosophy is the belief that the activities of each collaboration should be driven by the needs of international partners. The programs and courses offered are dynamic and constantly evolving to meet the needs at each partner site. This helps ensure that the curriculum is locally relevant and culturally appropriate to each setting. Unlike short-term surgical missions that focus primarily on clinical care based on the interests of visiting surgeons, IGOTs programs focus on education of local providers through exchange and courses driven by local needs. Research questions are driven by partners and hence generate results with the potential to change practice both locally and globally among surgeons practicing in low-resource environments. The impact, therefore, extends well beyond the individual patient encounters that occur in a typical surgical mission.

GSE: The IGOT SMART Course

With the growing global burden of injury (1), there is an increasing need for orthopedic services worldwide. Unfortunately, the traumatic injuries encountered are often not limited to bone. Many cases of severe orthopedic trauma also involve extensive soft-tissue injury. Without soft-tissue coverage procedures, such as muscle flaps or skin grafts, this damage can lead to infection, amputation, or even death (19). In high-resource settings, these complex injuries are usually treated using multidisciplinary approach, which typically includes plastic surgeon with specialization in soft-tissue reconstruction to manage the soft-tissue loss. While studies have shown that interventions to address soft-tissue injury in LMICs improve patient outcomes (20), there is a dearth of local surgeons with sufficient training. Similarly, most orthopedic surgeons from HICs on mission trips are similarly unable to address the issue because they are accustomed to having plastic surgeons available for assistance. With this in mind, IGOT has created a cross-disciplinary training approach, hosting an annual course designed to train orthopedic surgeons from low-resource settings how to address complex soft-tissue injuries in addition to providing more conventional training focused on complex fracture management.

A short course teaching soft-tissue reconstruction was first suggested by IGOT’s partners at SIGN Fracture Care International. Soft-tissue management was identified as a critical skill needed for surgeons who, despite having the ability to nail long bones using SIGN implants, were struggling to manage complex open injuries. Initially small “flap courses” were held at Duke and the University of Southern California. In 2010, IGOT hosted its first flap course in San Francisco (SF), which has now become an annual event in conjunction with the SIGN Conference in Richland, Washington. Over time, it was recognized that more surgeons could be reached by conducting the course abroad at partner sites in addition to the annual course in SF. At that point, the modular curriculum encompassing treatment for complex limb injuries became known as the Surgical Management and Reconstructive Training (SMART) course.

The SF SMART course is held annually at the Orthopedic Trauma Institute within the Zuckerberg San Francisco General Hospital. This facility provides both lecture and laboratory space to enable didactic as well as hands-on practical education

in a cadaver lab. The course focuses on topics, such as wound healing, skin grafts and rotational muscle flaps, and principles of limb reconstruction (21). Surgeons are invited from many different countries to attend the course. Attendees are either funded through their own institution, their Ministry of Health, or occasionally self-funded. In some select cases, IGOT will cover travel costs for attendees. IGOT incurs the cost of hosting the event, such as laboratory costs, food, and transportation to and from accommodations. There is no registration fee to attend.

During the course, participants split time between lectures, small group case-based panel discussions, and skills lab sessions. Lectures are designed to teach the limb-salvaging procedures that will subsequently be performed in the skills lab. These lab sessions take place in a simulated operating room environment and feature fresh cadavers to better replicate an actual surgical setting. Procedures are taught by fellowship-trained plastic surgeons with experience in extremity reconstruction. The curriculum focuses on flaps that can easily be performed without loupes, an operating microscope, or microvascular instruments. The major emphasis is on lower leg coverage using the gastrocnemius, soleus, and reverse sural flaps. The SMART course also utilizes case-based panel sessions that engage participants in problem solving complex cases based on the resources available in their settings. Panels are held on a variety of topics, such as the mangled extremity, osteomyelitis, bone loss, as well as other subspecialty topics such as pediatric trauma, bone tumors, and amputations. Attendees have the opportunity to submit relevant cases beforehand to be discussed during the small group panels. This helps to engage participants and ensures the case discussions are relevant to the problems faced by surgeons in LMICs.

Despite the burden of trauma in LMICs, there is a paucity of research that is locally relevant or generalizable from HICs to quantify the burden or establish guidelines for appropriate treatment based on available resources. Few initiatives exist that promote local investigation, despite the growing need for region-specific research. To support the growth of research capacity, IGOT created the International Research Symposium, a 1-day course held in conjunction with the SF SMART course. The course structure is divided into three parts: (1) developing a research question, (2) developing a research protocol, and (3) implementing your research. Each section is comprised of one to two lectures followed by small group discussion. Attendees are encouraged to come to the symposium with a specific research question prepared. The goal is to develop the idea from a non-specific question to a well-developed hypothesis and outline for a study protocol that addresses issues ranging from study design and eligibility to budget and personnel. The International Research Symposium is open to all surgeons attending the SMART course and is typically attended by approximately one-third to one-half of the larger course.

To increase access to the SMART course for surgeons unable to travel to SF, IGOT began hosting an annual “In-Country” course in 2014 at the MOI in Dar es Salaam, Tanzania. The course is modeled after the SF SMART course, but includes additional modules focused on fracture management principles. The most recent course included a separate module focused on deformity

management using both acute and gradual correction methods with Ilizarov techniques. The course is attended by approximately 100 surgeons from roughly 10 countries across East and Central Africa. This has greatly expanded the reach of the course for practicing surgeons and trainees who would otherwise be unable to afford travel to SF.

After the success of Tanzania, IGOT has expanded the “In-Country” model to Asia. In November 2016, IGOT conducted an inaugural Nepal SMART course in Kathmandu in collaboration with the National Academy of Medical Sciences of Nepal, the Nepal National Trauma Center (Bir Hospital), and Tribhuvan University Teaching Hospital. This course was more focused, as all attending surgeons were from Nepal. This partnership developed out of conversations surrounding the Nepal earthquake in April 2015.

In contrast to Tanzania, the course faculty included Nepalese plastic surgeons in addition to international faculty. From the beginning, one of the explicit goals in bringing the SMART course to Nepal has been an emphasis on “training the trainers.” A Memorandum of Understanding was established with the goal of transitioning the SMART course from being externally organized by IGOT to being driven primarily by Nepalese leadership with limited outside support after 3 years. This model builds capacity and allows IGOT to focus resources on fostering new partnerships and expanding the SMART course to other locations.

In 2015, researchers at IGOT published an article detailing some of the successes of the SF SMART course from 2010 to 2014, as well as the 2014 and 2015 Tanzania SMART course (21). The SF SMART course during that time hosted over 200 participants from 25 different countries, while the Tanzania SMART course taught over 100 attendees from 12 different east African countries. A 1-year follow-up was sent to the 2012 SMART course participants detailing flap use. About 77% of surgeons responded. Collectively they reported using 594 flaps, of which they considered 554 to be successful. Overall they reported these flaps to have prevented 121 amputations. Additionally, these surgeons reported disseminating the knowledge to other surgeons and residents, such that an additional 28 surgeons were now performing flap procedures (21). These data demonstrate that the SMART course is an effective method for teaching orthopedic surgeons how to successfully perform flap procedures and prevent limb loss. IGOT intends to use mobile technology to more objectively measure clinical outcomes after flap procedures following the 2016 Nepal SMART course.

To facilitate independent study both pre- and post-course, IGOT has begun creating content for an online education curriculum using the edX platform (22). edX is an open-source software developed by MIT and Harvard that is now used at over 70 universities across the United States to create interactive online courses that include reading material, instructional videos, questions, discussion forums, and robust analytics to evaluate use and knowledge acquisition. The IGOT Portal curriculum will coincide with the curriculum of the SMART course modules, beginning with soft-tissue flaps and limb reconstruction. The portal will also provide a forum to share cases and feedback among users and moderators. Ultimately, this interface will be powerful reinforcement for SMART course attendees.

GKE: Resident Exchange Program and Visiting Fellowships

International volunteerism has long been an unofficial facet of the orthopedic surgery department at UCSF. Beginning in 1992, residents of the department departed on short-term mission trips to Central and South America through Operation Rainbow. From 1992 until 1998, nearly half of the graduating residents in that timeframe incorporated an international mission into their residency experience. Of these, six continued to volunteer overseas after graduation; of these six, three went on to lead other UCSF residents on international trips (23). In providing residents these global experiences early in their career, the department hoped to instill them with a life-long desire for overseas work.

With the popularity and success of these mission trips, personnel at UCSF sought to expand. It was believed that increasing the duration of the trips and establishing fixed locations would accomplish more than simply provide a meaningful international experience. The increased time would grant residents deeper perspective about the challenges faced by local surgeons working in LMICs. Additionally, having fixed locations would facilitate a more continuous exchange of knowledge among the visiting residents and the local staff members. Thus in 1998, UCSF implemented a 1-month long global health elective for orthopedic surgery residents. This rotation was offered in Umtata, South Africa in conjunction with Orthopedic Overseas. An article published in 2002 stated that 13 out of 17 (76%) of residents had chosen to pursue this elective since its inception (24). The program has continued to remain effective, as residents who take part in the elective are more likely to pursue international work following residency (25).

Though the elective is no longer offered in South Africa, residents now choose among IGOT's five partnerships in Africa, Asia, and Central America. Currently nearing the end of its second decade, the resident global elective remains a unique and vital aspect of the orthopedic residency program at UCSF.

In addition to sending residents overseas, IGOT also provides opportunities for orthopedic surgeons from around the world to visit UCSF. In collaboration with the Orthopedic Trauma Institute at the Zuckerberg San Francisco General Hospital, IGOT offers clinical observerships to provide global leaders in orthopedics a chance to work and learn in SF. These observerships are 2–4 weeks long, and are open to attending physicians, residents, researchers, and medical students. Since 2006, IGOT has hosted over 60 scholars from 20 different countries (26). Often, IGOT will also sponsor visitors to continue their stay in SF following the SMART course. By hosting physicians and researchers from around the world, IGOT hopes to provide valuable experience with surgical practice and research processes at UCSF.

Global Research Initiative

The GRI seeks to foster and develop research capacity among orthopedic surgeons practicing in LMICs. Despite an overwhelming burden in low-resource settings, the majority of research involving orthopedic trauma is conducted in high-resource environments. In one study, less than 7% of orthopedic research was authored by researchers from developing countries (27).

Through collaboration with academic sites around the world, IGOT seeks to foster and support clinical research programs in developing countries. While both resource and labor intensive, these partnerships are very fruitful in producing high-quality research studies. Support ranges from simple feedback on project proposals to intensive collaborative studies supported through study design, funding, short-term personnel, and data analysis. By utilizing teaching hospitals as partner sites, the effect is exponential. Not only are locally relevant questions answered but a culture of research and critical assessment of outcomes is also fostered in an environment that trains future leaders. Our prior work has demonstrated the positive effects of collaboration on the quality of clinical research generated in LMICs (28).

At present, three of the five IGOT partners are actively engaged in major partnership research projects including two randomized controlled trials, one multicenter study, and one long-term prospective cohort study. Partners have twice won the best international presentation at the OTA annual meeting in the last 4 years. Perhaps more importantly, partners have increasingly been presenting and publishing their own works without external assistance, indicating the capacity building nature of the partnership model.

As an example, a major research priority for the GRI has been assessing the value of surgical treatment for femoral shaft fractures, one of the most common and debilitating fractures encountered in LMICs. A large prospective cohort study was recently completed in Tanzania demonstrating that surgical treatment is safe and effective when performed with intramedullary implants rather than plates and screws (29). Secondary studies have also demonstrated the potential cost savings associated with access to efficient surgical treatment and relatively poor outcomes with skeletal traction (30, 31). A multicenter study is currently ongoing in Malawi to establish the cost-effectiveness of surgical treatment compared to skeletal traction. Combined with a current study in Tanzania estimating the country-wide incidence of femur fractures and access to surgery, these data will be able to establish the unmet surgical burden of femoral shaft fractures in LMICs. These data will fill a critical gap and not only influence clinical care, but perhaps more importantly, form the foundation to advocate for increasing access to surgical treatment in LMICs.

Through a generous endowment, IGOT has the capability to support a senior medical student for a 1-year research experience. This opportunity is designed for students interested in orthopedic surgery and global health. Every year, IGOT awards this fellowship to one senior medical student who then becomes involved in a multitude of roles. Foremost, the fellow has an active role in IGOT's research activities. Responsibilities include the design and implementation of new projects, assisting in the support or analysis of current projects, and the writing of abstracts or manuscripts for completed studies. Additionally, fellows serve as a key component in communications among IGOT and both local and international partners. Finally, the fellow assists with the other various aspects of IGOT operations, from the SMART COURSE and Research Symposium to numerous other events throughout the year. The utilization of senior medical students in this role creates a mutually beneficial relationship. The fellows gain invaluable

experience in their anticipated field of interest prior to starting their graduate education, while IGOT acquires an individual who can devote the vast majority of his or her time to research activities. In a field where researchers are usually also practicing surgeons, having a dedicated research personnel grants IGOT a larger capacity to manage projects and pursue additional studies.

Global Leadership and Advocacy

The final pillar in IGOT's four-pillar organizational structure is Global Leadership and Advocacy. The purpose of this facet is to raise awareness about the global burden caused by musculoskeletal disease and orthopedic trauma. IGOT accomplishes this through a variety of methods. One example is the annual Bay Area Global Health Film Festival, a film screening event hosted by IGOT that highlights pertinent issues in public health relevant to IGOT's mission. In addition, members of IGOT actively raise awareness and promote efforts to improve orthopedic care in LMICs through publications, editorials, and conferences year-round. Faculty members also endeavor to find leadership roles in organizations, such as the AAOS International Committee and OTA Humanitarian Committee, among others.

DISCUSSION

While IGOT now has a decade of experience, many challenges still remain. A significant one is the relative lack of objective, measurable outcomes regarding its interventions. As referenced earlier, available data support the positive impact of the SMART course. However, studies to date are limited to pre- and post-course assessments and self-reported data. Feedback from contributors maintains the overall adaptability of the model and ensures that the interventions remain dynamic. However, long-term outcomes are needed to evaluate the broader impact and sustainability of the model. We are currently utilizing mobile-based data collection tools to record skills taught at the SMART course longitudinally both to measure the effectiveness of the program and provide real-time feedback to course participants.

The financial sustainability is a second major challenge. IGOT functions primarily on grant funding and charitable donations. Grants support has largely been through foundations supporting IGOT's general mission and educational programs. In addition, the GRI has been supported for specific projects by research funding predominantly from orthopedic organizations, such as the Orthopedic Research and Education Foundation, Orthopedic Trauma Association, AO Foundation, and Foundation for Orthopedic Trauma. A critical next step for IGOT is to successfully compete for grant funding from the NIH and other global

health funders that have not historically provided support to orthopedic initiatives.

One final challenge encountered by IGOT is the navigation and growth of international partnerships. While these collaborations are what make this organization successful, the maintenance of these relationships is quite labor intensive, which only increases as new partnerships are created. The most successful programs are typically driven by a champion on each side of the partnership who maintains the relationship, facilitates communication, and ensures that goals are being met. This restricts growth to the number of willing and available champions, which in a busy orthopedic surgery department, often becomes the rate-limiting step for new partnerships and long-term growth.

FUTURE RECOMMENDATIONS: EXPANDING THE MODEL

In light of the rapid growth of IGOTs programs over the past decade and demand for new partnerships, efforts are underway to expand the model by replicating it at other institutions. Through a collaborative initiative among personnel at IGOT and orthopedic surgeons across North America, a novel coalition has been created to develop capacity for global orthopedics at multiple academic institutions. The Consortium of Academic Traumatologists (COACT), though still in its organizational infancy, already boasts 20 participating institutions in the United States and Canada. In these partnerships, COACT has developed an extensive network that aims "[t]o support the collaboration of academic global health and orthopedic efforts through mentorship, sharing of best practices, research opportunities, and resources" (32). Through this consortium, investigators at IGOT hope to exchange ideas with like-minded institutions and expand educational and research support more broadly to LMICs in a way that a single university cannot realistically achieve. Based on the lessons and pitfalls from more than a decade of experience, IGOT hopes to share best practices for global partnership in orthopedic surgery that can be replicated. Ultimately, we believe these strategies are a model to address the growing burden of musculoskeletal injury in LMICs in a sustainable manner driven by local needs.

AUTHOR CONTRIBUTIONS

DC is the primary author responsible for writing the article. RC and AC were invaluable in contributing information and guidance throughout the manuscript. DS is the senior author responsible for overseeing the manuscript and performing final editing/review.

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Advancing Physical Therapy Practice through Curriculum Revision: The Malawi Experience

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Challenged health systems are a motivation for health education reform. Although resources-limited areas cover our planet, sub-Saharan Africa has the highest disease burden, yet the lowest health-care provider and medical school density of any region in the world. Malawi is among the most under-resourced countries in the world. While much of the data focus on dental, medical, and psychiatric service provision, physical therapists are also in short supply. Among the barriers to achieving the recommended standards for physical therapist education, African physiotherapists (the term for “physical therapists” in Africa) identify limited training opportunities, limited research education, and limited resources and funding. The purpose of this article is to describe an international partnership for strengthening the Malawian physiotherapist workforce capacity through curriculum revision in the Department of Physiotherapy at the University of Malawi’s College of Medicine.

Keywords: physiotherapy, curriculum, health education reform, instruction, pedagogy, Africa

BACKGROUND

Malawi is a small country in southeast Africa with a population of 17,215,000 (1) and an acute shortage of rehabilitation workers: a ratio of 0.8 physiotherapists per 100,000 people (by comparison the United States has nearly 1,350 per 100,000 people) (2). Malawi has 147 qualified physiotherapists and 27 physiotherapist interns registered with the Medical Council of Malawi (3). This number overstates the Malawian workforce because it includes physiotherapists who are volunteers during the year and are not residing in Malawi. At the time of this evaluation, only 26 physiotherapists had been trained in Malawi; therefore, more than three-quarters of the physiotherapists had been trained outside of the country. Historically, Malawi has depended on expatriates in the provision of these services through projects like Malawi against Physical Disabilities and the Sue Ryder Foundation (4).

Physiotherapists are represented worldwide by the World Confederation for Physical Therapy (WCPT) (5). According to the WCPT, physiotherapy is a vital portion of the health-care delivery system concerned with maximizing musculoskeletal function, within the areas of disability prevention, health promotion, rehabilitation, and treatment. Physiotherapists provide services to clients to develop, preserve, and return functional capacity and maximal movement throughout the lifecycle. It is at the core of impairment and disability prevention (5).

The provision of physiotherapy services in Malawi has lagged far behind other health services in the country. In Malawi, physiotherapy activities started back in the mid-sixties in response to polio outbreaks and only modest improvements have been made since that time (4). Despite the dearth

of physiotherapists, the demand for rehabilitation services has continued to rise due to high numbers of road traffic accidents, diseases of lifestyle, HIV, and AIDS, and more people seeking high standards of health care which includes functional restoration (6). Malawi's HIV prevalence is one of the highest in the world, with 14.5% of the population living with HIV in the most prevalent region of southern Malawi (7), where the College of Medicine (COM) is located. People with HIV infection often develop multiple complications requiring the need for physiotherapy such as tuberculosis of the spine, neuropathies, and meningitis (8). Workforce needs are growing for physiotherapists around the world. Malawi's population is expected to triple by 2050 (1). A growing population will only increase the need for rehabilitation professionals in Malawi as a significant portion of the population is under 18 years of age and as it ages, the incidence of chronic disease will increase (9).

PHYSIOTHERAPY EDUCATION IN MALAWI

Development of the Physiotherapy Program at the University of Malawi

A 1998 Ministry of Health Unit Review revealed that the Ministry had no policy on medical rehabilitation services; there was no staff development plan for rehabilitation personnel and very few facilities where people could access physiotherapy services in the country (10). The review, therefore, recommended that the Ministry should support the establishment of a school of physiotherapy in Malawi. The recognition of the shortage of rehabilitation workers was instrumental in approving, funding, and enrolling students in a new Department of Physiotherapy, which was started in January 2010 at the University of Malawi's COM in Blantyre. The department offers a Bachelor of Science (B.Sc.) Honours in Physiotherapy degree. After students complete their degree, they are expected to complete a 1-year internship. The first two cohorts of 46 Malawian physiotherapists graduated from the COM in 2014 and 2015.

Before 2010, Malawi had no program to train physiotherapists within the country. All Malawian physiotherapists since 1968 were trained in the United Kingdom, Germany, South Africa, Zambia, Zimbabwe, Kenya, and Tanzania. This mode of training failed to produce significant numbers of physiotherapists to meet the needs of Malawi because of the prohibitive costs of and lack of access to foreign training. The development of the B.Sc. program at the University of Malawi's COM was a significant step in producing locally trained physiotherapists to meet the country's needs.

The WCPT defines physical therapy as a dynamic health-care profession that aims to assist individuals with the achievement, maintenance, and restoration of maximal physical functioning and health throughout their life (5). Not only is physiotherapy intervention associated with improvements in physical function, but in health-related quality of life (11). Physiotherapists have a leadership role in the prevention of loss of function and maintenance of functional mobility for individuals within communities. This is a very important role for physiotherapists and

is endorsed by the WCPT (5). Physiotherapists can use their extensive knowledge and skills to promote improved public health by being involved in programs that promote health and wellness and reduce the risk of injury (12). People with a disability have a lower standard of living in Malawi and less than 25% of people with disabilities receive rehabilitation (13). Approximately 80% of people in Malawi live in rural areas (14) and rural people depend mostly on the physical demands of farming (15). Timely access to physiotherapy is not only beneficial to the patient, but, to society as a whole in order to insure functional mobility and economic stability.

Capacity of the COM to Host the B.Sc. Physiotherapy Degree

The mission statement of the COM includes the training of cadres in the health sector in addition to medical doctors. It is responsible for developing high quality, entry-level programs in the health sciences that will produce graduates who can meet the service demands of the people of Malawi and its neighbors in the southern African region. The COM has committed senior management and academic staff and has established good links with the Ministry of Health for the implementation of the Physiotherapy program. The College has successfully sought funds to build its own lecture hall and other purpose-built physiotherapy teaching areas as well as an outpatient faculty physiotherapy clinic. The Physiotherapy Department accepts about 30 students to begin the 4-year curriculum every August. The College has appointed 10 full-time faculty members (nine physiotherapists and one exercise scientist). The 10 faculty members include: an associate professor (who is an expatriate), four lecturers, and five assistant lecturers who are new graduates from the first cohort of graduates from the program. Among the four lecturers, one is an expatriate and three are Malawians. Practicing physiotherapists in Malawi who belong to the Physiotherapy Association of Malawi (PAM) have committed themselves to act as part-time lecturers to the program. The Malawi government and the donor community have provided additional lecturers and clinical supervisors.

The Bachelor's program in Physiotherapy was developed to teach a deep grasp of the pathogenesis and systems of diseases, specialized knowledge and skilled expertise to deliver rehabilitation services, administer assets, and teach lower-cadre rehabilitation workforces. The degree program is a full-time 4-year program. Before students start the first year of the Physiotherapy curriculum, they are enrolled into a 1-year foundation program where they learn premedical sciences such as Mathematics, Biology, Chemistry, Physics, language for communication, and Information Technology as a prerequisite to medical sciences. The first year of the physiotherapy program covers basic medical sciences which are taught in conjunction with other health sciences students by the Divisions of Basic Medical Sciences and Pathology in the COM. From years 2–4, the core subjects of physiotherapy are covered. Clinical work is conducted *via* placements at designated teaching hospitals at district and central hospital levels. The students have hands on experience at selected district hospitals under the supervision of assigned tutors/supervisors. They have regular assignments and a research project. During the fourth year of study, students are exposed to community physiotherapy

and also undergo training in management and administration of programs at district and central hospitals. Upon completion of the fourth year of study, students complete a government-paid internship at district and central hospitals. The paid internship ends after 12 months.

STANDARDS UNDERLYING THE EDUCATIONAL ACTIVITY

The World Confederation of Physical Therapy recognizes that the education of physical therapists takes places in very diverse cultural and political climates around the world. The WCPT recommends that education for entry level physical therapists be based on university studies of a minimum of 4 years (16), and the baccalaureate degree meets that standard. However, the global trend is to advance from the entry-level physical therapist masters level to doctorate entry qualifications (CAPTE number). This has a significant impact on what is taught and practice expectations around the world (17).

The following resources were used in guiding the curriculum members to participate in a week-long curriculum planning workshop: WCPT Guideline for Physical Therapist Professional Entry Level Education (16); A Normative Model of Physical Therapist Professional Education (18); the curriculum revision which was led by the Consultant from South Africa in 2013; and, course syllabi from the Doctor of Physical Therapy program at California State University, Northridge. As described by the WCPT, the acquisition of broad-based knowledge, critical thinking, self-directed learning and reflection, problem solving, teamwork, and communication is germane to the practice of physiotherapy (16).

RATIONALE FOR REVISION

There were five basic reasons why the original curriculum was revised:

- *to update* outmoded content and methods in light of recent research findings and to correlate the subject matter of the program more closely to current issues and problems in rehabilitation in Malawi;
- *to create* an integrated progression of instruction, with no holes or superfluous content within departmental courses or between cohort levels, that precisely signifies what faculty assess and teach and what undergraduates are supposed to learn from year I to graduation;
- *to improve* awareness across campus of the program's curriculum and of teaching approaches, priorities, and capabilities among coworkers, as they appear over time in the ongoing college-wide discourse;
- *to document* a printed scope and arrangement of teaching that will aid new faculty members in planning for the teaching obligation when they arrive to the COM, and which will also clarify the program's curriculum to accreditation teams, prospective students, and others;
- *to deliver* the groundwork for an open-ended dialog every year about what is taught, why it is taught, how it is assessed, and

how things might be done otherwise to better help the students and make the most of the COM's strengths.

DESCRIPTION OF THE PROCESS

Pedagogical Framework

The process of effective curriculum planning and decision-making is the key to the successes of educational programs. The original curriculum for Malawi's only educational program in Physiotherapy at the University of Malawi's COM was approved in 2009 for inception of the newly created program in 2010. The revision of the original curriculum was well thought out and has been several years in the planning. The University of Cape Town (South Africa) provided expert advice on course development, revision, and, curricular sequencing in 2013 with help from representatives from the Physiotherapy Associations in Zimbabwe and Malawi as well as from other stakeholders in Malawi. The Head of Department (HOD) from the Physiotherapy Programme made a trip to Singapore and consulted with members of WCPT at the 2015 World Congress. All of these efforts resulted in a revised curriculum; however, the program required capacity building before its implementation. By the time the second cohort had graduated from the program, the program's faculty had expanded and it was time to attempt to implement the new curriculum in 2016. At that time, there were new faculty members within the department since the original curriculum was approved in 2009 and a curriculum workshop served as local teacher training in curriculum development for these faculty members as well.

Learning Environment

Groups who had a stake in the outcome of a revised curriculum were invited to a 4-day workshop held at the Department of Physiotherapy in April 2016. Stakeholders included representatives from the Malawi Ministry of Health; the faculty from both the University of Malawi's COM and Department of Physiotherapy, including the Principal and Dean; members from the PAM, clinical physiotherapy supervisors, alumni (two cohorts had graduated from the program), patients, and, a Fulbright Specialist (19, 20) from the USA. The HOD from Malawi met the Fulbright Specialist at the WCPT Conference in Singapore in 2015 where they both moderated a panel of leaders of physiotherapy international associations. When the HOD returned to Malawi, she contacted the Fulbright officer at the American Embassy in Lilongwe, followed the procedures and submitted a grant proposal detailing the need for curriculum revision and requested that the Fulbright Specialist come to Malawi.

Objectives

The Curriculum Revision Plan helped guide participants' development of new and/or revised course curriculum, with the following objectives:

- identify how faculty will integrate their workshop experiences and new knowledge into their course curriculum
- align course revisions with current physiotherapy and university concepts, theories, practices, and policies

- document changes and/or additions faculty intend to make in their courses or teaching practices
- ensure the curriculum contains descriptions of essential elements for effective instruction, including:
 - specific outcomes or skills that students will demonstrate
 - instruction formats to be used
 - instructional tools needed
 - assessment plans to determine if students have achieved the set outcomes and skills.

Pedagogical Format

The research procedures used in this study consisted of systematic document analysis and interviews with educators and the above-mentioned stakeholders. The curriculum workshop was 4 days in length and each 1 of the 4 days of the workshop was devoted to 1 year of the 4-year curriculum: the first day for year I, the second day for Year II, etc. The workshop was an opportunity to come together to find solutions to problems that had cropped up in the course of this new program. The process was structured, and initiated by the consultant, but, then guided and steered by leaders among the stakeholders present.

Procedures

The stakeholders explored many resources to justify suggested modifications to the originally proposed physiotherapy curriculum in the COM. This process culminated in a week-long Curriculum Workshop to revise the curriculum. The process was structured, and organized/started by the consultant, but, then guided by the leaders within the faculty.

To guarantee that the workshop completely met participants' educational needs, participants were asked to choose and work on the courses they wished to revise by the conclusion of the workshop. The curriculum was divided into seven course clusters: Basic Medical Sciences, Clinical Sciences, Physiotherapy Sciences, Workplace Practice (including Management), Behavioral Sciences, Research, and Community Physiotherapy.

Each day, stakeholders had the opportunity to make comments and observations on the courses offered in each year of the old curriculum. Then, they were divided into small groups based on course clusters for breakout sessions where as a participant they had selected the courses and objectives they wished to work on and would aid in selecting the course content for the group breakout session work. A fundamental characteristic of the workshop was complete active participation by each attendee: the entire purpose of attendance was to perform and to discover from practical experience.

One of the widespread approaches used in workshops is group conversation on selected topics, the size of the group being small enough to foster complete involvement by each member and big enough for each participant to grow from the knowledge of the others (21). There is nothing special about a small group, but it does extend each member a chance to make his or her own contribution. It gives members the opportunity to discuss and solve the problems of most importance to them. This workshop made everyone (participants and organizers) accountable for assisting

to find solutions to the curriculum revision. The breakout sessions were used as working sessions to fill out the college's curriculum form and write the course syllabus.

At the end of each day, we came together in plenary session for group feedback and consensus on course content. We ended the day with a recap summary session on the day's activities and the beginning of each new day was a chance for feedback in the opening session on what worked well and what needed improvement from the previous day's activities. Participants had to act as small group leaders, reporters, or note takers. The consultant was there for consultation and to facilitate where needed (but not to impose solutions). The workshop schedule included plenary sessions, small group discussion and other activities.

The main intent of the curriculum revision plan, which was directed to stakeholders, was to:

- *have an introductory discussion* on learning theories; domains of learning; program's mission, goals, and objectives; curricular models; course design with skill development; review of how to write instructional goals; and objectives using Bloom's taxonomy of cognitive learning.
- *discover minimum proficiencies*. What are the essential knowledge data and skills that students must acquire as a result of acceptably finishing a class? What is the purpose of the curriculum?
- *recognize what is in fact taught, in what progression, in each cohort/student*. The objective is for faculty and the academic programs to justly document *when* the content is taught and *what* content is taught. A precise "plan" presents where there are common characteristics, holes, insufficiencies, overemphasized content, etc.
- *measure objectives with the international educational norms to distinguish main concerns and disparities*. This is a vital and rather subjective piece of the method—it obliges faculty members to come to agreement about what they attach importance to with regard to the university's mission and instructional objectives. This can be contrasted with what international standards deem that students need. And, there is the realization that, usually, it is not possible to lecture on the complete span of international guidelines in every cohort level or course.
- *document the extent and series of the core curriculum*: as soon as the program expressed its objectives for the curriculum, it was vital to chronicle them carefully, for reference and for future deliberations.
- *guide continuing assessment and modification*: Curriculum revision never ends, as requirements, educational standards, faculty, students, and needs change.

RESULTS

Immediate Outcomes

The key outcomes of the curriculum revision process included:

- extensive revision of course offerings
- rewritten course learning objectives (written as measurable actions)
- creation of new Teaching/Learning methods in order to achieve new learning objectives

- alignment of student assessment methods with each learning objective
- creation of new courses to allow faculty to teach up-to-date content which match WCPT guidelines (16) and the rehabilitation needs in Malawi
- renumbering of courses as distinguished by course code numbers based on year taught (1, 2, 3, or 4), semester taught (1 or 2), and module taught (#)
- development of a plan for the new curriculum proposal to be reviewed by the University of Malawi Senate (the COM is a constituent college of the University of Malawi) for implementation in August 2017.

Progress to Date

New courses, course content, and course outlines have been developed and revised and the goal, although ambitious, was to implement the new 4-year curriculum for the next academic year. This timeline has been pushed back 1 year to allow other departments under curriculum review within the COM to be reviewed at the same time as the Department of Physiotherapy by the COM Faculty Senate.

DISCUSSION

The aim of this article is to describe the application of best practices to bring an outmoded curriculum into alignment with prevailing standards and practices in physical therapy education and practice within the University of Malawi's COM's Department of Physiotherapy. In summary, the program's curriculum was approved in 2009 and a curriculum revision plan was established in 2013. The revised curriculum was not implemented until further capacity building was accomplished within the program. As soon as sufficient capacity building had been achieved, the implementation plan for the new curriculum began with a week-long curriculum workshop in 2016. The process resulted in the establishment of a curricular infrastructure (mission/vision, curricular goals, professional and educational philosophies, and pedagogy). A recap of the curriculum revision plan's outcomes include a revised/new curriculum, rewritten course learning objectives, alignment of student assessment with learning objectives, new teaching methods, a revised course numbering sequence, and, a plan for approval by the University of Malawi Senate.

Lessons Learned

The curriculum revision was revitalizing for the faculty. Not many career training occasions are more energizing than meeting with coworkers in a purposeful attempt to discover and discuss how to educate more successfully. The workshop refreshed experts, informed novices, and served to stimulate faculty members.

The challenge was to revise the curriculum in a manner that conformed to the international standards defined by WCPT (16), but, also addressed the needs of Malawi (22). Curricular content needed to be useful for the people of Malawi and requests were made by stakeholders to include content on communicable

disease, community-based rehabilitation, and victims of torture from the Dzaleka refugee camp in Malawi with refugees from Burundi, Rwanda, and, the D. R. Congo. It is extremely important for Malawian physiotherapists to have a community-focused approach because most Malawians live in the rural setting (14) and to maintain this focus in the revised curriculum. This process took a dedication among the faculty to think about and reveal their pedagogical methods, establish objectives, and pursue means to meet them. It unified and supported faculty in a manner that, hopefully, over time, will make the educational existence simpler and more satisfying.

Several factors that can restrict curriculum innovation have been identified in the literature. They include issues of time, unavailability of instructional materials, and, instructors' lack of pedagogy (23). The workshop offered each participant a unique opportunity for uninterrupted time and thought on the curriculum which is universally admitted to be important, but is frequently neglected in all universities.

Constraints

The faculty in the Department of Physiotherapy must deliver primary content through classroom instruction because of limited access to textbooks and other instructional materials. There is a need to investigate new ways of delivering instruction with the use of distance education (24). In addition, it is important that the faculty are skilled in pedagogy. There is a need to provide pedagogical training to faculty as well as to graduates of the physiotherapy program who are seeking to become faculty at the university level (25). In order for the Physiotherapy program to be sustainable, it will need to produce its own faculty. To that end, two assistant instructors from the first cohort have received grant funding to earn their Masters' degrees in Physiotherapy from a university in South Africa. Thoughtful faculty with experience in education and physiotherapy will be required for the program to be sustainable and they will need to be engaged in active, relevant research. This approach means that the COM must provide appropriate support for lab-based and community-based research. These resources will support the Physiotherapy program as it prepares the next generation of faculty.

In addition, in order for the Physiotherapy program to be sustainable, graduates will need job availability upon graduation. This will be a challenge, as, to date, graduates from the first two cohorts have not been hired to work in government-run hospitals.

Next Steps

The next step is to get the revised curriculum approved by the University of Malawi Senate. Curriculum evaluation is an essential phase of curriculum development. Through evaluation a faculty discovers whether a curriculum is fulfilling its purpose and whether students are actually learning. Both summative and formative evaluations of the curriculum have to be considered. In the short term, here is a need to develop a systematic way of obtaining both student and peer assessments of teaching (26). In the long term, assessment of graduate employment needs to be

done to provide information about the success in which graduates are being prepared to enter the workforce, including rates of unemployment (27).

The opening of the Physiotherapy Department at the COM has brought great hope for the growth and delivery of physiotherapy services in Malawi. The function and sustainability of the program requires significant planning and partnership to sustain and retain the profession in the future.

Implications

The curriculum workshop was analytic, from a practical perspective, in serving to recognize holes and redundancies in the program's curricular continuum. It was emphasized that no one participant was more significant than anyone else. It was further emphasized that the workshop belonged to the participants and would be what they made of it. And, everyone was to keep in mind, that the end of the week was not the end of the workshop, but, rather the start of a long and exciting process which includes challenges posed by implementation of the curriculum, attending to necessary periodic revisions, staff changes, and all other challenges to sustainability. The program's sustainability will impact the profession of physiotherapy and the society of Malawi. For physiotherapy to flourish in Malawi, it will be necessary to educate the array of stakeholders about the value of this rehabilitation discipline and its impact on quality of life for the individuals and communities it serves.

ETHICS STATEMENT

The work presented in this manuscript did not involve human or animal subjects.

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AUTHOR CONTRIBUTIONS

Both JB and EC made substantial contributions to the conception or design of the work, drafted the work or revised it critically for important intellectual content, had final approval of the version to be published, and are in agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Building Surgical Research Capacity Globally: Efficacy of a Clinical Research Course for Surgeons in Low-Resource Settings

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Musculoskeletal injury confers an enormous burden of preventable disability and mortality in low- and moderate-income countries (LMICs). Appropriate orthopedic and trauma care services are lacking. Leading international health agencies emphasize the critical need to create and sustain research capacity in the developing world as a strategic factor in the establishment of functional, independent health systems. One aspect of building research capacity is partnership between developing and developed countries, and knowledge sharing via these collaborations. This study evaluated the efficacy of a short, intensive course designed to educate surgeons on fundamental aspects of clinical research using evidence-based medicine (EBM) principles. Orthopedic surgeons from the United States and Canada presented a one-day course on the fundamentals of clinical research in Havana, Cuba. Knowledge acquisition was assessed on the part of course participants and surveyed current involvement with and attitudes toward clinical research. Questionnaires were presented to participants immediately preceding and following the course. The mean pre-test score was 43.9% (95% CI: 41.1–46.6%). The mean post-test score was 59.3% (95% CI: 56.5–62.1%). There were relative score increases in each subgroup based on professional level, subjective level of familiarity with EBM concepts, and subjective level of experience in research. This study establishes the short-term efficacy of an intensive course designed to impart knowledge in EBM and clinical research. Further study is necessary to determine the long-term benefits of this type of course. This may be a useful part of an overall strategy to build health research capacity in LMICs, ultimately contributing to improved access to high-quality surgical care.

Keywords: clinical research, course design, efficacy evaluation, orthopedic surgery, resource limited setting

INTRODUCTION

A fundamental understanding of the concepts behind research design, implementation, and analysis is increasingly necessary on the part of physicians and surgeons in order to incorporate rapidly developing biomedical knowledge into practice and deliver the highest quality of patient care. Evidence-based medicine [EBM; or practice, as opposed to opinion-based medicine (Straus et al., 2004)] is the judicious and intentional application of the highest quality available medical knowledge, including epidemiology and clinical research, in conjunction with clinical acumen and experience to the treatment of an individual patient (Evidence Based Medicine Working Group, 1992; Sackett et al., 1996; CEBM, 2013).

Clinical research is intimately connected to EBM. The former provides material for the latter, and the practice of seeking data to answer clinical queries reveals when gaps in that material exist, provoking additional relevant research. Certain underlying knowledge and skills are necessary to both appraise and conduct such work (Evidence Based Medicine Working Group, 1992). Working knowledge of study design types, levels of evidence, power calculation, statistical significance, and outcome selection are all relevant to the critical interpretation of literature as well as to study design. Formulation of a clinical question to answer *via* literature review or for the purpose of study genesis is the same skill applied to two related purposes. The course examined in this study took as its purpose the instruction of health professionals in the conduct of clinical research. Doing so required introducing and emphasizing the aforementioned underlying common principles of EBM. The instruction did not extend to the interpretation and application of evidence-based guidelines to clinical care.

Prior literature has described the lack of knowledge and instruction in EBM in surgical training programs in North America as well as a growing receptiveness to acquire these skills (Poolman et al., 2007; Sprague et al., 2012). This is no less true in resource-scarce regions of the world. International organizations have characterized the need for health research capacity strengthening in low- and moderate-income countries (LMICs) (Commission on Health Research for Development, 1990; Changing Mindsets, 2008). The Global Forum for Health Research described the 10/90 gap, an observation that a mere 10% of the world's health research budget is devoted to the health problems that affect 90% of the earth's population, and the Commission on Health Research for Development described the crucial relationship between local health research capacity and sustainable, cost-effective health and development (Commission on Health Research for Development, 1990; Global Forum for Health Research and Davey, 2004).

From an orthopedic perspective, it is clear that musculoskeletal injury is a major contributor to disability and mortality in the developing world. Rates of extremity injury from falls and road traffic crashes are two to five times higher in LMICs than in high-income countries (HICs) (Mock and Cherian, 2008). Disability data consistently demonstrate that LMICs suffer an enormous burden of long-term injury-related disability. One study in Ghana found a 0.83% population prevalence of injury-related

disability; 80% of this disability was due to extremity injuries (Mock et al., 2003; Mock and Cherian, 2008). Serious injuries are twice as likely to result in death in the developing world (Mock and Cherian, 2008). These numbers represent avoidable death and disability. Resolving this disparity is a complex problem involving training, resources, infrastructure, and political will. Supporting research capacity is an important part of developing robust global health systems and empowering local health professionals to examine and solve the healthcare challenges that their countries face (Global Forum for Health Research et al., 2009). Given the massive impact of orthopedic injury on the global burden of disease, this is particularly important for the orthopedic community to recognize and act upon at this time.

An ongoing collaboration exists between the Orthopaedic Trauma Institute at the University of California, San Francisco (UCSF) and the Centro de Investigaciones Medico Quirúrgicas (CIMEQ) hospital in Havana, Cuba. *Via* this collaboration, surgeons determined that despite some degree of infrastructure in Cuba for clinical research and professional interest in carrying it out, there was an inadequate understanding in the Orthopedic Surgical community on how to engage in clinical studies. Although Cuba has medical institutions (i.e., hospitals and clinics) with the capacity to support clinical research and ancillary workers who can assist with study design, data collection, and statistics, their system is not ideal because Cuban orthopedic surgeons do not receive sufficient training to engage clinical research.

In response, faculty from UCSF, CIMEQ, and the Mexican Orthopaedics and Trauma Association [Asociación Mexicana de Ortopedia y Traumatología (AMOT)] collaborated on the design of a one-day clinical research course, to be taught in conjunction with a national course in orthopedic trauma presented at CIMEQ in Havana. The course was designed to impart fundamental skills and knowledge to surgeons on the design, implementation, and publication of original research, employing basic EBM principles. Teaching attendees how to use and interpret EBM in their practice was not a specific course goal, but knowledge of EBM principles will arguably influence clinical practice. The aim of the present study was to evaluate and quantify the efficacy of this course.

MATERIALS AND METHODS

Course Presentation and Content

During the clinical research course, surgeon researchers from the United States, Canada, Mexico, and Cuba presented lectures on study protocol, surgical research methodology, and navigation of the publication process (**Figure 1**). Surgeons presented the one-day training immediately prior to a course on orthopedic trauma. All slides were in Spanish, and live interpreters translated for those presenters who lectured in English. In addition, each participant received a 60-page syllabus, also translated into Spanish.

Course Evaluation

No existing and validated tool specifically addressed the content of our course, which included instruction on fundamental elements of EBM incorporated into instruction on practical aspects

I: Preparing the Study Protocol
Selecting the Right Study Design
Preparing Study Protocols: “The Essentials”
Function and Quality of Life Outcomes: Which are Valid?
Is the Trial Feasible?
II: Executing the Project
How Should We Randomize?
Trial Organization: Research Coordinators and Committees
Data Management: How to Adjudicate Outcomes
How Should the Data Be Analyzed?
III: Reporting Research
Presentation Tips: PowerPoint
Authorship: How Will I Get Credit?
Writing Your Paper for Publication
Getting Your Research Paper Published: Do’s & Don’ts

FIGURE 1 | Plenary session topics.

of carrying out clinical research and preparing work for publication. Therefore, established quality guidelines (Shaneyfelt et al., 2006) were used to design our own assessment tool.

Evaluation instruments for education in EBM are diverse. Multiple authors conclude that no one tool would be appropriate to evaluate any proposed EBM training intervention—rather a tool designed to evaluate knowledge acquisition in the domains of intended knowledge gain should be thoughtfully selected (Straus et al., 2004; Shaneyfelt et al., 2006). Straus et al. proposed a conceptual framework for the evaluation of EBM that advised considering a physician’s “mode of practice” of EBM and choosing an evaluation instrument that reflects the different learners, interventions, and outcomes expected (Straus et al., 2004).

A recent review of instruments available for the evaluation of evidence-based practice suggested that the highest quality instruments were characterized by “interrater reliability (if applicable), objective (non-self-reported) outcome measures, and multiple ($> = 3$) types of established validity evidence (including evidence for discriminative validity)” (Shaneyfelt et al., 2006). Ultimately, an instrument was designed specific to the course, using the quality guidelines established by Shaneyfelt et al. and focusing on fundamental knowledge acquisition, appropriate for a one-day educational event. This was adapted in part from the questionnaire designed by Sprague and colleagues, who described the development and evaluation of a short training course in EBM for a surgeon audience in North America. Using a pre- and post-course questionnaire scheme, they reported a

statistically significant increase in knowledge acquired based on relative increase in score as well as participant satisfaction with the training (Sprague et al., 2012). The instrument they employed was fundamentally based on the highly reliable and validated Fresno Test (Ramos et al., 2003; Thomas and Kreptul, 2015). The Fresno Test is a performance-based measure that was designed to evaluate a broad range of EBM knowledge and skills. Sprague and colleagues adapted it to their group’s more narrow goals and requirements, and the instrument was altered to apply to our training event.

By defining the learners (surgeons, physicians, etc.), intervention (education on clinical research and EBM), and the outcome (objective questionnaire results), our tool was consistent with the Straus conceptual model (Straus et al., 2004). A demographic survey, which specifies gender, age, and profession was also included. Once participants were separated into subgroups, it could then be determined which subgroups entered the course more knowledgeable in clinical research and EBM principles than others, and which subgroups benefited the most from the one-day course (as indicated by an increase in test scores). Pre-course and post-course questionnaires were intended to highlight objective (and not self-reported) measures, and the self-reported levels of knowledge were only present on the pre-test. In total, there were 18 multiple choice questions, eight of which referred to a specific clinical scenario case study, and 10 relating to clinical research design and methodology.

Participants received a printed pre-test upon entering the conference area, and these were collected before commencement of proceedings. Post-tests were handed out at the conclusion of the course and collected as participants exited the conference area. The outcome measure was defined as change in number of questions answered correctly on the post-test compared with the number answered correctly on the pre-test; thus, it was objective. Responsive validity was ensured by comparing individual participants’ scores from before and after the intervention. Discriminative validity was maintained by our ability to stratify participants based on their reported level of expertise in EBM and clinical research.

Statistical Analysis

Descriptive statistics were performed using means and proportions. The distribution of scores pre- and post-course were assessed for normality. The paired Student’s *t*-test was used to assess the difference in means of pre- and post-course scores for statistical significance, assuming an assumption of normal distribution of scores. The data were further analyzed for further trends and hypothesis setting. The data were stratified based on professional level (surgeon, physician, and other health professional) as well as by experience with EBM and by experience in clinical research, rated by participants based on six-point scales. All analyses were conducted using STATA version 12.0 (College Station, TX, USA).

Ethics Statement

This study was submitted to the University of California, San Francisco’s Human Research Protection Program (IRB number: 11-06489) and was certified as exempt from Institutional Review

Board consideration under Exempt Category 2: Use of educational tests, surveys, interviews, or observations of public behavior.

As required by this body, participants were provided a document with details regarding risks and benefits of the study. This document informed them that completion of the survey was considered consent to participate. The Human Research Protection Program did not require a signature on this document.

RESULTS

Participant Characteristics

Ninety six of 102 registered attendees (94.1%) completed both the pre-course and post-course questionnaires. Eight participants completed only one of the two instruments and were, therefore, dropped from the analysis. Attendees were asked beforehand to complete the questionnaires only if they planned on staying throughout the entirety of the course. Surveys were collected from 104 total attendees, indicating that at least two other non-registered attendees elected to participate in the questionnaires.

Though the course was aimed at a surgeon audience, professionals from a number of other healthcare disciplines also attended and completed the surveys. Due to the high participation rate among attendees, it is improbable that certain demographic groups were more likely to complete the survey than others. Thus, in terms of who completed the survey, there was little to no selection bias. The mean age of participants was 44.6 years (SD: 11.8 years) and 52% were male. 46% identified themselves as surgeons, 17% as physicians, 23% as other professionals (nurses, physical therapists, etc.), and 15% did not respond to this question (**Figure 1; Table 1**). Self-reported exposure to EBM and clinical research on the part of this group was low to moderate; 46% of participants judged their EBM experience to be “poor” or “very poor,” and 38% described it as “good” or “average.” Similarly, 30% of participants

judged their clinical research knowledge to be “poor” or “very poor,” while 53% described it as “good” or “average.”

The mean pre-test score was 43.9% (95% CI: 41.1–46.6%). The mean post-test score was 59.3% (95% CI: 56.5–62.1%). Despite the relatively low mean post-test score of 59.3%, there were no clear trends in what questions participants answered correctly or incorrectly. Overall, participants demonstrated a significant increase in post-course questionnaire scores compared with pre-course scores. 68% of participants improved by at least 20% relative their pre-test scores, and 35% of participants improved by at least 50% relative to their pre-test scores.

All professional groups demonstrated relative score increases (**Table 2; Figure 2**). At 57.9% (CI: 43.1–72.7%), non-surgeon, non-physician professionals showed the highest relative score increase. Physicians showed the lowest relative increase at 31.6% (CI: 10.2–53.0%). Scores increased at all EBM and clinical research experience levels. There were no clear patterns relative to changes in score based on pre-course self-assessment of experience with EBM (**Figure 3; Table 3**) or clinical research experience (**Figure 4; Table 4**).

DISCUSSION

This study of 96 participants in a short course on clinical research in an international setting demonstrated a significant improvement in test of knowledge acquisition. These participants represented a range of healthcare disciplines and endorsed a spectrum of levels of experience with EBM and clinical research. The magnitude of increase in score on our evaluation instrument was consistent with significant improvement (Sibley et al., 1982; Sprague et al., 2012). The results of this study suggest that a brief, intensive course presented by surgical faculty on the fundamentals of clinical research using EBM principles can be an effective way to support clinical research capacity in a LMIC setting.

Intended as a pilot project for future courses in Latin America, the aim of quantifying the value of this course was achieved in terms of knowledge acquisition on the subject of clinical research. This finding is consistent with previous work. Sprague et al. demonstrated that participants who took a short course in clinical research skills taught by surgical faculty significantly increased their scores on a test of knowledge acquisition (Sprague et al., 2012). They used a pre- and post-test format to evaluate the efficacy of the *Principles and Practice of Family Research Course*, a two and one-half day course that was offered to medical students, medical residents, physicians, surgeons, and research coordinators. Medical students and residents in particular appeared to

TABLE 1 | Demographics of course participants.

Characteristic	Number, total n = 96 (%)
Gender	
Female	46 (48)
Male	50 (52)
Mean age (±SD)	44.6 ± 11.8
Profession	
Surgeon	44 (46)
Physician	16 (17)
Other health professional	22 (23)
Not reported	14 (15)

TABLE 2 | Change in scores from pre-course to post-course questionnaire by profession.

Participants (n)	Pre-course test score	Post-course test score	Mean (SD)%		
			Absolute change in score	Relative increase, % [95% CI]	p-Value
All (96)	43.9 (13.6)	59.3 (13.8)	15.5 (12.7)	44.3 [35.3, 53.2]	<0.0001
Surgeons (44)	44.7 (14.9)	58.0 (15.3)	13.3 (14.1)	41.9 [25.5, 58.2]	<0.0001
Physicians (16)	49.3 (16.5)	62.1 (18.5)	12.9 (15.0)	31.6 [10.2, 53.0]	0.0067
Other professionals (22)	39.6 (10.3)	60.4 (10.0)	20.7 (8.6)	57.9 [43.1, 72.7]	<0.0001
Unknown (no response) (14)	41.7 (8.1)	58.8 (6.4)	17.1 (8.3)	44.8 [29.9, 59.8]	<0.0001

Relative Increase in Score by Profession

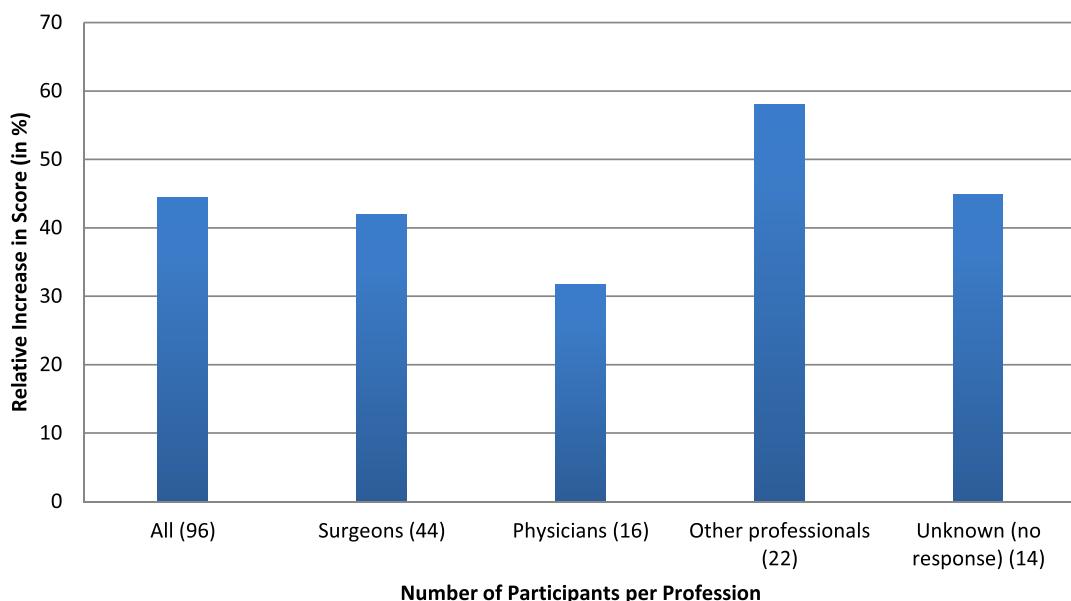


FIGURE 2 | Relative increase in scores from pre-course to post-course questionnaire by profession.

Relative Increase in Score by EBM Knowledge

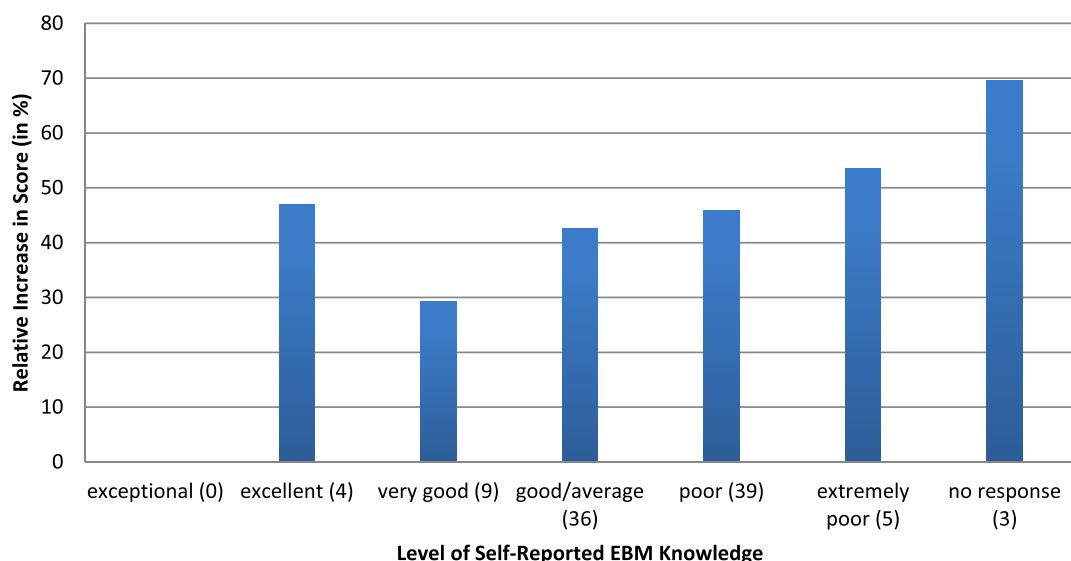


FIGURE 3 | Relative increase in scores from pre-course to post-course questionnaire by level of self-reported evidence-based medicine (EBM) experience.

benefit from the course. Argimon-Pallàs et al. (2011) found a significant increase in EBM knowledge and skills among family medicine residents who underwent a short training course on evidence-based practice. Nadler et al. found that a career and research development course presented to Nigerian surgeons had at least short-term efficacy and observed that potential cultural differences were not an impediment to knowledge acquisition

(Nadler et al., 2010). Dodani and LaPorte (2008) showed short- and long-term benefits of a relatively more extensive course on research methodology presented in Pakistan.

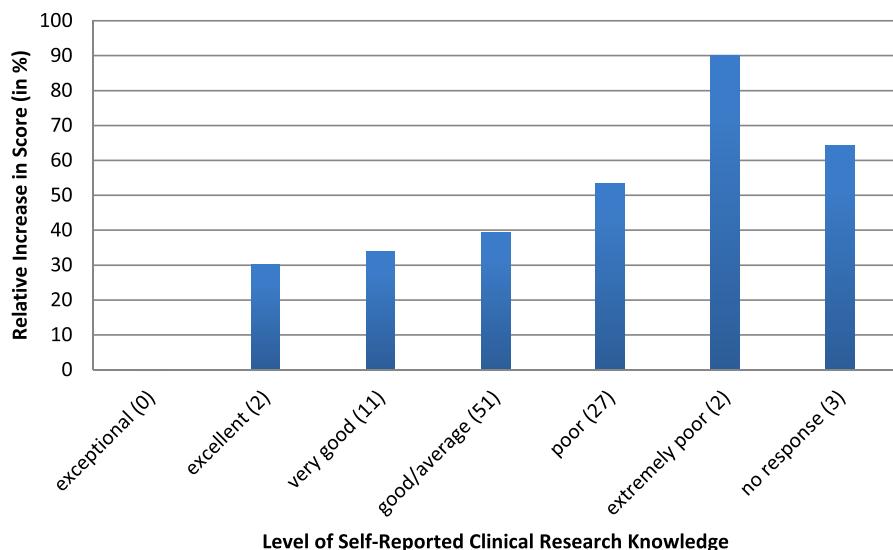
Strengths and Limitations

The strengths of this study included a design that utilized a pre- and post-course questionnaire. As these were matched for

TABLE 3 | Change in scores from pre-course to post-course questionnaire by level of evidence-based medicine (EBM) experience, participant reported.

Participants (<i>n</i>)	Mean (SD)%				
	Pre-course test score	Post-course test score	Absolute change in score	Relative increase, % [95% CI]	p-Value
Exceptional (0)	0	0	0	0	Na
Excellent (4)	41.7 (9.7)	61.1 (13.6)	19.4 (5.6)	46.9 [27.6, 66.1]	0.0045
Very good (9)	45.1 (6.5)	57.4 (6.8)	12.4 (8.2)	29.3 [14.0, 44.5]	0.0022
Good/average (36)	43.7 (3.2)	57.1 (13.5)	13.4 (12.3)	42.6 [25.0, 60.6]	<0.0001
Poor (39)	44.0 (14.3)	60.5 (14.4)	16.5 (14.4)	45.9 [31.9, 59.8]	<0.0001
Extremely poor (5)	43.3 (26.5)	60.0 (20.9)	16.7 (8.8)	53.4 [7.3, 99.5]	0.0323
No response (3)	44.4 (14.7)	72.2 (14.7)	27.8 (14.6)	69.5 [-38.5, 177.4]	0.1094

Relative Increase in Score by Clinical Research Knowledge

**FIGURE 4** | Relative increase in scores from pre-course to post-course questionnaire by level of self-reported clinical research knowledge.**TABLE 4** | Change in scores from pre-course to post-course questionnaire by level of clinical research knowledge, participant reported.

Participants (<i>n</i>)	Pre-course test score	Post-course test score	Absolute change in score	Relative increase, % [95% CI]	p-Value
Exceptional (0)	0	0	0	0	na
Excellent (2)	47.2 ± 19.7	61.1 ± 23.6	13.9 ± 4.0	30.3 [-0.08, 68.5]	0.0628
Very good (11)	43.9 ± 7.2	57.1 ± 5.0	13.2 ± 10.3	33.8 [14.0, 53.6]	0.0034
Good/average (51)	46.2 ± 13.4	61.5 ± 14.0	15.4 ± 11.3	39.3 [29.5, 49.2]	<0.0001
Poor (27)	40.7 ± 15.9	55.8 ± 15.3	15.0 ± 15.9	53.2 [28.6, 77.8]	0.0001
Extremely poor (2)	27.8 ± 0.0	52.8 ± 4.0	25.0 ± 4.0	89.9 [-38.0, 217.9]	0.0710
No response (3)	40.7 ± 8.5	64.8 ± 16.0	24.1 ± 19.5	64.1 [63.9, 192.1]	0.1640

each participant, a more robust statistical analysis was possible. Published guidelines were engaged to develop a high-quality instrument specific to the course content, participants, and structure. Potential contamination was limited by implementing both parts of our instrument on the same day as the course—immediately prior to its start and before participants departed from the final lecture.

Though our intended audience was orthopedic surgeons, many professionals from other health disciplines also registered for and benefited from the course. It would seem that non-physician, non-surgeon participants benefited the most, although their relatively higher change in score is the result of a lower pre-test mean. The intervention appears on the whole to have raised all participants to a common, higher level of

understanding of the fundamentals of clinical research as presented in the course.

Limitations to our study include the possibility that an unknown proportion of participants were unable to be present for all portions of the course. In addition, the degree of effort exercised by participants in completing the questionnaires could not be assessed. Also, because of the nature of this course, with distance and logistics as significant barriers, an instrument was not designed to test the knowledge retention of the attendees over time. However, other similarly structured 1-day courses in pediatric life-support and partner abuse suggest that trainees retain increased knowledge for at least 3 to 4 months after the course (Durojaiye and O'Meara, 2002; Madden et al., 2015). Finally, it is unknown whether the gain in knowledge and skills that were measured will translate into an increase in clinical research or improvement in patient outcomes. Other studies have shown that teaching EBM knowledge and research skills can change health care professional behavior (Straus et al., 2005), and international health organizations, including the World Health Organization (WHO), the Council on Health Research for Development, and the Global Forum on Health Research, have consistently emphasized the critical importance of health research capacity development for the success of health systems in LMICs (Commission on Health Research for Development, 1990; Global Forum for Health Research and Davey, 2004; Lansang and Dennis, 2004; Changing Mindsets, 2008).

Application to Global Orthopedic Practice

The lack of quality data on the burden of global orthopedic trauma and the availability of care to manage trauma-related injuries impede the establishment of policies that prevent avoidable morbidity and mortality (Elliott et al., 2015). It is most appropriate that those who live and practice in the affected communities conduct the research, collect the data, and apply the results to their practice (Gosselin et al., 2009).

A 2004 Bulletin of the WHO states: "A combination of short-term and long-term strategies, directed at individual, institutional, and country levels are necessary to develop a sustainable system of health research." (Lansang and Dennis, 2004). The authors believe that directed coursework is an effective short-term strategy to improve clinical investigation. Following this course, academic and clinical research collaborations developed between the course supporters, including UCSF, CIMEQ, AMOT, and the Osteosynthesis and Trauma Care Foundation (OTCF). It was felt that the course enabled this collaboration, most importantly by improving the understanding of EBM and the ability of the Cuban orthopedic surgeons to access more established and resourced international partners. Subsequent to this course, there are plans to include Cuban surgeons in large prospective studies through McMaster University and the University of California, San Francisco. While not a direct indication of the long-term efficacy of the course, Cuban surgeons who participated in this work have become active members of the recently established international research consortium, Asociación de Cirujanos Traumatologicos en las Americas

(ACTUAR) that supports clinical research across the Americas (Chomsky-Higgins et al., 2017).

Based on the results of this work and successful experience with this course, the authors plan to offer additional clinical research courses to medical professionals in other countries in Central and South America. Similar results are anticipated, and the attendees of these courses are expected to not only improve their ability to better interpret the existing literature but also engage with local, regional, and international clinical research efforts. Ultimately, the authors hope to empower surgeons to create their own an international Latin American network, where the most relevant questions for their patient populations can be addressed.

CONCLUSION

Despite the favorable short-term impact of this course, future work will be needed to establish the long-term content retention of this type of course, as well as the impact the information has on the development of clinical research capacity. It would be informative, for example, to know whether attendees of such courses publish more papers, pursue additional further education in clinical research, develop practice patterns that incorporate EBM, or have improved patient outcomes.

ETHICS STATEMENT

This study was submitted to the University of California, San Francisco's Human Research Protection Program (IRB number: 11-06489) and was certified as exempt from Institutional Review Board consideration under Exempt Category 2: Use of educational tests, surveys, interviews, or observations of public behavior. As required by this body, participants were provided a document with details regarding risks and benefits of the study. This document informed them that completion of the survey was considered consent to participate. The Human Research Protection Program did not require a signature on this document.

AUTHOR CONTRIBUTIONS

TAM and KC-H contributed equally to the development of this article. All authors participated in the discussion and intellectual contribution that was the foundation of the report. TAM, KC-H, and TM wrote the draft manuscript. Each of the authors critically reviewed the content, approved the final version to be published, and agreed to be accountable for all aspects of the work.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Strengthening Educational Capacity through Context-Relevant Curriculum Design and Evaluation

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There is an acute shortage of health-care workers in Sudan. The Academy of Health Sciences was created to prepare health-care professionals in order to restore and ultimately maintain the requisite skills-mix. This necessitates transformative education using a context-relevant curricula. A context-relevant curriculum is one that is feasible, consistent with the mission of the educational institution, and responsive to the communities of interest. This article describes a partnership to strengthen the local capacity of health workforce educators. The article describes one of a series of faculty development workshops, with this first aimed at the skills to develop and evaluate context-relevant curricula using community midwifery curriculum as exemplar.

Keywords: curriculum, CIPP, transformative education, evaluation, capacity, pre-service education

BACKGROUND AND RATIONAL

There is an acute shortage of health-care workers in Sudan. According to the Sudan Academy of Health Sciences (AHS), an estimated 180,000 health professionals are needed (Elhuda, 2015). A transformative scaling up of health professional preparation is imperative to the improvement of population health outcomes in Sudan, similar to other low- and middle-income countries. Critical elements of transformative education include a clear strategy or framework, and effective and relatable health sciences education to increase—not just the quantity—but also the quality and relevance of health-care professionals (Celletti et al., 2011; World Health Organization, 2013). This necessitates context-relevant curricula developed and revised by local faculty. Iwasiw and Goldenberg (2015) define context-relevant curricula as feasible, responsive to the communities of interest, and consistent with the mission of the educational institution.

Aiming at such a transformative scaling up, the Federal Ministry of Health (FMH) in Sudan created the AHS. The AHS has 17 campuses throughout the country and is dedicated to sustained “improvement of the health of the people of Sudan through innovation, equity, excellence in health professions education, service, and research” (Elhuda, 2015). Envisioned as a unique institute for educating and developing nurses, midwives, and other health-care professionals including; community health workers, anesthesia assistants, theater room attendants, sanitary overseers, and medical assistants, with a mission “to restore and maintain the skill-mix of the health team” (Elhuda, 2015). This article describes a partnership to strengthen the local capacity of educators to develop and evaluate context-relevant curriculum to support such a transformative education of the health workforce. While the focus of the article is on the process of curriculum review and revision, findings from the review will be shared.

THE SUDAN PUBLIC HEALTH TRAINING INITIATIVE (SPHTI)

The SPHTI is a collaborative effort between The Carter Center (TCC) and the AHS to build capacity for the education of community midwives and community health workers, among others. The SPHTI creates an enabling environment to leverage local expertise and skills contributing to the development of a health work force that is able to respond to the primary health-care needs of both urban and rural communities. As in many countries, there is a need for faculty development (Kiguli-Malwadde et al., 2014; Olopade et al., 2016) and SPHTI works with health science faculty at AHS to strengthen curriculum and teaching skills, develop health learning materials based on the local context, and build capacity of local health science educational institutions. The Carter Center–Emory University partnership creates a platform for north–south collaboration among higher education institutions with faculty from Emory’s Nell Hodgson Woodruff School of Nursing (NHWSN) serving as educational consultants to the program.

The goal of the (SPHTI) is to strengthen the health professions education system to develop a well-performing, stable, and equitably distributed workforce with an appropriate mix of skills to meet maternal and child health needs in Sudan. Objectives include:

- Develop skills of health science faculty members;
- Develop/adapt health learning materials; and
- Monitor and evaluate SPHTI contributions to United Nations’ Sustainable Development Goals 3 and 4 focusing on health and quality of education, respectively.

A core structure for the project is the SPHTI Technical Working Group (TWG). Based in Sudan, the TWG is composed of technical advisors from the FMH with expertise in health workforce development, management, planning, and monitoring of public health training. The TWG works with TCC on a daily basis and provides technical input to the project. In an effort to address the first two objectives, the TWG identified a need for faculty development and the NHWSN was asked to design a series of workshops. This article describes the first of these workshops.

PEDAGOGICAL FRAMEWORK: THE CONTEXT, INPUT, PROCESS, AND PRODUCT (CIPP) MODEL

Rather than importing curricula, health sciences education should be aligned with the health needs of the country (Miller et al., 2011) and context relevant. Using the “CIPP Model” can help determine the feasibility, responsiveness, and relevance of curriculum. The CIPP model, developed by Daniel Stufflebeam, is a unique, inclusive method of evaluation (Stufflebeam and Shinkfield, 2007). Each of the four components of the model; CIPP, is important, and when viewed together allow evaluators to access a rich, full picture in terms of not just the content and implementation of a project, but also its setting. This is imperative

when analyzing curricula and programs in places as diverse as Taiwanese universities (Chien et al., 2007), agricultural schools in Nigeria (Osokoya and Adekunle, 2007), service-learning programs in North Carolina (Zhang et al., 2011), and allied health education in Sudan. The underlying theme of the CIPP model is “that evaluation’s most important purpose is not to *prove* but to *improve*” (Stufflebeam, 2003, p. 31).

LEARNING ENVIRONMENT AND FORMAT

Two, 2-day workshops were held in Khartoum, the capital of Sudan in a conference room of a centrally located hotel. The two workshops were attended by 42 faculty and administrators of the AHS (chosen by the FMH and AHS) who were involved in the various programs of the AHS. The NHWSN team consisted of two faculty members from NHWSN with expertise in education to serve as workshop facilitators, two staff from TCC, including local national staff and two Ethiopian midwives, staff of NHWSN’s Maternal and Newborn Health Program (MaNHEP) in Ethiopia. Facilitators from NHWSN were educational experts with many years of global health experience. In addition to the workshop, the team was requested to produce a standard operating procedure (SOP) for the evaluation of AHS curriculum. The CIPP model was chosen for the SOP.

The NHWSN team facilitated the workshop in English as the AHS faculty went through a curriculum review process, using the CIPP framework and the midwifery curriculum as a template. Ideally, having completed the process once, it can be repeated for the curricula for the other health cadres. Participants were divided into groups, sitting at tables of 5–7 in order to potentiate participation. Each group had a copy of the AHS mission and vision statement, the AHS midwifery curriculum and supporting documents, the International Confederation of Midwives (ICM) Global Standards for Midwifery Education [International Confederation of Midwives (ICM) (2011)] and Essential Competencies [International Confederation of Midwives (ICM) (2013)], the World Health Organization Global Standards for the Initial Education of Professional Nurses and Midwives (World Health Organization, 2009), and other relevant documents. These documents were used to assess the alignment of the curriculum with the AHS mission and values as well as the alignment with international standards.

Additionally, in-depth interviews and focus group discussions were conducted with faculty, students, and alumna of the program outside the capital in Wad Madani in Al Gezira state. This was an important part of the CIPP process to assure input from the communities of interest as discussed below. A full analysis of these focus groups is beyond the scope of this paper and is forthcoming. Interviews and focus groups were conducted by Arabic-speakers, recorded, transcribed, and translated into English.

Workshop objectives were met. By the end of each training session, participants demonstrated competency in the use of the CIPP model for curriculum review. Findings of the review are discussed below.

Further, the curriculum documents were reviewed separately by the two team members from Ethiopia using the CIPP Model.

These Ethiopian team members have created curriculum and taught community midwifery skills in the Emory MaNHEP program (Spangler et al., 2014) and are familiar with Ethiopia's community health worker program. Ethiopia borders Sudan and faces similar challenges in maternal/child and reproductive health. Suggestions for improvement were given. Ethics approval for the project was given by both Emory and AHA Institutional Review Boards Teaching.

COMPONENTS OF THE CIPP TABLES

Context

Curriculum must be considered in the context, or "big picture," of where the program "lives." Curriculum to prepare midwives at an institution in Ireland (Phelan et al., 2014), Jordan (Shaban and Leap, 2012), and Sudan may have shared competencies, but should also reflect the local context. A context evaluation looks at the fit of a program within a larger framework, be that university, college, or community. It can determine opportunities and threats/strengths and weaknesses that can influence the program (Mertens and Wilson, 2012). Context includes the program's written and published vision, mission, and goals and should be compatible and aligned with the mission of the institution in which the program is offered. These serve as the basis for development of the curriculum.

Inputs

This component identifies assets and needs in order to determine current system capabilities. Both material and human resources for the program should be included. Material resources such as teaching facilities, textbooks, computers, skills lab items, and student living facilities are included. Existing and proposed student-related policies are considered. Human resources include faculty, staff, students, and other communities of interest. When identified at the onset of a program, inputs describe the starting point and help to define a program's needs, propose budgets, and identify appropriate curriculum design (Zhang et al., 2011; Frye and Hemmer, 2012).

Process

Process evaluation monitors, assesses, and documents the implementation of a program. Process evaluation provides feedback on

the program by assessing and documenting the level of success in meeting the needs of the communities of interest. The evaluators regard the original plan, explore its implementation and, through multiple methods, determine the alignment and accuracy of the proposed and implemented plans. These methods can include document review, interviews with students and alumni, and observations of classes and practical experiences. The goal of process evaluation is: "to forecast the mistake of designs; to provide information for decisions; and to assure the procedure of plans" (Tseng et al., 2010, p. 257). Keeping in mind the underlying theme for using the CIPP model, process evaluation is better seen as identifying areas for *improvement*, rather than simply *proving* the planned activities were completed as designed.

Product

This component seeks to determine if the product of the program meets the needs of the targeted beneficiaries and communities of interest. In order to consider short- and long-term outcomes for a community midwifery educational program, evaluators would look not just at a graduating class, but ideally, the performance of those graduates 3–5 years after graduation. Additionally, faculty outcomes must also be considered as they are also of the community of interest. Product evaluation necessitates a variety of resources and techniques. Document review, including student logs, papers, and exams and summative evaluations, is important. As well, focus groups and interviews with students, alumni, faculty, employers, and other members of the community of interest can be informative. Finally, determining the program's own systematic plan for evaluation is informative. When compared to the standards identified for the context of the program, product evaluation may inform "decisions to continue, stop, or improve the effort" (Stufflebeam, 2003, p. 32).

THE SITUATION IN SUDAN

AHS Context

Workshop participants reviewed the mission and vision statements for the FMH, the AHS, the midwifery curricula, and the competencies and standards for midwifery education per the ICM [International Confederation of Midwives (ICM, World Health Organization, 2011, 2013)] and World Health Organization (World Health Organization, 2009). The mission, vision, and goals of the FMH, AHS, and the midwifery curriculum are well

TABLE 1 | Comparison of vision, mission, and values.

Characteristics	Curriculum/program	FMOH, human resources for health (HRH) strategic plan
Vision	Graduate midwife students with high professional efficiency to meet the need of Sudanese society	Sudan to be a country with skilled and diversified health workforce capable of delivering the right health-care interventions for achievement of Millennium Development Goals (MDG) and health promotion
Mission	Reducing maternal and newborn mortality by graduating qualified cadre for rural areas	To build and make operational, adequate numbers, and the right mix of skilled workforce through properly institutionalizing HRH functions (policy, planning, education and management collaboration, coordination, and partnership)
Goal	Qualified community midwives able to provide effective primary health care and appropriate midwifery service to improve maternal and newborn service and family services in different environment	Improve coverage and accessibility to quality health services, achieve health-related MDG, promote healthy life styles and reduce the burden of non-communicable diseases, creation of an environment conducive to partnership, and building and promoting of the role of the private sector

aligned (see **Table 1**). The mission of the midwifery program, however, is limited to reducing maternal mortality. Participant faculty indicates that this should be expanded to include health promotion of women and infants.

A strength of the CIPP model for evaluation of this program is the inclusion of context. During the curriculum review, the AHS faculty found the midwifery curriculum to be consistent with the mission statements of both of the FMH and AHS, which seek to address the critical shortage. In the situation of Sudan, the context includes a lack of midwives and other health professions, high maternal and infant mortality, and limited capacity for educating health professionals. The innovation of a 15-month community midwifery program is designed specifically for Sudan to fill the gap. However, even with the 1-year apprenticeship program required for the students to sit the qualifying exams, this does not meet the minimum length of education as published in the Global Standards for Midwifery Education (ICM, 2013). A footnote to these standards recognizes that "the actual time needed may vary depending on many factors within countries" [International Confederation of Midwives (ICM), 2013, p. 6]. This is an important consideration. Further analysis is needed to determine if quality of care is compromised by AHS' variance from the recommended time frame.

AHS Inputs

As stated above, inputs include both material and human resources for the program. For many low resource settings, this can present a challenge. There are limited materials published in Arabic for midwifery education. Furthermore, sanctions on Sudan make the importation of learning materials and equipment problematic. However, there are some teaching and learning materials published locally in Arabic including lecture notes. In terms of human resources, an additional consideration is the admission criteria presently being unmarried females under the age of 25. Officially, the entry criteria include high school completion (consistent with the ICN standards), but students are accepted in rural areas with completion of primary school. In more remote areas, recruiting candidates interested in midwifery who meet all the entry requirements can be challenging. It was felt that having communities select and recommend candidates might improve the recruitment of young women into the profession.

AHS Process

The third component of the CIPP is process evaluation. Following a review of the curriculum, workshop participants determined that the World Health Organization's International Guidelines for

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Midwifery Education (World Health Organization, 2009) were adapted appropriately for the context in Sudan. The curriculum is well developed both vertically and horizontally, allowing students to build on previous knowledge. The core competencies were all addressed but individual curricular objectives could be revised for clarity. For instance, ethics content, which was felt to be essential for this cadre, was lacking in the first semester. Faculty teaching in the program was able to describe the student log books used for continual assessment but the process of evaluation of this component was limited in that the workshop format did not allow for participants to view actual student documents, visit classrooms, or interview students.

AHS Product

The last aspect of the CIPP is product evaluation. While lacking a published systematic plan for evaluation, the AHS does have standard assessment tools and requirements for passing. Faculty and students complete end of course questionnaires and some are interviewed. A year-long mentorship after graduation assists with competency evaluation after which graduates take a national qualifying examination.

DISCUSSION

The CIPP model for curriculum design and evaluation served as a useful tool to determine the context-relevance of one of the AHS program curricula. It allows for a rich, full picture in terms of not just the content and implementation but considers the context for the program. Overall, the review of the community midwifery curriculum by the AHS was seen by participants of the workshop as providing sustainable skill for the expansion of health professional education. It was seen as important efforts to increase the quantity and relevance of the health-care work force in Sudan. To determine if the program will truly strengthen the country's health system and improve outcomes, it is imperative to evaluate the quality of care provided by the new class of midwives 3–5 years after completion of the program. Faculty attending the workshop will train other AHS education personnel in the use of the CIPP model in evaluating other health professions programs taught by AHS.

AUTHOR CONTRIBUTIONS

ED, JW, MB, AM, and SB were all substantial contributors to the conception or design of the work; the drafting and revisions of it; responsible for important intellectual content; for final approval of the version to be published.

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How a Training Program Is Transforming the Role of Traditional Birth Attendants from Cultural Practitioners to Unique Health-care Providers: A Community Case Study in Rural Guatemala

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In low- and middle-income countries (LMICs), where the rates of maternal mortality continue to be inappropriately high, there has been recognition of the importance of training traditional birth attendants (TBAs) to help improve outcomes during pregnancy and childbirth. In Guatemala, there is no national comprehensive training program in place despite the fact that the majority of women rely on TBAs during pregnancy and childbirth. This community case study presents a unique education program led by TBAs for TBAs in rural Guatemala. Discussion of this training program focuses on programming implementation, curriculum development, sustainable methodology, and how an educational partnership with the current national health-care system can increase access to health care for women in LMICs. Recent modifications to this training model are also discussed including how a change in the clinical curriculum is further integrating TBAs into the national health infrastructure. The training program has demonstrated that Guatemalan TBAs are able to improve their basic obstetrical knowledge, are capable of identifying and referring early complications of pregnancy and labor, and can deliver basic prenatal care that would otherwise not be provided. This training model is helping transform the role of the TBA from a sole cultural practitioner to a validated health-care provider within the health-care infrastructure of Guatemala and has the potential to do the same in other LMICs.

Keywords: traditional birth attendant, Guatemala, training model, rural HEALTH, Indigenous health, maternal mortality, low resource settings, low- and middle-income countries

INTRODUCTION

The majority of mothers from low- and middle-income countries (LMICs), specifically in rural settings, continue to seek and prefer traditional birth attendants (TBAs) over clinics and hospitals for care during pregnancy and delivery (1). Thus, TBAs are important to both the local community and national health infrastructure as their training and integration in the current health-care system can help improve maternal and neonatal outcomes in LMICs (2–4). Despite the significant role TBAs

hold there are limitations, as few sustainable training programs exist that properly train TBAs in how to provide basic prenatal care, detect early complications, or refer high-risk pregnancies appropriately. The lack of sustainable interventions leads to major discrepancies between the skills of individual TBAs and adversely affects the care of expectant women in LMICs. The purpose of this community case study is to describe a training program for TBAs in rural Guatemala that is redefining their role as health-care providers, integrating them into the current health-care system, and increasing access to basic prenatal care for the women they serve via a collaborative and sustainable approach.

BACKGROUND AND RATIONALE

Significant worldwide progress has been made toward lowering rates of maternal mortality in the last two decades (5). Yet maternal mortality ratios (MMRs) in the developing world, especially in rural regions, continue to be unacceptably high (6). This holds true in Guatemala where the national average MMR of 88 maternal deaths per 100,000 births (5) does not reflect the major disparities that exist between rural and city births and, more importantly, between indigenous and non-indigenous women (ladinas). The MMR for Mayan women is more than twice that of ladinas (163 per 100,000 compared to 78 per 100,000) (7).

One of the largest contributing factors to the difference in MMRs is that up to 80% of Mayan women deliver at home without ever receiving prenatal care due to limited access to essential obstetric care (8). In the rare event that a Mayan woman has access to higher levels of care a home birth is still preferred as health facilities present many challenges. There is a clear language barrier at predominantly Spanish-speaking hospitals as many Mayans do not speak fluent Spanish (9). Additionally, national hospitals often prohibit Mayan practices such as traditional steam baths, massages, and plant-based remedies (10). The strong adherence to cultural practices, lack of access, and distrust of health facilities causes the majority of Mayan women to rely on a Guatemalan TBA (comadrona) during labor and pregnancy (10).

Guatemala comadrona culture is unique as it is founded on a belief that their abilities are a direct gift from God revealed to them in a dream or vision that must be accepted as fate (11). Once their calling is accepted they become respected elder women in the community and are constantly sought out during pregnancy and childbirth to counsel on common problems during pregnancy, provide spiritual guidance, abdominal massages, and traditional hot steam baths (11).

Comadronas hold a unique relationship with Mayan women, and their comprehensive training can improve care during pregnancy and childbirth yet this potential role has historically been rejected by the national health system (12). Not until recently has there been some national efforts to help integrate comadronas into the health-care system by providing licenses to comadronas that attend national monthly trainings (13). During these meetings, national health staff teach about signs and symptoms of danger that require referral during pregnancy (13). Problems exist with this national monthly training program as classes are often canceled for months at a time due to shortage of training staff, and

there are no data collected that measures how well comadronas are retaining and applying knowledge learned at meetings.

Ultimately, a sustainable, culturally appropriate, and comprehensive training program for TBAs that can be incorporated by national health programming should be used to help meet the health-care needs of women in rural Guatemala and other similar LMICs.

DESCRIPTION OF THE CASE

The case study presented here is the School of POWHER training program for TBAs. The School of POWHER, which stands for Providing Outreach in Women's Health and Educational Resources, was founded after recognizing the importance of training comadronas to become experts in basic prenatal care and safe labor. The goal of the School of POWHER is to train comadronas in focused maternal health-care while respecting local customs with appropriate obstetric referral as the key to decreasing maternal death and complications in the region. To improve acceptability of the intervention, and to improve sustainability, comadronas were trained to ultimately be the trainers of the School of POWHER.

The development of the School of POWHER began in 2011 after 3 months of initial community surveying by a physician assistant educator and recognition of the unique health-care needs of Mayan women in rural Guatemala. After the importance of comadrona training was identified, WHO guidelines were considered (14) and a thorough literature review of other TBA training programs as well as a review of other training curriculum used in Latin American countries was completed. Ultimately, the curriculum was the result of a dynamic process shaped by a relationship with International Medical Relief Fund midwives that implemented a successful program for TBAs in rural El Salvador (15), the health practices of comadrona elders in Lago Atitlan Guatemala, the Saving Mothers medical team headed by the physician assistant educator, and a local Mayan physician who translated the cultural practices of her community. All lecture and clinical topics reflect current WHO and Guatemalan health-care guidelines and were approved by the local branch of the Guatemalan Ministry of Public Health and Social Assistance.

SETTING

The School of POWHER is based out of the rural department of Sololá, which is nestled in the Western Highlands of Guatemala. This region is 96.5% indigenous, has 10,051 births per year, and only 2.7% of all consults/visits in the region's health facilities are for prenatal care (16). These demographics are reflective of rural Guatemala as a whole as the country's poverty and low health-care access is concentrated in the rural communities mainly occupied by indigenous Mayans (17). In early 2017, an innovative primary care health model, the Inclusive Health Model (*Modelo Incluyente de Salud* or MIS in Spanish), was launched in select departments in Guatemala (18). This primary health-care model aims to provide the necessary health care for the rural populations, but more importantly, incorporates TBAs and traditional healers alongside doctors and nurses intending to bridge the gap between indigenous people and the health-care system (19). This recent shift

in health-care delivery recognizes the importance of integrating indigenous health facilitators within the health-care infrastructure in a standardized way (20), a model in line with our School of POWHER training program presented in this case study.

COLLABORATIVE PARTNERSHIPS

Saving Mothers is a United States-based NGO dedicated to eradicating preventable maternal deaths and birth-related complications in LMICs. Their efforts are predominantly focused on providing education and training to local health-care providers on maternal and reproductive health. Saving Mothers has been working in the Western Highlands of Guatemala since 2009, focusing in the rural communities in the department of Sololá due to the high MMR in this region (16, 21). In 2014, Saving Mothers established its main educational intervention in Guatemala, the School of POWHER training program for comadronas. The aim for this educational program is to provide a sustainable solution for the lack of access to prenatal care and safe labor while respecting local customs and traditions. Funding for the School of POWHER, made available through small international grants and private donors, will continue to support the training program for a minimum of five more years and/or until the model is incorporated by national health programming.

The Guatemalan Ministry of Public Health and Social Welfare (MSPAS) aims to provide social assistance to all its people and therefore must carry out prevention, promotion, recovery, rehabilitation, and any necessary complementary activities to provide its people with the most complete physical, mental, and social well-being (22). The regional branch of the MSPAS in Sololá partners with Saving Mothers to help integrate education initiatives for health providers into the current health-care infrastructure. Specifically, they assist in the recruitment of comadronas for the School of POWHER, pair each comadrona student with an MSPAS auxiliary nurse at ministry health-care facilities throughout the region, and aid in the execution of any ongoing Saving Mothers research or clinical initiatives. The objective of this partnership, in line with the current primary health-care model, is to respect, support, and integrate cultural practitioners into current infrastructure to better the health of Mayan women and children.

METHODOLOGICAL ASPECTS

From 2014 to 2017, the School of POWHER training program has had three graduating classes with a total of 48 trained comadronas. Three months prior to the start of the School of POWHER, every student was screened and selected after thorough community surveying with elder comadronas by a physician assistant-educator, also the Saving Mothers Guatemala Program Director, and input from the local branch of the MSPAS. This twofold approach ensures that the community is identifying elder comadronas that are respected and also known to MSPAS staff due to their involvement in monthly licensure meetings. Ideally, each comadrona selected speaks moderate to fluent Spanish, has her MSPAS license, is relatively young (preferably 55 years old or younger), can commit to the time intensive school schedule (only two absences are allowed in 3½ months of training), and has at least four active patients.

Once the students are identified and enrolled, usually 15–20 students per class, the School of POWHER runs for 14 weeks and teaches comadronas how to perform focused prenatal care, how to refer appropriately, tests their knowledge retention via three exams, and assesses their clinical skill improvement in real time. This immersive intervention is based on a two-pronged method composed of a 28-module didactic and a separate clinical constituent designed to incorporate all literacy levels and delivered by a certified physician assistant-educator with 10 years of experience working in the field of OB/Gyn at a large teaching hospital in the United States and in rural settings in LMICs. The School of POWHER also has a collaborative approach as a portion of the lecture arm of the curriculum is delivered by elder comadronas well versed in ancestral practices such as abdominal massages and natural remedies.

Two afternoons a week are dedicated to the 3-h intercultural didactics which have an emphasis on recognizing signs of referral for mom and baby, prenatal care, and initial management of postpartum complications (**Table 1**). These 28 lectures are presented in a multifaceted way including lectures, group work, role-playing, case studies, and tutorials. The clinical arm of the school ensures that the comadronas refine their traditional midwifery abilities while learning new skills under the supervision of a clinical preceptor. During monthly home visits, the comadronas practice counseling the mother about tetanus vaccines, measuring blood pressure, using a fetal Doppler, and correctly estimating delivery date. A minimum of 25 recorded prenatal visits, 1–3 supervised births, and 3 postpartum visits are required of each student during the school.

Each woman that completes the School of POWHER training program receives a stethoscope, blood pressure equipment, a fetal Doppler, prenatal vitamins, and safe birthing kits funded by international grants and private donations. More importantly, each comadrona is integrated into the current network of School of POWHER graduates and continues to receive monthly education, prenatal vitamins for all their patients, and safe birth kits for each birth they attend.

THEORETICAL FRAMEWORK

The School of POWHER was developed around the “rational model” also known as the “knowledge, attitudes, practice model” as outlined in “Health education: theoretical concepts, effective strategies, and core competencies” (23). This theoretical framework is based on the premise that increasing a person’s knowledge will induce behavioral changes (23) and was deemed the most culturally appropriate as the comadronas hold such a high-stake position in their communities and have so much influence over the health of their patients. At the core of the School of POWHER is community health education and if the comadronas begin to change their attitudes and beliefs, for example, of when it is necessary to refer during pregnancy, this change in attitudes and behavior will improve the health of their patients. By influencing both individuals’ capacities and providing environmental support, in this case through the integration into the current health system, a meaningful and sustained change in the health of individuals and communities can occur (23).

TABLE 1 | The School of POWHER curriculum overview.

Topic
Week 1
Day 1 An Overview of Maternal-Infant Care
Day 2 The Role of the Birth Attendant, Health Care Resources, and the Emergency Plan
Week 2
Day 3 Sexual Organs, Sexual Desire, and Menstruation, Ovulation, and Fertilization
Day 4 The Natural Development of Pregnancy
Week 3
Day 5 The Choice of Motherhood, The Importance of Prenatal Care—Part 1
Day 6 The Importance of Prenatal Care—Part 2
Week 4
Day 7 Pregnancy Complications, Part 1
Day 8 Pregnancy Complications, Part 2
Week 5
Day 9 Signs and Symptoms of Danger during Pregnancy
Day 10 Case Studies on Prenatal Care, Exam 1
Week 6
Day 11 Review Exam 1
Day 12 Tetanus Vaccine, Introduction to Stages of Labor
Week 7
Day 13 Uncomplicated Labor: Stage One and Two
Day 14 Uncomplicated Labor: Stage Two and Three
Week 8
Day 15 Review of Stages of Labor, Basic Care of the Newborn
Day 16 Complications during Labor and Delivery
Week 9
Day 17 When to Refer during Labor
Day 18 Neonatal Resuscitation, Immediate Post-Partum Care, Maternal Lactation
Week 10
Day 19 Maternal Lactation Review, Post-Partum Care: Day 1 & 4
Day 20 Review of Normal and Complicated Labor, Exam 2
Week 11
Day 21 Medicinal Plants, Sharing of Experiences during Labor
Day 22 Infection Prevention and Management, Sterilization of Birth Tools
Week 12
Day 23 Family Planning Methods
Day 24 Case Studies: Family Planning, Self Breast Exam
Week 13
Day 25 Vaginal Infections and STIs
Day 26 Nutrition and Malnutrition
Week 14
Day 27 Complicated Labor
Day 28 Cumulative Review, Final Exam

TEACHING FRAMEWORK

The teaching framework for the School of POWHER follows the guidelines set forth by the Health Professions Networks Nursing & Midwifery Human Resources for Health in “Framework for Action on Interprofessional Education & Collaborative Practice” (24). This teaching framework outlines that education collaborations should occur between two or more professions in order to improve health outcomes (24). These partnerships should

(1) include in-depth intercultural exchanges as well as (2) collaborative clinical practice (24). The curriculum presented in this community case study reflects these teaching guidelines. The didactic portion involves exchanges between the physician assistant educator, elder comadronas well versed in ancestral practices, and the comadrona students themselves. The clinical curriculum component reflects the importance of collaborative clinical practices as each participant is paired with an MSPAS auxiliary nurse at the national health clinics during part of her clinical training. These collaborate teaching strategies, when integrated into the current health-care system, strengthen health systems, and ultimately improve health outcomes (24).

METHODOLOGICAL ADAPTATIONS FOR SUSTAINABILITY

The ultimate goal of School of POWHER is to have a sustainable training program for comadronas taught by comadronas. This train-the-trainer model is key as improvement in a health-care workforce is largely based on training programs that can identify proficient health-care providers and prepare them as trainers (25). In working toward this, eight School of POWHER graduates from the first class continued their training in basic maternal health with Saving Mothers. They have learned the School of POWHER curriculum in depth (Table 1) through their work as teaching assistants during the second and third classes of the School of POWHER. Two head comadronas, graduates from the original class, have been identified as lead educators that will deliver the lecture portion of the school in Mayan dialect. Six additional graduates have been selected as clinical preceptors that will teach prenatal home visits during the clinical portion of the curriculum. During the 2017 School of POWHER class, there will also be a senior medical student on ground to aid in the transition, modification, and execution of the School of POWHER. The senior medical student is receiving training at a large teaching institution in the United States and has 5 years of experience in implementing educational programming in LMICs.

In addition to modifying who delivers the educational intervention, future classes of the School of POWHER will incorporate a new real-time clinical skills assessment. These clinical skills will be assessed with a prenatal skills checklist (Figure 1) that was developed from WHO health-care practices (14), other successful TBA training programs (26, 27), and whose contents have been approved by the MSPAS. In order to ensure that the prenatal clinical skills checklist was culturally relevant and an appropriate clinical tool within the School of POWHER curriculum, a pilot study testing its contents was completed from January through March of 2017. During this pilot phase, 18 graduates were assessed, 84 home visits were observed, and its final contents were adapted based on our study pilot results to modify aspects of the emergency birth plan.

With the conclusion of the pilot study demonstrating that the clinical skills checklist is culturally appropriate and relevant within the School of POWHER, the prenatal skills checklist will be administered prior to starting the curriculum and after completion of the program. This data will directly measure

			
Prenatal Care Skills Checklist			
Name of Comadrona: School of POWHER Class: Student (Y/S): Observer: Date: Initial visit/Revisit			
		Trimester:	
HISTORY		Task	
		Performed (✓) X(NA)	
1 If mother knows LMP, accurately calculates EDD			
2 If mother knows LMP, calculates current weeks of gestation			
3 Pocaud OB history:			
Age			
# of previous pregnancies			
# of living children			
Ask about problems with previous pregnancies*			
4 Ask about appropriateness of prior complicated pregnancy*			
5 Ask about any significant past medical history			
6 Ask about current medications			
7 Document history			
CLINICAL SKILLS		Task	
		Performed (✓) X(NA)	
1 Washes hands with soap and water or uses anti-septic			
2 Accurately measures blood pressure			
3 Accurately measures heart rate			
4 Correctly measures fundal height*			
5 Listen to fetal heart rate with Doppler			
6 Palpate position of fetus			
7 If fetal position is oblique, transverse, or breech, discusses with mother appropriate place to birth			
8 Documents all findings*			

* See Observer Guide for additional instructions

Notes/Observations:

Prenatal care skills checklist adapted from:

1. Training Manual for Traditional Birth Attendants in Hospital/Maternal Care, Unesco Regional Institute for Education, 2000.
2. WHO, UNICEF, & UNFPA. Maternal mortality ratio - the critical role of the midwife. Geneva, 1999.
3. WHO, UNICEF, & UNFPA. Trends in Maternal Mortality: 1990-2000. Geneva, 2004.
4. Sacks et al. Quality of antenatal care in rural southern Jamaica: a quality check. BMC Research Notes 2013 6:200.
5. Sacks A.R., et al. Evaluation of a Childbirth Partners Attended pilot training program in Bangladesh. Int J Gynaecol Obstet 2009; 100:134-137-142.

FIGURE 1 | Clinical assessment tool.

the clinical improvement of each comadrona as a direct result of their participation in School of POWHER and gauge the level of clinical competency of participants. The clinical skills checklist not only provides a way to directly measure clinical skill development before and after the School of POWHER but also provides an accessible tool for the clinical preceptors to use as they evaluate ongoing clinical skills development of participants.

EVALUATIONS

All School of POWHER participants have been assessed in their clinical knowledge and retention on prenatal care, basic obstetric practice, and emergency management. This is quantitatively measured via multiple choice exams. During the School of POWHER, the 28 lectures are divided into 3 broader modules, and on the first day of each module, every student received a pre-test that was repeated the last day of that module. Knowledge retention is also measured 1 year post graduation. Qualitative evaluations were performed via surveys and informal discussion sessions at the end of the School of POWHER. At monthly follow-up meetings, patient prenatal and birth data and number and reason for referrals are collected from each

participant and reported to the local MSPAS staff. In addition to all aforementioned evaluations, all future classes of the School of POWHER will have their clinical skill knowledge and retention measured before and after the educational program.

RESULTS

Participants in the School of POWHER educational intervention have demonstrated an improvement in multiple basic obstetrical knowledge areas such as anatomy, physiology, and pregnancy diagnosis/management (Table 2). They have strengthened their knowledge in areas of Newborn Assessment/Care, Labor & Delivery, and Family Planning (28). At 1-year follow-up of the first graduating class, basic obstetrical knowledge remained improved from the original pre-test knowledge scores (Table 2).

When participants were surveyed upon completion of the educational program, they reported a new interest in continuing their education and increased confidence in themselves due to their newly learned skills. During the informal discussion sessions, the participants largely discussed the need for the training they were receiving and positively reacted to the structure/curriculum of the School of POWHER. Some of the comments reflecting the participants' assessment of the educational intervention included:

TABLE 2 | Mean test scores for School of POWHER class of 2014 students.

Topic	Pre-test (%)	Post-test (%)	1-year test (%)
Knowledge test			
Anatomy/physiology	53	70	64
Pregnancy diagnosis	35	83	70
Prenatal care	35	70	91
Emergencies	66	86	94
Labor and delivery	68	88	78
Postpartum care	52	81	55
Newborn care	74	79	86
Sterile techniques	62	86	70
Infection prevention	62	86	70
Baby care	90	100	100
Prevention	62	76	91
Total knowledge score	59	82	79

Nobody ever thinks about comadronas. I've never been a part of a program like this and I'm touched that we are being involved.

The way we are learning, through group work and cases, is new for me but I have found it very helpful.

I am excited to take blood pressure and learn how to listen to the baby's heart.

We are creating a sisterhood of comadronas, students and teachers coming together to help our community.

The training of comadronas has also significantly increased the number of women who receive prenatal care and timely referrals. In 2016, the School of POWHER participants performed 360 recorded prenatal visits and identified 15 women at risk of complicated labor, which were referred to appropriate higher level of care.

The clinical skills checklist pilot study highlighted areas of clinical strengths in the School of POWHER participants. From the 84 prenatal home visits, 56% of the visits were considered complete (at least 75% of the checklist was accurately completed). A total of 30 women were referred (6 for a previous complicated pregnancy, 4 for fetal malposition, and 20 for reporting one of the signs or symptoms of warning including fever, abdominal pain, hemorrhage, or severe headache); one of these referrals revealed fetal demise. Overall skill strengths were found in correctly taking basic vitals (correct blood pressure measurement in 76/84 visits) and providing adequate counseling (**Table 3**).

Skill weaknesses were evident in lack of hand washing (during 55/84 visits, no hand washing occurred) and lack of a discussion of an emergency birth plan (36/84 women were not asked about their plan of emergency during labor). These areas highlighted the need for further curricular emphasis on topics of hand washing and emergency birth plan during future classes of the School of POWHER. Additionally, three comadronas were identified to be consistently taking blood pressure incorrectly and were appropriately retrained.

DISCUSSION

This community case study presents a sustainable method of training TBAs in order to increase access to basic health care for

TABLE 3 | Type of counseling discussed during prenatal home visit in skills pilot study.

Type of counseling	# of visits counseling occurred/total visits	# of visits counseling did not occur/total visits
Discussion of fever	40/84	44/84
Discussion of severe headache	56/84	28/84
Discussion of epigastric pain	56/84	28/84
Discussion of hemorrhage	53/84	53/84
Discussion of important of Td vaccine	64/84	20/84
Discussion of importance of prenatal vitamins	60/84	25/84

indigenous women and improve their pregnancy and labor outcomes in a rural community in Guatemala. While this case study is novel in its educational delivery approach of using trained TBAs to teach other TBA participants, other successful programs have informed this intervention.

When training is successfully implemented in rural communities, TBAs increase their basic obstetric knowledge, are equipped for safe home deliveries, and are able to identify problems requiring referral; factors that markedly improve obstetrical outcomes (29). TBAs that go through these training programs report increased job satisfaction, are more motivated to continue improving their skills (30), and have improved knowledge, attitudes, and behaviors (31). Recent systematic reviews have identified that successful programs are those that can be integrated into an existing health-care system, continue skill development (monthly or bi-monthly) of its participants for at least a year, and provide access to birth kits and resuscitation equipment (3, 4, 31).

These factors of success reported by other programs are also what makes the School of POWHER a success in rural Guatemala as evidenced by the increase in knowledge of the participants, increased prenatal visits performed in the region, and increased referrals of high-risk women. Of most significance is the increased recognition and referral of high-risk pregnancies as these are factors that inarguably improve maternal health outcomes (3). When TBA training programs fail in LMICs, it is due to lack of integration into the current health-care infrastructure and unwillingness of national health workers to accept the potential role of TBAs (32). Fortunately, these are factors that have not been heavily faced as the MSPAS has supported and helped to integrate the School of POWHER into the current health-care infrastructure from its conception.

In the current medical literature on birth attendant training programs, whether traditional or skilled, the reports on training programs is increasing but there are little data on how those programs directly affect clinical skills and access to prenatal care (4). Some studies have evaluated antenatal care skills yet they have focused on simulated sessions (33) and cross-sectional views on current prenatal skill set (34). Such studies do not provide a real-time look at how a training program directly affects the antenatal clinical skills of their trainees. In order to provide pertinent information lacking in the current literature and further integrate these indigenous health providers within the Guatemalan health-care system a real time, systematic assessment of the School of POWHER participants has been added to the clinical curriculum.

With the incorporation and implementation of a clinical skills checklist, there will be a sustainable quantitative measure of the capability in which participants of the School of POWHER are performing basic prenatal care during their routine home visits. Future applications for the skills checklist include an assessment of how many threshold home visits and/or total months of clinical education are required from each participant to optimize prenatal care. Additionally, the checklist will help to capture larger outcomes measures including number of referrals of expectant women to MSPAS health clinics, maternal and neonatal mortality, and other complications during pregnancy. Ultimately, by demonstrating to the MSPAS that participants can provide adequate prenatal care, refer appropriately, and adhere to their national guidelines, the School of POWHER is helping to create a standard of care for the comadrona practitioner.

The School of POWHER, of a school for comadronas run by comadronas, is critical. Integrating comadronas as leaders and educators will help shift the view some still hold of comadronas as a burden to the system (12) to actual players within the health-care infrastructure (13). Ultimately, the School of POWHER will further reiterate the pivotal role comadronas, and all TBAs in LMICs, hold as educators, knowledgeable birth attendants, and unique health-care providers.

LESSONS LEARNED/ RECOMMENDATIONS

The need for sustainable TBA training programs in LMICs is much needed. TBAs have held, and will continue to hold, a very important role in their communities and their adequate training can help create the link between women in rural communities and the national health-care infrastructure. Yet, establishing this crucial link is a gradual process that faces some barriers and limitations.

Despite the long-standing collaboration between Saving Mothers and the MSPAS, participants in our School of POWHER continue to report some ongoing conflict with particular MSPAS health staff. Comadronas have described, during informal discussion sessions, that they are reprimanded and blamed for patient complications when they refer a high-risk patient to the local MSPAS health post or hospital. Although these interactions are isolated events they have the potential to affect comadrona attitudes toward certain physicians. These changes in attitudes might influence their decision on whether or not to refer their patients. With the recent implementation of the new primary health-care model in Guatemala, which acknowledges the role of the comadrona as a type of health-care provider, the negative attitudes toward comadronas, and instances of friction, might be decreasing. This case study is limited in that the viewpoint and/or opinions of the MSPAS on-call physicians are not presented. In future research, it would be of value to discuss, through focus groups and/or anonymous surveys, why certain physicians prefer that comadronas not be trained in basic prenatal care. These opinions would present a more complete picture of the actual health-care attitudes in rural Guatemala.

A limitation of this community case study is the quantity of reportable data available from the School of POWHER that can assist in measuring its objective success. From the beginning of the training program, knowledge acquirement and retention data were easily collected through written exams. Yet during the initial intervention, mainly due to lack of on the ground staff, amount of prenatal visits completed and number of high-risk patients referred from program participants was not wholly captured. As the educational intervention began to acquire larger amounts of funding, additional on the ground staff could be hired thereby increasing the amount of reportable data collected in 2016. Finally, with the launch of the 100% sustainable School of POWHER in early 2017, data collection by the eight comadrona educators will be an easier process during monthly follow-up education. This increase in data collection, specifically recorded prenatal visits as well as number and reasons of referrals by each participant, will help both Saving Mothers and the MSPAS gage the educational intervention's direct effect on the health-care outcomes of women in the region.

Lessons learned on how to implement and sustain a training program for TBAs in rural Guatemala can be applied to other LMICs, specifically in indigenous populations. Implementation of the School of POWHER needs the dual support of the community as well as the Ministry of Health in each country using this model. Follow-up education, both for skills maintenance and data collection, is key and must be incorporated from the beginning. This community case study is one of the first to report on an educational model that is run by TBAs for TBAs in an indigenous rural population and demonstrates the importance of respecting cultural customs and traditions while building strong collaborative relationships between international and national partners.

CONCLUSION

This community case study of the School of POWHER has documented the health deficit encountered in many LMICs, has discussed its methodological framework, proposed ways of evaluating its success, and ultimately demonstrated the importance and value added in training TBAs and having them train their counterparts. This immersive intervention has created a new model of TBA recruitment and training that instills a value of knowledge sharing and apprenticeship while emphasizing a strong partnership with local MSPAS providers. In essence, the School of POWHER is positioning comadronas as cultural medical brokers between indigenous women and the health-care system (35) ultimately increasing access to health care for women and reducing complications during pregnancy and labor with the potential to do the same in other LMICs.

AUTHOR CONTRIBUTIONS

SH assisted in the transition of the new model of the training program, acquired study data, and drafted, and revised the manuscript. JO contributed to the conception, initial development, and implementation of the training program. TS contributed to the initial conception and development of the training program and revised the manuscript. All authors approve the final manuscript.

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Utilizing Behavior Change Techniques to Elicit Adherence to Clinical Practice Guidelines

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Introduction: Two 2-day continuing education seminars were developed to address the orthopedic physical therapy deficits in Guyana. Material was presented in a way to address all stages of behavior change.

Methods: Surveys evaluating preseminar and postseminar knowledge was conducted. Chart reviews to establish adherence to clinical practice guidelines were performed.

Results: Preseminar surveys revealed minimal knowledge of clinical practice guidelines, which was consistent with preseminar chart review data. Postseminar data indicate improvements in both knowledge and adherence to guidelines.

Discussion: A brief series of two 2-day seminars utilizing behavior change strategies to improve adherence to clinical practice guidelines shows promise for countries and regions that rely on international health volunteers to provide clinical instruction. Because this study is limited to one situation, further studies with longer follow-up in a variety of clinical settings are recommended to support generalizability of findings.

Keywords: continuing education, behavior change, clinical practice guidelines, best practice, orthopedic pain management

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INTRODUCTION

Background

Chronic musculoskeletal pain (excluding arthritic pain) accounts for a third of all disability claims in the United States with over 7.6 million people on long-term disability for spine problems alone (1). Rates in developing nations are less well reported but are likely to be at similar rates. To further strain medical management resources, many developing nations are faced with a dual burden of battling infectious diseases along with non-communicable diseases such as chronic pain. Although multifactorial in nature, one factor that has been attributed to the development of chronic pain is poor management of acute and subacute pain (2–4). To assist in providing the most efficacious care, clinical practice guidelines for physical therapy (PT) interventions have been established (5–12). These evidence-based guidelines provide practitioners assistance in evaluating and treating certain common musculoskeletal pathologies. As these guidelines were designed in response to the American Physical Therapy Association's objective of standardizing clinical care and reducing unwarranted variation, clinical practice guidelines have started emerging utilizing the most current evidence-based research (5). Despite evidence that treatment outcomes improve when utilizing clinical practice guidelines (13, 14), awareness and utilization of them is still not universal.

In Guyana, the only English-speaking country in South America, there has been historically a high reliance on Voluntary Service Overseas volunteers to administer rehabilitation services. Physical therapists in Guyana have little or no exposure to or implementation of clinical practice guidelines for the management of commonly seen musculoskeletal impairments. In fact, it has been only within the last 10 years that the government has started to invest in rehabilitation services by sending students overseas to receive PT education and later establishing a bachelor of PT program at the University of Guyana. Currently, there are eight PT in Guyana: six of whom are foreign trained (four in Cuba and two in Jamaica) and two are the first to graduate from the University of Guyana program. Of these eight PT, three hold supervisory roles and do not practice clinically on a regular basis. The remaining five PT serve the entire country and rotate through orthopedic, pediatric, and neurological settings. Therapy services are supplemented with several dozen rehabilitation technicians (RT) who undergo an 18-month program that involves introductory training in physical, occupational, and speech therapy. These RT are expected to perform evaluations and establish treatment plans as if they were PT.

In Guyana, the prevalence of non-communicable diseases is on the rise. The problems related to these diseases are often compounded by high rates of infectious disease. As the population lives longer, it is expected that chronic conditions, like chronic pain, will become more of a burden on society. Understanding and complying with clinical practice guidelines might be helpful in managing a burgeoning population of people with chronic pain—a necessary goal for Guyana to attempt to achieve.

Behavior Change Theory

Improving compliance with utilization of clinical practice guidelines requires incorporating behavior change theory into PT education. The behavior change theory suggests that behaviors do not occur due to obstacles that impact the individual's ability to perform desired tasks. The obstacles may be cognitive or physical in nature and vary depending on the stage along the behavior change spectrum the person is in. There are five stages of behavior change: (1) precontemplation, (2) contemplation, (3) preparation, (4) action, and (5) maintenance (15) (**Table 1**).

The first stage, precontemplative, is where the individual is unaware of the desired behavior and therefore does not perform it. People in this stage benefit from knowledge dissemination and actions that draw awareness to the behavior and its consequences. Consequence-based arguments work well in this stage of change (16).

The next stage is contemplation where the individual is aware that there is a problem, but is unclear about strategies and may be limited by perceived social norms. Both descriptive (a person's perception of whether others perform the given behavior) and prescriptive (person's perception of what other people think that they should do) norms can influence peoples' behavior in this stage. Overcoming these norms is crucial to move beyond contemplative to preparation stages of change (17).

The crucial element of the third stage, preparation, is the need to provide self-efficacy training to ensure that individuals feel comfortable with their abilities to perform the desired behavior.

TABLE 1 | Guide to stages of change and strategies to implement.

Stage of change	Problem faced at this stage	Strategies
Precontemplative	Unaware of desired behaviors	Consequence-based arguments focusing on desirability and likelihood (use social stats)
Contemplative	Perceptions that others do not think they should change (prescriptive norms); or perceptions others are not performing given behavior (descriptive norms)	Encourage more weight on own beliefs. Help change social norms (get others who support behavior involved)
Preparation	Perception of poor ability	Provide opportunities for success with rehearsal and modeling
Action	Motivation and opportunity	Utilize point-of-action cues (like prompts in medical record) and explicit planning
Maintenance	Relapse to prior behaviors once prompts are removed	Provide encouragement and positive feedback to practitioner. Reward good desired behavior

Even with knowledge of the consequences of the behavior—and addressing both prescriptive and descriptive norms—if there is low perceived ability, there is less likelihood that the behavior planning will turn into the fourth stage, action. Therefore, removing obstacles to performing action is necessary in this stage. Self-perceived limitations of skill can be overcome with modeling and rehearsal (18). Transfer from preparation to action has been shown to be optimal when both positive and negative scenarios are presented, when practice included trainee-generated scenarios and instructed to set goals, and when participants' supervisors were also trained (19).

Action is the stage when the desired behavior is attempted. Ways to facilitate this stage are to provide prompts and explicit planning strategies. In the clinic, this means providing opportunities to be reminded of the need to adhere to the clinical guidelines (possibly in the chart, etc.) and creating scenarios where the treatment planning is concretely determined to optimize treatment. Prompts provided at points of decision have been shown to be effective in modifying a variety of behaviors (20–22).

Once action occurs, the person moves into the last stage, which is maintenance. Maintenance is the continuation of the action after the prompting has stopped. In this stage, it is important to provide support to the individual along with positive feedback to ensure continued compliance.

Similar to health care practitioners and their patients, far too often educators treat all learners as if they are in the precontemplative stage by providing information (almost always in a consequence-based argument format) regardless of assessing the stage of change they may be in. Recognizing that individuals may be in different stages of change is necessary to effectively elicit the desired behavior outcomes. Instructors simply providing information on the best practice guidelines without addressing barriers (real or perceived) has been shown

to be ineffectual and not an ideal mechanism to elicit change in treatment practice.

The Process

A Peace Corps Response volunteer with a Doctor of Physical Therapy degree, and 10 years of clinical experience was placed at the Ministry of Health's rehabilitation department to help supervise PT students and work with the RT and establish whether there were any areas of deficit in their orthopedic skills. Although he was there, he carried out a needs-assessment that indicated a lack of awareness about clinical practice guidelines and a heavy reliance on passive modalities (especially ultrasound). In addition, evaluations did not typically include special tests that might help guide therapists in their clinical decision-making. From that assessment, a proposal for continuing education was developed, which would utilize a volunteer instructor.

In this case report, therapist knowledge of clinical practice guidelines will be discussed, and the outcomes of two 2-day symposia, utilizing behavior change techniques to influence evidence-based best practice, will be described.

METHODS

Symposia Development

Knowledge and use of clinical practice guidelines for common musculoskeletal orthopedic conditions (lower back, neck, hip, knee, and ankle/foot pain) was determined to be the most critical continuing education need. Therefore, two 2-day symposia were created: Symposium I and Symposium II. The symposia were planned so that Symposium II would take place 2 months after Symposium I.

Evidence suggests that dissemination-only training interventions have little to no effect (23) since these interventions are only useful for people in the precontemplative stage of change. Strategies that also address other stages of change may be more effective. Therefore, the symposiums involved not only presentation of materials but also an opportunity to practice skills and problem-solve scenarios. The objectives of the symposia were threefold.

First, it was designed to draw attention to clinical practice guidelines. This mirrors the precontemplative stage of the behavior change model. Practitioners were provided with consequence-based arguments on the importance of providing optimal care. Second, social norms were addressed discussing expectations of the therapists and patients. Addressing social norms is important to draw attention to best practice compliance among their peers to allow those in the contemplative stage to consider the need for changing their own behavior/practice. And the last objective was to provide the opportunity to actually rehearse and model the behaviors and techniques necessary to adhere to the clinical practice guidelines. Thus, the symposium was broken into three parts, a lecture element where the material was presented, breakout groups where scenarios and current practice were discussed and concerns were addressed, and a hands-on lab section where the volunteer demonstrated the techniques and then had clinicians practice. Continued practice was encouraged once the symposium was finished.

SYMPOSIUM I

The first symposium focused on introducing clinical guidelines for the five orthopedic conditions. This symposium was composed of approximately 50% lecture and 25% for breakout groups and hands out sections. In this manner, drawing learners' attention to the clinical practice guidelines and providing them information *via* consequence-based arguments on their importance was utilized for learners' in the precontemplative stage. As was seen with the presymposium survey, most practitioners were in this precontemplative stage. If the survey was aware of the guidelines but did not adhere to them, then the initial emphasis may shift to another stage with less time spent on the basic information. However, as mentioned, these practitioners did require this information and thus were provided with consequence-based arguments on the importance of providing optimal care.

Instruction did not end at this level, however, as social norms were addressed by discussing expectations of the therapists and patients. This was done to draw attention to best practice compliance among their peers to allow those in the contemplative stage to consider the need for changing their own behavior/practice. As their most immediate peers were also not compliant, a larger cohort (i.e., international) was utilized to illustrate that the *majority* of their peers did, in fact, adhere with the evidence-based clinical recommendations. Therefore, a portion of the lecture was utilized to discuss social norms. This discussion carried over to breakout groups to discuss among each other case studies and application of the newly learned materials.

The last portion of the first symposium was to provide the opportunity to actually rehearse and model the behaviors and techniques necessary to adhere to the clinical practice guidelines. This hands-on portion contained instruction and performance of the actual techniques recommended by the clinical guidelines. Emphasis of this section was on the manual interventions as these require the most intensive support and guidance for proper technique, review of red flags, and comfort to perform independently. Approximately 4 h were spent with clinicians practicing on each other the variety of manual techniques. In addition to proper technique, increasing comfort also helps to reduce perceived barriers to implementation of recommendations and thus can help those practitioners in the action stage remain adherent or allow those in the preparation phase move to action.

Clinicians were encouraged to continue to practice on each other as well as start utilizing techniques and guidelines in their daily practice. In the 2 months between symposia, the instructor was available *via* email. He was also available in-person for instruction and modeling for therapists located in the capital of Guyana. Clinicians were encouraged to contact the instructor if they had further questions or needed clarification during the interim.

SYMPOSIUM II

The second symposium reviewed the clinical practice guidelines briefly (~15% of time) but spent far more time honing clinical skills (~60% of time) and allowing for breakout sessions to review cases (~25% of time).

Pretests and Posttests

Two pen-and-paper tests of knowledge were developed by author and were reviewed by another US-based therapist with 10 years of clinical and academic experience. Input was provided, and modifications were made to improve clarity. Each test included five clinical scenarios: one for each of the five clinical guidelines [neck (6), low back (8), hip (7, 9), knee (11), and ankle/foot (5, 12)]. Each scenario was followed by five questions that were created to assess knowledge. The clinical scenarios were designed to elicit information about clinical decision-making. Multiple-choice options for each question were designed to offer a wide variety of treatment options, but only one held the proper choice advocated by the clinical practice guidelines. For each scenario, there was at least one treatment option that included the inappropriate use of ultrasound.

After gaining informed consent, participants were randomly assigned to complete one of the pen-and-paper tests prior to Symposium I. After Symposium II, they completed the alternate test.

Participants were instructed to make decisions about the case scenarios to determine appropriate treatment options. Survey results would be evaluated for correct responses and to evaluate deviation of scores between the two variations of the test.

The second part of the survey evaluated demographics of the therapists such as years of experience, job type (RT vs PT), and national or foreign education.

Chart Reviews

Chart reviews were performed before and after symposia to evaluate clinician treatment selection. Two charts from each clinician currently working in an orthopedic setting ($n = 16$) were reviewed for each of the five clinical presentations (10 total charts reviewed). Charts reviewed were from patients who initiated treatment after the first symposium. Ten charts were also reviewed from patients seen prior to the first symposium and were to serve as a comparison.

Chart reviews explored whether documentation of clinically important questions were asked during history taking, whether appropriate special tests that assist therapists in correctly classifying patients into certain treatment groups were performed, and whether treatment selection matched clinical assessment. Each element was given a score of 0 (absent) or 1 (present). Charts were graded from 0 to 3. As a separate factor, the prevalence of ultrasound treatment was also evaluated.

RESULTS

A total of 21 clinicians attended both symposia, and data were collected from those participants (Table 2).

Awareness of Guidelines

Data from Pretest and Posttest

Presymposia results indicated that clinicians were unaware of clinical guidelines as correct selection of proper treatment options was infrequent. In total, 27–30% of participants were able to correctly recommend treatment options for neck pain, 18–20%

TABLE 2 | Clinician demographics.

Total respondents (n)	21 (18 females/3 males)
Percentage with physical therapy degree	38% ($n = 8$)
Average years of practice	12.8
Percentage physical therapists trained overseas	75% ($n = 6$)
Percentage of clinicians with at least 1 year rotation in orthopedics	95% ($n = 20$)
Percentage of clinicians currently work in orthopedic setting	76% ($n = 16$)

TABLE 3 | Accuracy of responses to clinical decision-making questions.

	% Correct presymposium	% Correct postsymposium	% Change in correct response
Survey 1	$n = 10$	$n = 11$	
Question 1 (neck)	30% ($n = 3$)	82% ($n = 9$)	200%
Question 2 (back)	20% ($n = 2$)	71% ($n = 8$)	300%
Question 3 (hip)	30% ($n = 3$)	91% ($n = 10$)	233%
Question 4 (knee)	50% ($n = 5$)	91% ($n = 10$)	100%
Question 5 (ankle/foot)	40% ($n = 4$)	82% ($n = 9$)	125%
Survey 2	$n = 11$	$n = 10$	
Question 1 (neck)	27% ($n = 3$)	70% ($n = 7$)	133%
Question 2 (back)	18% ($n = 2$)	60% ($n = 6$)	150%
Question 3 (hip)	36% ($n = 4$)	80% ($n = 8$)	100%
Question 4 (knee)	45% ($n = 5$)	90% ($n = 9$)	80%
Question 5 (ankle/foot)	36% ($n = 4$)	80% ($n = 8$)	100%
Total survey correct responses	33% (35/105)	80% (84/105)	140%

for back pain, 30–36% for hip pathology, 45–50% for knee pain, and 36–40% for foot and ankle pain (Table 3). Individually, only one respondent was able to answer all five questions correctly. The other 20 respondents averaged 30% correct responses.

Postsymposium surveys revealed an improved understanding of clinical guidelines (see Table 3). The percentage increase in correct responses ranged from 80 to 300%. The lower percentage increase appears to be related to a ceiling effect based on a higher initial correct response rate.

Chart Review

This improvement in knowledge did appear to correspond with a carryover to treatment as review of treatment choice revealed a significant improvement in utilization of evidence-based treatment options while use of ultrasound was concurrently reduced (Table 4). Of note, treatment compliance did not increase consistently across the five body parts investigated. Knee treatment compliance rated at 75%, while neck intervention compliance was at 32%. This may be seen as a result of a more uniform treatment regime for treating knee pain as opposed to a diverse treatment protocol for the variety of neck problems.

Qualitatively, documentation of charts overall saw improvement (coherence, flow, and reasoning). Clinically important history questions increased markedly but still were occurring in less than 50% of chart reviews. Similarly although special tests were being performed more frequently after the symposium, they were not consistent as hip and back special tests that were performed at quite a higher rate than neck, knee, and foot/ankle. While clinical

TABLE 4 | Chart review findings.

	Presymposium	Postsymposium	Percent change
Correct use of special tests			
Neck	6% (2/32)	38% (12/32)	500%
Back	3% (1/32)	47% (15/32)	1,400%
Hip	19% (6/32)	63% (20/32)	233%
Knee	13% (4/32)	32% (10/32)	150%
Foot/ankle	6% (2/32)	32% (10/32)	400%
Clinically important questions asked during history			
Neck	19% (6/32)	38% (12/32)	100%
Back	25% (8/32)	50% (16/32)	100%
Hip	13% (4/32)	41% (13/32)	225%
Knee	19% (6/32)	47% (15/32)	150%
Foot/ankle	22% (7/32)	53% (17/32)	143%
Treatment matching clinical assessment			
Neck	0% (0/32)	32% (10/32)	—
Back	0% (0/32)	50% (16/32)	—
Hip	0% (0/32)	63% (20/32)	—
Knee	6% (2/32)	75% (24/32)	1,100%
Foot/ankle	7% (4/32)	38% (12/32)	200%
Use of ultrasound	94% (30/32)	38% (12/32)	60%

assessments were still less than optimal, they also saw improvement. Use of appropriate orthopedic special tests also improved.

DISCUSSION

This report shows that even a small and modest study can provide information that can contribute to improving health professions training that ultimately improves clinical care. However, the study does have some limitations that must be acknowledged. Limitations include a small sample size, a short follow-up, as well as not evaluating whether the clinicians did any further research on their own that may have skewed postsurvey scores. The small sample size could not be overcome due to the dearth of clinicians in Guyana. The short follow-up does draw to question whether there will be long-term carryover in knowledge although it was promising that both knowledge and behavior were changed. A model that includes continued prompts, communication with volunteer, and “refresher” courses is likely to improve chances of maintenance of desired behavior.

Also it is unclear what elements of the symposia (lecture, discussion of patient scenarios, or rehearsal and hands-on practice) were the most effective. There is also the possibility of the Hawthorne Effect impacting performance; where clinicians knew that their performance would be monitored and therefore chose improved treatment options. However, if this is the case, it bolsters the argument for need for continued cuing and feedback as part of the maintenance phase of change. Another limitation is with survey design. As there were two separate surveys with similar but not identical case scenarios, it is possible that one was easier than the other, which might have skewed the results. However, regardless of this overestimation of the percent improvement in correct responses, there was still a significant increase indicating at least a degree of retention of knowledge, which corresponded with increase in proper treatment choice noted in chart review. Finally, Guyana being an English-speaking country made provision of supplemental materials and electronic communication

easier than it would be for a volunteer in a foreign language-speaking nation.

From this study, it was evident that knowledge about clinical practice guidelines was sparse among both PT and RT in Guyana. Promisingly, it appears that brief bouts of concentrated in-services focusing on addressing the stages of behavior change supplemented with electronic communication available appear to improve knowledge of best practice. It also appeared to improve adherence to PT clinical guidelines at the 2-month follow-up. In addition, treatment strategy was shown to be modified with a single bout of continuing education and addressing several stages of behavior change. This suggests that that volunteer-based education platforms focusing on areas of greatest educational needs may positively impact clinical decision-making and treatment plans.

This model may be most appropriate for countries and regions with the least amount of basic resources and knowledge as there was a large area of improvement that was available, making significant change easier to elicit than if in a situation where there had been some knowledge but inappropriate treatment adherence and ingrained poor practice interventions. Having no knowledge may have actually been a positive as it allowed for tabula rasa approach where adherence without conflicting strategies may have been easier. It is unclear whether it was a simple exposure to non-conflicting information or whether intervention to modify behavior elicited the change seen in treatment intervention.

Promoting behavior change through proven strategies based on an individual's readiness to change is often an underutilized strategy when providing in-services and educational seminars but may be necessary to optimize best practice utilization. Understanding that not all health care practitioners are limited by a lack of knowledge but rather by possible knowledge, social, or physical constraints that need to be addressed is an important first step in shifting the focus of educational interventions. Providing educational materials that meet the learners' needs is a crucial element that this article discusses. Once educational content matches learners' needs, the transfer from abstract information to practical application is possible.

Utilizing international partnerships has long been a cornerstone in provision of health care education and support. As many developing nations do not have the resources to provide this support, these partnerships remain important for delivery of health care. Based on educational research, providing simple information-only learning material is not very efficacious. Therefore, there may need to be a paradigm shift in how educational support is provided. This study suggests that utilizing the behavior change model to evaluate where learners are in stages of change may provide benefit in promoting evidence-based practice awareness and adherence. It also strengthens the argument for short-term international partnerships where skilled clinicians can provide brief concentrated bouts of education concentrating on the areas of greatest need.

Despite limitations, this case report suggests that there may be positive effects of short-term continuing education interventions utilizing behavior change techniques supplemented with electronic communication to improved clinical practice guidelines adherence and eliciting practice change. International

collaborations that can provide educational materials targeted at the level of behavior change of the learners may increase best practice compliance. Further studies that can control for confounding variables with a larger and more diverse sample size are needed before recommending the implementation of behavior change strategies universally. Considering readiness to change while providing education does hold promise to better address clinical guideline adherence.

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