Association for Academic Surgery

Utilizing technology for global surgery: a survey of the West African College of Surgeons

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ABSTRACT

Background: Information and communication technology (ICT) has been heralded as a possible mechanism for expanding global surgery collaborations. However, little is known regarding feasibility of ICT use in low- and middle-income countries (LMIC). We sought to determine the appropriate ICT platforms for surgical education initiatives and international collaborations.

Materials and methods: We conducted a survey of members of the West African College of Surgeons. Topics included computer and internet access/utilization, familiarity with ICT, such as social media (SM), virtual document sharing platforms (VDS), virtual meeting applications (VM), and learning management systems (LM), and interest in ICT adoption. Statistical analyses were done using chi-squared tests, with Bonferroni corrections.

Results: Survey respondents included 83 individuals from 10 countries, 50% of whom had been in practice >10 y. All had computer access, with most (95%) using SM compared to all other modalities ($P < 0.001$); 77% used SM for professional reasons and 57% for education. Sixty percent of participants used VDS, 73% of whom used it for education. The utilization of other ICTs was lower (VM 43%, LM 32%). Unreliable Wi-Fi hindered every ICT, less often SM (41%) and VDS (23%), and more commonly VM (64%) and LM (52%). Despite this, VM was most often used in international collaboration (79%, $P < 0.01$). Most respondents (98%) supported ICT use for international collaboration.

Conclusions: ICT platforms can support education initiatives and international collaborations in resource-limited areas. Deployment of similar surveys and ICT workshops across other LMIC regions could maximize ICT utilization, further expanding global surgical collaborations.

Introduction

As highlighted by the Lancet Commission, international collaborations may support the establishment of research and education initiatives focused on improving surgical care in low- and middle-income countries (LMIC).[1] Information and communication technology (ICT) has been proposed as a mechanism for fostering such partnerships. Specifically, given the success of e-learning for facilitation of surgical education in high-income countries (HIC), distance learning in LMIC may be further expanded through ICT use.[2,3] Even so, many cite poor internet connectivity, difficulties downloading material, limited access to computers, and frequent power failures as primary barriers to using ICT in these regions.[3,4] While true, as ICT platforms vary significantly in their bandwith requirements and utilization in different LMIC regions, successful use of locally relevant ICT platforms is often still possible.

Previous data have demonstrated that HIC participants have a strong interest in using ICT platforms to facilitate global surgical collaborations.[5] However, ultimate success of international partnerships depends on both HIC and LMIC collaborators having familiarity with the chosen platform. While studies show that LMIC students, residents, and faculty support expansion of e-learning and ICT utilization, little is known about the current access to and familiarity with ICT among surgeons in LMIC.[6] We sought to determine which ICT platforms may be best suited for use in education initiatives and international partnerships, and hypothesized that LMIC surgeons shared a similar interest in using ICT to facilitate these efforts.

Materials and methods

We conducted a cross-sectional survey of members of the West African College of Surgeons (WACS), which includes 17 West African countries: Benin Republic, Burkina Faso, Cameroon, Ivory Coast, Democratic Republic of the Congo, Gabon, Gambia, Ghana, Guinea, Guinee Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Questions focused on computer and internet access/utilization and familiarity with different types of ICT, such as social media ([SM], e.g., Facebook or LinkedIn), virtual document sharing programs ([VDS], e.g., Google Drive and Dropbox), virtual meeting applications, ([VM], e.g., Skype and Facetime), and learning management systems ([LM], e.g., Blackboard and Moodle). Other topics included interest in ICT adoption and the potential for expanded utilization in both regional educational initiatives and international collaborations. A literature search of previous studies examining participant familiarity with different ICT formats in LMIC was used to inform the survey question design.[3,6-11] Survey question language and length, branching logic, and internal validity was then examined through a survey pilot that was distributed to six international partners from West Africa.

Once finalized, we distributed English and French (the primary languages of the region and most of the medical community) versions of the survey electronically through the WACS email list. Paper versions were also distributed at the 57th Annual WACS Conference and the 11th Biennial meeting of the Pan African Pediatric Surgical Association in Lagos, Nigeria.

Survey responses were collected and managed using REDCap electronic data capture tools hosted by the Oregon Clinical and Translational Research Institute.[12] Study approval was obtained from the Oregon Health & Science University Institutional Review Board (IRB0012015). A wavier of documentation of consent was obtained from our Institutional Review Board, and participants were provided with an information sheet about the study. In addition, on the first page of the survey, participants were asked to select "yes" or "no" to the following statement: "I have read the above information and understand that in proceeding with this survey, I consent to participate."

Statistical analyses were completed on STATA 14. Descriptive analyses using question-specific frequencies and cross-tabulations were used to examine question responses. Comparisons between ICT platform familiarity and interest were assessed using chi square tests, with Bonferroni pairwise comparisons as appropriate. Statistical significance was set at $P \leq 0.05$.

Results

Demographics

A total of 83 individuals began the survey, and 71% completed all sections. Most respondents were males (80%) and most (81%) had ages ranging from 35-54 years-old (Table 1). While almost all were attendings/faculty (80%), only 50% had been in practice for greater than 10 y. Most respondents came from

Table 1 — Demographics ($n = 63$).		
Patient characteristics	N	%
Age	63	
<25	2	3%
25-34	1	2%
35-44	24	38%
45-54	27	43%
55+	9	14%
% Male	50	79%
Position	59	
Student	1	2%
House officer (intern or resident)	6	10%
Fellow/Advanced trainee	5	8%
Faculty/Consultant	47	80%
Years in practice	60	
Still in training	2	3%
<1 y	5	8%
1-4 y	13	22%
5-9 y	10	17%
10-20 y	7	12%
>20 y	23	38%

Nigeria (67%), with the others hailing from an additional nine countries: Ghana (8%), Ivory Coast (6%), Benin Republic (5%), Burkina Faso (3%), Mali (3%), Niger (3%), Cameroon (2%), and Republic of the Congo (2%). In addition, respondents were typically general surgeons (70%), and other specialties included anesthesiology, obstetrics/gynecology, emergency medicine, neurosurgery, orthopedic surgery, urology, thoracic surgery, pediatric surgery, plastic surgery, and oncology.

Internet and computer use

All respondents reported computer access, typically at home (94%), at the hospital (81%), or at the university (45%). Computers were used for a wide variety of tasks, including accessing the internet (100%), designing presentations (98%), conducting literature searches (91%), word processing (79%), managing data (68%), and accessing multimedia (62%). Smaller proportions also reported using computers for video conferencing and taking online courses, 32% and 37%, respectively.

The vast majority of respondents, 97%, reported access to the internet (Table 2), with most using laptops (91%), smartphones (82%), and/or tablets (62%) to connect. Familiarity with the internet was high, with participants finding it either very easy (67%) or somewhat easy (20%) to use. Other common activities included downloading (95%) and uploading material (85%), although notably this process would take 1-5 min for

>50% of respondents and greater than 5 min for over 30%. Despite these difficulties, more than half were able to use the internet to stream both video and audio.

Use of ICT platforms

Social media was the most common ICT platform used by 95% of respondents. Most accessed SM daily (80%), with 14% accessing it 2-3 d a week, and 5% accessing SM once a week or less. SM platforms used included WhatsApp (91%), Facebook (82%), LinkedIn (61%), and YouTube (56%). Between 40% and 50% used Skype, ResearchGate, and Google+, 20%-30% used Twitter or Instagram, and less than 10% reported use of Podcasts, MySpace, Pinterest, Wikis, or Blogs. Although all respondents used SM for personal reasons, 77% did use it for professional reasons, with 62% using SM to support medical education. Almost all respondents (98%) agreed that SM could be used for educational purposes moving forward.

Virtual document sharing programs was the next most common ICT modality, with 60% of participants reporting use. Most used DropBox to share information (88%); however, 55% also reported using Google Drive and 45% used YouTube. Less than 10% used OOdesk, Vimeo, or AirDrop. Similar to SM, a large proportion of individuals (75%) used VDS for personal reasons. Many also used VDS for professional reasons (73%), such as educational conferences (82%) and research meetings (64%), while a smaller percentage (53%) used VDS to connect with international partners.

The utilization of other ICTs was lower (VM 43%, LM 32%). Of those who use virtual meeting applications, Skype was the most common (79%), with 20%-30% using Facetime, Adobe Connect, and GoToMeeting. Less than 15% used Google Hangouts and 10% or greater used Doodle, Elluminate, or Web X. Similarly to VDS platforms, these systems were primarily used to facilitate educational conferences (79%) and research meetings (46%), and unlike VDS, VM was frequently (67%) used to communicate with international partners. Notably, a small proportion, less than one-third of respondents, used learning management systems, primarily either Blackboard (77%) or Moodle (41%). Over half (57%) encountered difficulties when using these systems, typically when streaming assigned videos (50%) or downloading/uploading documents (33%).

Comparisons of current ICT platform use

In comparing ICT platforms, we found that a significantly greater proportion (95%) of participants used SM as compared to all other modalities ($P < 0.001$ for all comparisons, Figure). No differences were found in the use of ICT by age group. Unreliable Wi-Fi hindered every ICT, less often SM (41%) and VDS (23%), and more commonly VM (64%) and LM (52%). As a result, SM was the most common platform used to support current medical education efforts (SM [71%] *versus* VDS [35%], $P = 0.001$; SM *versus* LM [25%], $P < 0.001$; SM *versus* VM [23%], $P < 0.001$). However, in international collaborations, a significantly greater proportion used VM as compared to all other platforms, despite being frequently stalled by poor bandwidth (VM [84%] *versus* SM [42%], $P = 0.007$; VM *versus* VDS [42%], $P = 0.007$; VM *versus* LM [32%], $P = 0.001$).

| Table 2 − Ease of accessing and using the internet.		
Questions regarding internet use	N	%
Access to internet	77	
Yes	75	97%
No	2	3%
Ease of using the internet	70	
Very easy	47	67%
Somewhat easy	14	20%
Average	5	7%
Difficult	4	6%
Activities performed on the internet	73	
Check and respond to e-mails	73	100%
Download material	69	95%
Upload material	62	85%
Stream video	41	56%
Stream audio	38	52%
How long does it take to download material?	68	
<1 min	7	10%
1-5 min	39	57%
6-10 min	13	19%
>10 min	9	13%
How long does it take to upload material?	62	
<1 min	7	11%
1-5 min	34	55%
6-10 min	12	19%
>10 min	9	15%
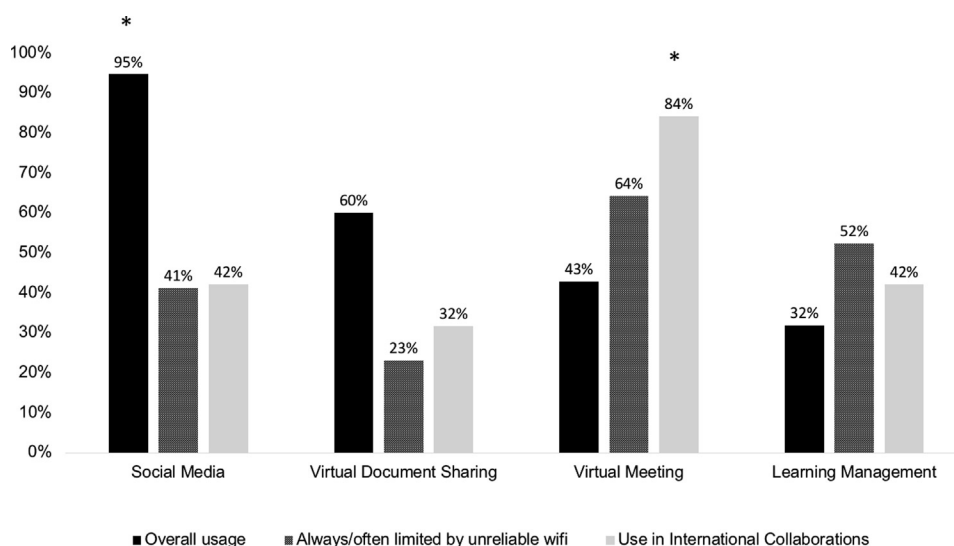
Fig — Overall usage of ICT platforms compared against both frequency of ICT platform hindrance by unreliable Wi-Fi and ICT use in international collaborations: a significantly greater proportion of respondents used SM as compared to all other modalities. VM was also used significantly more frequently to support international collaborations (* denotes P < 0.01).

Furthering education initiatives and international collaboration

Educational initiatives

Most respondents, 90%, were involved in medical education programs in their own countries. Despite the challenges to ICT utilization described previously, almost all either strongly agreed (77%) or somewhat agreed (20%) that ICT could be used to support medical education in LMIC. For instance, respondents stated that ICT could be used to create online content (97%), computerized case simulation (90%), collaborative tools (89%), interactive educational software (87%), communication tools (78%), and podcasts or videos (77%). In doing so, respondents strongly agreed that ICT improves access to educational resources, helps enrich teaching content, and makes educational materials more available (Table 3). While fewer respondents believed ICT could create platforms more suitable to their country's setting, many highlighted other potential benefits of ICT in their free responses: improving access and decreasing barriers to medical education, enhancing teaching sessions, and ensuring more equitable distribution of learning tools and resources. Overall, when specifically asked about their interests in using various platforms to support their educational endeavors, SM was the most strongly favored (85%).

International collaborations

A smaller proportion (39%) reported involvement in regional or international collaborations. Many had up to three country partners, most of which were HIC-based institutions (83%), primarily in the USA, Canada, or Europe, and 20% also had LMIC partners. The vast majority of respondents expressed interest in using ICT to support local (98%) and international collaboration (100%). However, despite the predominance of VM in international collaborations described previously, a large majority expressed interest (86%) in using VDS to support these partnerships.

Discussion

Our findings demonstrate high levels of access to and familiarity with ICT in West Africa. Significant support exists for expanding ICT use in both bidirectional education initiatives and international collaborations. While Wi-Fi remains a major limitation of ICT utilization in West Africa, especially when using VM and LM platforms, SM and VDS were least likely to be inhibited by poor internet connectivity. As respondents were most familiar with SM platforms and supported its use in medical education, we recommend increased utilization of SM by those involved in global surgical education. In addition, despite the current reliance on VM to support international collaborations (Figure), given that 86% of respondents expressed interest in using VDS for these endeavors, significant potential exists for increasing VDS use in international partnerships.

These findings call into question the continued reliance on video conferencing and LM to facilitate medical education initiatives in LMIC. Previous established efforts, such as the Réseau en Afrique Francophone pour la Télémédecine program, rely heavily on live and prerecorded videos, computer simulation, and tele-expertise for medical discussions.[13,14] Similarly, other programs focus on video lectures and animations to expand access to continuing medical education services.[3,15] However, as our results demonstrate, these ICT platforms are the most likely to be restricted by poor bandwidth, which in turn is likely to limit expansion and replication of these programs in resource-limited settings.

Conversely, SM platforms are widely available and well-suited for mobile devices such as smartphones and tablets. As an estimated 46% of Africa's population uses mobile

Table 3 — Ways by which information and communication technology (ICT) can support medical education initiatives.

Benefits of ICT use in education initiatives	n	Strongly agree (%)	Somewhat agree (%)	Neutral (%)	Disagree (%)
Improving access to educational resources	65	91	9	0	0
Enriching teaching content	65	85	9	5	2
Making educational material more available	65	85	15	0	0
Improving understanding of evidence-based medicine	64	63	31	5	2
Developing learning platforms more suited to your country's setting	63	48	21	22	10

services, with 226 million using smartphones,[16] it is vital that the platforms used to support medical education are accessible in mobile formats. An increasing number of services are being created for mobile platforms to assist and support physicians in LMIC.[17] However, most of these innovations focus on infectious disease control, and few have applications in the instruction of surgical care.[3] Even so, e-learning is widely used to facilitate surgical education in HIC.[2] Rather than building LM specific to surgical training, SM platforms could be used to adapt the existing HIC e-learning methods to low-resource settings. Overall, as SM was clearly favored for medical education, greater efforts should be taken to incorporate SM into global surgical education initiatives.

A primary benefit of SM is its ability to link multiple resources in one easy to access location. An SM page can support threads with case-based discussion, allow for posting of resources like PowerPoints, websites and articles, and connect users to material on specific topics like laparoscopic surgery. SM may also help maximize the effectiveness of in-person or video conferencing sessions. For instance, a recent focus of surgical education in LMIC is training of LMIC surgeons in minimally invasive techniques.[18] However, most programs rely on telesimulation, which uses both computers and webcams.[18] Given the resources required, it is vitally important that participants are prepared for each session. SM provides an effective means by which instructors can be connected to and share resources with trainees.

One potential issue with the expansion of SM into surgical education is the concern that HIC providers feel that SM use in the workplace is unprofessional.[8] However, younger professionals and individuals who use SM frequently are more receptive to the potential use of SM to facilitate medical education.[10,19] Regardless of what HIC surgeons prefer, our results demonstrate that there is frequent use of SM for professional reasons and medical education by LMIC surgeons. As SM applications (Facebook) have launched efforts to provide free internet access worldwide,[20] it is likely that SM represents one of the few familiar and reliable ICT platforms in areas with limited internet access. A few examples of SM pages that support global surgical collaboration exist, such as the "InciSioN-International Student Network" and the "Global Surgery Student Alliance" Facebook pages.[21,22] Thus, it behooves those interested in global surgery to consider the usage of SM sites as a hub for educational initiatives.

With regard to ICT use in international collaborations, our findings demonstrate that there is an over-reliance on VM for facilitating these partnerships and an underuse of VDS

platforms. A major benefit of VDS is the ability to see changes made to a document in real time. While weekly video conference calls, as done in the African Research Group for Oncology,[23] can be helpful for keeping a collaboration on track, it is important to remember that VDS and SM can provide a similar service with less bandwidth. A different approach could include using VM to establish trust and define the partnership, SM to communicate about small goals and tasks, and VDS to share resources and track productivity. Use of such ICT platforms could also allow for the expansion of LMIC-focused research consortiums and international partnership to lower resource and rural settings. Overall, expanding the breadth of ICT use in international partnerships will help ensure that such collaborations are both effective and sustainable.

LMIC surgeons are eager to learn more about how to use ICT to support global surgery initiatives, mirroring previous findings from the Association of Academic Surgery "Fundamentals of Surgical Research" course offered to LMIC surgeons.[24] In addition, similar workshops have also demonstrated strong interest from HIC surgeons in expanding ICT use.[5] Thus, our results support the continued deployment of ICT workshops at forums like the annual WACS Congress. Given the variability in ICT exposure, it is vital that such workshops remain interactive, allowing participants to practice with all available options and develop their own preferences. In doing so, we can empower LMIC partners to discuss with their HIC collaborators the ICT best suited to their setting.

Overall, given the wide variety of ICT platforms used in LMIC, we encourage HIC collaborators to deploy similar surveys at their LMIC partner sites to determine the platforms best suited for their collaboration. This could help map ICT use around the world, guiding future international collaborators toward the platforms most likely to create successful partnerships in their regions of choice. Such a map would also help further develop current educational programs, ensuring that efforts to expand medical education in low-resource settings are maximally effective.

Our study's primary strength is the comprehensive nature of our survey. Unlike previous studies, we did not limit our topics to computer/internet usage or interest in e-learning. Instead, we focused on ICT platforms that are available on both computers and mobile devices. As a result, we were able to capture use of platforms like SM and VDS, which were previously overlooked, despite their widespread usage in LMIC.

A number of limitations exist in the study. First, our convenience sample of participants may have biased the results toward individuals with ICT familiarity. As the survey was distributed through the WACS email list, access to the internet could be a major factor in a respondent's ability to complete the survey. To combat this potential bias, we also distributed paper versions of the survey at the WACS conference, but as not all WACS members attend the conference in any given year, we likely missed a portion of members who could not attend.

Furthermore, while our survey did reach a number of countries, most respondents were Nigerian. While this distribution potentially limits the generalizability of our findings to all countries in the WACS region, notably, approximately two-thirds of WACS members are Nigerian. Thus, while our study had mixed participation from non-Nigerian countries, our study sample does mirror the distribution of WACS members.

In addition, as residents and medical students are not WACS members, our study lacked significant trainee participation. Previous studies do demonstrate that LMIC trainees have significant interest in using e-learning resources to support their education.[6] However, others show that LMIC medical students and residents in LMIC may have decreased exposure to computers during training,[11] limiting trainees' ability to effectively maximize these tools.[6] Additional studies examining medical student and resident familiarity with ICT are warranted to better understand how we may target and engage these future surgeons.

Conclusions

ICT platforms can support bidirectional education initiatives and international collaborations in resource-limited areas, with surgeons in both LMIC and HIC expressing high levels of interest. However, continued reliance on VM and LM for the facilitation of global surgical partnerships and education initiatives is likely to limit the success of these endeavors. Given the penetrance and reliability of SM and VDS programs, increased use of both platforms could improve the efficiency and effectiveness of global surgical initiatives. Deployment of similar surveys and ICT instructional workshops across other LMIC regions could maximize ICT utilization, further expanding global surgical collaborations and educational initiatives.

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Authors' contribution: C.Q.S., E.A.A., M.S., E.Y., and S.K. conceived and designed the study. Data acquisition was undertaken by C.Q.S., E.A.A., B.C.N., and S.K. C.Q.S. and A.A. completed the analysis and interpretation of data and drafted the article. All authors contributed to its critical revision.

Disclosure

The authors reported no proprietary or commercial interest in any product mentioned or concept discussed in this article.

Supplementary data

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