

PROJECT LEAD Margolis, Peter A & Muething, Stephen E (PCORI # 26643):

HSII PARTICIPATION PROPOSAL TEMPLATE: Call for Proposals to Participate in the Health Systems Implementation Initiative (HSII)

Provide the information requested below. Replace the gray italics and any instructional text with your response, but retain the bold headings. Upload the completed template as a single PDF to PCORI Online. Refer to the Call for Proposals to Participate in the Health Systems Implementation Initiative for additional guidance.

PARTICIPANT QUALIFICATIONS

Do not exceed 35 pages.

SECTION A: Applicants that are Healthcare Delivery Systems.

Applicant Organization: Cincinnati Children's Hospital Medical Center

A.1. Describe the Applicant Organization's commitment to launching and sustaining evidence-based improvements in care

A.1.i: Alignment with HSII Goals: CCHMC is a unique organization with respect to alignment with the HSII goals. We are not only one of the largest pediatric health systems in the nation, but we are also one of the largest organizational programs in health systems improvement and evidence-based practice in the world. CCHMC's mission to be the leader in improving child health has propelled the organization to build the regional, national, and international capacity, reach and collaborations to measurably impact care for populations of children and youth. Throughout this application we will demonstrate the expertise, broad reach, and capability to work within and across health systems in a manner that is fully aligned with the goals of the HSII.

Cincinnati Children's Hospital Medical Center (CCHMC) has maintained a consistent focus on evidence-based improvement of the health care and health outcomes for children and youth for more than 20 years. CCHMC's emphasis on health system quality and improvement was developed in the late 1990s. A strategic plan, adopted in 2000, resulted in the organization's mission statement "to improve child health and transform delivery of care through fully integrated, globally recognized research, education, service, and innovation." CCHMC's vision is "to be the leader in improving child health." The mission and vision have driven the organization's well-documented¹⁻² commitment to health system transformation. CCHMC's foundational organizational strategy is thus extremely well aligned with the HSII goals.

CCHMC's organizational commitment to and enthusiasm for outstanding, evidence-based, health system transformation is reflected in four core organizational strategies (see text box) for achieving innovation, translation, and evidence-based practice in pursuit of the institution's vision and mission. These strategies are well aligned with HSII goals of engaging the expertise and motivation of patients, clinicians, and researchers working within the health system to implement evidence-based care in real world settings. CCHMC seeks to improve the health of children and youth locally, regionally, and around the world, build compelling examples of system change, drive national scale up, and provide knowledge necessary to facilitate the transfer of learnings broadly. CCHMC's unifying organizational culture of an "unrelenting focus" on health outcomes of individuals and populations is reflected in the current (2023) strategic plan as a strategic focus on "Outcomes that Matter." This strategy leverages longstanding investments that have built advanced improvement science capability across every department, division, and facility within the health system. CCHMC's focus on scientific evaluation and rigor is described in Section A.3. CCHMC investments in achieving meaningful reach have enabled us to

CCHMC Drivers of Health System Transformation

1. An unrelenting focus on the health outcomes of children and families
2. Adoption of aspirational goals
3. Build improvement science expertise everywhere including our healthcare system, our region, and the nation
4. Develop systems of continuous learning including improvement, research, and transparent sharing of data

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affect population health in our community of Southwest Ohio, nationally, and internationally through our Learning Health Networks (see Sections A.5 and A.6). The emphasis on harnessing comprehensively the insights, expertise, and enthusiasm of patients, clinicians, and researchers (reflected in CCHMC's tag line, "Change the Outcome Together") is a core principle aimed at spreading and scaling what has been learned.

A.1.ii: CCHMC Emphasis on Innovation and Continuous Quality Improvement: CCHMC created the [James M. Anderson Center for Health Systems Excellence](#) to be an integrating organizational structure that brings together operational improvement and health systems change capabilities with support for innovation, research, and evaluation. The vision and mission of the Anderson Center (Table) is to build a continuously improving *system* capable of enacting the four strategies (above) for health system transformation to achieve a global impact on child health and well-being.

James M. Anderson Center for Health Systems Excellence

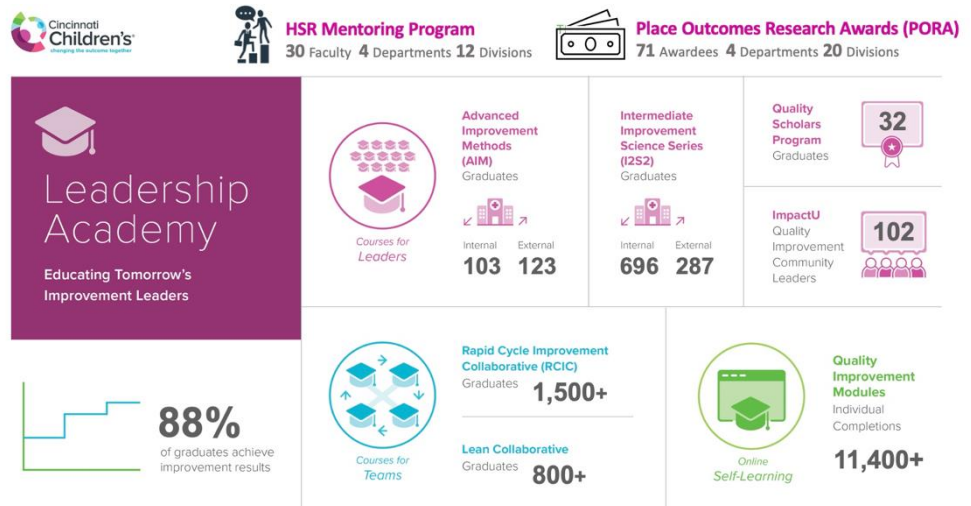
Vision: To be the catalyst for improving child health

Mission: Serve as trusted and effective partners to:

- Achieve unprecedented outcomes, experience, safety, and affordability at Cincinnati Children's
- Help Cincinnati's kids to be the healthiest in the nation
- Create new knowledge and accelerate its application into practice and policy
- Cultivate learning health systems
- Develop leaders for health system transformation

The structure of the Anderson Center is described in Section A.2. The activities of the Anderson Center illustrate the depth of our commitment to continuous improvement. A faculty and staff with expertise in health system science. The 40 faculty (jointly appointed in 15 Divisions and Departments) and 200 staff provide methodologic and technical expertise in advanced improvement and implementation science across every division, department, and facility of Cincinnati Children's, the region, and nationally and internationally through our Learning Health Networks. Broad improvement capabilities and capacity enable the Anderson Center to support system-wide improvement initiatives on safety, flow, experience, and clinical outcomes, develop and maintain hospital level metrics and goals, provide improvement support for teams throughout the organization, and support established structures to oversee operational excellence.

Capability and capacity building to improve systems. The Anderson Center's [courses and educational programs](#) and [Learning Health Networks](#) support the development of healthcare quality improvement and system change skills among leaders, faculty, staff, patients, families, and community members (see Figure) from beginner to advanced levels. The Anderson Center's Quality Scholars' Fellowship is aimed at developing faculty expertise in system change and advanced improvement science research. CCHMC has worked to evolve the University of Cincinnati's promotion and tenure criteria to recognize expertise in improvement science in the evaluation of faculty advancement.



Tools to support evidence-based decision making. The Anderson Center has a dedicated team of staff and faculty focused on [evidence-based decision making](#) (EBDM) including the development of evidence-based guidelines and

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recommendations, use of rapid evidence adoption processes, and training of others to use evidence evaluation tools and resources. The Anderson Center develops 45-50 evidence summaries each year.

Innovation and Research in Health System Science. The path from basic science discovery through clinical trials must include testing innovations and successful incorporation of evidence into practice to produce measurable transformation of health care within and beyond CCHMC. The Anderson Center's research capabilities described in Section A.3 includes approximately \$12 million/year in extramural funding to support action-oriented health services research focused on developing and testing health system interventions. The Anderson Center's Place Outcomes Research Award program provides approximately \$1 million/year for internal investigators to accelerate health services and quality improvement research at CCHMC, provide results for subsequent external research funding, and ensure optimal implementation of clinical and operational innovations in the care delivery system. The Learning Health Networks program includes health care delivery sites, robust data, and engaged clinicians and patients. It has resulted in a real-world laboratory for developing evidence about how to implement innovations and evidence (see OPQC example in Section A.5)

A.1.iii: Commitments from Leaders to Support and Sustain Practice Change Efforts: This application is submitted with the full alignment and commitment to improving outcomes and implementing evidence-based practice by the organization's senior leaders (see Letter of Support): CEO, Steven Davis, MD, MMM, COO, Evaline Alessandrini, MD, MSc, CMO, Director of the CCHMC Research Foundation, Department of Pediatrics Chair, Tina Cheng, MD, MPH, Senior Vice President and Chief Nursing Officer, Barbara Tofani, RN, MSN, and Chairs of the Departments of Surgery (Daniel VonAllmen, MD), Radiology (Brian Coley, MD), and Anesthesiology (John McAuliffe, MD).

The Project Leaders for this application, Peter Margolis, MD, PhD, and Stephen Muething, MD (described below) are Co-Directors of the Anderson Center and have organizational authority, responsibility, influence, and accountability to support and sustain practice change efforts and health system science throughout the organization, the region, and nationally.

A.2. Describe the Applicant Organization's composition and staffing structure.

A.2.i: Health Care Delivery System components that will participate

Care Delivery Sites: The entire Cincinnati Children's Health System will participate in HSII activities. CCHMC provides a full range of services spanning primary through quaternary care, mental health, home health, physical and occupational therapy, and rehabilitation through a system comprised of:

- 2 hospitals
- 1 pediatric mental health hospital including inpatient, outpatient, and residential behavioral health services
- 2 emergency departments
- 5 urgent care sites
- 12 ambulatory practice sites outside the main CCHMC campus for specialty services
- 13 primary care locations (4 academic primary care clinics, 9 community primary care practices in the CCHMC Community Health Services Network)
- An Accountable Care Organization (HealthVine) (16 primary care and 19 mental health practices)
- A CCHMC Physician-Hospital Organization (Tri-State Health Services) 25 primary care practices
- 3 school-based health centers

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Non-health care supporting structures: Activities related to the HSII initiative will be organized and coordinated by the Anderson Center. The Anderson Center faculty and staff leads CCHMC's Hospital Quality and Safety, Population Health, and Community Health programs. They also lead health systems research, as well as large-scale improvement and multi-center research through Learning Health Networks. The unique Anderson Center structure links operational improvement, innovation, and research. It enables on-going interaction between leaders in each domain and facilitates bidirectional influence to align strategies, improvement goals, and priorities of the organization with the academic and research efforts of faculty.

Anderson Center expertise includes the design of systems for safety, acute, hospital and critical care, and chronic disease management. The Anderson

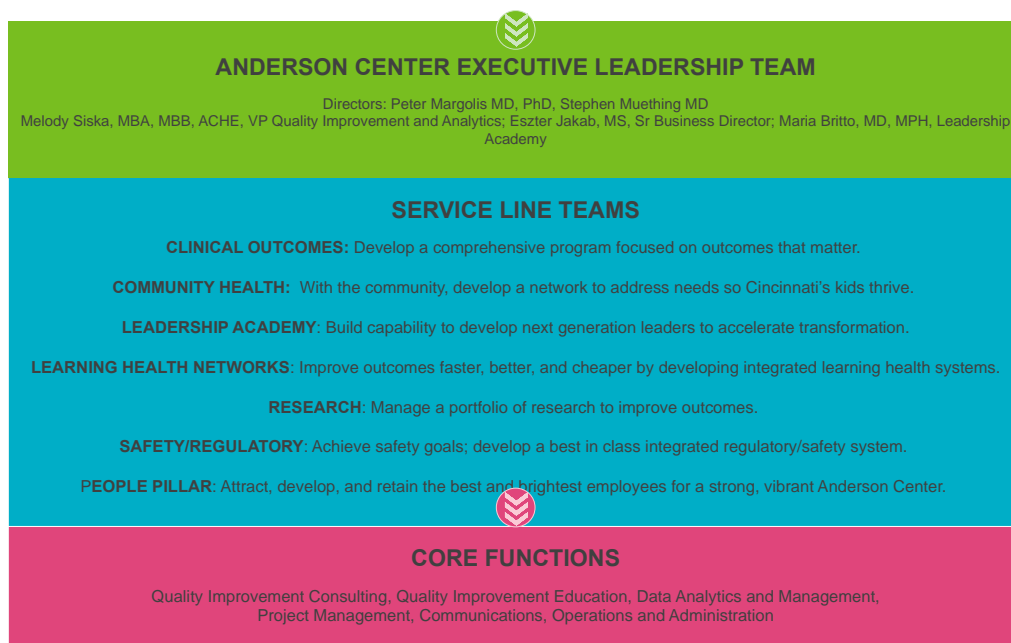
Center also provides methodologic expertise in improvement and implementation science, health services research, clinical epidemiology, population health, health disparities, behavioral science, complex intervention design, qualitative research, shared decision making, engineering, biostatistics, and large-scale data analytics. Anderson Center staff with complementary skills, lead educational programs aimed at building capacity in methods for the continuous redesign of health systems, support operational improvement projects across Divisions and Departments at CCHMC, and conduct research and evaluation of practice change efforts (see Section A.3).

Collaborating and connected healthcare delivery entities

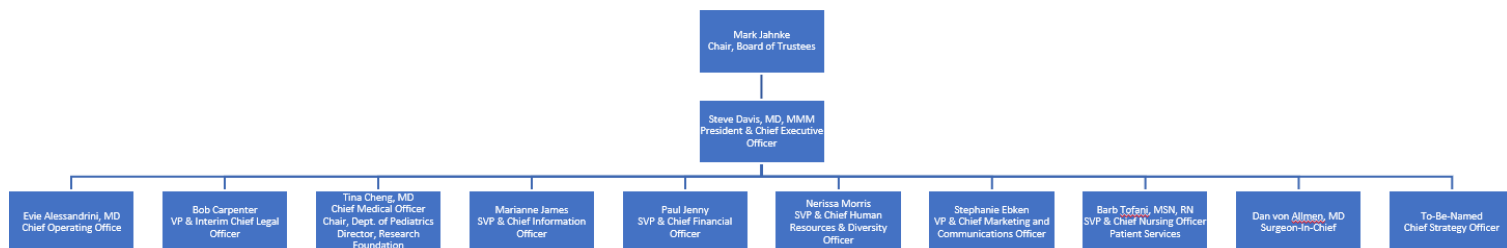
Learning Health Networks: The Anderson Center coordinates and provides leadership and professional staffing services for 12 Learning Health Networks. Learning Health Networks are enduring communities of patients and families, clinicians, researchers, and improvers who collaborate at scale to improve population health outcomes.³ The Learning Health Networks impact care for millions of children cared for by thousands of clinicians in collaborating institutions across nearly 700 clinical sites, and over 300 hospitals across the US, Canada, Europe, and the Middle East. Many Learning Health Networks operate in collaboration with national patient organizations providing further reach and sustainability. Each of the networks and their reach is listed in **Section A.6**. We have provided letters of support from the leaders of the Learning Health Networks indicating the willingness of these organizations to participate in the HSII.

A.2.ii: CCHMC Corporate Organizational Chart and Leadership Structure

The corporate organizational leadership structure is shown in the organizational chart below.

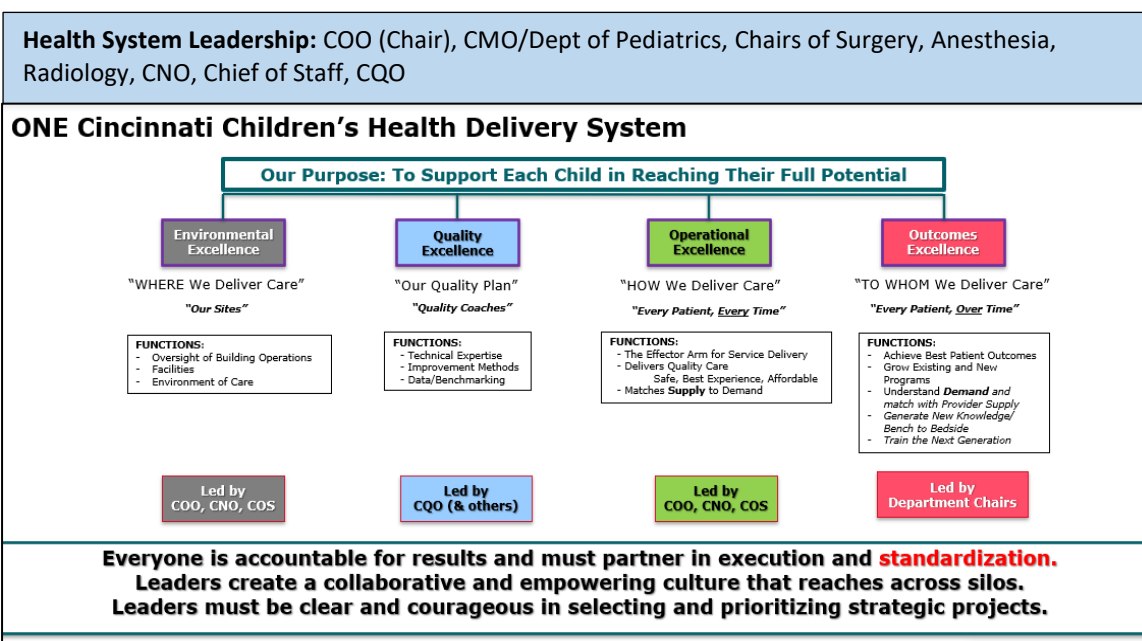


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Three Core Committees lead and provide direction across the clinical, research, and education missions and ensure the availability of resources to enable growth and innovation. These groups are empowered to make decisions and act quickly in the best interest of our patients, families, and employees, in support of CCHMC's strategic plan. The Health Care Delivery Committee is chaired by Evie Alessandrini, MD, MSc, Chief Operating Officer. This committee is responsible for strategy, design, execution, and performance for delivering care, education, talent, and advocacy for our mission. Dr. Alessandrini is a pediatrician trained in Emergency Medicine and a member of the faculty of the Anderson Center. The Research Committee is chaired by Tina Cheng, MD, MPH, Chief Medical Officer, Chair of Pediatrics and Director of the Cincinnati Children's Research Foundation. This committee is responsible for the design, execution, and performance to enable the best science and discoveries, education, talent, and advocacy for the organization's mission. Dr. Cheng is a general pediatrician with expertise in public health. The Business and Administration Committee is chaired by CFO, Paul Jenny. This committee is responsible for sustaining and growing institutional resources to enable growth and innovation across clinical care, research, and education.

Leadership of the health delivery system is matrixed like almost all academic healthcare systems. This structure is illustrated in the diagram below. The CCHMC leadership structure has evolved over the last 20 years as our improvement and learning system has matured. This structure reflects the complexity of healthcare leadership while also understanding the need for clarity of purpose and the importance of design structure based on function.



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The **Health System Leadership** team is led by an 8 person In-Chiefs group. This includes the Pediatrician-in-Chief/Chief Medical Officer, Surgeon-in-Chief, Anesthesiologist-in-Chief, Radiologist-in-Chief, Chief of Patient (and Nursing) Services, Chief of Staff, Chief Quality Officer, and Chief Operating Officer.

The **Operational Excellence** function is based on understanding the need to align the macrosystem, mesosystem and microsystems within the organization. Microsystems are the fundamental organizing structure. Microsystem teams are responsible for achieving excellence in safety, experience and access and are also responsible for continuous improvement. Each of these levels is co-led by a multi-professional group that includes both a physician and nurse leader and, where appropriate, an operational leader. Microsystems are grouped into multiple meso-systems (e.g. inpatient, peri-operative, etc.). Together the meso-systems create one macrosystem with leadership taking place at each level.

The operational excellence groups work in concert with the **Outcomes Excellence** groups which are responsible for the healthcare and health outcomes of specific populations of patients over time. They are responsible for using data to identify gaps between current state and idealized state including equity gaps and having annual improvement plans to continuously close these gaps. These groups are variously organized by sub-specialty divisions and, at times, by multi-specialty and multi-professional teams into clinical teams.

The **Quality Excellence** team provides consultation and support for the entire health system. The Quality Excellence team exists to help assure the Outcomes Excellence, Operational Excellence and Environmental Excellence teams achieve both quality improvement and quality assurance goals. Quality Excellence groups are organized by quality domain (safety, experience, outcomes, efficiency/access, equity). Each is led by a team that includes a faculty leader, quality engineers, analysts, and others (e.g., human factors experts).

The **Environmental Excellence** team is responsible for assuring that buildings, supplies, and services are always available and always meet all standards and regulations for healthcare facilities. This team is expected to be agile and responsive to ever changing conditions while also being predictive and planful to proactively manage risks to minimize chances for risks to harm the system and in turn harm the patients and staff.

Programs that support CCHMC's reach to the community (Community Health), our region (ACO and PHO), the nation and globally (Learning Health Networks), report directly to the COO and CMO. We have provided letters of support from each of the following key leaders, as well as the leaders of Community Health and the ACO.

Letters of Support	
Steve Davis, MD, MMM	Chief Executive Officer, CCHMC
Evaline Alessandrini, MD, MSc	Chief Operating Officer, CCHMC
Tina Cheng, MD, MPH	Chief Medical Officer, CCHMC Chair, Department of Pediatrics Director, Research Foundation
Brian Coley, MD	Radiologist In Chief, CCHMC
Patricia Manning, MD	Chief of Staff, CCHMC
John McAuliffe, MD	Anesthesiologist In Chief, CCHMC
Daniel von Allmen, MD	Surgeon In Chief, CCHMC
Barbara Tofani, RN, MSN	SVP Patient Services, CCHMC
Jeff Anderson, MD, MPH, MBA	VP External Medical Affairs, CCHMC
Robert Kahn, MD, MPH	Executive Lead, Community Health

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A.2.iii: Staffing structure: CCHMC has over 16,000 employees, including over 1,000 active medical staff and faculty, 400+ residents, 200+ research fellows, 250+ clinical fellows, 453 nurse practitioners, 32 physician assistants, 125 pharmacists, 241 licensed social workers, over 4,000 nurses, and over 1,300 other allied health professionals. All of these individuals report up to the leaders who have committed to this initiative.

A.2.iv: Structures to ensure meaningful patient engagement: At Cincinnati Children's, in community and population health, and within the Learning Health Networks, patients and families are considered partners in care, improvement, and research. CCHMC has robust structures in place to include patients' and families' perspective, experience, and expertise in the design and delivery of care. In addition to partnering with clinicians during family-centered rounds for their children who are hospitalized, parents, caregivers, and patients are actively engaged across the medical center and research enterprise in the following ways:

The CCHMC Board of Trustees includes voting members who are parents with personal experience at Cincinnati Children's. Three parents serve on the Patient Care Committee of the Board of Trustees, which provides oversight and guidance on the strategy, quality, and operational execution of clinical departments within the institution.

The Patient and Family Advisory Councils play an important role in the hospital's decision-making processes. The *CCHMC Family Advisory Council (FAC)* consists of 26 parents and caregivers who meet monthly from September-June. This council is representative of the population that CCHMC serves with respect to race, experience, socioeconomic status, and geographical area. Input from FAC members has contributed to numerous improvements throughout the organization, including PreOp video planning, MyChart and Telehealth services. Patient families were very involved in the opening of the new critical care building in November of 2021, including the design of the rooms and family spaces, and use of interactive patient care iPads in patient rooms. They provided input on transitioning patients from their current rooms into the new space. In preparation for the move, patients and families participated in a mock move exercise where they observed staff and provided feedback from a patient family lens. The *Patient Advisory Council (PAC)* includes 8 current and former patients ranging in age from 12-21 years. This team meets monthly and provides feedback on a wide range of hospital initiatives, allowing them to share their stories and advocate for patients across CCHMC.

There are numerous divisional and service program patient and family advisory groups that provide support and direction at the department, program, research study, and community level, as well as deep involvement in our national efforts through Learning Health Networks. Parent and family advisory groups exist in multiple divisions, as well as service programs including Audiology, Research (multiple groups), DDBP (Division of Developmental and Behavioral Health), Disorders of Sexual Dysfunction, Fetal Care Center, Psychiatry, and Transitional Care Center. Two parent representatives serve on the CCHMC Ethics committee, which reviews current clinical ethics cases and provides input to the Ethics Steering Team. Parent involvement in safety includes participation in the CCHMC Serious Harm Collaborative, a monthly meeting where Hospital Acquired Condition (HAC) teams report progress and share barriers and potential solutions. There is parent representation on all 8 of our HAC teams. We also created a virtual advisory committee to assist with our COVID-19 protocols which includes a parent representative. Families are a part of the resident role-playing program where parents and residents work on giving and receiving feedback on how to communicate difficult news. The Pastoral Care and Bereavement department operates multiple parent, caregiver, and patient groups that have family representation, including the End-of-Life Care committee and an annual conference for bereavement called "Navigating Grief."

A virtual patient family community provides a forum that encourages patients, as well as their family members and caregivers, to actively participate in improving the patient and family experience at Cincinnati Children's by serving as a

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virtual advisory resource for our staff and leadership. Feedback from this online community is used to inform and improve hospital policies, programs, and practices to help improve the safety, quality, and experience of health care at Cincinnati Children's.

In community health, the All Children Thrive Learning Health Network includes parent and patient leadership throughout its operational leadership. Plans are also underway to create a family advisory council for CCHMC's HealthVine ACO which will include a patient family representative from each networked pediatric primary care office. Additionally, a CHCMC parent partner co-leads the national Pediatric Experience Collaborative, a group of 15 hospitals who work together to co-design, with patients and families, improvement projects deployed locally to learn collectively how to optimize patient, family and care provider experiences and pediatric healthcare nationally.

In Learning Health Networks, patients and families are full partners in improvement, clinical care, and research, as well as in decision making and leadership. Patient/family partners (PFPs) have roles on boards of directors, research committees and projects, care center teams and QI initiatives.

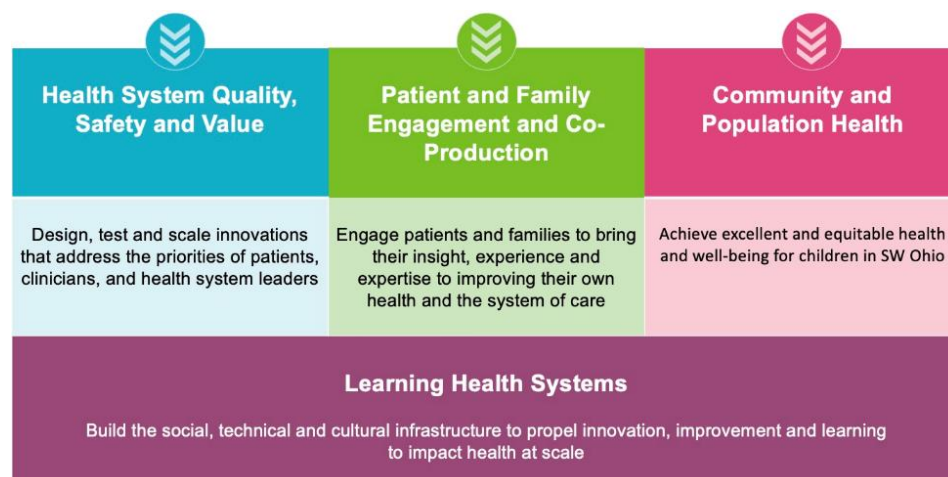
The Research Participant Advisory Group (RPAG) engages Family Partners who participate in decisions about how to improve how research is done at Cincinnati Children's. RPAG members participate on panels, focus groups, our Institutional Review Board (IRB), as well as on individual grants or projects. The Research Participant Advisory Council (RPAC) is a sub-group of the RPAG that provides consultation to guest researchers and administrative staff on ways to improve specific research studies, from design to dissemination, as well as the research process across the hospital and beyond, such as the research priorities for PCARN. Additionally, guest researchers often present findings and offer more in-depth information to RPAC members about specific research or how research is conducted at the hospital. We also partner with the 20-member West End Community Research Advisory Board (WE C-RAB). The West End is a neighborhood in the urban core of Cincinnati with high rates of poverty and a complex history influenced by structural racism. The WE C-RAB seeks to engage with researchers and inform initiatives to ensure that they support the West End's health goals. The Board also addresses collection of study data, provides input on how to make research easier and more understandable for the community, and guides what research happens in the West End. This group is currently working with our Clinical Research Professionals Group to improve diversity and equity for and among engaged research participants. An example of the combined work of these groups is the SMART at Home Care project. For this project nine adolescent members of the RPAC and WE C-RAB, ages 11-18, are involved in designing, along with clinicians, a platform for health care providers to easily develop and use mobile apps with their patients. The goal is to improve how patients and families manage their condition at home and provide much needed data to clinicians on patient symptoms, progress, and any potential problems they might experience during the time between clinic appointments.

A.3. Describe the Applicant Organization's capacity to support evaluation of practice change efforts.

A.3.i: Systems and organizational infrastructure for program evaluation. The Anderson Center serves as CCHMC's core for interdisciplinary health system research. It supports research and evaluation activities by faculty across Divisions and Departments whether their "lab" is an individual clinic or a global Learning Health Network. Anderson Center faculty have expertise in advanced improvement science, implementation science, as well as in formative and summative evaluation methods. As described in the examples in Section A.5., we use a wide range of study designs and analytic methods including experimental, quasi-experimental, and qualitative methods. The local, community, and network settings constitute large health system science "labs" with data, engaged patients, clinicians, and clinical staff trained in systems changes methods who actively participate in designing, testing, and scaling changes.

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CCHMC has extensive data and analytic capability including people, process, and technology. The Anderson Center has a large team of >20 analysts who use data from the EHR to undertake real-time outcome measurement across Divisions and Departments. The Anderson Center also has clinical research coordinators and data management staff who facilitate primary data collection. Cincinnati Children's The Division of Biostatistics and Epidemiology (DBE) specializes in the design, data management and statistical analysis of randomized controlled trials, observational studies, clinical studies, quality improvement initiatives, and translational research. Over 20 faculty and more than 50 staff have expertise in numerous statistical and epidemiological methods that advance understanding of child health and help ensure that the research done at Cincinnati Children's is world class. The Divisions of Biomedical Informatics has over 20 faculty. The Department of Information Services collaborates closely in providing access to digital assets, analytics, and technology. For instance, Information Services leads organizational data governance to drive transparency and trust in data used for care, improvement, and research. Digital tools leveraged for these ends include a modern data catalogue, data warehousing and data virtualization to aid user discovery or data assets and retrieve or combine data in meaningful ways that lead to information and insight.



A.3.ii: Experience using health information technology and related tools: As described below, CCHMC has extensive experience in using health information technology to support and evaluate practice change efforts, as well as to improve health outcomes and healthcare delivery.

Clinical Registries: CCHMC has approximately 500 registries for clinical research, as well as scores of clinical registries in the EHR for improvement, safety, and population management. There is close collaboration between Information Services and clinical divisions to develop registries in the electronic health record to drive innovative, data-driven care of populations. These registries have been used to identify patient populations by condition, disease severity, procedures, hospital site of care, age groups, and payor group. The largest registry has over 20,000 patients (food allergy), while some are small (e.g., MS-Neuroinflammatory) with about 100 patients. For example, a hemophilia registry was used to screen and detect patients in real time with this bleeding disorder presenting for surgery, thus enabling planning and management of peri-operative treatment by the division of hematology; a vital intervention for patient safety.⁴ The team identified dozens of patients lacking pre-operative planning from the hematology team to prevent bleeding complications well in advance of the procedure date. This proactive surveillance approach allowed the team to mitigate delays in care or bleeding-related complications in this vulnerable cohort.

Clinical Decision Support Systems: The Division of Biomedical Informatics and Department of Information Services have extensive experience in the design and implementation of clinical decision support tools in service of quality, safety, operational and clinical care goals. Clinical informatics subject matter experts (CMIO, Assoc. CMIOs, Clinical Informatics Fellows) provide consultation in the design, implementation and monitoring of decision support assets that are built into the electronic health record. In addition to decision support systems in the health record, CCHMC has implemented ancillary systems that drive real-time decision support. For example, Vigilanz is a platform that actively surveils for

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specific criteria such as pathogen/antibiotic mismatch or multiple nephrotoxic medications and notifies clinical teams in real time for immediate mitigation.⁴⁻⁶ The development of clinical decision support tools has also enabled improved operational efficiency by identifying patients meeting criteria for medically ready for discharge (whereby physicians designate when it's safe for a patient to go home with orders and nurses execute a discharge once these criteria are met). Deployment of this clinical decision support tool improved the efficiency⁷ of bed-use (opening up beds earlier) and allowed patients to go home earlier in the day. It also saved millions of dollars.

IT Platforms and Tools: CCHMC has implemented many IT platforms and tools in service of provide real time decision support to frontline clinicians. The institution is currently investing millions of dollars in a significant organization-wide initiative to improve the ways in which digital assets are used as part of our clinical information ecosystem. Numerous software systems such as middleware (Connexall) help freestanding information systems “talk” with one another. For example, these tools connect monitor (vital sign anomaly) alerts or other real-time alerts, such as those generated by Vigilanz, to send alerts via secure text message, phone calls or text messages to designated clinical team members.

Multi-institutional “triple-use” registries in Learning Health Networks to support clinical care, research, and improvement. The concept of a broadly distributed EHR-based Learning Health System has been more aspirational than operational. This stems in part from two technical challenges: designing information systems that need to support clinical care, research, and QI activities concurrently, and having to fulfill the needs of users who are dispersed geographically across multiple organizations. In addition to the technical challenges, there are numerous social and scientific barriers to overcome, such as achieving alignment among stakeholders and handling the difference in operational time scales. As a result, most efforts have focused on optimizing systems to support the use of EHR data either for research or for clinical care and QI.

We have overcome these problems by taking a whole-system perspective by designing an architecture that supports the needs of various stakeholders of the Learning Health System at the same time (clinicians who want to provide more effective care, improvement experts who aim to create more effective health systems, researchers who wish to accelerate research, and patients and families who desire better information along with the ability to participate in their own care). A collaboration between the Anderson Center, Division of Biomedical Informatics and Epidemiology and Biostatistics has led us to demonstrate how to transform web-based multicenter QI registries for serious and rare chronic illness into “enhanced registries” that could help improve chronic care management, facilitate QI, enable comparative effectiveness research, and engage patients and families.⁸ This model has been replicated across multiple conditions (see Section A.6.) demonstrating the ability to use data to support improvement and research. There are many published examples of how these data are used to drive improvements in care and research. For example, data from the National Pediatric Quality Improvement Collaborative Registry was used to evaluate the impact of digoxin use on interstage outcomes of single ventricle heart disease.⁹ Data from the ImproveCareNow Registry was used to support a PCORI-funded study of the use of N-of-1 methods to understand the impact of dietary therapy for inflammatory bowel disease,¹⁰ and measure the impact of QI on changes in use of corticosteroids across the network of 100 care centers.¹¹

Multi-institutional EHR data sharing through PCORnet for research and evaluation. CCHMC was a founding member of PEDSnet, a pediatric clinical data sharing network that has been part of PCORnet since its inception. The PEDSnet learning health system concept was prototyped in a single specialty (pediatric gastroenterology), a single condition (inflammatory bowel disease), and a single disease-specific network (ImproveCareNow)¹²⁻¹⁴ led by CCHMC. Learning from these early projects coupled with becoming a PCORnet Clinical Research Network (CRN) led to the maturation of PEDSnet, a process elaborated in Health Affairs¹⁵ and the Journal of the American Medical Informatics Association.¹⁶ The PEDSnet Clinical Research Network includes 10 large children’s hospital health systems whose patients reside primarily in 12 states (PA, DE, NJ, MD, FL, OH, KY, IN, IL, CO, CA, WA). PEDSnet EHR data comes from all inpatient and

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outpatient service settings, wherever children receive healthcare and includes > 7 million children. PEDSnet has very large samples of patients with rare diseases, which are commonly diagnosed during childhood (70% have a pediatric onset) and frequently specialized pediatric care in children's hospitals. A PEDSnet study on the development of a computable phenotype for pediatric glomerular disorders of the kidney identified 6,500 affected patients, which is an order of magnitude larger than prior studies.¹⁷ The network maintains a robust data quality program providing PCORnet with highly curated data for queries and studies

To test the use of data from PCORnet to compute benchmarks for quality of care, we studied 3 diverse pediatric health conditions: screening children with sickle cell anemia for stroke risk, screening children taking antipsychotic medications for metabolic syndrome, and treating otitis media with appropriate antibiotics. We hypothesized that the EHR-derived data standardized to the PCORnet Common Data Model would provide means of rapid, valid, and comparable evaluation of quality across multiple health systems to inform benchmarking and continuous improvement. To test this hypothesis, we evaluated three NQF-endorsed measures quantifying compliance with treatment guidelines in children using EHR-derived data. We studied children cared for in the outpatient setting including the emergency departments in 13 pediatric health systems from 2 PCORnet networks, PEDSnet and OneFlorida.¹⁸ We developed electronic specifications using the PCORnet Common Data Model that align with the NQF measures for (1) transcranial doppler screening among children with sickle cell anemia; (2) metabolic screening for children on antipsychotic medications; and (3) appropriate first-line antibiotics for children with acute otitis media. We assessed the accuracy of each electronic measure compared to a manual chart review. We found that only 39% (N = 2,923) of 7,278 children on antipsychotics received metabolic screening (range: 20%–54%). If the measure indicated screening was performed, chart review agreed 88% of the time [95% confidence interval (CI): 81%–94%]; if it indicated screening was not done, the chart agreed 86% (95% CI: 78%–93%). Only 69% (N = 793) of 1,144 children received transcranial Doppler screening (range across sites: 49%–88%). If the measure indicated screening was performed, the chart agreed 98% of the time (95% CI: 94%–100%); if it indicated screening was not performed, the chart agreed 89% (95% CI: 82%–95%). For acute otitis media, chart review identified many qualifying cases missed by the National Quality Forum measure, which excluded a common diagnostic code. We concluded that (1) measures of healthcare quality developed using electronic health record (EHR)-derived data are valid and that these data can facilitate the identification and spread of best practices, and (2) parents and health system leaders affirmed the potential value of such benchmarking measures.¹⁹

Health Information Exchange: Finally, we have the capability to access and integrate public health and regional health information exchange data. These data have been used to provide daily situational awareness for our region's COVID-19 response efforts since Spring 2020. As COVID-19 found its way into Greater Cincinnati, like many communities, the region lacked processes and infrastructure to optimize pandemic control. Our team sought to catalyze an agile and adaptive regional response using a learning health system lens. We applied methods for networked organizational design and quality improvement to build a situational awareness and continuous learning system. Working with the regional health information exchange organization, the 22 regional hospitals contributed data and information to support a collaborative, regional response. Our initial measurement activities began in mid-March, 2020, when SARS-CoV-2 testing was limited and laboratory turnaround times were slow. We focused initially on using the most accessible data, which included hospitalizations and emergency visits for influenza-like illness, fever, and cough. We accessed, via the regional Health Information Exchange (Health Collaborative), EHR data and scaled this approach across hospitals throughout the region. As testing became less scarce and laboratory capacity improved, we extended this infrastructure to observe additional relevant measures, including COVID-specific healthcare utilization, completed and positive tests for SARS-CoV-2, and time from test to result. Using geocoded address data, we created maps of testing and positive case rates at the census tract level of aggregation which, in Greater Cincinnati, align closely with commonly recognized neighborhood boundaries. Ultimately, we were able to integrate additional healthcare and public health data sources to achieve more complete population health situational awareness. Daily numbers of patients with COVID-19 hospitalized,

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in ICU beds, and on ventilators were obtained and tracked. Numbers of occupied and available hospital beds and ventilators, across all causes, were also integrated into our learning health system. We compiled measures into daily “dashboard” visualizations designed to provide a common operational picture of the state of the pandemic in the region. The resulting infrastructure enabled operational leaders to develop a shared understanding of the interdependent components of the pandemic response system they were simultaneously both a part of and seeking to manage.²⁰

A.4. Describe the Project Lead’s qualifications to lead practice change efforts under HSII.

A.4.i: Project Leaders’ Qualifications. This project will be led by Drs. Stephen Muething and Peter Margolis, Co-Directors of the Anderson Center. Dr. Muething serves as CCHMC’s Chief Quality Officer. He is regarded as one of the nation’s leading experts in safety and quality. Dr. Muething was one of the founders of the Children’s Hospital Solution for Patient Safety (SPS) Network, winner of the John Eisenberg Award for Quality and Safety from the National Quality Forum. This network of more than 140 children’s hospitals across the United States and Canada has reduced multiple measures of harm for both patients and staff.

Dr. Margolis is regarded as one of the nation’s experts in large scale health system transformation, innovation, and research. He and other faculty in the Anderson Center led the development of the Learning Health Network model which has been applied across diverse care centers (ambulatory and specialty care, hospital care, communities, social services). He was co-PI of an NIH Transformative Research Grant focused on developing learning health systems for children with chronic illness by harnessing the inherent motivation and expertise of all stakeholders. Learning health networks routinely use data used for large scale collaborative quality improvement and clinical research. Dr. Margolis served as Chair of the PCORnet Council guiding the Patient Centered Outcomes Research Institute’s investment in transforming research infrastructure in the U.S. The ImproveCareNow Network which he leads, of >50,000 children with inflammatory bowel disease and >100 care centers, was awarded the Drucker Prize, the largest nonprofit management and innovation award in the U.S. Dr. Margolis was a co-founder of PEDSNet, one of the PCORNet clinical data sharing networks. He is currently site-PI and leads a team of informatics faculty and analysts who use multi-center EHR data routinely. He is an elected member of the National Academy of Medicine.

A.4.ii: Project Leaders’ Influence and Decision-Making Authority. Drs. Muething and Margolis lead the Anderson Center’s program of services illustrated in the Section A2.i. above. These services have resulted in a standard improvement model used across CCHMC; broad fluency with improvement science from the CEO to the frontlines; development of faculty and clinical leaders in improvement and implementation science; robust process and outcome measurement infrastructure; extensive research and evaluation capability; and a community of individuals at CCHMC and around the world knowledgeable and committed to applying methods of systems change. Dr. Muething has authority to direct and sustain practice change activities across the healthcare delivery system. Dr. Margolis has authority to direct evaluation of practice change initiatives.

A.4.iii: Reporting structure. Dr. Muething reports to the COO, Dr. Alessandrini (also Anderson Center faculty) and Dr. Margolis reports to Dr. Cheng, Director of the CCHMC Research Foundation. They are thus placed to direct and ensure practice change initiatives across the organization.

A.5. Describe the Applicant Organization’s experience in successfully implementing and evaluating practice change.

Faculty at CCHMC have produced an extensive body of research documenting how continuous improvement and health system redesign and innovation can close gaps between current performance and desired health outcomes. The

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following section describes examples that illustrate CCHMC's experience in successfully implementing and evaluating practice change: a) within the CCHMC system, b) regionally and c) nationally through Learning Health Networks. The success of these efforts has been well documented in over 370 publications in the last 8 years. A snapshot of publications from 2022 available on the Anderson Center [website](#).

The following examples demonstrate CCHMC's capacity to implement as well as de-implement new approaches across a range of domains including hospital-based care, ambulatory-care, and community health, and across institutions and sectors.

A.5.i. Implementing and evaluating practice change for hospitalized pediatric patients: Beginning in 2011, the Division of Hospital Medicine at CCHMC undertook an ambitious initiative to address the well-recognized gap between published research or guidelines and actual care delivered, by rigorously applying improvement, dissemination, and implementation methods to improve the delivery of care by identifying and mitigating barriers within the context of their settings.

A.5.i.1. Evidence-based practice changes. The initiative focused on infections, the most common reason for hospitalization in children. We chose specific infections for our improvement work using the following criteria: 1) high prevalence and/or cost; 2) availability of strong evidence in the form of national guidelines or high-quality meta-analyses; 3) availability of concrete treatment recommendations within the guidelines (i.e., actionable evidence), and 4) potential for impact on patient safety or clinical outcomes. The infections meeting these criteria were osteomyelitis,²¹ urinary tract infection (UTI),²² acute gastroenteritis (AGE),²³ community-acquired pneumonia (CAP),²⁴ and skin and soft tissue infections (SSTIs).²⁵ These infections account for >2,500 hospitalizations at our center annually.

A.5.i.1.a. Osteomyelitis: For children hospitalized with uncomplicated acute hematogenous osteomyelitis, evidence demonstrates that early transition to oral antibiotics (vs. prolonged intravenous antibiotics) has similar effectiveness and decreased risk of catheter-associated complications (e.g., catheter-associated infection, venous thromboembolism, mechanical dysfunction).²⁶⁻²⁸ Prior to our project, as per traditional therapy for bone and joint infections,²⁹⁻³⁰ most children at our center completed a 4-6 week course of intravenous (IV) antibiotics.²⁸

A.5.i.1.b. Urinary Tract Infection: In children, UTIs are typically attributable to pyelonephritis rather than cystitis; recurrent UTIs in childhood are a risk factor for end-stage renal disease.³¹⁻³² Therefore, detection of risk factors for recurrence (e.g., severe vesicoureteral reflux) using routine voiding cystourethrogram (VCUGs) had been an important aspect of management of first UTIs in children.³³ In September 2011, the American Academy of Pediatrics published a new clinical practice guideline for management of first urinary tract infection (UTI) in children.³⁴ This update, the first update to the UTI management guideline in over a decade, incorporated emerging evidence surrounding risk associated with radiation of VCUG, the expense and VCUG of the procedure, along with limited evidence to delay identification of vesicoureteral reflux and initiation of antibiotic prophylaxis therapy to prevent recurrent febrile UTI. A major change to the updated guideline considering this evidence was that VCUGs were no longer recommended routinely for all patients with first time UTI, but rather just for patients with an abnormal renal and bladder ultrasound (RBUS). Prior to our work, the baseline median rate of VCUG completion after normal RBUS for children hospitalized at our center was 92%.

A.5.i.1.c. Acute Gastroenteritis: Although the mainstay of treatment for AGE is rehydration it does not reduce the severity or duration of intestinal symptoms.³⁵ At the time of this work, the most up to date evidence suggested that probiotics such as lactobacillus given to children with AGE could shorten the duration of diarrhea.³⁶ Despite multiple evidence-based guidelines identifying probiotics as a valid and effective adjunct to oral rehydration, and a local practice guideline recommending consideration of probiotics,³⁷⁻⁴⁰ inpatient prescribing in our hospital was 1%.

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A.5.i.1.d. Community-Acquired Pneumonia: In August of 2011, the Pediatric Infectious Diseases Society (PIDS) and Infectious Diseases Society of America (IDSA) published evidence-based guidelines for the treatment of uncomplicated CAP in children.⁴¹ This guideline recommended ampicillin as first-line antibiotic therapy for the fully immunized child without underlying medical conditions and with uncomplicated CAP who requires hospital admission. At the time of guideline publication, aminopenicillins accounted for just 30% of empiric therapy for patients hospitalized with CAP at CCHMC.

A.5.i.1.e. Skin and Soft Tissue Infections (SSTI): The IDSA suggests that short courses of antibiotics (5-7 days) are effective and appropriate treatment for uncomplicated skin and soft tissue infections.⁴² Shortening duration of antibiotics may help prevent development of resistant bacteria, lessen cost, and reduce the chance of unintended effects of antimicrobial therapy.⁴³ Review of internal data demonstrated a lack of both standardization of care and adherence to published best practices, with over 70% of hospitalized patients with SSTI being prescribed >7 days of antibiotics upon discharge.

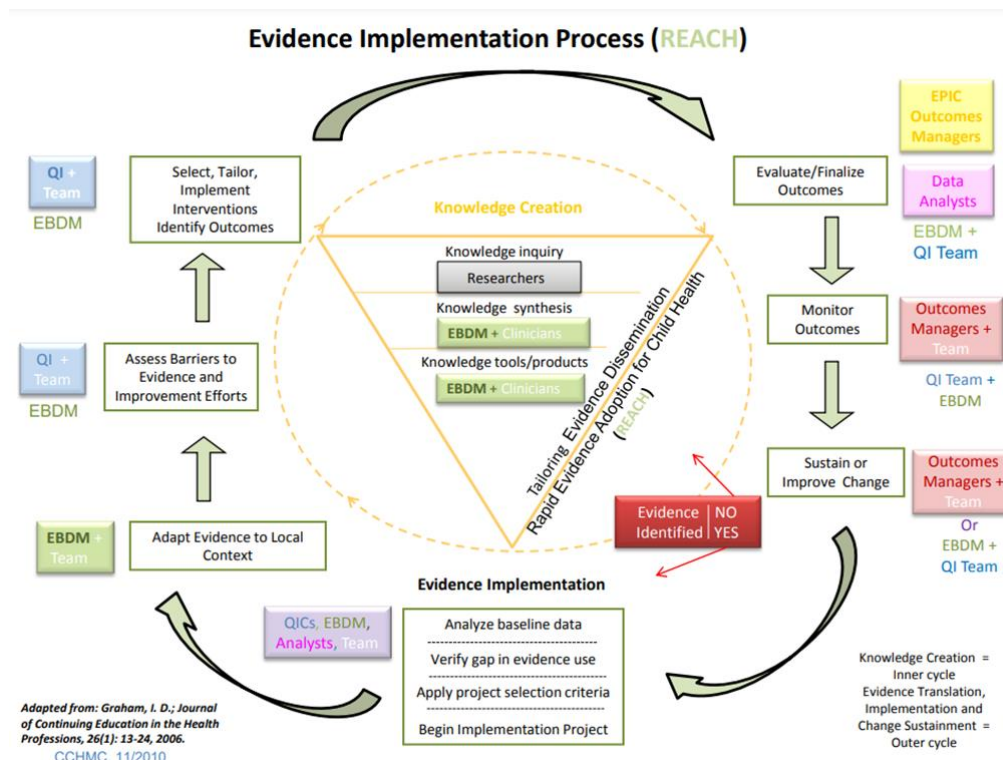
A.5.i.2. Participating Personnel. Participating personnel for this initiative included both core multidisciplinary improvement team members and frontline clinical staff. There were over 60 multidisciplinary improvement team members across these 5 projects. This collaboration included 27 physicians from 4 divisions (Hospital Medicine, General Pediatrics, Infectious Diseases, and Emergency Medicine), 3 clinical research assistants, 13 nurses, 3 clinical pharmacists, 12 information services and decision support experts, a data analyst, and a member from the hospital's human resources office.

Beyond core multidisciplinary improvement team members, frontline clinical staff were integral to the success of this work. The number of clinical staff involved in this work is substantive: 1) our institution's 300 pediatric residents; 2) faculty and staff physicians and advanced practice providers from the Divisions of Hospital Medicine (60), General Pediatrics (45), Infectious Diseases (35), and Emergency Medicine (90); 3) ~100 inpatient clinical pharmacists; and 4) > 100 inpatient nurses on our three main hospital medicine inpatient units.

A.5.i.3. Implementation. We used an adapted version of a well-known implementation science⁴⁴ framework known as the knowledge-to-action cycle. Our adaptation of the framework, called **Rapid Evidence Adoption to improve Child Health (REACH)** enables the quick translation of evidence into point-of-care decision-making by clinicians, families, and patients. The framework includes horizon scanning, evidence synthesis, embedding evidence into practice, and measuring and spreading evidence adoption as indicated in the Figure below.

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Our goal was to reduce the gap between evidence generation/publication and the application of the evidence in patient care. We developed and tested this framework with 5 projects, as described below, to identify factors associated with rapid, reliable application of evidence. Since this initial period of development and testing, the Division of Hospital Medicine has continued evidence adoption (implementation and de-implementation) in other areas of inpatient pediatric care over the last decade. Examples are described in numerous additional publications.^{7, 45-50}



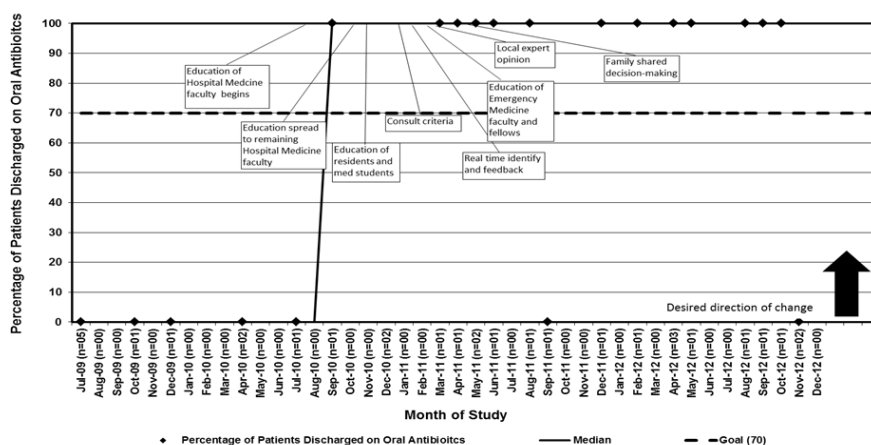
CCHMC has adopted the Model for Improvement throughout the health system, community, and Learning Health Networks as a standard framework for initiating and implementing practice change.⁵¹ For each individual project, a multidisciplinary team was formed to guide the work and ensure that voices were represented in planning tests of change. Process maps depicting current processes of care and ideal processes of care were created. Failure Modes and Effects Analyses (FMEA) were utilized to identify potential breakdowns within the process. A theory of change called a Key Driver Diagram was developed to accomplish each improvement aim. Multiple interventions were designed to address the identified key drivers. Candidate interventions were tested and refined through multiple plan-do-study act (PSDA) cycles.

There was also collaboration across improvement teams to share interventions that were most impactful. This approach demonstrated transferability of certain interventions across conditions. For example, the shared decision-making aid developed for the intervention by the osteomyelitis team was modified and provided to parents to facilitate information dissemination and decision-making for the use of lactobacillus for acute gastroenteritis. Additionally, the EHR modifications developed to reduce VCGUs in children with their first UTI (i.e., modifying the order set to facilitate adherence to the recommendations) were also adapted to facilitate appropriate first-line antibiotic prescribing for CAP. Finally, integration of focused feedback from key stakeholders, including patients' families, physicians, nurses, and pharmacists allowed us to incorporate the invaluable perspective of families and care providers into our implementation efforts, optimizing intervention design, outcome measurement, and overall study execution.

Below, we detail our implementation efforts for each project tied to the practice change for hospitalized pediatric patients. Here we present each project, highlighting *interventions*, the number of patients (or encounters) that experienced *improved care because of the change*, and how the change was *sustained*. All analyses were conducted internally.

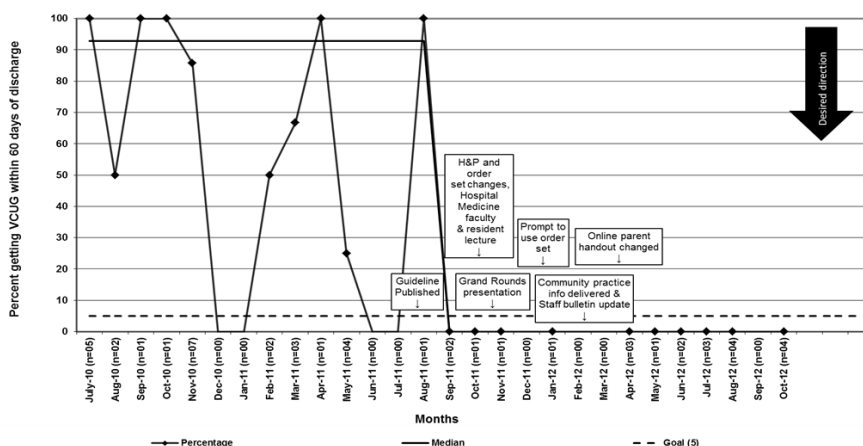
A.5.i.3.a. Osteomyelitis: The focus of this project was to increase the proportion of children admitted with acute osteomyelitis on the hospital medicine service who were discharged on oral antibiotics. Through collaboration with front-line residents and nursing, we developed and implemented a case-based education series, an order set in the EHR, a shared decision aid for use with families, and a structured process to identify potentially eligible patients and provide evidence to treating team in near real-time. Through our efforts, we improved the median percentage of patients discharged each month on oral antibiotics from 0% to 100% and sustained that improvement for two years prior to publication²¹ and in the 8 years since publication.

Figure. Annotated run chart showing % of eligible patients with acute osteomyelitis discharged home on oral antibiotics by month.



A.5.i.3.b. Urinary Tract Infection: The focus of this project was to implement the new evidence-based imaging recommendation with the goal of decreasing the proportion of guideline-eligible patients with a normal RBUS who underwent VCUG in the 60 days after diagnosis during hospitalization. Interventions utilizing the EHR (e.g., order sets, history and physical templates, and electronic discharge information) were most impactful. The proportion of children hospitalized with first UTI and normal RBUS who underwent VCUG decreased from median of 92% to 0%.²² This change was sustained in the 12 months prior to publication and in the 9 years since publication.

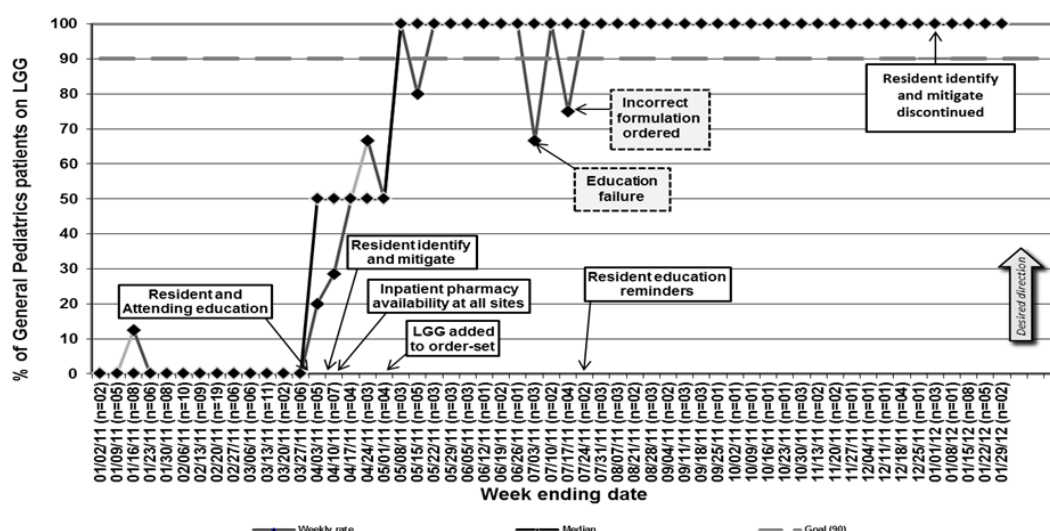
Figure. Annotated run chart showing percent of eligible patients with UTI and a normal RBUS who had a VCUG within 90 days of discharge by month.



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A.5.i.3.c. Acute Gastroenteritis: The aim of this project was to increase the percentage of children with AGE admitted to our hospital medicine service who received lactobacillus (LGG). Key interventions were collaboration with colleagues in pharmacy, utilization of an EHR order set, and identification and mitigation of failures with real time interventions. Since probiotics are considered a dietary supplement, they are not covered by most insurance plans and families would have paid out of pocket for a 30-capsule box purchased over the counter. To help families continue therapy, we partnered with colleagues in pharmacy by allowing families to fill the prescription of 5-7 capsules at the hospital for a significantly reduced cost. As a result of this improvement work, inpatient prescribing of probiotics for children admitted with acute gastroenteritis increased from 1% to 100% within 6 weeks; results were sustained for over a year prior to publication.²³ Since this intervention was implemented, more recent evidence has called into question the efficacy of probiotics for acute gastroenteritis. Therefore, we have purposefully not sustained this improvement.⁵²⁻⁵⁵

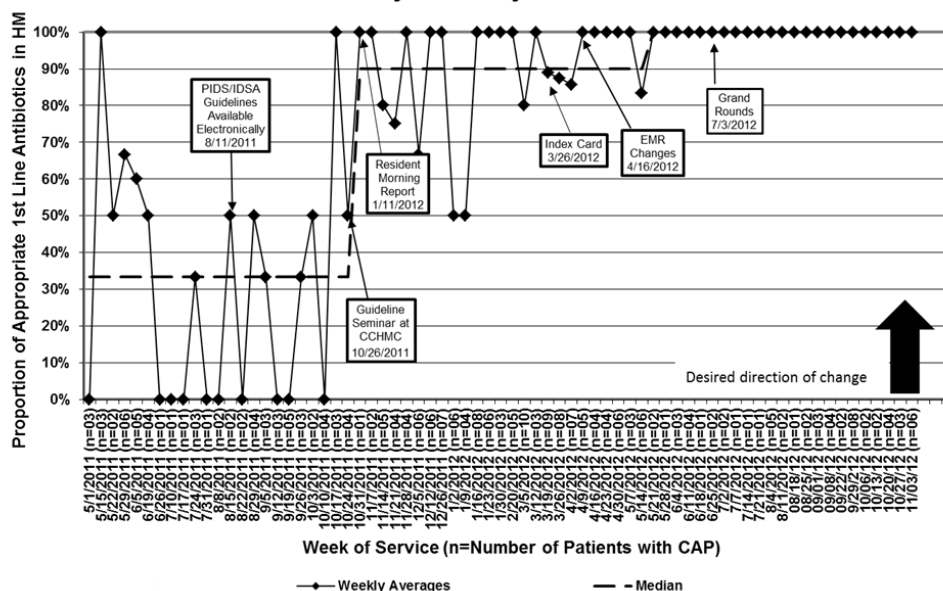
Figure. Annotated run chart showing percent of eligible patients with AGE prescribed lactobacillus (LGG) by week.



A.5.i.3.d. Community-Acquired Pneumonia: In this project, we increased the percentage of otherwise healthy patients admitted with the diagnosis of community-acquired pneumonia receiving appropriate first-line antibiotic therapy as recommended by the PIDS/IDSA guidelines from a median baseline of 30% on the hospital medicine service to 100%. This improvement was sustained for 12 months prior to publication²⁴ and the 9 years since publication. The CAP project was innovative as we were able to drastically change prescribing behavior early in our work with low reliability interventions focused on provider education. We have been able to sustain this behavior with higher reliability interventions targeting EHR order sets. Additionally, this change in antibiotic behavior initially occurred in the absence of a formal antimicrobial stewardship program. Our institution has now created an antimicrobial stewardship program and hospital medicine physicians have continued working with the program to incorporate quality improvement methods into other initiatives that focus on improving antibiotic prescribing, including accelerating the initiation of adequate antimicrobial therapy using microarray testing and real-time decision support.⁶

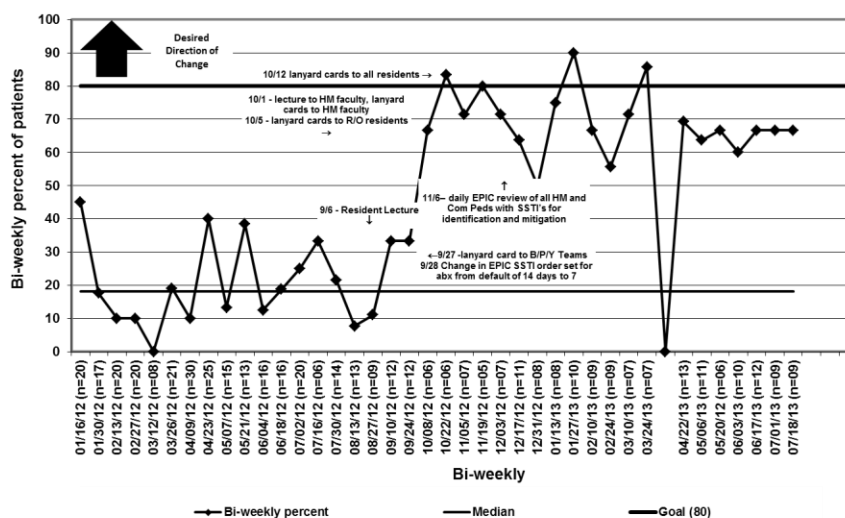
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Figure. Annotated run chart showing percent of eligible patients hospitalized with CAP prescribed appropriate first line antibiotics by week.



A.5.i.3.e. Skin and Soft Tissue Infections: In this project, we aimed to increase the percent of hospitalized patients with SSTI who were prescribed 7 days or fewer of antibiotics upon discharge. With interventions including provider education, use of a EHR order set with standardized duration of antibiotics, and daily identification mitigation of failures, the team was able to increase the percentage of patients prescribed 7 days or less of antibiotics on discharge from a baseline of 18% to 70% over a period of 6 months.²⁵ These changes have been sustained in the 6 years since publication.

Figure. Annotated run chart showing percent of eligible patients hospitalized with SSTI prescribed 7 or fewer days of antibiotics on discharge (bi-weekly).



A.5.i.4. Incentivizing, Motivating, Monitoring and Evaluating Practice Change: Improvement across CCHMC is not so much “enforced” as it is part of a constellation of discrete organizational processes. CCHMC’s 20-year journey to improve care has focused on building an institution-wide, multi-component learning system to support improvement and evidence-based practice described in the text box below. Today, there are countless ongoing improvement activities taking place throughout the organization daily. At an institutional level, Divisions and Departments identify strategic improvement initiatives aligned with CCHMC strategic priorities as part of annual planning.

Elements of the CCHMC System of Learning

1. Clarity of system (purpose and structure)
2. System level measures (including the use of statistical process control methods to increase the focus on prediction)
3. Explicit theory or rationale for system changes as part of all initiatives
4. Appropriate segmentation (e.g., patients, divisions, sites of care)
5. Sequential learning methods using multiple methods of evaluation (e.g., experimental, quasi-experimental and qualitative methods).
6. Multiple feedback loops and regularly scheduled learning events
7. (Numerous) Leadership systems to keep the organization focused on learning (e.g., high degree of transparency, routine use of data (for learning rather than punishment), structures and processes to increase attention to outcomes, alignment of improvement with performance evaluations).

Progress is routinely tracked using internal and benchmarked data and analytics. Transparency of results is part of the CCHMC culture. As such, ensuring that data and improvement are front and center, visible to those who are part of the system of care, is the motivation needed to monitor, motivate, and evaluate the degree to which change is resulting in improvement. Continuous improvement is simply a deep part of our culture where it is part of everyone's job.

A.5.i.5. Results of Practice Change: Over the last decade, over 20,000 children have received appropriate evidence-based care because of our improvement work focused on 5 infections. The Division of Hospital Medicine continues to be a national leader in generating and implementing evidence for hospitalized children beyond these five diagnoses as demonstrated in a multitude of publications – improving discharge efficiency,^{7,47} reducing continuous pulse oximetry use in stable patients⁴⁵ with bronchiolitis and asthma, improving asthma care by connecting at-risk families to a community based program to reduce home environmental risks⁵⁶ and leveraging the outpatient pharmacy to reduce medication waste,⁵⁷ standardizing the approach to diagnosis of neonatal herpes simplex virus⁴⁹ infections, reducing unnecessary electrolyte testing,⁵⁸ improving the timeliness of transition from intravenous to oral antibiotics,⁴⁸ decreasing hospital observation time for febrile infants,⁴⁶ and improving the readability of discharge instructions⁵⁰ and the translation of discharge instructions for patients with limited English proficiency.⁵⁹

A.5.ii. Implementing and evaluating practice change to improve hospital safety

A.5.ii.1. Evidence-based practice change: Although serious complications during pediatric anesthesia are less common than they were 20 years ago, serious airway events continue to occur and often lead to patient morbidity, unplanned hospital admission, and escalation of care.⁶⁰⁻⁶¹ Serious airway events related to anesthetic care most commonly occur during induction of anesthesia, emergence from anesthesia, and in children with preexisting airway abnormalities. Failure to recognize and treat airway obstruction, especially in younger children, can rapidly lead to oxygen desaturation and cardiovascular compromise. The Pediatric Perioperative Cardiac Arrest (POCA) Registry found that 27% of reported cardiac arrests from 1998 to 2004 were respiratory related, and the majority related to airway obstruction from laryngospasm.

CCHMC's Department of Anesthesia provides anesthetic care to one of the busiest pediatric operating rooms in the United States. Analysis of Quality Improvement (QI) data over a 2-year period (July, 2009 to June, 2011) showed that anesthesia-related serious airway events occurred in as many as 2 per 1000 anesthetics. Apparent cause analysis

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determined that system factors related to clinical practice may have played a role. Thus, a QI project was designed and implemented to reduce the incidence of serious airway events and cardiac arrests.

A.5.ii.2. Participating Personnel: The improvement team consisted of the safety officer and QI experts within the Anesthesia Department at our base hospital and outpatient facility. All members of the team were regularly involved with the clinical care of patients in the operating room. Quality Improvement data from the past year were presented to all members of the department (anesthesiologists, CRNAs, nurse practitioners), anesthesia fellows, and other rotating trainees at our monthly departmental continuous quality improvement (CQI). Smaller meetings were held with individual practice groups and feedback was also obtained during yearly evaluations with individual practitioners. Members of the department were specifically asked for ideas regarding why the incidence of these serious airway events had increased and for possible interventions that might lead to improvement.

A.5.ii.3. Implementation and results: The improvement team developed a Smart Aim and Key Driver Diagram. The Smart Aim of this project was to reduce the incidence of serious airway and airway cardiac arrests by 50% (2/1000 to 1/1000 cases) by June 30, 2012. A Key Driver Diagram identifying critical elements essential to reducing these events and specific interventions which might impact the key drivers was developed for our base hospital and outpatient facility. First, having succinylcholine and atropine readily accessible (visible on the anesthesia machine or drug cart) during anesthetic induction and throughout the procedure. Second, using nondepolarizing muscle relaxants for endo- tracheal intubation in children 2 years and younger for cases longer than 30 min. The specific interventions and focus on younger age children for administration of muscle relaxants was determined after detailed analysis of previous events. A common scenario in our practice was the development of laryngospasm following prolonged laryngoscopy by a trainee or relatively inexperienced practitioner, and that in children 2 years and younger this more commonly led to severe hypoxemia and cardiovascular compromise. We felt that the use of nondepolarizing muscle relaxants provided better intubating conditions, reduced the amount of anesthetic required for endotracheal intubation, and minimized the chance for laryngospasm following a failed laryngoscopy. The third intervention at our base hospital was to assess ventilation after extubation by auscultation or end-tidal carbon dioxide analysis before transport to the post-anesthesia care unit (PACU). At our outpatient facility, the third intervention was to extubate the trachea once the patient was awake, or if an airway device was removed during anesthesia, to request emergence in the operating room or with the anesthesia staff present in the PACU. These proposed interventions were presented to the department and clinical providers were asked to provide feedback regarding their feasibility. Departmental leadership identified the project as very important, and a portion of compensation was dependent on the group as a whole successfully implementing these interventions.

A.5.ii.4. Monitoring and evaluation: Departmental leadership emphasized the necessity of reporting all serious adverse events. Quality improvement data regarding our incidence of serious airway events and airway cardiac arrests were presented to the anesthesia group before initiating the project. This included specific case presentations so that providers could better understand the scope of the problem and its impact on patient outcomes, and data continued to be presented regularly throughout the intervention period. Although we strongly encouraged providers to implement the recommended interventions, the final decision regarding how to conduct the anesthetic was made by the anesthesiologist. We chose to impact behavior by presenting data showing the scope of the problem, discussing our success with the process and outcome measures monthly, and listening to feedback from clinical providers.

The primary outcome measures were the incidence of serious airway events and airway cardiac arrests. These data were obtained through self-reporting of events by anesthesia staff, reporting of emergency calls in the OR and PACU by nursing staff, and reports through the hospital Safety Event Reporting System. Data were also collected on the success of each intervention (process measures). Fifty anesthetic records were evaluated each month to assess whether

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nondepolarizing muscle relaxants were being used for endotracheal intubation in children 2 years and younger for cases longer than 30 min. Clinical research staff randomly monitored whether succinylcholine and atropine were visible on the anesthesia workstation, ventilation assessed following extubation, and anesthesia providers present until emergence from anesthesia. Using the random sampling method, research staff made approximately two observations per day for each measure. Our research coordinators often gathered this data while collecting data for other studies which required their presence in the operating room or PACU. The succinylcholine and atropine syringes needed to be visible on either the anesthesia machine or cart, and ventilation assessed by either capnography or auscultation of the chest. Group data were presented to clinical providers monthly, and they were given the opportunity to provide feedback to members of the improvement team.

Baseline data were obtained for each of the process measures for 1 month (approximately 50 data points) prior to implementing the interventions and a median determined for the intervention period. Run charts for the primary outcome measures were developed and statistical methods applied to show when a 'shift' or significant change had occurred. The percentage of cases where muscle relaxants were utilized in children 2 years and younger for endotracheal intubation and where atropine and succinylcholine were readily available increased at both our base and out-patient facilities. Over the 2.5-year study period, the incidence of serious airway events and airway cardiac arrests was reduced by 44% and 59%, respectively compared to the previous 2-year period.⁶²

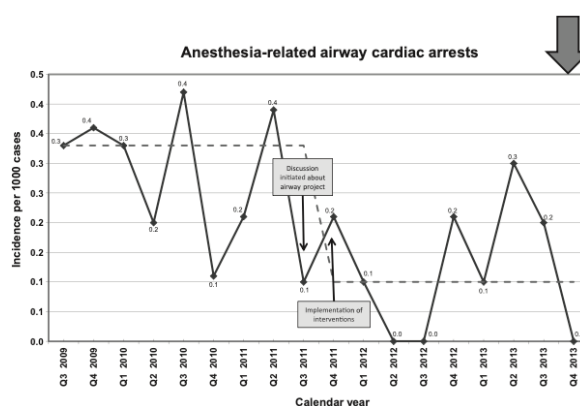


Figure 6 Run chart showing the incidence of anesthesia-related airway cardiac arrests from July, 2009 to December, 2013. The improvement project was initiated in July, 2011.

Number of patients affected: The Department of Anesthesia performs approximately 45 000 anesthetics per year across 38 operating rooms, an imaging center, ambulatory surgery center, and multiple nonoperating room locations.

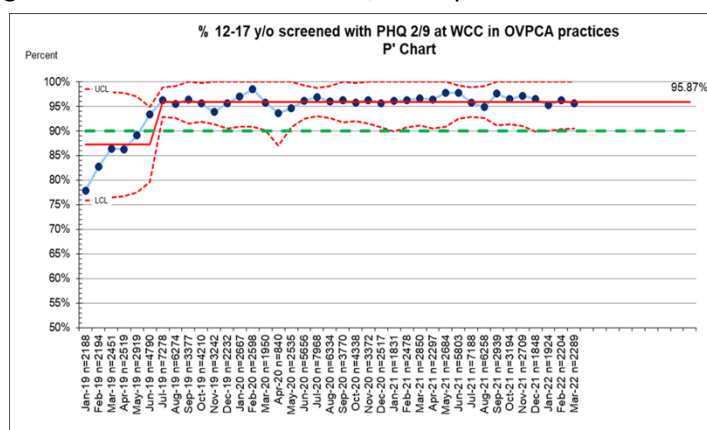
A.5.iii. Implementing evidence-based change and improving outcomes in primary care: Over the last 20 years, Tri-State Child Health Services, our physician hospital organization (PHO), has used improvement and implementation science methodology as described above to improve clinical outcomes across a number of conditions. The PHO has worked on a number of evidence-based practice change initiatives. Here, we describe improving screening and treatment of adolescent depression as an example of practice change in a regional primary care network

A.5.iii.1. Evidence-based practice change: Depression among adolescents is common, with a prevalence of 14.4% of all 12- to 17-year-olds (Anand, et al.). Community-based research indicates that only 50% of adolescents with depression are properly diagnosed before reaching adulthood (Kessler, et al.). Further, roughly 2 out of 3 adolescents with depression are not identified by their primary care provider and thus, do not receive any mental or behavioral health care (Burns, et al.).⁶³⁻⁶⁵ Screening for and responding to depression symptoms is evidence-based and increasingly viewed as a component of standard preventive care.

A.5.iii.2. Participating Personnel: We used workgroups comprised of primary care physicians and general pediatricians, informed by patient-level outcomes data, to identify important improvement projects relevant to adolescent

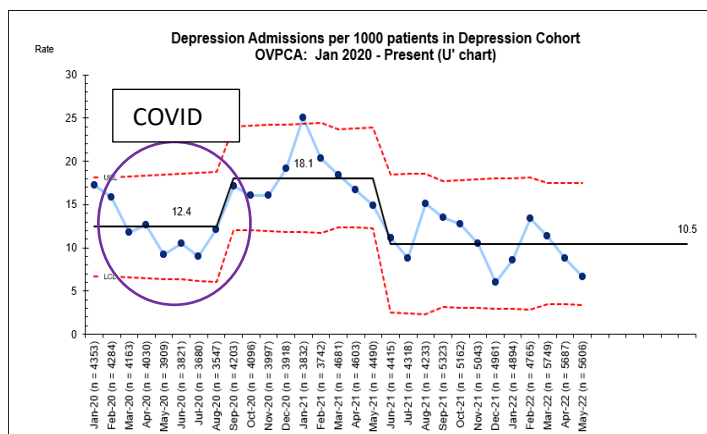
depression, along with other primary care relevant topics. Planning and implementation activities used the Model for Improvement including an explicit theory of change (Key Driver Diagram) to design intervention approaches. Quality Improvement Coaches, worked with each PHO practice, guiding them through implementation of necessary practice changes. In addition to implementation support, educational programming was created by the workgroups to raise the level of skill and comfort of the frontline pediatricians in making changes related to depression screening. A 5-module depression education program was developed and delivered via QStream platform to over 175 community primary care providers in the PHO network, beginning in March 2020. Modules focused on risk factors, self-care strategies, medication management, clinical care algorithm, screening, and patient/family education. Completion rates among each module ranged from 86.5% to 97.2%.

A.5.iii.3. Implementation and results: The PHO began collecting network-wide rates of PHQ 2/9 completion at well child checks (WCC) among 12- to 17-year-olds in January 2019. At baseline (January 2019), 77% of 12- to 17-year-olds were properly screened for depression at a WCC. By June 2020, PHQ 2/9 screening rates in the network rose to roughly 95 (see Figure). This performance has been sustained over the following 2 years and as of March, 2022, 96% of 12- to 17-year-olds were properly screened for depression at a WCC (a 19 percentage point increase in a 3 year period).



Since January 2020, hospital admissions have decreased as illustrated in the figure. Note that there was a decline in admissions associated with the initial stage of COVID. among the network-wide cohort diagnosed with depression.

A.5.iii.4. Monitoring and evaluation: The approach to catalyzing improvement is described above. Of particular note, the data presented here are shared regularly with PHO practices to engage practices to inform this effort and bridge to next opportunities for improvement.



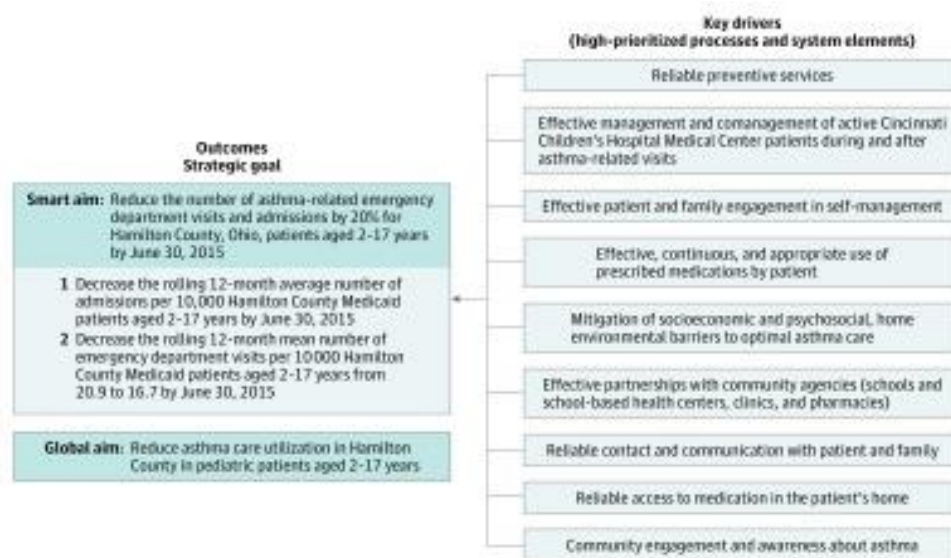
A.5.iv.1. Health equity-oriented evidence-based asthma care in community health: Hamilton County, Ohio, our region's most populous county, with ~190,000 children, and the location of Cincinnati Children's, has long been a hot spot for pediatric asthma morbidity, particularly for Black and Latinx children living in poverty. Hamilton County has more than 36,000 pediatric patients with asthma; more than 13,000 are Medicaid insured. More than 7,000 patients receive long-term asthma care in the CCHMC pulmonary or general pediatrics clinics each year. There are approximately 1,000 hospitalizations and approximately 2,500 emergency department visits annually for asthma for in-county children and adolescents.

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A.5.iv.2. Participating Personnel: With an aim of improving the health of pediatric patients in our service area, Cincinnati Children's launched an Asthma Improvement Collaborative (AIC) in 2007. The AIC multidisciplinary improvement team consisted of hospitalist, primary care, and community pediatricians; pediatric pulmonologists and allergists; ED physicians; pediatric residents; social workers; respiratory therapists; nurses; care coordinators; pharmacists; project managers; quality improvement consultants; and representatives from Medicaid managed care organizations and the Cincinnati Health Department school health program. The AIC's aim was to reduce asthma-related hospitalizations and emergency department visits for Medicaid-insured pediatric patients aged 2 to 17 years in Hamilton County by 20% by June 30, 2015. Specifically, the AIC sought to reduce the asthma-related hospitalization rate by approximately 20%, from a rolling 12-month mean of 7.2 to 5.8 per 10 000 patients per month and the ED visit rate from 20.9 to 16.7 per 10 000 patients per month.⁶⁶

A.5.iv.3. Implementation: The Key Driver Diagram (figure) that guided improvement efforts is depicted on the right. It incorporated existing evidence, the chronic care model, and voice of customer data from children and families navigating asthma symptoms in our region. Improvement activities using the Model of Improvement, occurred in the inpatient setting, outpatient setting, and community setting. Implementation efforts led by the multidisciplinary AIC team were phased by site of care.

Phase 1 activities were hospital-based and included: providing medications in hand prior to discharge, enhancing social and environmental risk assessment, and developing transition-related interventions that included a home health nursing pathway.⁶⁷ Phase 2 focused on outpatient activities, including: asthma care coordination for patients with difficult-to-treat disease, and providing a medication home delivery option for families. Finally, Phase 3 involved community-based testing strategies, including sharing data with schools, connections to Legal Aid and Healthy Homes education, and advocacy.^{56, 68-71}

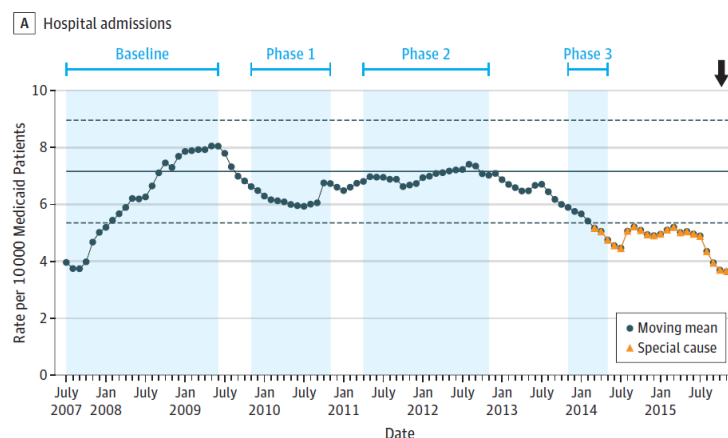


A.5.iv.3. Incentivizing, Motivating and Evaluating Practice Change: As above, transparent data was a core working principle. Primary outcomes were the rates of asthma-related hospitalizations and ED visits by Medicaid-insured children and adolescents aged 2 to 17 years living in Hamilton County. Hospitalization and ED data were obtained from hospital administrative databases and reported per 10,000 total Medicaid enrollees. Asthma-related visits were identified using International Classification of Diseases, Ninth Revision (ICD-9) codes. Secondary outcomes were the percentage of patients with an asthma-related rehospitalization or emergency department revisit within 30 days of a hospital discharge and the percentage of CCHMC primary care patients with well-controlled asthma, defined as an Asthma Control Test score greater than 19. Process measures were assessed using data collected at the point of care or extracted from the EHR daily, weekly, or monthly. Changes over time were tracked on annotated run charts and statistical process control charts to distinguish random, common-cause variation from significant, special-cause changes attributable to the interventions. The primary statistical process control analysis was a rolling 12-month mean of the

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rate of asthma-related hospitalizations and ED visits. Data were shared with inpatient, outpatient, and community stakeholders to motivate continued improvement and demonstrate progress.

A.5.iv.4. Results of practice change: We obtained data in July 2007 from the state Medicaid office. Early in the baseline period, we worked to ensure data accuracy and completeness accurate and complete data on enrollment (denominators). This influenced the initial rise in our measure between 2007 and 2009. After implementation of our phased improvement approach, efforts resulted in statistically significant decreases in hospitalizations, emergency department visits, and reutilization (return to hospital or emergency department within 30 days). The 12-month moving average hospitalization rate decreased from 8.1 to 4.7 per 10,000 Medicaid patients, the emergency department visit rate decreased from 21.5 to 12.4, and the reutilization (rehospitalization or repeat emergency department visit) rate decreased from 12% to 7%. All improvements have been sustained, with improvement efforts now being spread across additional regional counties. The hospitalization chart is shown in the Figure.



A.5.v.1 Learning Networks: Implementing and Evaluating Practice Change at scale

Over the last 17 years, researchers, clinicians, and families, with support from CCHMC and leadership from the American Board of Pediatrics, have designed, developed and implemented network-based Learning Healthcare Systems, that we call Learning Health Networks, to improve the health of populations of children and youth. Learning Health Networks use a well-established organizational ‘actor-oriented’ network organizational architecture.⁷² ‘Organizational architecture’ refers to the way that an organization arranges itself to coordinate and control activities and to make decisions about distribution of resources and effort. ‘Actors’ are people, organizations, databases, and registries that are part of the network. The actor-oriented network organizational form has three components: (1) aligning participants around a common goal; (2) standards, processes, policies, and infrastructure to enable multi-actor collaboration; and (3) a commons where information, knowledge, resources and know-how⁷³ to achieve that goal are created and shared. The model recognizes that humans are predisposed to be cooperative and prosocial, and that an appropriately designed organization can facilitate these predispositions, thereby facilitating cooperation and coproduction, at scale, to improve health, care, and outcomes.⁷⁴⁻⁷⁷ This approach has resulted in many examples of practice change at scale including:

- The National Pediatric Cardiology Quality Improvement Collaborative (NPC-QIC) demonstrated a 40% reduction in mortality from hypoplastic left heart syndrome (HLHS) and a reduction in growth failure from 30% to < 10% for 95% of all children with this condition.⁷⁸
- The [Solutions for Patient Safety Network](#) of 140+ children’s hospitals across the US efforts have shown decreased serious safety events by 32%, decreased adverse drug events by 74%, and decreased unplanned extubations by 42%.⁷⁹
- The [Ohio Perinatal Quality Collaborative](#) Learning Health Network designed, tested, and diffused a new model of perinatal care that reduced hospital length of stay for infants with Neonatal Opioid Withdrawal Syndrome by 2 days across all of Ohio in less than three years.⁸⁰

Below is a more detailed example, also from the Ohio Perinatal Quality Collaborative, of decreasing elective preterm birth by 75% across all birth hospitals in Ohio⁷.

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A.5.v.2 Evidence-based practice change: Early elective deliveries, defined as scheduled inductions of labor or cesarean birth prior to 39 weeks' gestation without appropriate medical indication, result in increased neonatal morbidity and mortality, with these infants often requiring neonatal intensive care unit admission. The American College of Obstetricians and Gynecologists recommends delivery of an infant prior to 39 weeks only when justified by medical or obstetric complications.⁸¹

The Ohio Perinatal Quality Collaborative (OPQC) Learning Health Network focused on reducing Early Elective Delivery (EED). Phase one (January 2008-December 2010) involved systems and design thinking to pilot a new initiative in 20 of the largest maternity hospitals in Ohio. The project aim was to reduce scheduled births between 36- and 39-weeks' gestation without a medical indication. This work was based on increased adverse outcomes requiring NICU admission for infants born at 36-38 weeks, geographic variation within Ohio, and reports of successful hospital system level efforts to limit these births to women with a valid indication. Phase two (October 2011-September 2014), adapted the pilot program and the data collection systems to expand efforts to 15 community hospitals in Ohio. Phase 3 (October 2014-September 2017) involved an innovative step-wedge design to efficiently, and effectively spread the work to the 85 remaining maternity care hospitals in Ohio, including development of a "Change Package" curriculum and multiple educational and improvement efforts across Ohio. A secondary objective of Phases 2 and 3 was to improve the accuracy of Integrated Perinatal Health Information Systems (IPHIS) data so it could be used for perinatal quality improvement. These projects were supported by funding from ODH, the Ohio Department of Medicaid (ODM), the Centers for Disease Control and Prevention (CDC), and the Ohio Hospital Association (OHA).

A.5.v.3 Participating personnel: Phase one sites were asked to identify QI teams that included a nurse, data manager, and a physician, and confirm support from hospital administration. Deidentified site-specific data about each scheduled birth (e.g., gestational age, indication for scheduled birth), were collected at each site, submitted to OPQC, and shared regularly with each site team before monthly Action Period Calls, where aggregate data were presented. Quality Improvement Coordinators facilitated presentations by both successful and struggling sites to generate team-to-team learning. Stakeholders' efforts are further facilitated and supported by Learning Health Network staff (project management, data and analytics, quality improvement specialists) and faculty (improvement advisors).

A.5.v.4 How the implementation occurred: As in other Learning Health Networks the network framework aligns participants around a common goal of improving health outcomes, transparency of outcome measures and a flexible and adaptive collaborative learning system. Team collaboration is promoted by using standardized processes, protocols, and policies, including communication processes, data sharing, privacy protection and regulatory compliance. Learning methods include collaborative quality improvement using a modified Breakthrough Series approach and statistical process control methods. Participants observe their own results and learn from the experience of others. A knowledge repository (a 'commons') is used to share resources that are created by participants. Standardized data capture approaches facilitate data entry, resulting in data useful for research and learning.³

A.5.v.5 Approaches used for incentivizing and motivating relevant staff: This approach capitalizes on the idea that patients and families, clinicians, administrators, and others are inherently motivated to improve health and health care but are constrained by organizational, administrative, and sociocultural barriers. Instead of attempting to force staff to implement evidence-based practices, Learning Health Networks processes capitalize on inherent motivation, encouraging all stakeholders to organize around improving health outcomes, and applying the learning system principles (e.g., transparent data, sequential learning, peer-to-peer coaching, leadership to maintain focus on outcomes) described above. Because all stakeholders can collaborate to improve and because ongoing measurement shows the impact of their efforts, intended changes are reinforced and sustained.

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A.5.v.6 The number of patients who experienced improved care because of the change: The OPQC Early Elective Delivery project resulted in more than 66,000 births shifted to term between 2008 and 2016, saving millions of dollars in hospitalization costs for infants, and is an example of CCHMC Learning Health Networks achieving improved population health at scale.

A.5.v.7 How well the organization sustained the change: Ohio was the first state in the country to reduce Early Elective Deliveries at the population level, and in large part based on the success of this project, Ohio was selected by the Centers for Disease Control and Prevention (CDC) as a mentor site for other states interested in developing Perinatal Quality Collaboratives. The methods developed in Ohio continue to have been sustained and spread nationally

A.6. Describe the Applicant Organization's potential to achieve substantial and meaningful reach.

In alignment with the global focus of CCHMC's mission to be the leader in improving child health, we have developed the capability to impact care locally, regionally, nationally, and internationally. This includes: 1) the CCHMC healthcare system; 2) the Southwest Ohio region for population health and health equity including CCHMC's community health program focused on the children of Cincinnati, the CCHMC Accountable Care Organization, *HealthVine*, and CCHMC's Physician Hospital Organization that includes 25 affiliated primary care pediatric practices; 3) and 12 Learning Health Networks that support spread and scale of evidence-based practice across populations of individuals with a wide variety of health conditions including rare disease, chronic illness, common conditions (e.g., asthma, perinatal care), safety, and community health. The reach of the Learning Health Networks together with other local and regional activities enables us to reach tens of thousands of clinicians and millions of children and youth.

The CCHMC health system provides direct care to approximately 450,000 patients a year in approximately 1.5 million encounters, including approximately 28,000 admissions, 125,000 emergency and urgent care visits, 1.3 million outpatient visits, 6,500 inpatient surgeries, and 25,000 outpatient surgeries. In FY20, the Cincinnati Children's served patients from 51 countries and all 50 states including patients thousands of rare disease and children with intellectual and developmental disabilities.

Southwest Ohio Region, Population and Community Health: The primary service area for Cincinnati Children's includes a 14-county area covering Southwest Ohio, Southeast Indiana, and Northern Kentucky with well over 500,000 children and adolescents. The 14-county primary service area includes urban, suburban, and rural areas. A large portion of the youth population is covered by public insurance. Hamilton County, Ohio is the most populous of regional counties with a population of 800,000, including nearly 200,000 children and adolescents. Cincinnati is the largest city in the region. It has approximately 300,000 residents and 66,000 children. Forty-one percent of Cincinnati's residents identify as Black or African American, and 50% identify as white. Approximately 4% identify as Hispanic/Latinx.

Primary Care: Cincinnati Children's Divisions of General Pediatrics and Adolescent Medicine have 4 primary care clinics and 3 school-based clinics through which Cincinnati Children's provides direct primary care services. In FY2020, these Divisions had 63,479 outpatient encounters. The Pediatric Primary Care Center (PPC) is the largest of these clinics, with more than 30,000 visits each year. The clinic was awarded Level 3 national Committee for Quality Assurance (NCQA) accreditation status in year 2014. NCQA accreditation provides independent evaluation of an organization's ability to coordinate care and be accountable for the high-quality, efficient, patient-centered care. Two other general pediatrics clinics are: 1) Hopple Street Health Center, located in an urban neighborhood 3 miles away from the main hospital; and 2) Fairfield Primary Care Center, located 18 miles north of the main hospital. The 4th primary care center, operated by the Division of Adolescent Medicine, is the Teen Health Center, also located on the main campus. The vast majority of children and youth cared for across these primary care centers live in Greater Cincinnati's most impoverished

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communities. Approximately 70% of these children are African American; 5% Latinx/Hispanic and 25% white. Nearly 90% are insured through Medicaid.

In addition to the Divisions of General Pediatrics and Adolescent Medicine, CCHMC has 9 primary care clinics (Community Health Services Network - CHSN) located throughout the 14-county primary service area. CHSN practices have > 80,000 outpatient encounters each year. Taken together, CCHMC primary care facilities serve >70,000 patients and >140,000 outpatient visits yearly.

Tri-State Child Health Services is a physician hospital organization (PHO) that includes Cincinnati Children's >1000 subspecialists and over 200 primary care providers at 25 primary care sites. The PHO provides care to over 240,000 children in Southwest Ohio, Northern Kentucky, and Southeast Indiana (Greater Cincinnati region). This network participates in coordinated clinically integrated work, which over the years has dramatically improved patient outcomes in chronic disease (e.g., for asthma these practices have significantly reduced the number of patients seen in the ED for asthma exacerbation) and screening for and treating adolescent depression (see Section A.5 for details), among other improvement efforts.

CCHMC's Accountable Care Network, HealthVine, is the focus of Population Health. As of January 1, 2021, *HealthVine* has assumed accountability to provide high value care, and improve health, equity, and outcomes for children on Medicaid in Adams, Brown, Butler, Clinton, Clermont, Hamilton, Highland, Warren counties in Southwest Ohio (an estimated 140,000 children). There are plans to expand to include more children on Medicaid in our primary service area throughout Ohio, Kentucky, and Indiana, and develop value-based contracts for commercially insured children in the same geographic region. *HealthVine* includes 15 primary care practices and 19 behavioral health practices.

HealthVine has created the environment that enables the organization to test changes in care delivery, as well as sub-delegated alternative payment models to drive not only excellent and equitable outcomes but also affordable care. The HealthVine team includes practice liaisons, care managers, community health workers, and social workers. More than 5,000 outreach interventions are completed each month, with considerable focus placed on children with chronic conditions (e.g., asthma, diabetes, sickle cell disease) and those experiencing care transitions (e.g., post-discharge from hospital, after emergency department visit). Behavioral health is also integrated across HealthVine focus areas. Crisis intervention is augmented by a Social Investment Fund capable of providing financial assistance to patients and families with needs outside of typical medical expenses that cannot be addressed through traditional resource routes. One example is that of a 17-year-old with severe asthma who experienced multiple emergency department visits and hospitalizations for acute exacerbations, all thought to be triggered by loss of air conditioning at home. After one admission, a HealthVine social worker connected with the family to help prevent future morbidity (and utilization) by addressing financial insecurity. When the patient's mother was given 24-hour notice of service disconnection from the local energy company, she immediately called HealthVine. The HealthVine social worker was able to request a 7-day hold from Duke Energy, while a medical certificate waiver was completed and later approved for a 30-day hold. HealthVine worked with community non-profit organizations, St. Vincent DePaul, and Our Daily Bread Ministries, to help cover the \$1,200 disconnection bill. The patient's mother subsequently began working with the Community Action Agency to improve financial stability and keep the child out of the hospital. By investing \$1,200 in the patient and his family, HealthVine estimates saving of at least \$4,700. In 2021, this fund provided \$3,554 in financial assistance to HealthVine families resulting in an estimated savings of at least \$15,675 in unnecessary medical costs.

Community Health Program: CCHMC has a robust community health program that has achieved measurable improvements in population health for the children in Cincinnati. It is described in Section A.7.

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National and International Reach: Through CCHMC's Learning Health Networks we impact care for millions of children cared for in collaborating institutions by thousands of clinicians across nearly 700 clinical sites, in over 300 hospitals across the US, Canada, Europe, and the Middle East. Learning Health Networks focus on the entire patient population at participating sites and therefore reach millions of patients. Many operate in collaboration with national patient organizations providing further reach and sustainability. The following networks have been developed over the past 10 years.

Learning Health Network	Condition	Sites	Founded	Estimated # Patients
Advanced Cardiac Therapies Improving Outcomes Network	Pediatric Congestive Heart Failure	59	2017	950
All Children Thrive	Community Health	82	2015	66,000 children in Cincinnati
American Society of Hematology Sickle Cell Network	Sickle Cell Disease	16	2020	11,000
Autism Care Network with Autism Speaks	Autism Spectrum Disorder	21	2014	>1,300
Cystic Fibrosis Learning Network	Cystic Fibrosis	34	2014	3,200
Epilepsy Learning Health System	Epilepsy	15	2018	45,000
Fontan Outcomes Network	Single Ventricle and Fontan Circulation	31	2021	Registry starting fall 2022
ImproveCareNow Network	Pediatric Inflammatory Bowel Disease	99	2007	>50,000
Improving Renal Outcomes Collaborative	Kidney Disease	46	2016	3,750
National Pediatric Cardiology Quality Improvement Collaborative	Infants with Single Ventricle Disease	71	2009	>1,400
Ohio Perinatal Quality Collaborative	Perinatal Care in Ohio	52	2008	>100,000 births/year
Pediatric Rheumatology Collaborative Improvement and Outcomes Network	Juvenile arthritis	23	2011	> 5,000
Solutions for Patient Safety	Safety Programs in Children's Hospitals	147	2007	Millions/year - All patients in participating hospitals

A.7. Describe the Applicant Organization's experience with serving under-resourced patients and communities.

A.7.i. Ability to reach under-resourced patients and communities: As described above, Cincinnati Children's primary service area includes 500,000 children and youth. Population centers include the City of Cincinnati with nearly 70,000 children and Hamilton County with nearly 200,000 children. Cincinnati consistently ranks as having one of the highest child poverty rates in the country (~40%). Economic and racial segregation mean that many of our most under-resourced patients are concentrated in a small number of at-risk communities. For example, the Avondale neighborhood, the location of Cincinnati Children's main campus, includes approximately 3,000 children; 95% identify as Black/African American and approximately 50% live below the federal poverty level. Nearly all children living in Avondale receive primary and/or subspecialty care through Cincinnati Children's. Beyond this neighborhood, Cincinnati Children's provides care to approximately 80% of low-income children in Greater Cincinnati through hospital-owned primary care

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clinics, school-based clinics, aligned practices, and the Accountable Care Network. Cincinnati Children's also has the largest regional market share for emergency, inpatient, and subspecialty care of children.

Our ability to reach under-resourced patients and communities is matched by a deep organizational commitment to addressing persistent health inequities. Cincinnati Children's has committed "to help make Cincinnati's children the healthiest in the nation through strong community partnerships" as part of its long-term strategic plan called Pursuing Our Potential Together (POPT). A central part of this plan is the aim to achieve excellence across four domains: Care, Community, Cure, and Culture domains in advance of the institution's 150th birthday coming in 2033.

The Community portion of this effort includes expanded investments in community and population health with a \$100 million endowment devoted to a center for health equity, 25-30 staff and faculty, including a large cadre of community engagement specialists. These investments will ensure consistent investment in bold community health goals for the foreseeable future focused on meeting the needs of our region's highest risk children, across our region's urban, suburban, and rural communities.

The strategies associated with this commitment are depicted in the figure. Key focus areas within the Community program include: 1) the pursuit of excellent and equitable health outcomes (e.g., reducing socioeconomic and racial inequities for targeted conditions like asthma, diabetes, and sickle cell disease); 2) enabling safe and supported families; and 3) ensuring that all children are on a path to their full potential.

Pursuing Our Potential Together – Community



POPT vision Between now and our 150th birthday in 2033, we will pursue our potential together so all kids can pursue theirs			
Community aspiration	Together with families and the community we will help Cincinnati's kids to be the healthiest in the nation		
Themes	Excellent and equitable health outcomes	Safe and supported families	Path to full potential
Initiatives (Next 5 years; to be updated as work progresses)	<ul style="list-style-type: none"> Ensure delivery of equitable care Strengthen health-related wraparound supports 	<ul style="list-style-type: none"> Activate and integrate family voice in the community Prevent and mitigate adversities Improve access to evidence-based trauma prevention and intervention 	<ul style="list-style-type: none"> Optimize prenatal-5 development Ensure maximized academic, social and job readiness Equip all schools with necessities to enable learning
High-leverage partners	<ul style="list-style-type: none"> Cincinnati Health Dept, Adult / pediatric health providers, payers (Medicaid), IHI, community mental health providers 	<ul style="list-style-type: none"> JFS, Police Department, United Way, Project LIFT, Kroger, Regional Chamber, Fifth Third Bank, Metro Housing, Freestore Foodbank 	<ul style="list-style-type: none"> CPS, preschool providers, employers (e.g., Kroger, P&G), University of Cincinnati, Boys & Girls Clubs, Children's Home, MindPeace
North star metrics (Enduring)	<ul style="list-style-type: none"> Disparity in disease-specific physical & mental health outcomes Disparity in infant, child and youth mortality 	<ul style="list-style-type: none"> Community outcomes initiatives co-produced with parents Reduction in food and housing insecurity Reduction in child abuse and neglect 	<ul style="list-style-type: none"> Engage / enroll / enlist / employ at 18 Ready in K, 3rd, 9th (academic / behavioral outcomes)

A.7.ii. Linkages with community-based social

service organizations: Our focus on health equity requires co-production and collaboration across health, public health, education, and social services sectors. Indeed, community and population health efforts, including the forward-looking POPT-Community program, capitalize on the institution's unique position to bring the best from the research, clinical, and educational missions to identifying and implementing solutions to improve the health and well-being of Cincinnati's children. CCHMC's extensive partnerships with community-based organizations has enabled the organization to extend beyond a focus only on equitable health care services and to reduce pervasive health inequities in our community by improving the effectiveness and integration of health and social services. Our initiatives improve health at the individual and population level and address the root causes of disparities to achieve population health equity.

The primary strategy for connection to community and achievement of excellent and equitable population health outcomes is improvement deployed through the [All Children Thrive Learning Network](#) (ACT), one of the Anderson Center's Learning Health Networks. This network is dedicated to improving the health and well-being of children living in Cincinnati by improving *systems and structures* where families live, work, and play. By working with families and community partners, building trust, and listening to the needs of those we serve, ACT has achieved a unified vision and

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built strategic city-wide multisector partnerships to address the many complex determinants of health that lie outside of health care. These partnerships include Cincinnati Public Schools, Cincinnati Health Department, Hamilton County Jobs and Family Services, United Way, and many other community organizations. The ACT improvement work is driven by a strong measurement and learning framework that is supported by a data management and analytic core. ACT was established in 2015 and has worked to organize improvement teams, build broad quality improvement capability, data analytics, and an environment for professionals and parents to innovate together to pursue excellent and equitable health outcomes, in part by focusing on social determinants of health.

ACT now includes hundreds of individuals, families, and agencies from across Greater Cincinnati aligned around clear goals that are consistent with the Cincinnati Children's POPT focus. ACT is structured to promote communication and collaboration between the healthcare system, community partners, and parents. From its beginning, the Network has focused on bringing families, all of whom live in neighborhoods with poor child health outcomes, into the Network. Parent perspectives have been critical in the drive to integrate sectors and promote development of the Network's central principles: children are at the center of our work; equity is foundational; relationships, trust, and working together are essential; we all teach, we all learn; and daily work is action-oriented and results-focused.

These principles encourage not just participation, but active engagement which is promoted through a direct focus on capability building and shared understanding of issues and problems. ACT Network cores include: community-based quality improvement capability, family-centered co-production through neighborhood and community activation, data management and analytics, and in-home supports. The Network uses quality improvement methods and co-design, or co-production, to rapidly spur learning and action. Improvement teams are each co-led by an individual from the healthcare system alongside a respected community leader. Action teams include community leaders and parents who are now learning improvement methods and leading change. ACT enables capability building in multiple ways. First, a "BootCamp" course was developed to train frontline teams inside and outside of the healthcare system. Another course, "ImpactU," was developed to train senior community leaders from our partnered institutions in education, public health, city government and social services in quality improvement methods. Dozens of teams and community leaders have now completed these trainings, translating their learning to improvement projects all across the city (e.g., optimizing public benefit disbursement, decreasing school absences, and minimizing the harmful effects of food insecurity).

The POPT-Community efforts are also tied to the Cincinnati Children's Diversity, Equity, and Inclusion (DEI) and Community Relations efforts. When Cincinnati Children's first opened its doors as the Protestant Episcopal Hospital in March 1884, its mission was to care for children, regardless of race, religion, or socioeconomic status. That dedication to DEI has been part of the bedrock of the organization ever since. But in today's cultural climate of increasing racial tensions, gender and sexual orientation bias and social disparities, commitment to DEI has taken on a deeper urgency, especially as it relates to youth. In that spirit, Cincinnati Children's recently announced its new DEI Strategic Plan. The five-year comprehensive plan embeds DEI into every area of the medical center, covering four interrelated categories: 1) People – cultivating, retaining, and bringing in diverse talent, while also continuing to foster a welcoming environment where existing employees and leaders can reach their full potential; 2) Cultural competence – developing employees' capabilities and by embedding cultural competence into our systems and environments; 3) Equity and Health Excellence – co-creating equitable outcomes that account for individual and population needs, whether those individuals or populations are Cincinnati Children's employees or the patients, families, and communities served; and 4) Community and Neighbors – working alongside and as part of the community, partnering to advance the health, vitality, and well-being of the region. Cincinnati Children's has a long tradition of community involvement. From employee volunteer efforts to partnership investments with other nonprofits, the institution is deeply committed to leading, collaborating, and advocating to measurably improve the health of local children and reduce disparities in targeted populations. The

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Office of Community Relations develops and manages partnerships with key community stakeholders throughout the region and engages Cincinnati Children's employees in giving back to the community. Community Relations facilitates several activities with community groups, nonprofits, schools, and business leaders to provide a healthier place for children to grow and thrive. It also takes responsibility for programs related to Community Benefit and the Community Health Needs Assessment.

There have been several linkages with community-based social service organizations over the years that support patients and address social determinants of health. In 2008, the Legal Aid Society of Greater Cincinnati partnered with Cincinnati Children's to form a medical-legal partnership. The Cincinnati Child Health Law Partnership (Child HeLP) links Cincinnati Children's patients with legal advocates to address legal and social issues that often undermine the health and well-being of their children. To date, nearly 10,000 patients have been referred to this program for risks related to housing, public benefit denials, educational needs, and more.^{71, 82} We are now extending Child HeLP to subspecialty clinical areas (e.g., Asthma Center, Diabetes Center, Neonatal Intensive Care Unit). Soon after the initiation of Child HeLP, Cincinnati Children's partnered with the region's largest foodbank to develop an infant feeding program in regional primary care centers. The Keeping Infants Nourished and Developing (KIND) program provides emergency formula supply to food insecure households. This program formed the basis for later development of primary care-based food pantries to support additional households.⁸³⁻⁸⁴ The Collaborating to Lessen Environmental Asthma Risks, or CLEAR, program followed a similar playbook for the development and enhancement of an additional clinical-community partnership. CLEAR connects children hospitalized with asthma to health department sanitarians with expertise in healthy housing.⁸⁵ Programs like Child HeLP, KIND, the pantries, and CLEAR highlight the importance of meaningful partnership to addressing health-related social needs and social determinants. Clinical-community partnership, and consistent co-production with both parents and partners, has become engrained in our community health efforts. Relatedly, via an enacted ordinance, the City of Cincinnati formally enacted a Children and Families Cabinet in 2021. The ordinance reads, in part, "That the Mayor and City Council hereby establish the City of Cincinnati Children and Families Cabinet ... whose purpose is to advise the Mayor and Council about policy initiatives and to measure and monitor data on the improvement of safety, housing, health, cultural and societal exposure, and career opportunities for children and families. The Cabinet will also strive to improve communication between the City government and community stakeholders so that services to children and families are improved." Cincinnati Children's is represented on the cabinet, alongside many of the partners in our efforts, including representatives from Cincinnati Public Schools, social service agencies, neighborhood councils, and more.

In response to the COVID-19 pandemic, we were able to rapidly build upon the organization and history of CCHMC-community collaboration. Although community health efforts continued during the pandemic, CCHMC added objectives and responsibilities related to COVID to daily efforts. COVID-19 focused efforts included: supporting all area health systems and health departments with surveillance data, enhancing a city-wide focus on prevention (of both COVID-19 and on preventable disease), messaging and communication, meeting basic needs, and enhancing social connections by:

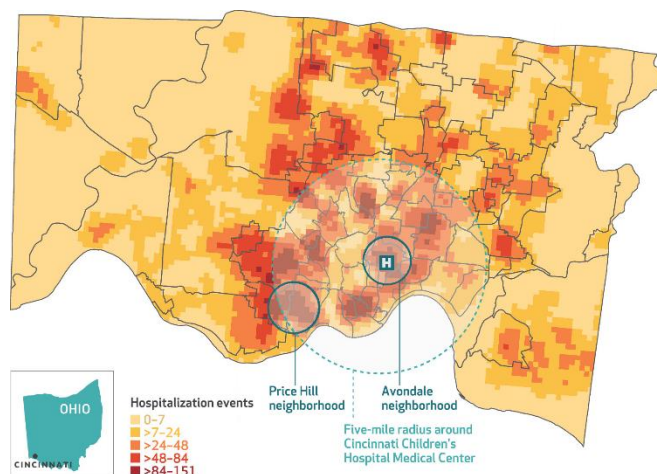
- Supporting situational awareness (as noted in Section A.5.) to provide every major hospital and health system in our region in using data from across systems (medical and public health) to depict daily updates for regional operations leads and inform regional strategy for confronting various phases of the pandemic.
- Connecting and supporting social service agencies in the region to support basic needs-related item sourcing and distribution (e.g., with Cincinnati Public Schools, the largest regional food bank, and more to best get meals to those in need, particularly as schools shut down).
- Pursuing new messaging strategies to ensure that trusted information on COVID-19 and responses to it are received by key target audiences.

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We anticipate that these efforts will provide insights and valuable infrastructure that will outlast COVID-19. The connections we have made (or strengthened) and the trust we are building are critical to maintaining our focus on achieving the best, most equitable possible outcomes for children.⁸⁶

A.7.iii. Implementing evidence-based practice change to improve the health and health outcomes of under-resourced patients and communities: Reducing neighborhood inequities.⁸⁷ In early 2015, Cincinnati Children's committed, as part of its 2020 strategic plan, "to help[ing] ensure Cincinnati's children are the healthiest in the nation through strong community partnerships." Discrete goals included the reduction of the rate at which children from high-morbidity, high-poverty neighborhoods spent days in the hospital and narrowing the gap between their neighborhoods and healthier ones. Meeting this goal required becoming accountable for an entire population and focusing on the root causes of place-based inequities, pursuing quality improvement in and with communities.

Improvement and implementation: In the spring 2015, a CCHMC improvement team used data from 2012-2015 and identified three neighborhoods (Avondale, East Price Hill, Lower Price Hill) composed of ~8,000 children that had a disproportionate number of hospital admissions. The vast majority of these children were of minority race and lived below the federal poverty level. The team identified an aim of reducing inpatient bed-day rate for children from Avondale and the Price Hill neighborhoods by at least 10 percent by June 30, 2020. The team also identified "control" neighborhoods with similar sociodemographic profiles.

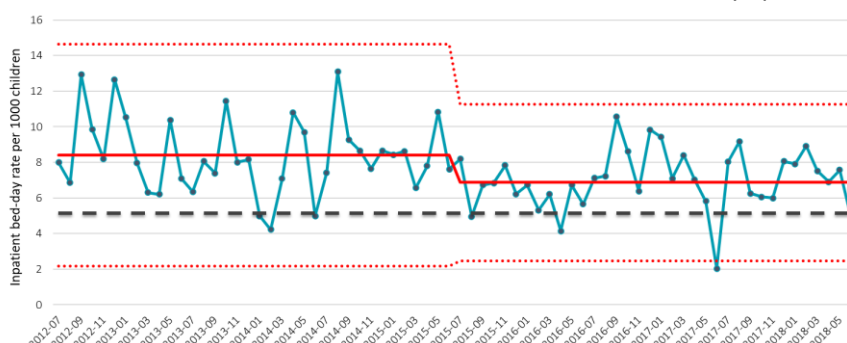


Theory development and testing strategies began in 2015.

Testing was informed via a multidisciplinary team that included inpatient and outpatient medical providers, social workers, community partners (for example, legal aid), and parents of neighborhood children. The team developed a theory of action/key driver diagram and interventions. Pertinent drivers included: 1) Families are partners in co-creating improvement strategies; 2) Families receive the right care in the right place at the right time; 3) Families trust that they are receiving the right care for them; 4) Clinical decision making is standardized but can be adapted to patient and family needs; 5) Families are well equipped to self-manage acute and chronic disease symptoms; 6) Proactive supports assist families in removing barriers to health; 7) The health care system is accountable to the population and able and willing to address disparities in care settings; and 8) Families and the community are activated in support of achieving health equity. Linked intervention, beginning in June-July 2015, focused on proactive care for children with chronic conditions, enhanced transitions in and out of care, mitigation of social risks in partnership with community organizations, and use of actionable real-time data.

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Results: At baseline, the inpatient bed-day rate for Avondale, East Price Hill, and Lower Price Hill was 8.4 days per 1,000 children per month. This equated to neighborhood children collectively spending about 75 days each month and 900 days each year on Cincinnati Children's inpatient units before improvement efforts began. By testing and implementing changes in care related to the drivers listed above, the team reduced the average monthly inpatient bed-day rate to 6.9 per 1,000 children; an 18 percent reduction in hospital days below the baseline rate (see Figure). There was no similar decrease in the rate for control neighborhoods. The rate reduction in target neighborhoods was likely driven by fewer hospitalizations instead of shorter lengths-of-stay. In a similar pattern to the inpatient bed-day chart, the hospitalization rate dropped 20 percent—from 4.1 events per 1,000 children per month to 3.3 events—again.⁸⁷ By narrowing the gap in outcomes with the rest of the region we achieved improvements in health equity. We are now working to scale and spread what worked to additional neighborhoods across the region.⁸⁷



Other examples: The extensive partnerships we have developed with community-based organizations have enabled us to extend beyond equitable health care services in the hospital setting to address and reverse other pervasive health inequities at the individual and population level by addressing the root causes of disparities. Examples of the impact of our community efforts include the use of quality improvement methods to help schools address reading outcomes among school children. This led to a 43% improvement (from 46% to 66%) in Cincinnati Public School children proficient in 3rd grade reading while ensuring the reading gap was substantially closed for Black children (unpublished data). Other examples include: a reduction in admissions from 3 of our highest risks neighborhood by over 20%, a 42% reduction in asthma hospitalizations for children with Medicaid in Hamilton County sustained since 2015 (see description in Section A.5. above⁶⁶), and a 38% decrease in hospital admissions associated with Legal Aid referrals.⁷⁰

A.7.iv. Community relationships, programs, engagement mechanisms: The All Children Thrive Network has been central to the neighborhood-based improvement efforts described above by serving as an infrastructure upon which community relationships, programs, and improvement initiatives are pursued. The network connects partnered organizations in action-oriented ways including CCHMC's DEI and Community Relations efforts, HealthVine, Cincinnati Children's and community-based primary care practices, behavioral health organizations, city government, non-profits, community benefit organizations, and parents/families across the region. For example, HealthVine is supporting equity-oriented efforts within primary care and subspecialty care partners by modifying the electronic health record to simplify and embed screening for health-related social needs. A new Health Equity Network (HEN), developed by Community Health with additional operational support from HealthVine, has subspecialty clinical teams work together to achieve better, more equitable care in their settings while identifying systems changes that can be scaled and spread. Similarly, HealthVine is bolstering analytic capabilities, now enabling access to Medicaid claims data for covered children. HealthVine has also created a Population Health Learning Health Network that includes 8 other value-based care initiatives across the country, providing an additional avenue for the spread of what is learned (Akron Children's Health Collaborative, Children's Mercy Integrated Care Solutions, Seattle Children's Care Network, Intermountain HealthCare Children's Health Network, Children's National Pediatric Health Network, and Children's Hospital Colorado Pediatric Care Network).

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In November 2021, Cincinnati Children’s also recently announced the launch of the Michael Fisher Center for Child Health Equity. The creation of the Center extends the institutional commitment to the community. The Center will build on the use of measurement and continuous improvement methods to catalyst impact and to spawn new knowledge and innovations. The Center will further integrate the activities of Community Health, DEI, Community Relations, and HealthVine. The formation of the Center highlights the CCHMC commitment to collaboration and partnership among families, community members and organizations, businesses, and government to address the diverse factors—from education to economic mobility to emotional well-being—so that youth and their families can be safe and reach their full potential.

ANTICIPATED CAPACITY BUILDING PROJECT ACTIVITIES (optional)

As demonstrated in the proposal, CCHMC has deep expertise and experience in the use of improvement and implementation science methods to design, implement and evaluate practice changes to improve quality of care. Our proposed capacity building activities will enhance this strong base of expertise by focusing on competencies that will accelerate our ability to achieve even larger improvements in outcomes and equity, rapidly share successful findings, and implement at scale. We will do this by expanding organizational capabilities in the areas of *Learning Health Systems*, *Agile Knowledge Management* and *Developmental Evaluation*. Strengthening skills in these areas will broaden our methodologic and analytical capabilities and towards broader portfolios and platforms where we can amplify our capacity to develop and test multiple practice change innovations focused on single strategic goal. We describe each of these in more detail below.

Proposed capacity building activities

Broaden faculty and staff expertise and competencies to build the next generation of Learning Health Scientists. The first goal of our capacity building plan is to systematically broaden the capabilities of improvement and implementation science experts to become *learning health scientists*. Learning Health Scientists are defined by AHRQ as *individuals who are embedded within a health system and collaborate with stakeholders to produce novel insights and evidence that can be rapidly implemented to improve the outcomes of individuals and populations and health system performance*. We will do this by enhancing their skills in selected Learning Health System competency areas.⁸⁸ Our emphasis will be on the following domains of competency that are most relevant to practitioners involved in implementing and evaluating practice change.

1. Health and Healthcare Equity and Justice: This domain involves assessing health equity and advancing equity and justice in healthcare delivery systems and health. We will expand training within our organization to include the use of recent equity focused implementation science frameworks such as the Health Equity Implementation Framework⁸⁹ and the Equity Focused Implementation Research Framework (EquiR)⁹⁰ that have been specifically designed to reduce inequities in the implementation of evidence-based practices, policies, or programs.
2. Systems Science: This domain focuses on the application of systems theory to research and implementation. In this domain, we will build skills both on Soft Systems methods⁹¹ (used to structure complex problems and to develop changes in organizations with stakeholders with diverse perspectives) and in Systems Dynamics that involves quantitative approaches such as community-based systems mapping, agent-based simulation modeling or social network analysis to explore complex systems dynamics over time.⁹²
3. Engagement, Leadership, and Research Management. The competencies in this domain involve approaches to engaging stakeholders and leading and managing teams and projects. We already have substantial expertise in engaging patients and families in the co-production of care. Additional capacity building in this domain will involve advanced project management and leadership skills to manage portfolios of practice change projects, and emerging topics such as “design justice”⁹³ that explicitly incorporate equity and anti-racism principles in patient/provider collaborations.

Develop agile knowledge management to accelerating knowledge-to-action. Practice change at scale requires the capability to efficiently manage knowledge and to rapidly disseminate evaluation results about promising practices, locally tested good practices, and evidence-based practice to health systems leaders, clinicians, patients, and families. Traditional approaches to knowledge sharing that involve dissemination through peer-reviewed publications, research reports, white papers or annual conferences are too slow and cumbersome to deliver the right knowledge to the right

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people at the right time to drive action. We will build organizational capabilities that incorporate agile project management principles into knowledge management and dissemination. Agile approaches are designed to be responsive to changing environments and customer requirement by delivering results in small iterative increments that can be quickly tested and modified as needed.⁹⁴ In the context of knowledge management, this involves the development of a strategy focused on delivering the most valuable and important information available to the right recipients at the right time.

We will engage our project management and quality improvement teams to assess our current knowledge management practices, networks, tools, meeting rhythms, and formal and informal communication channels and research to identify which components of agile methodology are best suited for improvement and implementation work. We will identify pilot projects to trial agile knowledge management, assess its impact, and make the necessary adaptations and train the organization in the best agile knowledge management practices. The outcome of improving our capacity to leverage agile project management will be a knowledge management system that transforms the process of exchanging, transmitting, developing, catching, and comprehending knowledge,⁹⁵ allowing us to more be more efficient in identifying and spreading promising practice changes through CCHMC activities, locally, regionally, and nationally.

Increase the use of developmental evaluation to respond to complexity. It has been well established that the number and types of interacting stakeholders (patients, families, doctors, nurses, system leaders, regulators etc.) in health care delivery makes it a *complex system*⁹⁶ where the relationships between care practices and outcomes are not always predictable. In addition, improvement efforts in these health systems are *complex interventions*⁹⁷⁻⁹⁸ that could involve multifaceted change bundles implemented at different levels within the health system. As we expand our capability to lead and manage large practice change programs, we also need to build capacity in evaluation methods that are suited for complex interventions in complex settings. *Developmental evaluation* is an approach that “provides evaluative information and feedback to social innovators to inform adaptive development in complex dynamic environments.”⁹⁹ Developmental evaluation recognizes that it not enough merely to ask whether a practice change results in an outcome, but that an ongoing assessment of where, when, how and for whom outcomes are achieved is critical for sustainment and equity. Rather than proposing a rigid evaluation approach, development evaluation provides evaluators with *essential principles* around which a customized, program and context-appropriate evaluation can be designed.¹⁰⁰ In our capacity building model, developmental evaluation skills will serve as the foundation on which our evaluators will apply the tools that they will learn (e.g. systems mapping, simulation, equity frameworks, design justice etc. mentioned above) as they acquire appropriate Learning Health System competencies.

Our capacity building activities are intended to build capacity in the settings where practice change efforts are taking place, and not in the abstract. To accomplish this, we will utilize use both *push* and *pull* methods. The push method will be *low touch high reach* and offer basic skills on the topic areas above to all practice change implementers and evaluators at CCHMC and in our Learning Health Networks. The intent will be for the participants to gain enough knowledge in the key topic areas to know when to use them but not for mastery. Capacity building experiences will be offered through a combination of online resources, seminars, and short workshops, all of which will be hybrid and available to implementers and evaluators for asynchronous self-study. Automated competency assessments and the use of digital badging¹⁰¹ will monitor skill acquisition at the organizational level. The knowledge management system will serve as the repository for the learning content, and a knowledge manager/librarian will curate and manage the content.

The pull method will be *on-demand high touch* and will be used to provide mentoring and expert support to enable broadening and deepening of knowledge through application just when it is needed. For each competency area, we will identify and engage experts within and outside CCHMC who are willing and able to serve as on-demand mentors to

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teams working on large and complex practice change initiatives. An “intelligent swarming”¹⁰² model will be used to match experts to team as needed. This approach, shown in Figure¹⁰³ was developed for efficient and collaborative technical support in the technology business sector. It is a collaborative, just-in-time approach to problem solving that pulls the right expertise at the right time to provide necessary support to implementation teams. Agile knowledge management processes will be used to determine what needs to be learned and shared at various stages of implementation and evaluation and will be the driver for the intelligent swarming model. Initially, librarian/knowledge manager will be the agile project manager and match expert resources to the appropriate teams. As the capacity building program matures, we will explore possibilities for automating the matching algorithms.

How these activities will strengthen CCHMC’s ability to undertake future implementation projects and to conduct required program evaluation under HSII. As demonstrated in the

proposal, CCHMC and the Anderson Center already have strong capabilities to implement and evaluate individual practice change projects. The next frontier is to leverage this expertise to improve outcomes for complex, context-dependent, multi-stakeholder health issues (e.g., mental health). This requires expanding to a portfolio approach that can simultaneously develop and evaluate multiple practice change innovations and rapidly select, disseminate and implement packages of innovations at the facility, community and national level. This requires capacity building beyond what we currently have. By focusing our capacity building activities on methods to implement and evaluate complex programs in complex settings, we are equipping our institutional and our national networks to bring about the next generation of change for our children and communities.

Operational units and personnel that will be involved in

undertaking the proposed work. We anticipate that the core capacity building activities will be centered in the Anderson

Center. We will build this work into the Anderson Center’s Leadership Academy infrastructure so that it can take advantage of the organizational infrastructure but with additional resources to support these efforts. We will also leverage capabilities of other components of the institution including the Office of Faculty Development, Cincinnati Children’s Research Foundation, our CTSA program, and relevant divisions particularly Biomedical Informatics, and Biostatistics and Epidemiology.

Cost drivers for the proposed capacity building project activities. We anticipate the primary cost drivers for our capacity building activities will be personnel and technology. For personnel, we will likely engage with a capacity building manager, support staff, a knowledge manager, instructional designers, trainers, expert mentors, and training evaluators. For technology, we may need to leverage a Learning Management System, A/V technology, digital badging, JIRA or other agile software, and AI software for automation.



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APPENDIX (optional)

Do not exceed 10 pages.
