Abstract:
Emergency medicine is a relatively new field of practice in sub-Saharan Africa, and the first specialty training in Tanzania started in 2010. Despite this, the majority of emergency care for children is done by providers with little formal emergency medicine or pediatric emergency training. A low-fidelity, in situ simulation curriculum was held at Bugando Medical Center in Western Tanzania in 2018. There were 11 simulation cases that covered core topics in pediatric emergency care, and these were done on an ad hoc basis during available education time in a busy emergency department using available resources. These cases were well received and represent an opportunity for using external specialists to assist with provider education.

Keywords:
simulation; pediatrics; emergency medicine; global health; Tanzania

In Situ Simulation for Pediatric Emergencies in a Busy Emergency Department in Mwanza, Tanzania

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Emergency medicine (EM) is still a fairly new field of practice in sub-Saharan Africa. The first EM postgraduate training program was established in South Africa at the University of Cape Town in 2004.[1] Following this, several other sub-Saharan countries have established EM training, including Tanzania.[2-4] The first emergency department in Tanzania was established at Muhimbili National Hospital in 2010, and the first EM residency graduates completed training in 2013.[5,6] As of 2018, there have been 37 graduates of the residency program, and these physicians continue to work in Tanzania. Despite advances in the field of emergency medicine, the majority of emergency care in Tanzania and throughout sub-

Saharan Africa continues to be provided by practitioners with no formal EM training and little pediatric-specific training.[3,7-9]

There is need for dedicated care for pediatric emergencies, as approximately 25% of pediatric patients presenting to health facilities in Africa have a high-acuity disease.[10] Most inpatient pediatric inpatient mortality occurs in the first 24-48 hours from admission to hospital, and 80% of child mortality can be attributed to few and treatable diseases,[11] emphasizing the need for early recognition, stabilization, and treatment. Several studies have shown that the majority of causes of morbidity and mortality can likely be reduced by effective emergency care.[3,7,10]

Bugando Medical Center (BMC) is a 900-bed consultant and teaching hospital located in Mwanza, Tanzania. It is run in partnership between the government of Tanzania and the Catholic Church and acts as the referral hospital for the Lake and Western Zones in Tanzania with a catchment area of approximately 13 million people. BMC has had a dedicated and renovated emergency medicine department (EMD) since 2012. In 2017, the first EM-trained providers began working in the EMD and initiated multiple areas of improvement in the patient care provided.

Simulation is an important and well-studied technique for medical education among health care providers. Simulation-based training creates a safe environment for adult learners to practice clinical scenarios and give and receive timely feedback, and emphasizes focused clinical learning objectives.[12] Pediatric emergencies are often rare and stressful events for medical providers, and simulation allows providers to maintain infrequently used clinical skills and gain confidence in their performance.[13] Much of the support for the use of simulation comes from data in high-fidelity simulation in high-income countries, but it has been shown that low-fidelity and in situ (based in the site of clinical activity) simulation is still an effective learning modality.[14] There is also a paucity of data available on the use of simulation for medical training in sub-Saharan Africa, but some studies have shown promising results, including a collaboration between Canadian and Rwandan institutions.[15,16]

A curriculum of core pediatric emergency medicine topics was developed and piloted with non–EM-trained medical providers working in an emergency department in Kenya in 2015.[17] After piloting this curriculum which was both didactic and simulation based, a simulation case was developed addressing each of the core topics. In collaboration between a pediatric emergency medicine trained provider from the United States and EM-trained providers in Tanzania, this simulation curriculum was implemented at BMC in 2018.

METHODS

Learners

Eleven simulation cases were held during designated education time in the morning at change of shift. All available staff in the in the EMD were present for the simulations. This varied by day but always included at least 1 intern (a physician, first year out of medical school), 1 registrar (a physician who has successfully completed his or her internship and is working in the EMD), and multiple nurses and medical assistants. All learners who were not otherwise occupied in patient care were invited to the simulations. Depending on the day, there were anywhere from 5 to 15 medical providers participating in the simulation. Those practitioners who were not directly participating in the simulated patient care were tasked to be observers.

The simulations were initially led by a pediatric emergency medicine physician from the United States for the initial month-long implementation and then were run by the Tanzanian EMD attendings continuously.

Environment

The simulations were held in situ in the EMD. The EMD has a bed capacity of 19 beds, approximately 40-50 high-acuity patients are attended to at the EMD daily, and 20% of those patients are children less than the age of 5 years. At BMC, a child is otherwise defined as any patient less than the age of 18 years, although due to space constraints in the inpatient side of the hospital, children older than 13 years are frequently admitted to adult services.

SUPPLIES

The supplies used for this curriculum were a toddler-sized mannequin and a neonatal mannequin. The toddler-sized mannequin was donated, and the neonatal simulator was purchased from Laerdal Global Health. Each of the mannequins had limited capabilities (they were able to receive breaths) and was used primarily as a focal point for the participants. By doing the simulations in situ, participants were required to identify and act out the use of local resources present to make the cases as relevant as possible.

CASE DEVELOPMENT

Pediatric residents from Lurie Children's Hospital in Chicago have been involved in a bidirectional relationship with pediatric residents from BMC since 2007. As part of this collaboration, the US-based pediatric residents participate in predeparture simulation cases relevant to clinical scenarios that may be encountered during their time at BMC. The templates for these cases were adapted to frame each of the core simulation cases from the pediatric emergency medicine core curriculum. In addition to the cases, resources created and packaged into the training manual included a short simulation orientation, a debriefing guide for each case, and a 2-page reference guide with teaching pearls for each case. The core topics used for reference were neonatal resuscitation, altered mental status and seizures, trauma, toxicology, sepsis and shock, respiratory distress, fracture management, upper airway compromise, and vomiting and abdominal emergencies.

RESULTS

Simulation Cases

Eleven cases were developed for use with the provided mannequins (Table 1).

Implementation

The 11 cases were first implemented over a 4-week period in the EMD. As it is difficult to predict patient acuity or volume in the EMD at any point in time, the typical morning downtime before patient influx was used as the preferred implementation time. In the BMC EMD, every weekday morning, there is a morning report where the day staff gathers with the staff from the previous night to review

TABLE 1. Simulation cases.

Case	Supplies Needed	Core Topic Addressed
Newborn in distress	Neonatal mannequin Bulb suction Blanket Ambu bag	Neonatal resuscitation
Sleepy 5-day-old infant with a hypoglycemic seizure	Neonatal mannequin Glucometer	Altered mental status, seizure management
2-year-old seizing child after head injury	Infant mannequin Towels/blankets to immobilize cervical spine	Head trauma Cervical spine management
3-year-old with trouble breathing after a road traffic accident	Toddler mannequin Towels/blankets to immobilize cervical spine A large gauge needle and syringe	Thoracic trauma
4-year-old with tachycardia after a road traffic accident	Toddler mannequin Towels/blankets to immobilize cervical spine Stethoscope	Abdominal trauma
3-year-old with altered mental status (organophosphate poisoning)	Toddler mannequin Glucometer	Toxicology/toxidromes
Irritable 6-month-old with fever	Infant mannequin	Sepsis and shock
4-year-old with respiratory distress due to asthma	Toddler mannequin Oxygen delivery systems (facemask, ambu bag)	Respiratory distress due to lower respiratory tract disease
2-year-old with a limp due to a septic knee	Toddler mannequin Photos of common pediatric fractures for review	Fracture management
Choking 3-year-old child	Toddler mannequin Coin	Respiratory distress due to upper respiratory tract disease
Vomiting infant with a gastrointestinal tract obstruction	Toddler mannequin Photos of x-rays and ultrasound pictures of common pediatric causes of vomiting	Abdominal emergencies

patient statistics and patient care. If there was high acuity in the EMD, typical care was resumed following this gathering. If there was a relative downtime, then available staff were invited to participate in the simulation case. The 2 mannequins were made available, and participants were charged with identifying and simulating the use of existing supplies in the EMD. Reusable supplies such as thermometers, pulse oximetry probes, basic airway equipment, manual suction, and sheets/towels for cervical spine stabilization were used. For nonreusable supplies such as needles and medications, it was asked that the participants locate and obtain each of the supplies to simulate a real-life scenario. This was done specifically to ensure that the simulation was best adapted to the setting it was held in.

Each case with subsequent debrief and teaching was completed in 30-60 minutes, depending on the amount of questions and teaching following the case. Prior to the initiation of each case, there was a brief introduction to the mannequin and the nature of simulation. Following each case, there was a structured debrief with a provided template, and then key clinical points from each case was reviewed. This 11-simulation curriculum exists in hard copy located in the EMD for continued use.

DISCUSSION

This curriculum using in situ, low-fidelity simulation represents an opportunity for knowledge sharing in pediatric emergency care that can be implemented using available materials and discrete curricular content in a variety of settings, in particular, at this site in Tanzania. The flexibility of the curriculum accommodates the high acuity and large demands on limited staffing in low-resource settings by being limited to short time duration and in that each case is not dependent upon others and so can be implemented whenever there is down time.

There were several challenges to implementing the curriculum in the EMD. There was a lack of prior simulation knowledge or experience among the participating staff. This was expected because simulation is not yet not a common practice in Tanzania or in other resource-limited settings. To address this, the first component of the curriculum is a brief introduction to simulation as a learning modality. Because these cases were held over a 4-week rotation, after several cases, the participants became more comfortable with the modality and with their participation. Additionally, the curriculum was developed in English. The primary language in Tanzania is Swahili. Although English is commonly used in the medical field, providers at different levels of training had various fluency with the language. There were multiple instances where either case components or learning points were translated into Swahili to facilitate participation.

As with other in situ simulation in an emergency setting, participation is often limited by patient acuity or provider fatigue. Although there was the option to conduct simulation most days, it was not done if there were multiple patients waiting to be attended to in the EMD. If the night shift was particularly busy, then these providers were unable to stay to participate in the simulation at the end of their shift.

Finally, the EMD at BMC is busy and growing, and the EM-trained providers, tasked with maintaining all continuing medical education for the staff, have less time to host simulations in an ongoing manner due to often overwhelming administrative responsibilities. Given the high burden on the Tanzanian specialists, having an external partner relieve some of this burden of continuing medical education upon staff may actually represent a specific model that other international health partnerships can explore. Having an external PEM provider assist with the simulations provided expert knowledge and simulation background but also gave the Tanzanian EM attendings opportunities to work on other aspects of their administrative duties.

Continuing Education

As with all medical training, there must be efforts put forth to develop continuing education rather than single-entity limited programs to ensure both sustainability of skills and continued improvement in patient care. It will be important to repeat these cases at designated intervals to ensure knowledge and skill retention. Additionally, these cases emphasize diagnostics and management, but a separate clinical skills curriculum such as point-of-care ultrasound or specific procedures has been proposed as a next step.

Evaluation Techniques

The next step in this program will be to implement evaluation techniques. There are multiple levels to evaluation of curricula—participant satisfaction; knowledge retention; demonstration of skills; teaching skills; and, ultimately, changes in patient outcomes.[18] A checklist styled as an observed clinical skills examination (OSCE) was developed for 1 case, the newborn resuscitation case, with specific demonstrable skills that could be

observed and documented. For appropriate implementation of this OSCE and additional OSCEs for the other cases, additional support staff will need to be available to have staff both run the cases and use the OSCEs.

NEXT STEPS

There are many opportunities for next iterations of this curriculum. In addition to running these simulations on a rotating basis, there can be additional teaching points added to each case to emphasize different aspects of care. This could be one way to maximize each specific case and the learning of the case leader by reusing the same case to discuss different topics.

Additionally, these simulation cases were implemented at a tertiary teaching hospital but could also be done at satellite sites and referral hospitals to improve the care provided to children prior to their transfer to BMC.

SUMMARY

This project represents one intervention in sharing pediatric emergency medicine skills between US and Tanzanian medical providers. Pediatric emergency medicine is globally still a nascent skillset, and because most providers who care for children in an emergency setting do not have dedicated PEM training, it is imperative to share knowledge and skills to improve the care of children. Although Tanzania is making incredible strides in improving emergency care, pediatric emergency care remains an area for improvement. US-based pediatric emergency medicine providers have a unique opportunity to share their expertise, and this curriculum is one possible avenue.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

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