Simulation in Low-Resource Settings: A Review of the Current State and Practical Implementation Strategies

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Simulation Pearls

1. Challenges to development, implementation, and maintenance of a simulation program are similar to those in improving healthcare in low-resource settings.
2. Education of technical and non-technical skills received by simulation training may enhance quality of healthcare provided in LMICs.
3. Low to middle fidelity simulation programs may be more cost-effective than high fidelity simulation with little to no difference in outcomes, and they are easier to organize and implement in low-resource countries.
4. Development, implementation, and maintenance of a simulation program is best accomplished by following a structured approach similar to that offered by Kern's six-step approach to curriculum design.
5. Reflection of the simulation experience should take into consideration communication and cultural differences in order to enhance the learning solidifying during debriefing sessions.

Introduction

Simulation in medical education has its roots in the aviation industry but has grown substantially within healthcare, particularly anesthesia and other acute care fields, over the past three decades [1]. Although computer-based simulation has been in existence since the 1960s [2], high fidelity mannequin-based simulation did not emerge until the 1980s [3]. In their comprehensive review of medical simulation, Cooper and Taqueti suggested that it is important to realize that the term "simulator" is used to refer to all technologies that imitate task [4]. As noted by Gaba, "simulation is a technique—not a technology—to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner" [5]. This understanding of simulation is especially important as we consider simulation in the setting of low- and middle-income countries (LMICs) or simulation for the austere environment.

Despite a greater than 50-year history of development and implementation in well-resourced areas, medical simulation is just breaking ground in low-resource settings. Although many perceived barriers exist, nongovernmental organizations (NGOs) and medical personnel funded by charitable organizations have been able to perform research studies or develop neonatal simulation programs in low-resource countries with some success [6–9]. However, there is a paucity of literature describing practical components of longitudinal program development, design, and implementation. Towards this end, we present this chapter divided into two main sections. First, a brief review of the use of medical simulation

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in low-resource settings including existing evidence on its utility in improving medical knowledge, clinical practice, self-efficacy and, ideally, clinical outcomes. The second section will describe best practices on the development, implementation, and maintenance of a successful simulation program in low-resource areas based on both current literature and the experience of the authors.

Chapter Objectives

This chapter focuses on the role of medical simulation in meeting educational and healthcare needs in low-resource settings, reviews current strides being made towards developing simulation programs, and discusses best practices in program development. There is a great deal of heterogeneity found between countries and regions in the clinical scenarios commonly encountered, availability of medical personnel and resources, health policies, and standards of medical knowledge and training. This chapter was developed to offer expert advice and evidence-based suggestions for those developing and implementing simulation in healthcare education in these low-resource settings.

History of Simulation in Low-Resource Settings

Medical simulation extends back to seventeenth–eighteenth-century France where M. Gregoire created the first obstetric simulator using a mannequin he created and a dead fetus in order to demonstrate techniques for assisted and complicated deliveries to midwives [10]. In 1748, the midwife for the Queen of France provided instruction on management principles of childbirth to other midwives using her own mannequin made from leather and bone [11]. While well-resourced countries have taken the lead in advancing technological development, knowledge, and experience in medical simulation since the 1960s, in low-to middle-income countries (LMICs) over the last decade, simulation training has increasingly been utilized as a means to provide medical education, improve knowledge gaps, and identify systems problems in order to enhance efficiency, efficacy, and outcomes of currently available medical care. In 2009, a systematic review of clinical interventions associated with reduced intrapartum deaths concluded that obstetric drills and safety checklists were among a limited number of strategies shown to improve provision of emergency obstetric care [12]. The authors suggest that simulation with “significantly lower cost, durable, easy to disassemble and sanitize, high-fidelity mannequins with culturally appropriate features” could reduce perinatal deaths in low-resource settings.

There are a variety of challenges to improving healthcare in low-resource settings: lack of financial support/funding, shortage of skilled healthcare workers, poor local and national infrastructure, availability and cost of transportation, and limited health supplies [13]. These features of some LMICs contribute to the “three-delay model,” the components of which can be interdependent. These three delays are (1) a delay to first seeking medical care, (2) a delay in reaching medical care, and (3) a delay in receiving adequate healthcare (Fig. 27.1). This phenomenon was first described in explaining pregnancy-related mortality in the areas of Ghana, Sierra Leone, and Nigeria [14]. Barnes-Josiah et al., in examining the causes of maternal mortality in Haiti through the lens of the three-delay model, found, similar to Thaddeus and Maine, that the three delays contributed to maternal mortality in 12 cases and were intimately intertwined as opposed to being a sequence of discrete events [15]. They concluded that the first two delays were in large part due to an apparent lack of faith in the Haitian healthcare system and a perception that available obstetric care was inadequate or ineffective. Simulation training may be able to play a role in directly addressing the third delay by improving healthcare providers’ knowledge, skills, and attitudes, identifying and addressing systems errors, and enhancing multidisciplinary teamwork and communication. Improved outcomes could, in turn, positively impact the first and second delay through a change in public perception of healthcare delivery with improved efficiency, efficacy, and safety of healthcare. In consideration of the healthcare disparities present in low-resource settings, the Lancet Commission in Global Surgery, the third Edition of the World Bank’s Disease Control Priorities (DCP), and the World Health Assembly have identified “access to safe emergency and essential surgical care and anesthesia” as a primary goal as part of the initiative to achieve universal health coverage [16]. As part of this initiative, the World Health Organization (WHO) identified three “bellwether procedures” or essential surgeries that are most commonly performed and most likely to predict the ability of the healthcare delivery system to perform other WHO primary care package procedures: [17] cesarean delivery, laparotomy, and open fracture repair. According to the DCP, through improvements in the provision of healthcare for these essential surgeries in low- to middle-income countries (LMIC), 3.2% of annual deaths and 3.5% of disability-adjusted life years could be prevented [18]. Given this emphasis, it is appropriate that the majority of current simulation literature in LMICs reviews training of neonatal, maternal, and trauma resuscitation scenarios [6–8, 19, 20].

Simulation courses designed for training in obstetric and neonatal emergencies include the Pacific Emergency Obstetric Course, the WHO Essential Newborn Care Course [21], the Life Saving Skills Course, the Practical

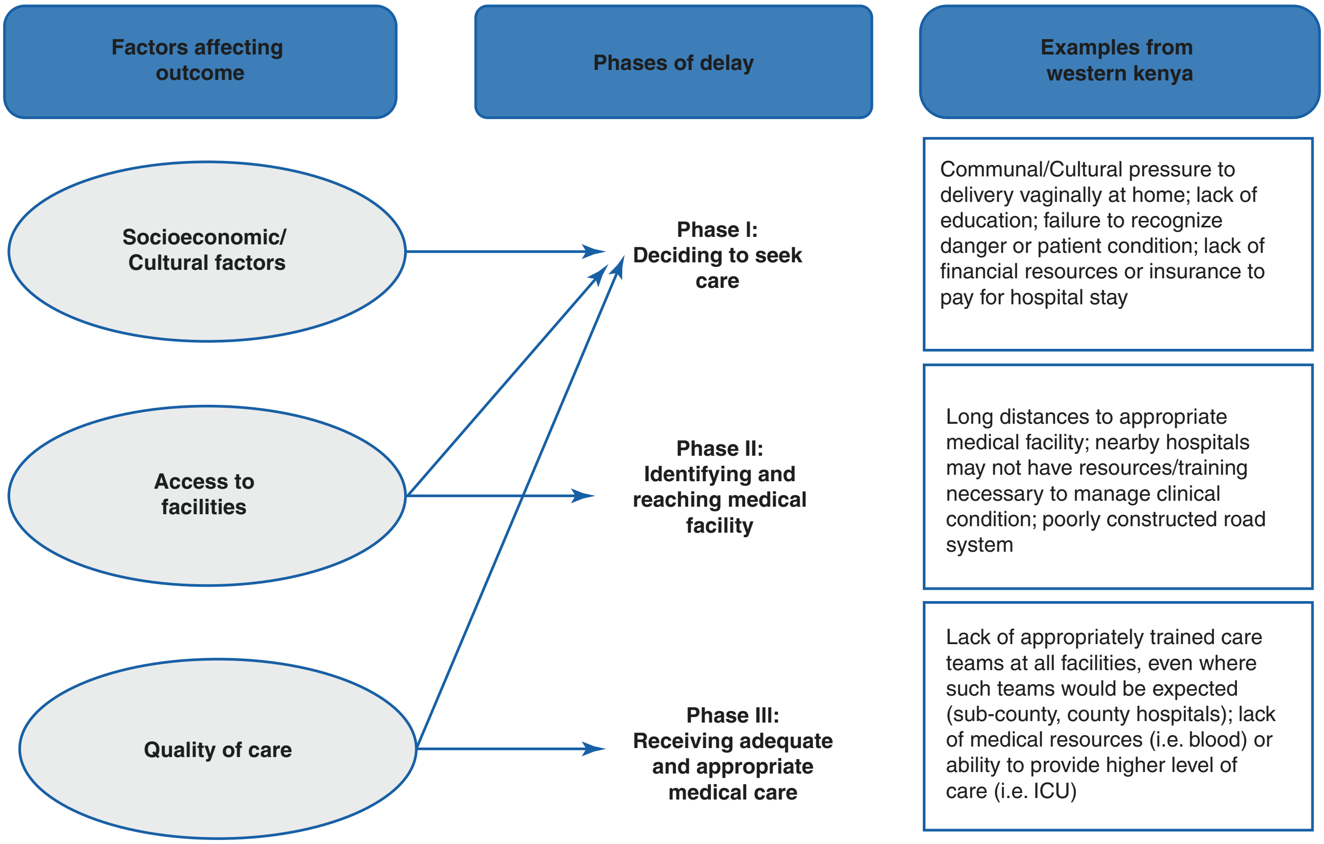

Fig. 27.1 The three delay model. First described in Ghana, Sierra Leone, and Nigeria, the three delay model offers an insight into the challenges that contribute to pregnancy mortality in low-resource countries. These factors are often interdependent, which makes seeking and obtaining medical care more of a challenge. (Based upon Barnes-Josiah et al. [15])

Obstetric Multi-Professional Training (PROMPT) Course, the PRONTO International Simulation Course [19, 20, 22–24], the IMPACT Africa Simulation Course (developed and directed by the authors of this chapter), and Helping Babies Breathe (Table 27.1). An evaluation following the implementation of the WHO Essential Newborn Care Course identified improvements in midwife skill and knowledge and demonstrated a reduction in perinatal deaths following its introduction in Zambia [21, 25]. While a randomized control trial assessing the impact of this course across multiple sites failed to demonstrate similar effects, it did reveal a significant decrease in the rate of stillbirths [26]. The simulation course led by PRONTO (Programa de Rescate Obstetrico y Neonatal: Tratamiento Optimo y Oportuno) International was reported to lead to improvements in inter-professional knowledge, self-efficacy [22–24], teamwork, and communication [19, 23] in two low-resource areas.

Helping Babies Breathe [HBB] is an American Academy of Pediatrics global neonatal resuscitation initiative that employs simulation training to improve neonatal resuscitation in low-resource countries and has been successfully implemented in more than 77 countries. In 2014, a report on perinatal mortality in Tanzania following implantation of HBB documented a decrease in early neonatal mortality (from 13.4 to 7.1 deaths per 1000 live births), stillbirths (from 19 to 14.5 per 1000 births), and early perinatal mortality (from 32.2 to 21.6 per 1000 births) [27]. Similar results have been reported from other countries following introduction of this training [28, 29]. A separate clinical trial evaluating the effectiveness of reducing perinatal mortality and resuscitation practices in three low-resources areas is currently underway [9].

PRONTO International conducted a randomized controlled trial with perinatal mortality at 12-month follow-up as the primary outcome in 12 government hospitals in Mexico [20]. Six hospitals were randomly selected to receive simulation training using a low-cost hybrid simulator (PartoPants™, or modified surgical scrubs on a simulated patient and Laerdal Neonatalie™). Simulation training consisted of scenarios focused on teamwork, communication, neonatal resuscitation, and obstetric emergencies (e.g., shoulder dystocia, hemorrhage, and preeclampsia/eclampsia). The authors reported a lower incidence of postpartum complications following cesarean delivery at 12-month follow-up but no other statistically significant results. Effecting improvements in maternal and neonatal outcomes through a

Table 27.1 Simulation courses

Program	Target population	Content focus	Training components	Course length	Scenarios	Type of simulator	Outcomes
Pacific Emergency Maternal & Neonatal Training	Nurses/midwives Selected clinical staff of those facilities delivering and providing postnatal care more than 200 women a year All staff of provincial labor and postnatal wards Reproductive health educators in the pre-service and post-basic training institutions	OB/neonatal	Manual, lectures, in situ simulation	3 days for TOT	Preeclampsia/eclampsia; neonatal resuscitation; maternal collapse	Partial task trainer/actors; mannequin	NP
WHO Essential Newborn Care Course	Nurses/midwives	Neonatal	Manual, lectures, demonstrations, skills training, role play	5 days +6–7 days for TOT	Newborn resuscitation; breastfeeding	Mannequin; actors	Improved midwife skill and knowledge (McClure 2007 [21]); decreased perinatal deaths in Zambia (Carlo 2009 [25]); decreased stillbirth rate (Carlo 2010 [26])
Life Saving Skills Course	Nurses/midwives, obstetricians, anesthesiologists, medical assistants	OB/neonatal	Lectures, scenario and skills teaching, demonstrations, workshops	3 days +1–2 days for TOT	Manual placental extraction; vacuum-assisted delivery; neonatal resuscitation	Partial task trainer/mannequin	NP
Practical Obstetric Multi-Professional Training Course	Nurses/midwives, obstetricians, anesthesiologists/anesthetists, medical assistants, pediatricians, nurse/midwife/medical students	OB/neonatal	Manual, lectures, in situ workshops	4×/year, 1 day for TOT course	PPH; cord prolapse; eclampsia; instrumental delivery	High-tech simulator (SimMom)	Reduction in neonatal hypoxic injuries, injuries from shoulder dystocia and improvements in emergency CDs and organizational culture [ref]
PRONTO International Simulation Course	Nurses/midwives, obstetricians, anesthesiologists/anesthetists, medical assistants, pediatricians	OB/neonatal	In situ simulation, team, and CRM training; debriefing; skills sessions; team building exercises; lectures	2 modules 2–3mo apart: Module I-2 days Module II-1 day	PPH; neonatal resuscitation; shoulder dystocia; preeclampsia/eclampsia	Partial task trainer/actress NeoNatalie newborn simulator	Improved interdisciplinary knowledge, self-efficacy, communication, and teamwork [Cohen, Walker]; achieved more than 60% of the goals set during training; decreased number of cesarean deliveries performed in hospitals in Mexico that received PRONTO training
Helping Babies Breathe	Nurses, midwives, birth attendants	Neonatal	Simulation, visual guidebooks, flipcharts, and posters; skills training; OSCE	1–2 days; 3 days for TOT	Neonatal resuscitation	NeoNatalie newborn simulator	Decreased early neonatal mortality, stillbirths, and early perinatal mortality (Msemo 2013 [27], Goudar 2013 [28], Hoban 2013 [29])
IMPACT Africa Simulation Course	Nurses/midwives, obstetricians, anesthesiologists/anesthetists, pediatricians, pediatric nurses, medical assistants/hospital staff	OB/neonatal	Simulation, team, and CRM training; debriefing; manual, lectures	2 days +1–2 days for TOT	PPH, preeclampsia/eclampsia; high spinal; difficult airway; obstructed labor/fetal distress; neonatal resuscitation	High-tech simulator (SimMom and NeoNatalie)	Adherence to best practices in safe CD Checklist[a]

Pacific Emergency Obstetric Course: https://www.psrh.org.nz; accessed Dec 8, 2016
Life Saving Skills Course: https://www.rcog.org.uk/en/global-network/global-health.../life-saving-skills-course; accessed Dec 8, 2016
Practical Obstetric Multi-Professional Training (PROMPT) Course: http://www.promptmaternity.org/au/training; accessed Dec 8, 2016
OSCE Observed Structured Clinical Evaluation, *TOT* train the trainer, *NP* not published
[a]Study Ongoing. Study design: pre- and post- training clinical observations. This best practice checklist was developed

simulation-based training program without a means to financially maintain a simulation center or the associated training program may prove pointless. At the Society in Europe for Simulation Applied to Medicine Conference in 2011, Msemo stated, "You need commitment to be there from the government side, because training without support for the trainee to have equipment [in order] to do resuscitation is useless." Professor Vanessa Burch of the University of Cape Town also warns against the impetus to pursue simulation in healthcare without considering the "hidden costs" of maintaining a center, equipment, and skills [30]. Given that simulation centers with advanced simulation technology, high fidelity mannequins, and software requiring trained personnel are the most financially intensive to maintain [31], some programs have used lower fidelity models with success to decrease cost [7, 20, 32]. A low-cost simulation course for trauma using only medical equipment and resources locally available demonstrated not only improvement in knowledge acquisition but also increase in number of tasks completed and a decrease in time in which critical actions were completed. The authors were able to develop their course for 33 participants for $2844.00 with a total maintenance cost for all participants of $8.82 as compared to using a single high fidelity chest tube simulator which may cost as much as $3000 [7]. Multiple studies have failed to demonstrate superior improvement in performance of trainees after high fidelity simulation training versus low fidelity [33–37], supporting the claim that low to moderate fidelity simulation programs are more cost-effective and can yield comparable outcomes in a low-resource country.

Development and Implementation of a Simulation Program

The currently existing models reviewed here provide examples of successfully implemented and sustained healthcare simulation programs. The following discussion will focus on development and implementation of an LMIC healthcare simulation program based on existing models including the ImPACT Africa project (ImProving Perioperative Anesthesia Care & Training in Africa) simulation program in East Africa which was created and implemented by the authors of this chapter. This capacity-building program involved the creation of two self-sustaining simulation centers of excellence in Kenya which function as components in a wider nurse anesthesia training program in Kenya.

Livingston et al. outlined key steps undertaken to develop and implement a sustainable simulation center-based training program in Rwanda. These include engaging multidisciplinary partners with a shared vision, identifying feasible short- and long-term goals, obtaining a viable funding source, recruiting local staff, developing site-appropriate curricula, training of local leaders, constructing a physical space, cultivating sustainable partnerships while engaging the wider community, and finally monitoring and evaluating use following program implementation [38]. Kern's Six-Step Approach to Curriculum Development offers a broader outline for application to the design and implementation of a simulation program [39]. Adaptation of the above two approaches alongside methods undertaken by these authors are represented in Fig. 27.2.

Prior to incorporating simulation training into medical education in an LMIC, an understanding of the healthcare environment is critical to the development of common clinical scenarios appropriate for achieving practical learning objectives. For example, there are 5.1 million trauma-related deaths worldwide each year, 90% of which occur in LMICs, with a majority resulting from road traffic collisions [7]. Against this backdrop, identification of the need to improve response time and trauma skill competency in Managua, Nicaragua, led to the development of a low-cost simulation program using Advanced Trauma Life Support (ATLS) principles and procedure stations made from local material. In another example, given that laparoscopic surgery is becoming more widely accessible to LMICs while laparoscopic simulation technology remains cost prohibitive, a teaching hospital in Northern Haiti provided simulation training for surgical residents using a box trainer (made from cardboard, plastic, a small webcam, and laparoscopic handles) alongside a structured modular curriculum [40]. Both of these courses addressed the needs of their medical community and targeted learners through the creation of programs that were reproducible and sustainable in a low-resource setting.

Assessment of local resources is a critical component of any needs assessment in the creation of a simulation training program. Croft and colleagues warn that we should heed the recommendations published by the WHO to avoid development of training models based on those created in high-income countries. They suggest that the success of any training model depends primarily on "appropriately skilled instructors in sufficient numbers and suitable, locally adapted training materials." They go on to state that "Care must be taken to ensure that areas with the highest maternal and neonatal mortality, and perhaps, with the most need for training are given appropriate support to develop and evaluate sustainable, clinically effective training programmes" [11]. A successful training program must be customized to fit the clinical ecosystem, resources, culture, language, and local leadership of the target environment.

During the initiation of a LMIC simulation training program, infrastructure, expertise, and funding from high-resourced educational institutions may be necessary. However, the relationship between the medical leaders in the LMIC and the high-resourced institution must be one

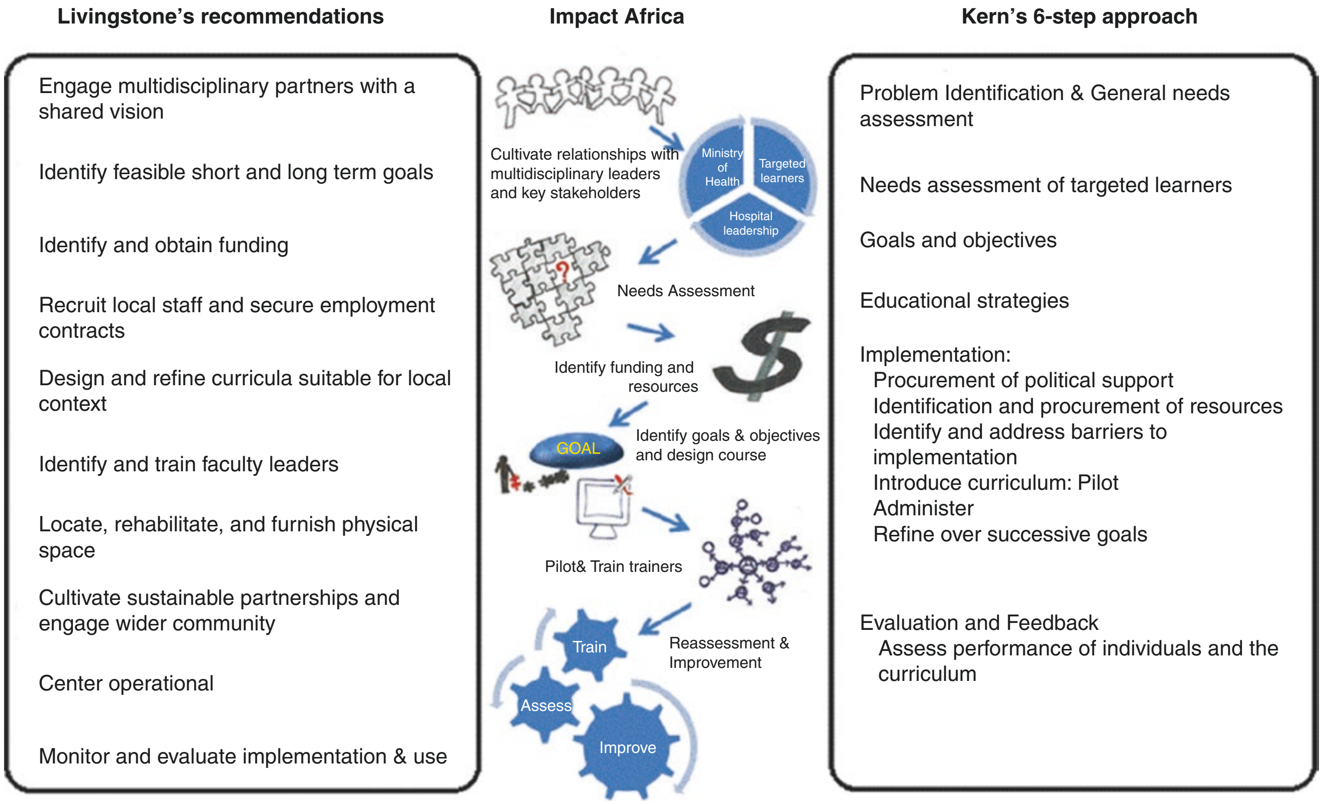

Fig. 27.2 Stepwise and dynamic approach to developing and implementing a simulation course in low-resource settings. This image illustrates a practical implementation of recommendations from two well-known curriculum development guidelines [38, 39] in an ongoing simulation training program in East Africa

of mutual respect and partnership. In the experience of the authors and of Livingston et al., this is more easily facilitated when there is a preexisting *relationship that has been cultivated with the principles of trust and support*. *Identification of both key stakeholders* (i.e., government officials from Ministry of Health, hospital leadership, targeted learners, and patients) *and potential barriers* is vital to ensure operability and sustainability.

Dependent upon both the resources and goals for a simulation program, one must address specific questions to identify the appropriate setting for instruction: "Are there sufficient resources available to construct a simulation center?" "Is in situ simulation a suitable model for meeting program goals?" "Can the objectives be accomplished utilizing a low technology center while still providing a high level of fidelity?"

A simulation center should be located at a site accessible to participants and in close proximity to a health facility to ensure consistent and ongoing participation, reduced travel costs, and improved security. Depending on the degree of technology employed, it may be necessary to train local staff as simulation technologists. An ideal simulation center would include both a simulation theater designed to maximize scenario fidelity and a separate space for safe and effective debriefing.

In situ simulation occurs in the clinical environment (e.g., hospital) with participants composed of on-duty personnel. Performing simulation in the actual clinical environment provides a realism that cannot be replicated in a simulation center, while also allowing the simulation program to meet goals less realizable through use of a de novo center. Center-based simulation, often associated with a prescribed set of learning objectives, is more often focused on the practice of technical and non-technical skills, whereas in situ simulation is more likely to identify system deficiencies and preexisting team dynamics. While it is difficult to compare outcomes between programs utilizing in situ or center-based simulation, one randomized controlled trial comparing NRP programs demonstrated improved technical scores (based on number of correct interventions performed), team performance scores, and greater efficiency of neonatal resuscitation based on mannequin heart rate at 3 and 5 minutes in an in situ simulation intervention group [42].

In Kern's Six-Step Approach, a learner's needs assessment must be performed in order that the *goals and objectives* of the course addresses the group targeted [39]. However, given the variable knowledge base within groups and over time, Kern emphasizes the dynamic nature of the Six-Step Approach. The learning objectives and goals, while initially developed to address the general needs of the group as a whole, adapt and evolve to meet the growing and changing needs of the targeted learners as discovered through repeated evaluative processes. Therefore, goals and objectives for a simulation program should result from a review of basic knowledge on a specific clinical topic (i.e., epidemiology, clinical presentation, management), reasons the topic is clinically relevant for targeted learners, and the relevant technical and non-technical skills. Furthermore, the information presented and the clinical scenarios practiced as part of a simulation course must be culturally and contextually relevant. This requires an understanding of current local practices, available resources (medical equipment and medications), and local health policy. For example, our Kenyan learners stated that they may respond better if the simulation mannequin had a greater resemblance to their patient population. Also, it is inappropriate to expect learners from low-resource settings to respond to certain emergencies with interventions available to those in a high-resource area, such as the initiation of a massive transfusion for an obstetric hemorrhage. Treatment protocols presented through simulation curricula must integrate context-appropriate interventions or the functional utility of the program would be compromised.

Results obtained from a needs assessment of the local environment and learners will guide simulation course design and decisions on logistics such as choosing among a de novo simulation center, in situ simulation, or a lower-cost hybrid to achieve the predetermined goals and objectives. The IMPACT Africa (Improving Perioperative Anesthesia Care and Training in Africa) Simulation Course for Obstetric Emergencies was developed with input from over 70 anesthesia and obstetric care providers practicing in East Africa (see curriculum description in Table 27.2). The IMPACT Africa simulation course provided didactic training on those obstetric emergencies determined to be the most common and critical based on learner input (obstetric hemorrhage, preeclampsia/eclampsia, obstructed labor/fetal distress, and high spinal) followed by an introduction to team training and crisis resource management principles. The knowledge and skills were incorporated into a series of simulation scenarios with structured debriefing. Soon after implementation, the importance of sharing common language to facilitate effective team dynamics and crisis management was discovered. This issue was compounded by the diversity of clinical backgrounds found among our learners (midwives, nurses, obstetricians, and anesthetists/anesthesiologists), and it became clear that an introductory didactic session was needed to build a common language which could be reinforced through simulation. This cycle of feedback and redesign through both and initial and repeated needs assessment is crucial to program success.

The goals of any simulation-based training program include improvements in individual and team knowledge, team performance, the culture of safety, and patient outcomes. Key characteristics that have been identified among obstetric simulation programs associated with improvement in clinical outcomes [41] include institution-level incentives,

Table 27.2 This describes the initial preparation and organization of the IMPACT Africa OB emergency simulation training course

Course preparation: An initial assessment was made by the course directors of each of eight government hospitals in Western Kenya to assess the need for the course and the type and frequency of obstetric emergencies encountered, in addition to the direct needs of the participants.	
Course registration: Agreement to participation was provided after supplementing a description of the course, its goals, and expected outcomes. Registration was opened to multidisciplinary members (including nurses/midwives, obstetricians, anesthesiologists, registered nurse anesthetists (KRNAs), student nurse anesthetists, security personnel, and administrators) that would be involved in delivering care to the pregnant patient.	
Course structure: An average of 20 participants were enrolled at each facility. The duration of the course spanned 2 days, for a total of 4 days. Each cohort was divided into two groups of ten, and during the course each group was further divided into two groups of five to facilitate efficient simulation sessions and in order to ensure each member was able to actively participate in each scenario.	
Participant preparation: At this time, preparation of the participants was not performed, but the ultimate goal is to provide each course member with a soft cover book reviewing all essential information regarding the most frequent obstetric emergencies encountered in Western Kenya, team training, and an introduction into simulation techniques and debriefing.	
Course curriculum	
Day 1	**Day 2**
Introductions	Overview of the day
Review basic obstetric and anesthetic principles	Review management of high spinal
Review of high-risk obstetrics	High spinal scenario
Break	Group debrief
Review neonatal resuscitation	Break
Review team training and simulation/simulator	Preeclampsia/eclampsia scenario
Introduction to mannequin	Group debrief
Lunch	Obstetric hemorrhage scenario
“Ice breaker” faculty simulation scenario and debrief	Group debrief
Peripartum hemorrhage scenario	Lunch
Group debrief	Review management of obstructed
Preeclampsia/eclampsia scenario	Labor/fetal distress
Group debrief	Obstructed labor/fetal distress scenario Group debrief

The course curriculum is outlined below

multidisciplinary training of all hospital staff within the unit in which they work, integration of teamwork principles into clinical teaching, and the use of a high-fidelity (though not high-tech) simulation model. In the authors' experience, offering institution level *and* individual incentives can aid in garnering initial interest and while also sustaining high rates of participation. Multidisciplinary training of all relevant hospital staff can also enhance participants' shared commitment to providing exemplary patient care.

In addition to incorporating a feedback mechanism to allow for simulation program revisions based on interval needs and program assessments, sustainability and contextual relevance is maximized through efforts at "training the trainers." As participants are trained as instructors, the needs of the health workers, facility, and community targeted by the program are likely to evolve. Finally, an assessment of needs and curriculum effectiveness based on outcome measures and participant feedback will allow for program improvements and potential expansion, at the regional or national level.

Debriefing and Cultural Influence

Debriefing is an exercise in facilitated reflection which helps to solidify the technical and non-technical skills gained during a simulation experience and ideally result in the restructuring of one's approach to real-life clinical scenarios [43]. When led by a trained facilitator, post-simulation debriefing plays a critical role in experiential learning. As Chung et al. have acknowledged, while simulation in healthcare has spread worldwide, the practice of debriefing and all related literature originate from Western culture with little consideration of cultural differences in learning and pedagogy. A deep understanding of the local culture and its bearing on learning and communication can play a decisive factor in ensuring a safe and effective learning environment in which learners feel capable of sharing their thoughts and gain from the simulation experience. The non-judgmental, objective nature of effective feedback provided as a component of facilitated debriefing [44] delivered with knowledge of the local culture will be more readily accepted by cultures prone to shame brought on by criticism or negative attention. More research is needed to understand efficacious and culturally appropriate debriefing methods and can be highly specific to cultural context.

Conclusion

Local and effective partnership with stakeholders, creation of simulation facility infrastructure appropriate for program goals and objectives, and curriculum development based on initial and repeated needs assessments performed in parallel with the training of local simulation faculty represent the critical initial steps in the implementation of a sustainable simulation program in an LMIC. While evidence demonstrating improvement in patient outcomes is largely lacking, guided debriefing of common and critical emergency scenarios can help identify individual and system deficiencies. In the experience of these authors, an effective simulation program can motivate local leaders to advocate for improvements to local infrastructure. Identification of each culture's unique modes of learning and communication and integrating these features into the simulation program can enhance the educational experience during the simulation experience and post-simulation debriefing.

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