Universities form research partnership to improve care in Mozambique

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HIGHLIGHTS

• Describes the physician shortages in Mozambique

• Provides details about a medical education research partnership between Universidade Eduardo Mondlane in Mozambique and the University of California, San Diego

• Outlines research findings and lessons learned from implementation

• Suggests how the research findings may be applied to improve surgical care in low-income countries
Mozambique, a country in sub-Saharan Africa, has experienced a severe physician shortage for many years, with patients having particularly limited access to surgical care. Medical education and surgical research partnerships formed in 2010 between Universidade Eduardo Mondlane (UEM) in Mozambique and the University of California, San Diego (UCSD), is developing potential solutions to the nation’s surgical care crisis. The findings that have emerged from this initiative, which are aimed at scaling up surgical services, will likely have important implications for improving surgical care in Mozambique and other underserved nations.

**Magnitude of the shortage**

Mozambique is a country of approximately 25 million people located in southeastern Africa. Mozambique gained independence in 1975 after more than four centuries as a Portuguese colony. At that time, most trained physicians fled the country, leaving Mozambique with one of the lowest physician-to-population ratios in the world. In 1977, the country descended into an intense, protracted civil war that lasted until 1992, further contributing to the physician shortage. Since 2001, Mozambique’s annual growth in gross domestic product (GDP) per capita has been among the world’s highest; however, the country still ranks among the lowest in GDP per capita, human development, measures of inequality, and average life expectancy.

As is the case in many other sub-Saharan areas of Africa, lack of surgical care is an important yet unaddressed public health problem. The maternal mortality ratio in Mozambique is 490/100,000 live births, with only 55 percent of births aided by a skilled attendant. Another surgical care challenge is that of injuries from road traffic accidents, which are the seventh leading cause of death in recent years. Other common surgical conditions include inguinal hernias, intra-abdominal catastrophes, and congenital anomalies.

From a health system’s perspective, formidable challenges exist, with only three physicians and 21 nurses per 100,000 inhabitants, compared with 256 and 937, respectively, in the U.S. Currently, there are fewer than 25 general surgeons for a total population of 25 million in Mozambique. With a national public health expenditure of $35 U.S. per capita annually—compared with $8,608 per capita in the U.S.—the need to maximize the public benefit of surgical services has never been greater.

The challenge that Mozambique health care providers face in providing surgical care is a microcosm of a global phenomenon. The World Health Organization (WHO) estimates that 2 billion people worldwide lack access to emergency and essential surgical care. Most of the surgical need exists in rural and marginalized populations in low- and middle-income countries (LMICs), where the poorest one-third of the world’s population receives less than 5 percent of all surgical services. According to the third volume of *Disease Control Priorities in Developing Countries*, to be released in early 2015, an estimated 1.4 million deaths and 77.2 million disability-adjusted life years (DALYs) could be averted in LMICs annually by scaling up basic surgical care at first-level hospitals. This reduced burden is roughly equal to the global burden of the human immunodeficiency virus (82.5 million DALYs) or malaria (84.4 million DALYs).

The potential to avert such a significant burden of disease by scaling up basic surgical care has led to interest in implementation strategies in LMICs. Although surgical care is cost-effective at the primary referral hospital level, many questions remain unanswered regarding optimal strategies for implementing surgical care and how best to measure its impact on the population’s health.

**UEM-UCSD surgical research partnership**

To define the surgical needs and ultimately improve delivery of care in rural Mozambique, UEM formed a research partnership with UCSD. The foundation for this partnership was established in 2008 when the two institutions began collaborating on infectious disease projects. In 2010, UEM became one of 13 academic medical centers across 12 African countries to participate in the Medical Education Partnership Initiative (MEPI) with 20 U.S. academic institutions. The MEPI represents a $130 million investment from the U.S. Department of State through the President’s Emergency Plan...
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for AIDS Relief and the National Institutes of Health (NIH) to address the public health crisis in sub-Saharan Africa. In Mozambique, a MEPI grant seeks to improve medical education; increase the capacity for locally driven, multidisciplinary research; strengthen the informatics infrastructure; and recruit and retain qualified medical faculty.12

The UEM-UCSD surgical research partnership is funded through the MEPI program with a MEPI linked award. The specific aims of the surgical research partnership are to identify the best strategies for building emergency and essential surgical capacity in rural areas of Mozambique and to increase capacity for surgical research at UEM and its allied institutions via training and partnerships. The partnership also has benefited from collaborations with the WHO and the Canadian Network for International Surgery.

It is important to note that surgical research and innovation have always been valued in Mozambique. For example, the training of nonphysician technicians (NPTs), or técnicos de cirurgia, was pioneered by the Mozambican surgeon, Prof. Fernando Vaz, MD, to help patients in rural areas with limited access to surgical care.13 More than 20 years later, NPTs perform major procedures at rural hospitals, and they tend to practice longer in rural areas than physicians and have competitive surgical results for common procedures.14-15 One study found that after seven years, approximately 90 percent of NPTs were still working in primary referral hospitals, while almost no medical officers remained in those facilities. This model has been duplicated in other countries in sub-Saharan Africa.

Early in the partnership, a surgical research team was organized with representatives from UEM and UCSD. The team comprises senior surgical and nonsurgical research faculty from UEM; an epidemiologist from the national Ministry of Health; a lecturer at the Higher Institute of Health Sciences in Maputo, Mozambique; and surgical faculty from UCSD. Researchers meet regularly to discuss ongoing projects and to set the research agenda. The UEM-UCSD surgical research partnership also has been fortunate to have a Fogarty International Clinical Scholar and a University of California GloCal Health Fellow participate in the research.

Surgical research is conducted in and around three primary referral hospitals in rural Mozambique (see Figure 1, this page). The three hospitals—Chókwè, Nhamatanda, and Ribaué—were strategically selected to represent the southern, central, and northern regions of the country.

FIGURE 1. Map of Mozambique showing primary referral hospitals of Chókwè, Nhamatanda, and Ribaué
Each hospital has a catchment area of approximately 250,000 people, with anywhere from 60 to 125 beds. The hospitals have a full complement of health care workers, including physicians, nonphysician providers who perform surgical procedures, nurses, and support staff. Each facility is equipped with an emergency room, laboratory, operating room, X-ray machine, and ambulance. More complicated cases are transferred to the nearest referral center, which is on average 130 kilometers away from any of the three referral hospitals.

**Preliminary findings**

A spectrum of research projects was initiated in the first three years of the UEM-UCSD partnership, five of which are described in this article.

**Operations performed by nonphysician surgeons**

Little research has been conducted on the operative variety and volume of nonphysician surgeons in LMICs. To better understand their role in providing surgical care, we reviewed case logs at Chókwè Hospital. During a five-year period, nonphysician providers performed 2,637 major surgical procedures, with 52 different operations. Emergency care accounted for 73 percent of all procedures. Cesarean section was the most commonly performed operation (62 percent of all cases, 73 percent of emergent cases). Interestingly, the 10 most common procedures performed resulted in 80 percent of all major operations. The other nine were herniorrhaphy, exploratory laparotomy, salpingectomy, hysterectomy, split-thickness skin graft, wound debridement and primary closure, appendectomy, hydrocelectomy, and limb amputation. Of these 10 procedures, nine have been classified as top-priority surgical procedures for primary referral hospitals in LMICs.

**Surgical admissions to three primary referral hospitals**

The importance of surgical care delivered at primary referral hospitals in sub-Saharan Africa is often underappreciated. To better define what role surgical services play at primary referral level hospitals, we prospectively examined all hospital admissions to Chókwè, Nhamatanda, and Ribáuè hospitals. We compared the number of surgical patients and their length of stay (LOS) to patients admitted to the medicine, pediatric, and maternity wards. Patients with surgical conditions (that is, patients admitted to the general surgical service or maternity ward requiring surgery) accounted for 57.5 percent of admissions and 48 percent of inpatient-days. Most patients were admitted to the maternity ward (32.3 percent). Other admissions were more evenly distributed to the general surgery (25.2 percent), pediatric (22.5 percent), and medical (20 percent) wards. General surgery patients had the longest average LOS (8.7 days versus 1.9–7.7 days) and the highest number of total patient days (891 versus 252–703 days). In addition, up to 30 percent of patients hospitalized on the surgical service did not have a procedure, reflecting a large nonoperative component of surgical management.

**Epidemiology of pediatric trauma admissions**

Approximately 45 percent of Mozambique’s population is younger than 14 years old, and injury is common in this demographic. To better define the epidemiology of childhood injuries in rural areas of Mozambique, we examined the types of pediatric injuries presenting...
to Chókwè Hospital.21 Trauma admissions accounted for 12 percent of all pediatric patients admitted to the hospital and 70 percent of pediatric surgery admissions. Falls were the leading cause of injury (44 percent), followed by burns (23 percent) and traffic accidents (18 percent). The average length of stay was 12.9 days. The mortality rate due to injuries was 3 percent. Pediatric trauma results in a significant burden of disease in rural Mozambique. The pattern of injuries is similar to that of other regions of sub-Saharan Africa.22

Community-based survey to define unmet needs
Little is known about the unmet need for surgical care in rural sub-Saharan Africa.23 We conducted a stratified, population-weighted household survey in three rural districts in Mozambique (see Figures 2–4, page 30 and this page).24 Of the 6,104 survey respondents, 4,498 (74 percent) reported the presence of at least one potential surgical disease. A total of 4,455 photos were taken of the potential surgical condition (99 percent frequency of photo acquisition). Review of these photos by a panel of trained surgeons revealed that 1,032 (17 percent) of all patients surveyed in the total population sample exhibited surgeon-subjective evidence of current or previous surgical disease. Our results demonstrate a large burden of current and historical disease requiring surgical care in the general populations of three rural districts in Mozambique. Further analysis of these and other data from LMICs may allow the quantification of both the met and unmet need for surgical care in underserved communities.

Risk-adjusted mortality of surgical patients at Chókwè Hospital
Surgical research in LMICs has traditionally focused on infrastructure rather than outcomes.25 To begin altering this paradigm, we developed a risk-adjustment tool for surgical patients based on the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP®) model.26 In the U.S., risk adjustment is achieved through rigorous data collection, including 66 preoperative variables and 30-day follow-up. Using ACS NSQIP data from U.S. hospitals, we validated statistical models that are tailored to the constraints of a Mozambican setting. We found that a minimum set of four to six variables is adequate to achieve robust risk-adjustment for inpatient outcomes (see Figures 5 and 6, page 32). A pilot study of this new tool is under way at three hospitals and will inform strategies to improve hospital guidelines and standards of care.

Keys to success
The goal of these surgical research projects is to develop an evidence base for surgical care in rural areas of Mozambique. Several factors contributed to the early success of our collaboration. Following are the lessons learned from these experiences.

Local buy-in is necessary
The importance of working in an environment in which surgical research is valued cannot be overstated.
Early success was contingent on senior Mozambican surgeons enthusiastically embracing the MEPI opportunity when it became available. The senior surgeons’ extensive experience with surgical care in Mozambique was invaluable in shaping research questions and setting priorities. Without their initial and ongoing support, the UEM-UCSD surgical partnership would not have succeeded.

Linking the surgical initiative with a medical programmatic grant
Another factor that helped this program succeed was the structure of the UEM-UCSD surgical partnership and our ability to integrate the surgical grant into a larger MEPI grant. Like the larger MEPI grant, the surgery-linked award has been structured such that it relies heavily on local leadership and priority setting. Integrating medical and surgical grants has allowed those who are interested in surgical research to take full advantage of the research infrastructure that has been developed in the other departments of Maputo Central Hospital and UEM-Faculty of Medicine. As a result, it was possible to leverage the larger grant to help create an environment in which surgical research is more easily accomplished. Examples include streamlining of the human subjects review process, the participation of surgeons in research training courses, and sharing tasks of grant administration.
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**Challenges: surgeon shortages**

Despite early successes, the UEM-UCSD surgical partnership has faced several challenges, the greatest being the lack of surgeons in Mozambique. With fewer than 25 general surgeons serving a population of 25 million people in Mozambique, practicing surgeons have little time for day-to-day research activities. The Ministry of Health’s recent decision to expand the general surgery postgraduate training program should help to remedy this problem, but these effects will take years to reach fruition. In the meantime, the MEPI team has sponsored the research of three NPTs. These técnicos de cirurgia are required to complete a research project as part of their certification through Maputo’s Higher Institute of Health Sciences. The goal of this mandate is to empower these health care professionals to perform surgical research at primary referral hospitals in rural districts.

**Future directions**

As the UEM-UCSD surgical partnership continues to develop, we see several areas where future research should be focused.

One of the greatest challenges of scaling up surgical care in LMICs lies in the deficiencies in the supply, training, and distribution of human resources. Surgical training takes time and money. Once qualified, surgeons are reluctant to serve in rural primary referral hospitals where the needs are greatest. Important questions remain regarding how surgical providers in LMICs should be trained, how their scope of practice should be defined, and how surgical skills should be assessed.

Another important need is the development of frameworks to assess surgical care within primary health care systems. The development of indicators for monitoring and evaluating projects and system performance is commonplace within health and economic development programs, but this process has yet to be systematically applied to the practice of surgery in LMICs. Developing population-based indicators of surgical care will

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facilitate the planning and implementation of surgical services in settings of limited resources.

In addition, assessment of surgical care in LMICs has typically focused on physical and human resources rather than processes and outcomes. Assessment of all four elements likely is necessary to gain a comprehensive understanding of how high-quality care can be delivered and how it affects the perception of the health care system. Instilling trust in a population is at the core of promoting access and proper use of health care services.

Although many challenges remain, over the past three years we have made significant progress toward establishing an environment in Mozambique in which it is possible for surgeons to undertake a broad range of surgical research projects and improve the delivery of care. Ongoing development of this enterprise will enhance Mozambique’s capacity to address important public health problems that are locally relevant and will accelerate the development of national universities. We anticipate that promotion of evidence-based surgical planning in global health care will be a lasting legacy of the MEPI program.

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