



## CASES IN GLOBAL HEALTH DELIVERY

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### CONCEPT NOTE

# Global Surgery Care Delivery

Surgical disease is defined as any disease state requiring the expertise of a surgically trained provider, which may or may not eventually require anesthesia, for incision, excision, and suture.<sup>1</sup> Modest estimates indicate that globally 11% of premature death or disability could be averted with surgical services concentrating on trauma, cancer, and congenital deformities.<sup>2</sup> The burden of surgical disease may be even higher considering surgically treatable infections, acute abdominal emergencies, and obstructed labor. For example, a recent cross-sectional, country-wide survey in Sierra Leone found that surgical diseases may contribute to up to 25% of the total disease burden in the country.<sup>3</sup>

Overall, six conditions make up 81% of surgical DALYs,<sup>i</sup> a comprehensive measure of morbidity and mortality caused by all surgically treatable conditions: injuries (38%), malignancies (19%), congenital anomalies (9%), obstetric complications (6%), cataracts and glaucoma (5%), and perinatal conditions (4%). Injuries kill more than five million people yearly. Road traffic injuries are the leading cause of death worldwide for persons aged 15-29 years, and 91% of road injury deaths occur in low- and middle-income countries (LMICs).<sup>4</sup> Surgical interventions that stop life-threatening bleeding, clean and close open wounds to prevent overwhelming infection, or repair damage to vital organs prevent morbidity and mortality attributable to traumatic injuries. Nearly two million lives could be saved annually by reducing deaths from injuries in LMICs to rates similar to those in high-income countries.<sup>5</sup> In addition, one third of obstetrical complications are surgical, and 3% of all births will need a major obstetrical intervention to prevent maternal death.

Resource-constrained environments often have limited access to surgical services. Only about 26% of the estimated 234 million surgical procedures performed worldwide each year take place in the poorest countries despite those countries being home to 70% of the world's population.<sup>6</sup> Part of the problem stems from the dearth of trained surgeons. Many have concluded that it will not be possible to attain the UN Millennium Development Goal of reducing maternal mortality by 75% by 2015 without improving access to surgical services and considering access to certain surgical interventions essential.<sup>7</sup>

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<sup>i</sup> Disability-adjusted life years (DALYs) have been used by the World Health Organization's (WHO) Global Burden of Disease project to calculate the health effects of certain disease states, with one DALY defined as the loss of the equivalent of one year of life at full health. DALYs lost due to disease are calculated using years of life lost (YLL) attributed to premature mortality and the years of "healthy" life lost as a result of disability (YLD), such that  $DALY = YLL + YLD$ .

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*Pratik Patel, Sam Enumah, Tiffany Chao, Julie Rosenberg, Meera Kotagal, Robert Riviello, and Rebecca Weintraub prepared this concept note to aid in classroom discussion rather than to illustrate either effective or ineffective health care delivery practice.*

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This concept note aims to describe the history of global surgery, the current landscape for providing surgical care in resource-limited settings, and future directions for research, funding, and advancement of global surgery.

## History of Global Surgery

The field of “global surgery” has evolved over time with the contributions and expanded roles of various actors. The organized provision of medical care outside one’s own country began in the nineteenth century with international relief organizations, faith-based organizations (FBOs), and nongovernmental organizations (NGOs). Since its founding in 1863 by the Swiss man, Henry Dunant, the International Red Cross has provided medical and surgical services to various populations worldwide, often in the context of humanitarian crisis.<sup>8</sup> Nearly a century later, in 1971, Médecins Sans Frontières (MSF; *Doctors Without Borders*) was founded in the aftermath of the Biafran War with the aim of providing access to health care for all persons irrespective of national boundaries.<sup>9</sup> Medical relief organizations have primarily centered on provision of clinical services in lieu of building infrastructure or establishing training programs.

In the first half of the twentieth century, the World Wars catalyzed the interconnectedness of the global community and the development of new advances in surgical technique and international relationships in the surgical field. The Plastic Surgery Foundation (PSF) formed in 1948, for example, to support the research activities of its members.<sup>10,11</sup> Additionally, the PSF supported international teaching and training opportunities. It later partnered with Medical International Cooperation Organization (MEDICO), an organization founded in 1958 to provide medical and surgical services in low-resource settings. Together they established volunteer training opportunities in LMICs, built infrastructure, and provided free and low-cost services. They emphasized training local health care providers with the long-term goal of establishing self-sustaining programs.<sup>12</sup> In 1969, Children’s Medical International established a permanent center in Saigon, Vietnam to provide clinical care as well as training opportunities for local surgeons.<sup>13</sup> Prior to the invasion of Saigon by North Vietnam in 1975, the center had performed more than 9,000 operations with Vietnamese surgeons involved in every aspect of patient care. The program had successfully transitioned to a Vietnamese-run operation in only a few short years, but the collapse of South Vietnam brought an end to this global partnership.

There are little published data regarding the amount of care provided by FBOs and NGOs, including short-term mission trips and long-term engagements, and metrics vary among organizations.<sup>14</sup> Between 1969 and 1999, multiple organizations (e.g., Interplast, Operation Smile, and Smile Train) were founded with the aim of addressing specific diseases (e.g., cleft lip and palate). They offered clinical care, often outside of existing national and local health care structures.<sup>15</sup>

In 1980, only two years after the 1978 Alma Ata Conference and the declaration of “health for all,” Dr. Halfdan Mahler—then Director-General of the World Health Organization—openly criticized Alma Ata’s limited definition of Selective Primary Health Care, which failed to incorporate surgical services as an “essential” component.<sup>16</sup> In his address to the International College of Surgeons, Dr. Mahler called for an expanded role of surgery in primary care and advocated for the development and dissemination of educational and training materials to address the growing surgical burden of disease.

The primary source of global disease burden began shifting from communicable to non-communicable diseases around 1990.<sup>17</sup> Surgical advocates took advantage of this shift and began to document the reasons for investing in surgery: its cost-effectiveness, the global burden of surgical conditions, and the role that surgery could play in public health. For example, a 1996 study assessing cataract surgery in Nepal reported costs as low as USD 5.07 per DALY averted.<sup>18</sup>

In 2004, the WHO launched the Emergency and Essential Surgical Care Project. The WHO developed the Integrated Management of Emergency and Essential Surgical Care toolkit, as well as the supplement text, *Surgical Care at the District Hospital*, in an effort to strengthen the delivery of surgical and anesthesia services at primary health facilities worldwide.

Nevertheless, during the 1990s and early 2000s, efforts to reduce the burden of communicable diseases—including HIV, tuberculosis, and malaria—dominated global health discourse and received a majority of global health funding.<sup>19</sup> The transmissibility of these diseases, the cost-effectiveness of treatments, and strong advocacy kept them in the spotlight. Because surgical pathologies are rarely transmissible from one person to another, they were often considered outside the traditional realm of “global public health.” Further, the human resource and infrastructure requirements limited capacity for surgical care in many settings. The high level of investments required, lack of public support, and underestimations of the surgical disease burden deterred many low- and middle- income countries from investing in building surgical capacity. Thus, by 2008, surgical care delivery had yet to establish itself as an essential component of the global health and was lamented by Drs. Kim and Farmer as “the neglected stepchild of global health.”<sup>20</sup>

This has changed in recent years.<sup>21</sup> A PubMed search of “global surgery,” for example, provides 90 publications, 84 of which were published between 2009 and 2014. Recent systematic reviews of all published reports reveal that surgical care provision can be cost-effective to very cost-effective, and is often comparable to “traditional” public health interventions. The median cost-effective ratio (CER) of circumcision (\$13 per disability-adjusted life year [DALY]) was similar to that of standard vaccinations (USD 12–25 per DALY). Median CERs of cleft lip or palate repair, general surgery, hydrocephalus surgery, and ophthalmic surgery (USD 47–136 per DALY) were similar to that of the BCG vaccine (USD 51–220 per DALY). Median CERs of caesarean sections and orthopedic surgery (USD 315–381 per DALY) are more favorable than those of HIV treatment with multidrug antiretroviral therapy (USD 453–648 per DALY).<sup>22</sup>

While short-term mission trips continue, some organizations have begun to expand their offerings (e.g., Operation Smile is training locals, and Smile Train is providing educational training and financial incentives to local physicians).<sup>23</sup> An increasing number of US-based institutions have formalized global surgery training initiatives, established research grants, and initiated partnerships with international universities, acknowledging the importance of surgical care in global health. Some academic surgical departments have created curricula that integrate international surgical care into all postgraduate training, and schools of public health have begun including discussions of surgery in global health courses.<sup>ii</sup>

## Surgery in Health Care Delivery Systems

Building robust surgical capacity in health care delivery systems in resource-limited settings is complex. The system must be prepared to address a diverse group of surgical conditions, including abdominal emergencies, traumatic injuries, obstetric procedures, infections, congenital anomalies, and cancers. Further, patients often need to receive such surgical interventions quickly and efficiently to avert life-threatening conditions or prevent life-long disability.

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<sup>ii</sup> Examples of training programs include: Ohio State University Global Health International Surgery Program; Vanderbilt International Surgery Elective Rotation; Brigham and Women’s Hospital’s Global Health Equity in Surgery track through the Center for Surgery and Public Health; The UCSF Program in Surgery & Global Health; Duke Global Surgery; Massachusetts General Hospital’s Global Surgery Program. The American College of Surgeons’ Operation Giving Back website provides an updated list of partnerships and training opportunities.

Surgical delivery systems require many components, including a properly trained and effectively managed team that includes a competent surgical provider and perioperative workforce. Laboratory testing, radiologic investigations, and pathologic diagnoses are helpful to determine appropriateness and safety of a surgical intervention. Anesthesia, including ventilating the patient, is crucial for sedation, pain management, and physiologic monitoring, both intraoperatively and perioperatively. Postoperatively, patients require skilled surgical nursing care as they recover and their physiology normalizes. Every level of care, ranging from outpatient to intensive care unit monitoring, is involved in the coordination and mobilization of these human and technical resources.

Many health systems around the world use a three-tier system for providing care. Each of the three tiers—local, district, and tertiary care centers—is equipped to meet specific surgical needs. Patients requiring more complex care are referred to the next level of care. Some systems offer disease-specific care.<sup>24</sup> Operation Smile, mentioned above, is an example of such a delivery model that works primarily on cleft lip/palate repair.

Infrastructure for surgical care includes operating rooms, laboratory equipment, surgical tools, and consumables. Sterility in the operating theaters and of all consumables is critical for safety, as is error-minimizing organization (e.g., algorithms and safety checklists).<sup>25</sup> Effective supply chains are a cornerstone of surgical efficacy. Establishing the infrastructure necessary to provide surgical and anesthesia care can strengthen entire health care systems if such infrastructure is not already in place. Integrating surgical delivery with a primary care system ensures optimal patient outcomes and safety and allows systems to leverage existing resources.

Global surgery also offers unique opportunities for innovation of low-cost solutions to address unmet needs. For example, Dr. Benjamin Warf, working in Uganda, developed a lower-cost, one-time treatment for infant hydrocephalus that requires far less monitoring and maintenance than traditional implanted shunts, a strategy that he was then able to use in the US.<sup>26</sup>

### ***Surgical Workforce***

Surgical care capacity in LMICs is highly correlated with the availability of surgeons and a perioperative workforce. LMICs generally face significant challenges to workforce development, including recruitment, training, and retention.<sup>27</sup> The scarce number of registered physicians in many LMICs reflects the limited number of providers who complete training as well as the significant proportion of trained physicians who emigrate.<sup>28</sup> Providers who do complete the necessary training may *want* to practice in their home towns or countries, but often find themselves without the resources needed to provide quality care. Their frustrations often drive them to migrate to bigger cities and eventually to resource-rich countries, where they can utilize their skills. As trained providers emigrate, there are even fewer physicians available to train the next generation.

Workforce issues are magnified in surgery due to the intensive training required of surgical providers—typically four or more years after completion of medical school—compared to general practitioners that may require one year of post-graduate training. Further, given the technical nature of surgery, there is an apprenticeship style to training, which differs from less interventional fields. The large perioperative team, including the anesthesia providers and specialized perioperative nurses, is another workforce-related challenge to providing safe and effective surgery.

### **Task Shifting**

Task shifting has been frequently implemented in LMICs to increase surgical capacity and decrease the burden on physicians. Task shifting may include surgical services provided by medical officers or general practitioners with apprenticeship training in specific surgical procedures, or anesthesia services provided by nurses or non-physician providers.<sup>29</sup> Because care is delivered by non-physician providers, many physicians and/or patients may feel uneasy about task shifting. However, it has been demonstrated that individuals without full surgical training can often perform curative procedures, including cesarean delivery, trauma-related procedures, orthopedic care and emergency conditions.<sup>30,31</sup> Another important consideration is that in resource-limited settings, the alternative to task-shifted surgical care is often no care at all.

### **Foreign Support**

Humanitarian crises or aid deployment often lead to influxes of foreign providers, including surgeons. The temporary influx of providers rarely increases long-term capacity and can be harmful due to lack of coordination of care and follow-up. Ethical dilemmas regarding standard of care and practice expertise are common.<sup>32</sup> Various practice models have been developed to maximize the ability of interested US surgeons to participate in the global surgical workforce while ensuring focus on longitudinal and sustainable care. Some small-group practices, for example, have developed rotating schedules that enable individual surgeons to practice abroad while maintaining a practice in their home countries.

### **Academic Partnerships**

Academic partnerships for treating non-surgical diseases have inspired several models of surgical partnerships that focus on developing the local surgical workforce, rather than simply substituting visiting surgical trainees.<sup>iii</sup> Some universities support “twinning programs”<sup>33,34</sup> in which providers from resource-limited settings visit hospitals in high-income countries to increase their technical knowledge and expand their areas of practice.<sup>35,36,37</sup> An important shortfall of many such partnerships remains the inherent misalignment of incentives among stakeholders, in which those from wealthy nations benefit the most.<sup>38</sup>

## **Surgical Capacity in Resource-limited Settings**

Accurately counting the number of trained surgical providers is a difficult task. The College of Surgeons of East, Central, and Southern Africa, an organization founded in 1999 with a commitment to train and support surgeons in Sub-Saharan Africa, operates in 10 countries in the region and has 830 registered members.<sup>39</sup> The West African College of Surgeons (founded 1960), Pan African Association of Surgeons (founded 1995), and the Association of Surgeons of South Africa (founded 1943) are other major surgical societies that work to represent registered surgeons and provide mentorship, training, and support to thousands of surgical providers on the continent with the aims of promoting surgical education and research.

Despite the challenges, there has been a concerted effort in recent years to develop tools and assess the capacity for surgical care in multiple resource-limited settings. There are three widely used standardized

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<sup>iii</sup> A list of these partnerships includes the UNC-Malawi surgical initiative, Indiana University’s AMPATH collaboration in Kenya, the Penn-Botswana partnership, and Harvard Medical School’s Program in Global Surgery and Social Change working in Liberia, Haiti and Rwanda, among others. A few new programs have been developed that facilitate the participation of faculty from high-income countries in training programs in LMICs. Examples of such immersive experiences include the Rwanda Human Resources for Health program and Seed Global Health, which launched in 2012 and 2013, respectively. These programs provide financial support to allow faculty from US institutions to practice and teach full-time in resource-limited settings.

survey tools: the WHO Situational Analysis Tool, the Harvard Humanitarian Initiative’s surgical capacity assessment tool, and the Surgeons OverSeas’ Personnel, Infrastructure, Procedures, Equipment and Supplies survey. Studies using these tools in sub-Saharan Africa reveal nearly universal under-investment in surgical care.

For example, the WHO Situational Analysis Tool was deployed in Liberian District Hospitals in 2008, five years after the conclusion of the Liberian Civil War, and revealed inadequacies in surgical infrastructure and human capital.<sup>40</sup> Rural Liberians still had limited access to life-saving health care. Services that donors favored, such as HIV testing and malaria treatments, were being implemented. This study supported the idea that disproportionate emphasis on specific interventions—often known as “vertical” programs—could leave health systems without the infrastructure and training necessary to address the diverse disease pathology found in resource-limited settings.<sup>41</sup>

The Harvard Humanitarian Initiative’s surgical capacity assessment tool used in Ethiopia in 2012 showed that shifting anesthesiology care to nurses alone was insufficient to bolster the surgical workforce. This study also supported the need for improved access to primary care by demonstrating the correlation between late presentation of disease and high surgical morbidity and mortality.<sup>42</sup>

In areas where data are scarce or survey tools cannot be employed for logistical reasons, modeling can assess surgical capacity. One such study examined ratios of operating theaters to hospital beds in 769 hospitals in 92 countries, representing seven geographical regions.<sup>43</sup> Data suggested that the lowest-income regions of the world, representing 2.2 billion people, had fewer than 2 operating theaters per 100,000 people and that approximately 20% of operating theaters worldwide were not equipped with pulse oximeters, a tool critical for basic perioperative monitoring.

## **The Future of Global Surgery**

As the field evolves from “calls to action” to implementation of surgical programs, delineating the value of surgical care for patients and populations will be key to monitor its impact. There is a wealth of information from past and present projects related to delivering surgical care around the globe that surgeons, public health experts, and policy makers can reference for identifying and implementing effective initiatives to deliver surgical care. These data will be key to scale the supply of surgical services to meet the demand for surgical services worldwide.

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