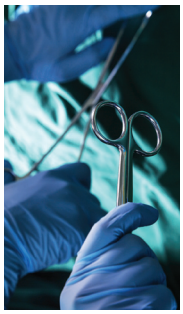

Chapter 12

Organization of Essential Services and the Role of First-Level Hospitals

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INTRODUCTION

Every country has some sort of system to provide surgical and other health services at various levels, with a progressive increase in the capacity to treat more complicated problems. Reliable evidence indicates that properly functioning small hospitals and health centers can deliver effective basic surgical services at very low cost; these surgical services can be one of the most cost-effective components of the public health system in low- and middle-income countries (LMICs) (Alkire and others 2012; Debas and others 2006; Gosselin, Maldonado, and Elder 2010; Gosselin, Thind, and Bellardinelli 2006; McCord and Chowdhury 2003). *Properly functioning* is a key phrase; a hospital lacking personnel trained in surgery and in the administration of anesthesia cannot provide major surgical procedures. Even minor surgery requires trained personnel. More than 50 percent of the disability-adjusted life years (DALYs) averted in a small hospital can derive from surgical treatment, (McCord and Chowdhury 2003) so the cost-effectiveness of these units is drastically reduced if this treatment is not available. Box 12.1 defines the three levels of hospital care.

Recommended Skills and Services

The World Health Organization (WHO) and others have provided descriptions of what services would be available at properly functioning first-, second-, and third-level facilities, and how such systems could function (Debas and others 2006; WHO 1992, 2003, 2010). The WHO has assisted countries in analyzing their current systems and asked them to make realistic plans to get from where they are to a point closer to the ideal. Chapter 67 in *Disease Control Priorities in Developing Countries*, second edition (DCP2), presents a detailed outline of what skills, services, and infrastructure would be available in an ideal district hospital and calculates the cost in 2004 U.S. dollars (Debas and others 2006).

This chapter considers, and generally follows, the recommendations of DCP2 and the WHO, discusses what is actually available in LMICs, and considers how to move from the current situation to an achievable improvement. The emphasis is on first-level hospitals—the lowest level hospital that provides major surgery—and the systems to support them.

Referral Systems

Referrals of surgical patients from lower levels such as clinics to first-level hospitals, as well as from first-level facilities to second- and third-level facilities, is an essential part of any system; however, in LMICs, the transport of referred patients is a major problem for families with low incomes. If surgical care is not available at an accessible first-level hospital, it is effectively beyond the reach of at least 1 billion people (Weiser and others 2008). This group includes 80 percent of the population

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Box 12.1

Levels of Hospital Care in Low- and Middle-Income Countries

Crucial treatment for surgical conditions can be available in clinics and dispensaries, especially treatment for surgical infections and simple trauma. However, the lack of trained staff, limited supplies, and unavailability of anesthesia seriously restrict the services that can be offered in these facilities, so most patients with important problems need to find hospitals (table B12.1.1).

The principal function of second- and third-level hospitals is to provide more complex clinical care to patients referred from lower levels; however, no agreed-on international definition determines which specific services should be provided at hospitals at the three levels in these settings. The range of services offered tends to vary substantially, even between third-level hospitals within the same country, as much because of historical accident as deliberate design. Also, almost all second- and third-level hospitals provide emergency services for local areas and thereby function as first-level hospitals to varying degrees.

Important differences exist among regions:

- In Sub-Saharan Africa, first-level hospitals are usually small facilities, serving populations of fewer than 500,000. They rarely have specialized physicians on staff. Surgical services are provided by general practitioners, often recent medical school graduates. In some countries (notably Malawi, Mozambique, Tanzania, and Zambia), nonphysician clinicians (NPCs) have been trained to do major surgery.
- In South Asia, first-level hospitals are larger and commonly serve much larger populations of 1 million to 2 million or more. They usually have several specialists on staff. Nonphysicians rarely perform major surgery.
- In Latin America and the Caribbean, small hospitals often provide first-level surgical services to populations of fewer than 100,000. They usually have a surgeon and an obstetrician, and nonphysicians do not perform major surgery.

Table B12.1.1 Definitions of Levels of Hospital Care

Level of care	Alternative terms commonly found in the literature
First-level hospitals: Few specialties—mainly internal medicine, obstetrics and gynecology, pediatrics, and general surgery; often only one general practice physician or a nonphysician practitioner; limited laboratory services available for general but not specialized pathological analysis; from 50 to 250 beds.	Primary-level hospital District hospital Rural hospital Community hospital General hospital
Second-level hospitals: More differentiated by function with as many as 5 to 10 clinical specialties; from 200 to 800 beds.	Regional hospital Provincial hospital (or equivalent administrative area such as county) General hospital
Third-level hospitals: Highly specialized staff and technical equipment—for example, cardiology, intensive care unit, and specialized imaging units; clinical services highly differentiated by function; could have teaching activities; from 300 to 1,500 beds.	National hospital Central hospital Academic or teaching or university hospital

Source: Adapted from Mulligan and others 2003.

of Sub-Saharan Africa and 60 percent of the population of South Asia, as well as large parts of the populations of Latin America and the Caribbean and middle-income countries (MICs) in other regions.

Distance and lack of transportation restrict patient travel outside of local areas, but the real barrier is cost. Transportation can generally be found, but the cost usually falls on the patient. Additional high costs include transportation of and accommodations for family members to accompany patients, the opportunity costs of family members taken away from work, medical supplies not provided by hospitals, and often "informal payments"

to hospital staff. Moreover, many patients are not in any condition to withstand a long trip, even if they can afford it.

The need for first-level hospitals is not limited to rural areas. In cities, population growth can overwhelm the third-level central hospitals; smaller urban hospitals are too often unable to provide 24-hour emergency services, except in private facilities that are too costly for most urban residents in LMICs.

Capacity Constraints

These issues place first-level hospitals at the center of any system to provide surgery in LMICs (Kushner and others 2010). Major constraints limit their capacity. These constraints reflect the extremely low budgets within which these hospitals must function—usually less than US$30 per day per patient in Sub-Saharan Africa (Kruk and others 2010)—and include the following:

- Lack of trained staff
- Inadequate supplies
- Inadequate maintenance of basic equipment
- Poor condition of buildings and intermittent or absent water and electricity
- Transportation challenges that restrict the effectiveness of a functioning referral system

FIRST-LEVEL HOSPITALS: POTENTIAL VERSUS REALITY

The Ideal

Although most health systems are organized as a pyramid, with primary care facilities at the base and national third-level hospitals at the apex, the specifics vary among countries (Chatterjee, Levin, and Laxminarayan 2013; Galukande and others 2010; Lebrun and others 2013; Zafar and McQueen 2011). In most of Sub-Saharan Africa, dispensaries and health centers provide primary care, deliver newborns, and usually perform minor surgery. When patients need major surgery, they are meant to be referred to a district (first-level) hospital, usually with 100 to 200 beds, serving a population of 100,000 to 500,000 (Galukande and others 2010). In Bangladesh, India, and Pakistan, the smallest unit regularly providing major surgery is also called a *district hospital*, but the districts are much bigger, usually with a population of 2 million or more (Chatterjee, Levin, and Laxminarayan 2013; Lebrun and others 2013; Zafar and McQueen 2011). In Latin America and the Caribbean, many quite small "basic hospitals" provide first-level surgical functions for populations of fewer than 100,000, and refer patients to a fairly extensive network of second- and third-level hospitals (Lebrun and others 2012; Solis and others 2013).

However the pyramid is structured, the constraints listed previously seriously limit the way it can function. The two most important and difficult of these constraints are the shortage of trained staff, which limits the services that can be provided, especially in first-level hospitals, and the weakness of the referral system, which often makes it impossible to send patients to a higher level, where more highly trained staff may be available. Clearly, the two problems work against each other. If trained staff are not available, patients should be referred. If they cannot be referred, they often do not receive appropriate treatment, which can lead to death or serious disability. Although the emphasis today needs to be on initiatives to increase the capacity of peripheral first-level hospitals, access to transportation and referral can reduce the need for this expansion of capacity and lead to a more efficient system.

In DCP2, Debas and others (2006) list the resource requirements for surgical services in ideal LMIC clinics and hospitals, based on their own estimates and those of the WHO (table 12.1).

The Reality

Table 12.2 presents the actual situation in 3 first-level hospitals in Tanzania, as well as the averages for 11 hospitals in Bolivia and 7 in Bangladesh.

- The Kasulu District Hospital is typical of the second-level hospitals in Tanzania and most other Sub-Saharan African countries, except that the population served is more than twice the national average. The one physician also serves as the district medical officer, an administrative job that occupies most of the physician's time. No specialists and no one fully qualified in surgery or obstetrics is on staff. Assistant medical officers (NPCs with six months of formal surgical and obstetrical training) perform the surgery.
- The Maweni Regional Hospital serves as the first-level hospital for two districts and receives few patients as referrals for higher-level care, a common situation in Tanzania. There are six physicians, including one academically qualified pediatrician, but no qualified surgeon or obstetrician. NPCs perform all of the surgery.
- The St. Francis Designated District Hospital is a large, faith-based hospital that serves as a designated first-level hospital for two districts. Although it has been named a regional referral hospital, it still serves a first-level function because a new first-level hospital has not yet been created. The six qualified specialists

Table 12.1 Resource Requirements for Surgical Services by Level of Care: The Ideal

Category of requirement	Community clinic	100-bed district (second-level) hospital	Third-level hospital
Infrastructure	Weatherproof building (100 square meters) Storage space Clean water supply Power supply	Inpatient facility of 100 beds, including several wards and an isolation ward Outpatient facility including an emergency room; operating rooms (at least two: one clean, one contaminated) Labor and delivery rooms Recovery room or intensive care unit Blood bank Pharmacy Clinical laboratory Radiology and ultrasonography suite	A major facility providing • Full emergency services with advanced diagnostic services • Inpatient wards for complex general medical and surgical care • Various types of specialty services • Several delivery rooms and operating rooms • One or more recovery rooms and intensive care units • Rehabilitation and occupational therapy facilities
Equipment and supplies	Furniture Refrigerator Blood pressure machine Minor surgical trays Sterile and burn dressings Autoclave Intravenous sets and solutions Bandages and splints Drugs: local anesthetics, nonsteroidal anti-inflammatory drugs, antibiotics, tetanus toxoid, silver nitrate ointment, oxytocin, magnesium sulfate Wireless communication equipment Materials for recordkeeping	Anesthetic machines and inhalation gases Monitors (electrocardiogram, blood pressure, pulse oximetry) Fully equipped operating room Fully equipped delivery room Fully equipped recovery room or intensive care unit Respirators and oxygen supply Blood products and intravenous fluids Basic microbiology equipment Pharmaceuticals, (anesthetics, analgesics, antibiotics) Surgical materials (drapes, gowns, dressings, gloves), and other consumables (disposable equipment and devices)	Equipment and supplies as for the 100-bed (first-level) hospital, plus all required equipment and supplies to undertake the range of routine and complex services provided
Human resources[a]	Nurse or nurse equivalent Skilled birth attendant Orderly	Nurses (50+) Midwives (5+) Anesthetists (2–3) Anesthesiologist (1)[b] Primary care physicians (4)[c] Obstetrician/gynecologist (1 or 2) General surgeons (2) Pharmacy assistants (2) Pharmacist (1)[b] Radiology technician (1) Radiologist (1) Physiotherapist (1)	Nurses (100+) Midwives (20+) Anesthetists (5) Anesthesiologists (3) Primary care physicians (10) Obstetricians and gynecologists (5) General surgeons (5) Orthopedic surgeon (1) Pharmacy assistants (2) Pharmacist (1) Radiology technicians (5)

table continues next page

Table 12.1 Resource Requirements for Surgical Services by Level of Care: The Ideal (continued)

Category of requirement	Community clinic	100-bed district (second-level) hospital	Third-level hospital
			Radiologists (2)
			Physiotherapists (5)
			Neurosurgeon (1)[b]
			Cardiac surgeon[b]
			Reconstructive surgeon[b]

Source: Debas and others 2006.
a. The variability in the size and the complexity of services provided by third-level hospitals makes it difficult to describe a standard third-level hospital; the human resource needs given in the table represent what is thought to be minimally adequate.
b. Desirable but not absolutely necessary.
c. May be a general internist, general practitioner, or general pediatrician.

Table 12.2 Human Resources and Infrastructure at Selected First-Level Hospitals in Three Regions: The Reality

	Kasulu District Hospital, Tanzania, 2010	Maweni Regional Hospital, Tanzania, 2013	St. Francis Designated District Hospital, Tanzania, 2013	11 "basic" (first-level) hospitals Bolivia,[a] 2012	7 district (first-level) hospitals, Bangladesh,[a] 2013
Population served	677,000	850,000	500,000+	134,000	1,879,000
Beds	200	256	372	54	140
Admissions per year	12,900	25,800	18,140	3,644	20,000
Operating rooms	3	3	3	2.1	2.4
Physicians	1	6	14	29.4	29.3
General surgeons	0	0	2	3.4	1.6
Obstetricians and gynecologists	0	0	3	3.5	1.4
Orthopedic surgeons	0	0	1	1.4	1.1
Anesthesiologists	0	0	2	3	1
Nurses	61	57	126	24.5	50.5
Beds per nurse	3.3	4.5	3.0	2.2	2.8
Nonphysician clinicians	23	29	8	0	0
Physicians and nonphysician clinicians per 100 beds	12	14	6	54	21

Sources: Kruk and others 2010; Lebrun and others 2012, 2013.
a. Average for all hospitals reviewed.

provide approximately 50 percent of the surgery, and NPCs provide the remainder.

- Bolivia, a lower-middle-income country with a large, very poor population, has trained enough physicians to be able to staff its first-level hospitals with qualified specialists.
- In Bangladesh, as in India, Pakistan, and Sri Lanka, districts are much larger (usually 2 million people or more); first-level surgery is rarely available below the level of the district hospital. Qualified surgeons, obstetricians, and orthopedists are usually present.

Data are not available from these hospitals to permit a calculation of nursing hours per patient-day. One staff nurse per bed is normally required to achieve the usually recommended five to six hours per patient per day for an average hospital (Coffman, Seago, and Spetz 2002; McHugh, Berez, and Small 2013; Needleman and others 2011). The number of beds per nurse far exceeds this level in all of these hospitals.

Surgical and obstetrical specialists are rarely available in Sub-Saharan African first-level hospitals, which typically have one or two general practitioners

(often a recently graduated doctor) for whom surgery is one of many clinical and administrative responsibilities. Tanzania is one of several Sub-Saharan African countries that have trained NPCs to provide basic surgery at this level, especially for obstetrical emergencies. In Mozambique, this training is a three-year program focused on all types of basic emergency surgery; but in most countries with these cadres, surgery and obstetrics are part of a course designed to produce general practitioners (see chapter 17).

Virtually every country has a private health sector, which is often divided into charitable facilities (usually faith based) and for-profit facilities. In much of Latin America and the Caribbean, multiple systems work in parallel: a public system for the poorest; a system serving those with insurance usually derived from salaried employment; and a private sector for the more affluent segment of the population (Lebrun and others 2012; Solis and others 2013).

In India, where the private sector accounts for 78 percent of health expenditure (Kumar and others 2011), the supply of medical school graduates is large, and in some places, excessive. In Sub-Saharan Africa the private health sector is much smaller but is growing rapidly, as is the supply of graduate doctors. In both South Asia and Sub-Saharan Africa, no matter how large the supply of doctors, persuading physicians, especially specialists, to work in rural areas or to serve the poor majority in the cities has been difficult. In Latin America and the Caribbean, the number of physicians is much higher, and many first-level hospitals, even in lower-middle-income countries such as Bolivia and Nicaragua, have specialists (Lebrun and others 2012; Solis and others 2013).

In many Sub-Saharan African countries, mission hospitals (faith-based) can offer to serve as the district (first-level) hospital for a specified area. In Tanzania, for example, if accepted as a "designated district hospital," these faith-based hospitals receive government support for salaries and supplies, and the government does not provide another first-level hospital for that area.

Everywhere, almost all of the second- and third-level hospitals act as first-level hospitals for local emergencies.

Table 12.3 presents the surgical volume and procedures in the same hospitals described in table 12.2. The detailed information presented in these tables is not available on a national scale for any of these countries, but the selected hospitals are probably typical for Latin America and the Caribbean, South Asia, and Sub-Saharan Africa. In Tanzania, private (usually faith-based) hospitals that have become designated district hospitals often have several surgical specialists on staff, and some of them have a larger number of nurses. Second-level hospitals are meant to be referral hospitals, but many in Sub-Saharan Africa have few or no surgical specialists and primarily function as larger first-level hospitals (Sanders and others 1998; Siddiqi and others 2001). South Asia has more physicians and specialists for a given population than Sub-Saharan Africa and Latin America and the Caribbean countries usually have many more than other LMIC regions. In Latin America and the Caribbean, this larger professional force is reflected

Table 12.3 Current Surgical Volume and Major Procedures Performed at Selected First-Level Hospitals in Three Regions

	Kasula District Hospital, Tanzania, 2010	Maweni Regional Hospital, Tanzania, 2013	St. Francis Designated District Hospital, Tanzania, 2013	11 "basic" (first-level) hospitals, Bolivia,[a] 2012	7 "district" (first-level) hospitals, Bangladesh,[a] 2013
Total operations per year	893	915	2,034[c]	730	3,215
General surgery	99 (11%)	119 (13%)	252 (12%)	284 (39%)	845 (26%)
Obstetrics and gynecology	635 (71%)	499 (55%)	1,386 (68%)	311 (43%)[b]	1,077 (33%)
Other	159 (18%)	297 (32%)	396 (19%)	135 (18%)	1,293 (40%)[c]
Population served	677,000	850,000	500,000	134,000	1,879,000
Operations per specialist	n.a.	n.a.	339	88	784
Operations per 100,000 population	132	108	407	545	171

Sources: Kruk and others 2010; Lebrun and others 2012, 2013.
Note: % = percentage of total annual operations that fall within a category; n.a. = not applicable (no specialist surgeons).
a. Average for all hospitals reviewed.
b. Average for hospitals in towns with no maternity hospital.
c. Includes 717 orthopedic operations; 349 ocular operations; and 199 ear, nose, and throat operations.

in adequate (even excessive) numbers of physicians and specialists in small first-level hospitals (Lebrun and others 2012; Solis and others 2013).

In Bangladesh as well as Pakistan, Sri Lanka, and much of India, most major surgery is provided at the district level or above. District hospitals in these countries serve populations of 1 million to 2 million people. These hospitals have specialists available, but the populations served are so large that the numbers of major operations per 100,000 people is comparable to those in Sub-Saharan Africa (Chatterjee, Levin, and Laxminarayan 2013; Lebrun and others 2013; Zafar and McQueen 2011).

The "population served" by these five hospital groups is an approximation given that patients often move in and out of an area to seek hospital care. In some places, such as Kasulu in tables 12.2 and 12.3, transportation is so difficult that practically no movement of patients to other districts occurs, so the population cited is the true catchment area.

In all three regions, operations for obstetrical emergencies are the largest single component of surgical activity; in Tanzania they are by far the most common kind of surgery. All over the world women are aware that these operations can prevent maternal, fetal, and newborn death. The demand for emergency obstetrical surgery is limited primarily by persistent restricted access to hospitals that can provide surgical care. Because the operations are common, relatively safe, and uncomplicated, general practitioners and NPCs have been trained to perform them with considerable success (McCord and others 2009; Pereira and others 1996). Still, met need for obstetrical surgery is 25 percent or less in most of Sub-Saharan Africa and much of South Asia (Paxton, Bailey, and Lobis 2006; Pearson and Shoo 2005). Latin America and the Caribbean have a much larger supply of obstetrical specialists working in first-level hospitals and a correspondingly higher met need and lower maternal mortality, even in very poor countries (Bailey 2005; Hogan and others 2010).

More general surgical operations (including trauma, acute abdomen, and other surgical emergencies) are performed in hospitals that have specialists available, but estimates indicate that in all regions, the met need for these emergencies is even lower than the met need for obstetrical care (chapters 5 and 6). The list of operations actually performed in one year in eight first-level hospitals in Sub-Saharan Africa (table 12.4) shows

Table 12.4 Annual Major Operations at Eight First-Level Hospitals in Sub-Saharan Africa

Percent, except as noted

	Tanzania, 2007		Mozambique, 2007		Uganda, 2006			
Procedure	**Bagamoyo**	**Kasulu**	**Chokwe**	**Catandica**	**Mityana**	**Kiryandongo**	**Buluba**	**Iganga**
Major nonobstetric (number)	428	242	171	133	456	80	125	711
Amputation	0	3	2	8	0	1	10	1
Appendectomy	11	2	6	2	2	0	1	4
Circumcision	0	1	13	18	1	68	1	0
Excision	0	10	0	5	0	0	0	0
Herniorrhaphy	22	24	17	20	41	16	24	29
Hydrocelectomy	13	8	4	20	2	1	4	0
Hysterectomy (elective)	6	2	9	0	5	1	2	17
Laparotomy	6	26	20	10	3	5	10	43
Open fracture reduction	3	0	2	0	31	0	0	0
Other	9	24	29	17	15	8	48	5
Obstetric (number)	431	883	377	110	754	35	100	915
Tubal ligation	6	11	7	4	10	14	0	0
Cesarean	61	62	80	73	63	74	88	88
Evacuation of uterus	30	22	0	1	19	0	0	0
Other	3	5	13	23	8	11	12	12

Source: Galukande and others 2010.

Note: Data are based on annual aggregate hospital statistics extracted from hospital information systems.

Table 12.5 Surgical Procedures That Could Be Managed at First- and Second-Level Hospitals

First-level hospitals with general practitioner surgeon or nonphysician clinician surgeon	Second-level hospitals with qualified specialist available (all first-level operations, as well as the following)
Emergency obstetrical surgery (including repair of ruptured uterus and emergency hysterectomy)	Elective major gynecological surgery
Salpingectomy for ruptured ectopic pregnancy	
Evacuation of the uterus	
Appendectomy	Gall bladder and biliary tract
Herniorrhaphy (elective repair and emergency)	Intestinal resection and repair
Intestinal obstruction	
Suture of intestinal perforation	
Plication of perforated ulcer	Operation for bleeding peptic ulcer
Colostomy	
Tube thoracostomy	
Cricothyroidotomy	
Closed fracture reduction and stabilization	
Open fracture management	
Amputation	
Minor burn care	Major burn care
Conservative management of head injury	Drainage of epidural and subdural hematoma
Wound care and repair	
Surgical infections	

that many of the problems in table 12.5 that could be addressed in these facilities were not treated at all. Wide variations exist among hospitals; in some cases, there was complete omission of operations that are urgently needed, not complicated, and within the competence of general practitioners with brief surgical training (for example, open reduction of compound fractures). Such omissions can lead to a major loss of cost-effectiveness in these hospitals.

Closed fracture treatment and some uterine evacuations may not have been recorded in the operating room logbooks (the source of data for this study) because they are not always carried out in the main operating rooms. Trauma is not listed separately, but the very small number of open fracture reductions (with the exception of Kiryandongo) indicates that major trauma either is not being seen or is being referred elsewhere.

If general anesthesia and a qualified surgeon are available in a first-level hospital, all of the procedures in table 12.5 can be done at this level, which would be ideal, since referral often is not possible or practical. If all of the procedures in the first-level hospitals column could be mastered by the staff available at this level, few patients would need to be referred. The ideal will be to put fully qualified surgeons and obstetricians in all hospitals, but better training of the general practitioners and NPCs now serving as the only surgeons in many first-level hospitals could bring these facilities closer to the ideal.

HEALTH CENTERS AS A SURGICAL PLATFORM

Health centers (clinics, usually without inpatient beds except for normal deliveries) deliver babies, suture small lacerations, and drain small abscesses, but very few provide more comprehensive services. The primary reason for the limited range of services is the limited training available to health care personnel; another reason is the shortage of medical personnel of all kinds, which results in heavy workloads and makes additional responsibilities and skill acquisition a problem.

As these issues are resolved, it will be important to ensure that basic surgical training is provided. The list of

services that could be provided at the health center level is substantial and includes the following:

- Treatment of simple fractures, burns, and other injuries
- Resuscitation of major trauma patients: control of bleeding, airway maintenance, fluid replacement, and shock prevention and treatment
- Tubectomy, intrauterine device insertion, and other contraceptive procedures
- Early management of postpartum bleeding, eclampsia, and prolonged labor; suture of perineal lacerations; extraction of retained placentas
- Uterine curettage for incomplete abortion
- Circumcision
- Removal of foreign bodies in eyes, ears, and noses

A functioning referral system with patient access to transportation will increase the efficiency and the effectiveness of these services.

BURDEN OF SURGICALLY TREATABLE DISEASE AND THE UNMET NEED

This volume has shown that universal provision of a package of essential surgical services would avert an estimated 1.5 million deaths per year, or 6–7 percent of all avertable deaths in LMICs (Debas and others 2006; Mock and others 2015). For many of the conditions treated by this package, surgical care is the only option. There are no preventive strategies for many pregnancy-related complications or for most general surgical emergencies. Similarly, road traffic crashes and other injuries are increasing in LMICs, and there is a substantial and growing burden of chronic, congenital, and acquired conditions that can be treated surgically.

Surgery for Obstetrical Emergencies

The need for emergency obstetrical surgery is relatively easy to calculate because the birth rate is almost always known, and it is generally accepted that 10 percent to 15 percent of births are likely to have complications, most of them requiring surgical treatment, that threaten the lives of the mothers or newborns. There are important exceptions: El Salvador, Honduras, and Sri Lanka, for example, have reduced the unmet obstetrical need to 25 percent or lower, with a corresponding drop in the maternal mortality ratio to well below 100 per 100,000 births (AMDD Working Group 2003; Paxton and others 2005).

Surgery for Trauma and General Surgical Emergencies

The surgical burdens due to trauma and general surgical emergencies are harder to estimate, but the burdens are unquestionably high; for trauma, the estimated burden is much higher than that due to obstetrical emergencies, even though trauma has been found to be a relatively small part of surgical activities in hospitals in LMICs (Canoodt and others 2012; Mock and others 2012; Mock and others 1998). The reason for this discrepancy in met need between traumatic and obstetrical emergencies seems clear: childbirth is a predictable event; when emergencies occur, there is usually enough time to bring patients to hospitals, even distant ones. That the unmet need for emergency obstetrical care is still greater than 80 percent in most of Sub-Saharan Africa is a measure of the very serious deficiencies in the health systems in the region. That the unmet need has been less than 25 percent in Sri Lanka for more than 20 years shows that these deficiencies can be corrected, even in LMICs.

Most of the causes of the unmet need for trauma care lie outside of the hospitals. Immediate emergency assistance and prompt transfer for definitive care are often needed and rarely available in LMICs; 21 percent of serious vehicle accident victims die before reaching a hospital in the United States compared with 51 percent in Ghana (Henry and Reingold 2012; Mock and others 1998). Emergency resuscitation is usually not well organized in LMICs, neither before nor after arrival at hospitals. Furthermore, the general practitioners or NPCs available for emergencies at most first-level hospitals are not well trained for trauma care after resuscitation.

Surgery for Disabling Conditions

Most LMICs have a high burden of surgically treatable disabling conditions (Beard and others 2013; Petroze and others 2013; Wu, Poenaru, and Poley 2013). Specialists visiting first-level hospitals can effectively treat cataracts, complicated fractures, burn contractures, congenital anomalies, vesico-vaginal fistulas, and many other conditions that are beyond the capacity and skills of the permanent staff of first-level hospitals; during the same visit, the specialists can provide in-service training and supervision. Many successful programs bring specialists to these hospitals, but too often the visits are sporadic and uncoordinated. Regular visits to provide continuity and follow-up can greatly increase the effectiveness of these programs (see chapter 13).

SURGICAL OUTCOMES AT FIRST-LEVEL HOSPITALS

Of the surgical patients seen in first-level hospitals, 50 percent to 80 percent present with emergencies. Problems with transportation to a higher-level facility

and the attendant costs of families' travel place a very high premium on managing these cases at first-level facilities. Fortunately, the surgical treatment needed for these emergencies is usually straightforward, relatively simple, and well standardized. Outcomes are remarkably good, given reasonable training to manage a relatively short list of problems, even when a fully qualified surgeon is not available.

Surgery for Obstetrical Emergencies

Obstetrical emergency surgery is the most common surgical problem presenting in first-level hospitals. The standard established in the United Nations process indicators (Paxton, Bailey, and Lobis 2006) calls for case fatality rates of 1 percent or less for mothers with obstetrical complications requiring hospital treatment. Many hospitals in LMICs, including those in which this work is usually done by NPCs, come close to this target, with mortality rates less than 2 percent (McCord and others 2009; Pereira and others 1996).

Surgery for General Emergencies

General surgical emergencies, including acute abdominal conditions, surgical infections, thoracic emergencies, and airway obstruction, can almost always be managed at first-level hospitals, with overall mortality rates of less than 5 percent (see chapter 4).

Surgery for Trauma Emergencies

Trauma can lead to very serious and complicated problems. Unfortunately, most seriously injured patients die before arrival, leaving first-level hospitals with patients who usually have treatable problems and a smaller group that can be stabilized and transferred. Because the number of accident victims is so high, caring for patients with manageable problems and treating them with straightforward procedures to prevent death and disability should be the most important surgical activity in first-level surgical systems. This potential is not realized in most LMICs, primarily because transportation systems to bring injured patients to hospitals safely are so poorly developed.

Postsurgical Treatment Needs

Successful operations will cure most patients requiring emergency surgery at first-level hospitals, and these patients usually will not need further treatment. A few exceptions exist: patients with peptic ulcers will need medical treatment for ulcer disease; many fractures will not have a positive outcome without follow-up basic physiotherapy; and patients with emergency relief of sigmoid volvulus will need resection of the sigmoid intestine to prevent recurrence, which is common.

Serious operative complications are also relatively rare. Infections are usually minor, and the proper use of anesthetics for these short operations is safe and effective. This surgical capacity relies on medical personnel, usually nurses, who have been trained to administer anesthesia, and surgeons who know when to take simple measures to prevent major infections, such as leaving the skin open with subsequent secondary closure in heavily contaminated operations, and using antibiotics appropriately.

SURGICAL COST AND COST-EFFECTIVENESS

When DALYs averted were calculated for all patients discharged from a first-level nongovernmental hospital in Bangladesh, surgical and obstetrical patients contributed the largest share by far: 80 percent of 3,309 DALYs averted in three months. The cost per DALY averted for the whole hospital was US$11, which was comparable to the cost per DALY of many public health interventions at that time (McCord and Chowdhury 2003).

Debas and others (2006) estimate a cost per DALY averted of the surgical services in the ideal first-level hospital described in table 12.1 at US$33 in Sub-Saharan Africa, US$38 in South Asia, and US$95 in Latin America and the Caribbean. Gosselin, Thind, and Bellardinelli (2006); Gosselin and Heitto (2008); and Gosselin, Maldonado, and Elder (2010) calculate US$32.78 per DALY averted for surgical services in a nongovernmental hospital in Sierra Leone, and US$172, US$223, and US$77 in nongovernmental trauma centers in Cambodia, Haiti, and Nigeria, respectively. These directly observed cost-per-DALY averted estimates, all of them in nongovernmental facilities (and three of the four were hospitals that did not provide obstetrical care), need to be supplemented by other studies in LMICs, with a focus on government hospitals, local private hospitals, and hospitals unable to provide major surgical services. It is likely that small, Sub-Saharan African government hospitals with active surgical services will have costs per DALY averted comparable to the Bangladesh hospital, given that hospital costs in these government hospitals are comparable (table 12.6). Government third-level hospitals and private hospitals are more costly and probably will be less cost-effective (Barnum and Kutzin 1993; Chatterjee, Levin, and Laxminarayan 2013).

Conducting cost analysis in hospitals in LMICs, especially in public hospitals, is difficult, and not many

Table 12.6 Hospital Costs and Surgical Services Costs at Hospitals in Sub-Saharan Africa (2010) and India (2012)

U.S. dollars

	Bagamoyo District Hospital, Tanzania	Kasulu District Hospital, Tanzania	Chokwe District Hospital, Mozambique	Hospital Catandica, Mozambique	Mityana Hospital, Uganda	Kiryandongo Hospital, Uganda	Private Hospital, India	District Hospital, India	Private Teaching hospital, India	Third-level Hospital, India
Total annual expenditures	329,716	800,662	286,593	155,908	251,448	369,419	13,758,650	2,315,165	4,606,788	10,152,380
Surgery annual expenditures	31,700 (9.6%)	84,492 (10.6%)	19,358 (6.7%)	11,376 (7.3%)	33,980 (13.5%)	33,470 (9.1%)	1,158,319 (8.4%)	181,468 (7.8%)	915,350 (19.9%)	517,657 (5.1%)
Beds	125	135	214	91	100	100	200	400	655	778
Admissions	6,545	10,296	8,089	3,861	9,106	5,713	5,925	25,871	19,139	205,949
Expenditure per bed	2,640	5,933	1,341	1,714	2,510	3,690	68,795	5,788	7,034	13,049
Expenditure per admission	53.02	85.24	43.33	42.11	39.96	68.81	134.54	7.58	6.63	11.81
Expenditure per day	17.70	26.84	10.79	18.16	11.22	22.05	n.a.	n.a.	n.a.	n.a.
Operations	980	2,045	601	256	1,484	248	2,508	3,623	2,768	3,219
Expenditure per operation	56.41	98.82	41.54	49.03	55.34	304.28	461.85	50.10	330.69	160.81

Source: Chatterjee, Levin, and Laxminarayan 2013; Galukande and others 2010; Kruk and others 2010.

Note: % = annual surgical expenditure as a percentage of total annual expenditure; n.a. = data not available.

comprehensive cost reports dealing with LMIC hospitals are available. Government funds come from different sources; there are nongovernmental gifts, grants, and programs; supplies and equipment may be provided in kind; the contribution of "cost recovery" (patient payments to the hospital) is often not well documented; and "informal payments" are usually not documented at all. Table 12.6 summarizes some of the findings in three analyses of annual recurrent cost, including depreciation of buildings and equipment, for several hospitals in India and Sub-Saharan Africa. No estimates of DALYs averted were available. Cost per surgical operation for most of the second-level hospitals in both regions was low and comparable. In the one Sub-Saharan African second-level hospital with high cost per operation, surgical activity was very low. The cost per operation in the single Indian third-level hospital was three times higher than the average for the six low-cost second-level hospitals; in the Indian private hospitals, it was seven times higher. There are some inconsistencies in these reports; the very high number of admissions to the Indian third-level hospital probably includes both inpatient admissions and outpatient visits.

In all public hospitals, personnel costs were considerably higher than those of any other cost centers within the hospital. Salaries were low, and staff shortages were pervasive, so relatively high personnel costs probably reflect inadequate funding for supplies, maintenance, and transportation, and certainly not large numbers of staff or excessive salaries. More analysis of this kind is urgently needed and could be combined with estimates of DALYs averted to better define the true cost and cost effectiveness of properly functioning hospital systems in LMICs.

Reasons for the Cost-Effectiveness of First-Level Hospitals

The high cost-effectiveness of surgery in a small first-level hospital is due to three factors: self-selection, effective and inexpensive technology, and efficient use of limited resources. Furthermore, the most common operations performed in first-level hospitals are very effective and low-cost procedures, including cesarean sections, acute abdominal emergencies, and herniorrhaphies.

- *Self-selection*: Few people want to be in a hospital, but the resource-starved hospitals in LMICs can be especially unpleasant places. People quickly come to know what services a hospital can and cannot provide, and they generally make intelligent choices with respect to the places where service provided is worth the cost in time, money, and discomfort. Very few patients with cancer select first-level hospitals for treatment in LMICs, but many women experiencing pregnancy-related complications will seek competent obstetrical care, if available. If the outcomes are suboptimal at a particular facility, patients will find better ones (Kruk and others 2009). The end result is a patient population that has self-selected itself so that individuals who seek treatment can be effectively treated.
- *Effective, inexpensive technology*: Operating rooms are not expensive; affordable antibiotics, anesthesia, and other supplies are usually effective. Training and mobilizing staff members is the largest expense. The total hospital cost in a first-level hospital is usually less than US$30 per patient-day (Kruk and others 2010), compared with US$1,000 per day or more in high-income countries (HICs), and surgical services cost is a fraction of total hospital costs (table 12.6).
- *Resource-limited hospitals*: Hospital budgets, even though they are a major part of total health budgets in LMICs, are low by any international standard. Despite this limitation, these hospitals are able to achieve good results in patient care. Undoubtedly, they could do better with more resources, but this relative starvation keeps costs down. One of the most important reasons for further analysis of the cost-effectiveness of different levels of hospitals in different places is to determine the most efficient ways to improve and expand services delivery with minimum increases in cost.

OBSTACLES TO LOW COST AND HIGH COST-EFFECTIVENESS

Not every hospital is cost-effective. The third-level hospitals and the private hospitals in table 12.6 are much more expensive than the smaller, first- and second-level government or nongovernmental facilities. Anything that diverts patients from low-cost hospitals to higher-cost, third-level ones increases the costs of the whole system and lowers the effectiveness of the first- and second-level hospitals.

Fixed expenses, notably for personnel, are the major component of hospital costs, so the cost per unit of service delivery rises when utilization is low.

Training

Less-than-optimal training may be the most important contributor to a reduction in cost-effectiveness. First-level hospitals in LMICs usually do not have

a fully qualified surgeon, obstetrician, or orthopedist on staff. General practitioners or NPCs generally learn to treat obstetric emergencies, but they often refer serious trauma and acute abdominal emergencies to higher-level facilities. If patient transfer could be made efficient and inexpensive, this process might work well. However, in many places, most transferred patients never arrive at the referral hospitals (Urassa and others 2005); death en route is common. Moreover, the receiving hospitals may be no better able to provide care than the hospitals from which the patients were sent (Grimes and others 2011; Siddiqi and others 2001). Patients bypass hospitals known to refer often, reducing surgical volume to inefficient levels. The operations and surgical conditions listed for first-level hospitals in table 12.5 are all within the competence of general practitioners or NPCs, given appropriate training. A six-month program in a busy second-level facility could provide substantial benefits. If this training could be combined with follow-up in-service training and supervision, the capacity and outcomes could be further improved.

Anesthesia

Major surgery usually requires general or spinal anesthesia. Doctors, nurses, and NPCs are not routinely trained to administer anesthesia. Many first-level hospitals do not perform surgery or perform very limited surgery simply because they lack trained staff to administer anesthesia. This relatively simple staff deficiency can be readily addressed. A one- or two-year course for nurses or NPCs can produce a sufficient level of competence for the safe administration of general and spinal anesthesia; a six-month course can be enough for hospitals to make spinal and Ketamine anesthesia available.[1] The same short course can produce competency in the resuscitation of patients with severe trauma, blood loss, or respiratory insufficiency.

Poor Quality of Service and Low Utilization

Poor quality of patient care reduces the number of positive outcomes and is a common reason for low utilization. Low utilization, in turn, reduces the experience of hospital staff and can lead to even poorer outcomes.

Informal Payments

The issue of informal payments has two components. The first is that hospitals with inadequate inventories ask patients to purchase medicine and other needed supplies, which adds considerably to patients' costs. The second component is outright corruption in the form of payments to staff for presumably better service; in some areas this abuse can more than double the costs to patients (Lewis 2007). Increased costs plus the associated loss of confidence in hospital staff can lead to further reductions in utilization and increase the cost per unit of service.

Epidemiological Transition

The epidemiological transition (from infectious to noninfectious, degenerative disease) is in full swing in MICs and among the upper classes in many low-income countries, with consequent increases in the incidence of cancer, diabetes, and complications from arteriosclerosis. Surgery for these conditions is generally more complicated and often will not be curative; the underlying disease remains and complications of the disease can recur. Costs are higher and cost-effectiveness is lower. Universal health coverage is increasing, and treatment for degenerative diseases certainly cannot be excluded, but health budgets in LMICs will not support, for example, the universal availability of cardiac surgery for coronary artery disease. Fortunately, diabetes, arteriosclerosis, and many cancers are preventable. Energetic efforts at primary and secondary prevention will pay off in lower hospital costs. The elimination of tobacco use and better management of hypertension could be the most important activities.

New Technology

New diagnostic and therapeutic technologies are usually expensive and have the further disadvantage of imposing an additional training burden to teach staff to use and maintain equipment. There are exceptions:

- Replacement lenses for cataract operations are made in India and Nepal at very low cost.
- The mesh for hernia repair greatly improves long-term results; mosquito netting seems to work well, but factories in LMICs could produce a standardized, sterile product at low cost.
- The pulse oximeter is a simple, sturdy, and relatively inexpensive electronic instrument that can greatly improve the safety of anesthesia and the control of respiration and circulation during resuscitation of severely injured patients.
- Flexible gastroscopes are expensive, but they can control bleeding from stomach and duodenal ulcers so well as to virtually eliminate the need for surgery for bleeding ulcers.

Careful evaluation, including cost analysis, of each example of new technology should be able to control a technological cost spiral, at least in the public sector. However, little is being done to make this increasingly important evaluation. The National Institute for Health and Care Excellence of the British National Health Service provides a model of how such an evaluation can be conducted (http://www.nice.org.uk).

FINANCING SURGICAL CARE

Financial support for surgical services delivery is discussed in chapter 18. The reality is that no matter how cost-effective it is, most people in low-income countries (LICS) and many in lower-middle-income countries, cannot afford surgery unless it is available without charge at the point of care. Although El Salvador, Honduras, and Sri Lanka, for example, have shown that free service can be made available within very low budget public health systems, most lower-middle-income countries, and many upper-middle-income countries, have hospital systems that reach only a fraction of the population, largely because of the cost barrier. Economic growth and increased government budgets for health are reducing this disparity, but progress is slow. In many LMICs, availability of trained staff and other resources has not improved at all in the past 20 years, especially in the first-level hospital network. Efforts to mobilize nongovernmental funds to support health care have had limited success.

- Although the private health sector is growing rapidly everywhere, it reaches only a fraction of the population. In India, 78 percent of health expenditures occur in the private sector, but in most Indian states, only a fraction of the population has access to private hospital care (Kumar and others 2011).
- Cost-sharing (fees for service) in public hospitals has been shown to reduce utilization, but it contributes very little to covering hospital costs (Lagarde and Palmer 2011; Robert and Ridde 2013).
- Government-run insurance systems that provide direct government financing of essential services have been shown to be possible on a large scale (Kruk 2013; Kumar and others 2011). The most common example is free emergency obstetrical care. If such plans can be successfully implemented, they will have a double benefit: they reduce the financial barrier to the use of clinical services, and they give purchasing power to patients, thereby directing income to the hospitals and clinics that provide the most popular, and it is to be hoped the best, services. The key is to direct the benefits to those who need them most and to those services that can give the greatest public health outcome, for example, obstetrics, trauma, emergency surgery, and neonatal care. However, equitable utilization of "free surgery" is by no means guaranteed; poor people continue to face high costs for transportation, supplies, food, and informal charges (El-Khoury, Hatt, and Gandaho 2012).

Financing of surgical care is further complicated by the large number of first-level surgical procedures that are emergencies. The need for out-of-pocket user fees (especially fees required before treatment can be provided) has been found to be a major barrier to the provision of emergency care in many places (Canoodt, Mock, and Bucagu 2012).

STRENGTHENING FIRST-LEVEL SURGICAL FACILITIES

The first-level hospitals and the clinics below them described in table 12.1 are an ideal, achieved in a few LMICs but far from a reality in most. Although existing first-level hospitals are cost-effective, and their surgical services seem to be especially so, they could be doing much more, especially for trauma, general surgical emergencies, and the backlog of treatable disabling conditions. The successful development more than 20 years ago of effective hospital systems in countries such as Sri Lanka has shown that this is possible even with low budgets for health. The number of available trained health personnel is increasing rapidly in almost all countries, and health budgets are rising, so that it should be possible for all LMICs to achieve a much better level of care in the next 20 years. The question is how to accomplish this rapidly and efficiently, so that the poor majorities in these countries are not left behind.

Removing Roadblocks

The following are three major roadblocks to better care:

- *Access to well-functioning health centers and first-level hospitals is critical*: These clinics and hospitals must have better patient transport available, and the financial barriers to travel should be removed to the extent possible. All of the financial barriers for families cannot be eliminated, but the cost of transport and the cost of the hospital's or clinic's services are the two most important. Not enough is known about how much free transport would cost, but it would probably not be an unbearable burden. The creation and analysis of real-life models will facilitate

the raising of funds for this purpose. Hospitals with limited budgets will not be able to pay for all of this, so outside funding sources will need to be found.

- *Staffing is inadequate, both in numbers and in training.* Many years will pass before fully trained staff can be available at all levels; therefore, it is important to identify intermediate solutions. These solutions include training general physicians and NPCs to perform basic surgery; training nurses to administer anesthesia; and providing in-service training of staff at all levels in such skills as better management of nonsurgical obstetric emergencies, patient resuscitation on arrival at the clinic or hospital, and appropriate care during transport for referral. Functioning models with cost analysis are needed.
- *Logistical systems to provide supplies and maintain equipment are usually underfunded and inadequate.* Closer consideration of areas in which such systems seem to be working better, such as Sri Lanka, will help solutions for widespread implementation to be developed.

Expanding Capacity

If the roadblocks are removed, utilization will increase and it will be necessary to expand facilities, eliminate the gross inadequacies in such fundamentals as water and electricity supply, and, in some cases, create new clinics and hospitals. Upgrading health centers to provide more surgical services will help ease the burden for hospitals.

As the medical workload increases, paying attention to staff morale in health centers and hospitals will be essential. Adequate pay, decent housing, sufficient staff numbers, and professional satisfaction from supportive supervision and recognition are all important.

FUTURE DIRECTIONS FOR SURGICAL SERVICES

Research and Training

Better determination of the burden of surgical disease is needed, but retrospective population surveys produce incomplete and imprecise information, and prospective surveys are expensive. Prospective studies in places with ongoing demographic surveillance could produce more useful information.

However, enough is known to begin the implementation of programs to improve services and increase access to services. Monitoring and evaluating the effectiveness and cost of these improvements as they are implemented will be important. Monitoring can provide ongoing evidence of the effect on utilization and outcomes.

Evaluation can include the evaluation of the population impact as well as of the costs and benefits. Training, especially to increase the availability of surgical skills in first-level hospitals, will be an essential element of these programs. National professional societies could play a crucial role in this process, and qualified surgeons from HICs could provide important assistance, improving the availability of trained staff in the first- and second-level hospitals that will be the principal venues for this training.

Finance

Hospitals and the systems to support them are terribly underfunded in most LMICs, as are all of the health services for the poor segments of the population in these places. For most people in these countries, a generation or more will pass before incomes rise sufficiently to provide purchasing power for basic surgical services. LMICs are increasingly embracing universal health coverage, primarily funded through taxes, as a means of improving access to services and ensuring that medical bills do not force families into poverty. Essential and life-saving surgeries are likely to be core components of these insurance programs.

Epidemiological Transition

Controlling the inevitable increase in cost and decrease in effectiveness associated with surgery for complications of arteriosclerosis, cancer, and diabetes is an important issue. The best approach is probably through primary and secondary prevention. Investments to control tobacco use and improve the medical management of hypertension could produce significant benefits to individual health, as well as reduce inefficient hospital use. Nevertheless, surgeons still need to be prepared to address the sequelae of chronic diseases.

Technological Advances

Although new technology can improve treatment and, in some cases, reduce costs, it initially increases costs for equipment, materials, and training. The demand for video-assisted surgery, computerized tomography scanning, and coronary artery stenting is likely to increase. These advances should be carefully evaluated before they are incorporated into public programs.

Referral Systems

Patient transportation is generally available, but paying for it is difficult. The most practical approach may be to provide ambulances to hospitals and health centers, with

adequate budgets for fuel and maintenance. A realistic evaluation of the cost for provision of adequate transport is needed; the costs may be less than expected if corruption and misuse can be controlled. Monitoring by community and district government councils could help. For example, second-level health teams in Uganda have established local transport committees to manage dispatch, communications, and repair and maintenance of donated vehicles.

There should be a tradeoff between more referral and less need for surgical facilities, but how important this tradeoff will be remains unknown. It is likely that the combination of more and better trained staff in first-level units, with better transport between units, will improve service, as well as pay for itself by reducing the need for multiple hospitals delivering service.

Supervision Systems

First-level hospital surgeons and other surgeons in LMICs generally work without effective supervision, oversight, and in-service training. These shortcomings can only be corrected if enough qualified specialists can be made available to provide training and supervision, as well as direct service. In the long term, most countries will have adequate numbers of specialists, but ways need to be found to make service provision in first-level hospitals and clinics an important part of their work.

Logistical Systems

Logistical systems need to be decentralized, adequately funded, simplified, and controlled. At all hospital levels in the public system, the cost of personnel is the largest budgetary component. It makes no sense to pay for trained staff and deny them the relatively small funds needed for basic supplies that make it possible to do what they are trained to do.

Health Policy and National Health Plans

Service delivery in almost all LMIC public hospitals is a government responsibility, but delivery of emergency and essential surgical services is usually not mentioned in health plans at either the central or the local level. Attention to surgical services in these plans would help focus attention on its importance (Hedges, Mock, and Cherian 2010).

Professional Societies

National professional societies need to play a more active role in the development of robust first-level surgical care in their countries; they have taken too little interest in first-level hospitals to date. Professional societies could take responsibility for equitable delivery of services; work with communities and government to develop the needed political will; and provide guidance in the development of programs for training, supervision, and logistical support.

Traditionally, advancement and recognition within the surgical community and within surgical organizations are based on factors such as the skills of individual surgeons; training of residents to become fully trained surgeons, and especially subspecialists; and research on basic science or operative surgical issues. Surgeons who develop and master the most difficult, complicated procedures are usually those who are most highly regarded. However, most of the burden of surgical disease could be lowered by improved access to fairly simple procedures that are both very cost-effective and very suitable to being performed in first-level hospitals. The surgical community and surgical organizations need to develop a focus on the wider population. Surgeons who choose to devote themselves to improving access to the most-needed procedures (whether through their own labor or through the training and research activities they conduct) need to be better recognized for these contributions. Professional organizations need to develop their own mechanisms for supporting and encouraging such work.

NOTES

One of the authors of this chapter is a WHO staff member. The authors alone are responsible for the views expressed in this publication and they do not necessarily represent the decisions or policies of the World Health Organization.

The World Bank classifies countries according to four income groupings. Income is measured using gross national income (GNI) per capita, in U.S. dollars, converted from local currency using the *World Bank Atlas* method. Classifications as of July 2014 are as follows:

- Low-income countries (LICs) = US$1,045 or less in 2013
- Middle-income countries (MICs) are subdivided:
  - Lower-middle-income = US$1,046 to US$4,125
  - Upper-middle-income (UMICs) = US$4,126 to US$12,745
- High-income countries (HICs)= US$12,746 or more

1. Ketamine is a relatively new and safe anesthetic agent that can induce general anesthesia without paralysis of respiration and the need for artificial respiration or a tracheal tube.

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