



Surgery in developing countries:

Should surgery have a role
in population-based health care?

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The purpose of this article is to find a potential solution to the problem of limited resources for diseases and conditions amenable to surgical interventions. The process commences with the quantification of the global burden of surgical diseases as resource allocation decisions are increasingly evidence based. Countries with developing economies often have not considered surgical care to be a public health priority.¹ Yet, untreated surgical conditions add to the preventable loss of life. Untreated surgical conditions add to the acute and chronic burden of diseases and have a negative impact on the microeconomy and macroeconomy of a nation. The importance of surgery as a preventive and a curative strategy in public health needs to be thoroughly investigated and documented.

The premise is that basic surgical care, which requires no advanced technological support, is as cost-effective in averting the global burden of disease as other preventive strategies. Surgery as a population-based intervention can reduce preventable deaths and reduce complications that result in chronic illnesses, thereby increasing both microeconomic and macroeconomic productivity. Population-based prevention is directed to an entire population or subpopulation and includes personal behavior change, control of environmental hazards, and medical interventions such as immunizations, screening, and referrals.²

Defining a “surgical condition”

Surgery is a specialty in which manual or operative conditions are used in the treatment of disease, injuries, or deformities. Yet, most public health policymakers appear to be unaware that surgery is a *treatment* and a *prevention* of certain diseases. Surgical diseases are neither a specific condition or disease nor a risk factor for specific diseases. The domain of surgical care is all-encompassing as surgical interventions may be required for components of both communicable and noncommunicable illnesses.

Surgical interventions differ from other medi-

cal and public health interventions in that a single outcome can arise from numerous origins. Thus, an amputation can be performed because of cancer (sarcoma), infection (gangrene), unintentional trauma (road accidents), or war. A single risk factor may not successfully predict whether a condition is treatable by surgery. In addition, surgical interventions can have an effect on premature mortality and morbidity both by operating directly on the condition itself and on the precursors or early signs of malignancy. Figure 1A and 1B on page 14 provides a conceptualization of the role of surgery to reduce the global burden of disease by averting morbidity from both infectious disease and trauma.

A surgical condition should be defined as procedure oriented or personnel oriented. The personnel-oriented definition would then be limited to those procedures that would be performed by a formally trained individual in the surgical sciences. This limitation may unnecessarily restrict the assessment of the types of conditions that should be considered surgical conditions. The immediate parallel is with the definition of the burden of disease attributable to sex and reproduction where one of six definitions proposed was all conditions managed through the reproductive health services.³

The procedure-oriented definition as described by Debas et al would include all conditions that require technical interventions such as incision, excision, suture, manipulation, or other procedures that require a type of anesthetic.¹ Other conditions that could be added to that definition include incision and drainage, endoscopy, and delivery. Surgically treatable conditions can be categorized into the following five classifications, (the fifth being recommended by the authors)⁴:

- Emergent obstetrical conditions
- Emergent abdominal conditions
- Elective or urgent condition such as hernias, cataracts, and deformities
- Unintentional and intentional injury victims
- Malignancies

According to recent estimates on the world's burden of disease, injuries account for approximately 38 percent of all surgical conditions, followed by malignancies and congenital anomalies.³

DALYs

A major effort was undertaken in 1990 by the World Health Organization (WHO) and the World Bank to estimate the global burden of disease.^{5,6} The result was the health gap measure called the DALY, or disability-adjusted life years. This measure was developed by combining mortality and nonfatal health outcomes into a single number. A DALY represents the sum of potential years of life lost (YLL) because of premature mortality in the population added to the years of productive life lost because of disability (YLD) for incident cases of the health condition. YLL is equal to the number of deaths (N) multiplied by the life expectancy at the age of death (L). YLD is equal to the number of incident cases (I) multiplied by disability weight and is included in the formula for the estimate of the severity of the disease or condition (DW) multiplied by the average duration of the case until remission or death. The formulas are as follows: $DALY = YLL + YLD$; $YLL = N \times L$; and $YLD = I \times DW \times L$. One DALY equals one year lost of healthy life. It is estimated that the global burden of disease is 1,467,257,000 DALYs. Although not perfect, this metric serves as a common tool to assess the burden of disease across the various regions of the world. We as surgeons can and should use this metric to estimate the global burden of surgical disease.

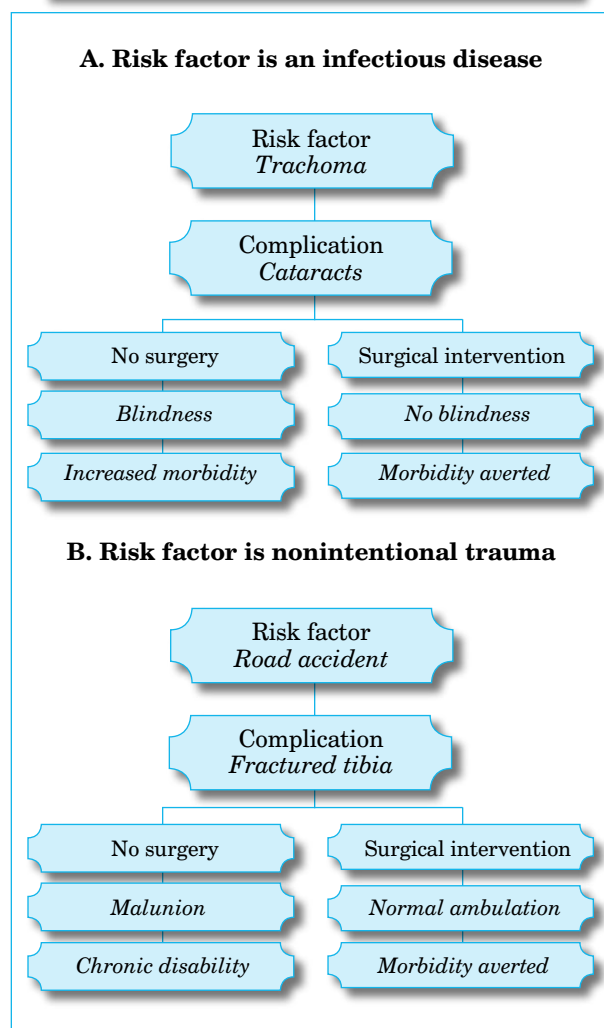
Estimating surgical conditions, services

A comprehensive community-based study on the health of adult women residing in Accra, Ghana, was performed in 2003. The Women's Health Study of Accra assessed the communicable and noncommunicable diseases and use of health services in a sample of women aged 18 years and older representing all socioeconomic and ethnic groups in the city.⁷ The study site was selected because of the previous collaborative professional relationships among the Harvard institutions and the University of Ghana. Among the 1,328 women interviewed during the clinical examination, 23 percent had had at least one surgical procedure and 81.8 percent of those were performed in a public hospital. The most common surgical procedures performed in the women were as follows: Cesarean section, 31.3 percent; hysterectomy, 15.3 percent;

nontraumatic abdominal surgery, 8.3 percent; fibroidectomy, 6.1 percent; tubal ligation, 3.8 percent; and trauma, 2.6 percent.

A substantial attempt to estimate the global burden of disease was performed by Debas et al.¹ The survey was developed to obtain a consensus, using the conditions listed in the 2002 WHO

Figure 1A and 1B:
Conceptualization of the potential contributions of surgery to the reduction of the global burden of disease



World Health Report⁸, as to the surgical burden of disease. Of 32 surgeons contacted to report on the proportion of conditions that would require a surgical intervention, 18 (56%) responded. The final results were obtained based on 14 responses after discarding the two highest and lowest responses. The lowest value was chosen

Table 1:
Estimated burden of surgical DALYs

Surgical condition	ESD*	% ESD	% total DALYs [†]	# per 1,000
Injuries	63	38	4.3	10
Cancers	31	19	2.1	5
Congenital	14	9	1.0	2
Obstetric	10	6	0.7	2
Cataract	8	5	0.5	1
Perinatal	7	4	0.5	1
Other	31	19	2.1	5
Total	164	100	11.2	26

*Estimated surgical DALYs (ESD) in the millions

[†]ESD as a percent of total DALYs

Table 2:
Overall causes of death in Accra, Ghana, between 1999 and 2002

Condition	Frequency n (%)
Cardiovascular diseases	4,581 (20.5)
	2,431 (10.9)
Perinatal conditions	1,217 (5.4)
Malignancies	1,127 (5.0)
Malaria	1,062 (4.7)
Trauma	1,051 (4.7)
Meningitis	833 (3.7)
Human immunodeficiency virus	706 (3.2)
Anemia	465 (2.1)
Intestinal infections	444 (2.0)

as the surgical DALY and 90 percent of all values were within 10 percent of the estimated burden of surgical diseases. In summary, approximately 11.2 percent of the world's DALYs are from conditions that would require surgery. Table 1 at left shows the results of estimating the surgical DALYs by condition.

Another attempt to estimate the surgical burden of disease was performed using the 1999–2001 mortality data from Accra. Death certificates with the cause of death recorded by a physician were examined for 22,404 deceased men, women, and children. All deaths were coded using the International Classification of Diseases, 10th Revision, coding system.⁹ Coding was performed by trained coders in Accra and rechecked by the authors. The 10 most common overall causes of death, not adjusted for age or sex, are shown in Table 2 at left. Noncommunicable diseases such as heart disease and communicable diseases such as pneumonias are well represented as overall causes of death in this population.

The Accra mortality data were further analyzed using the categories of surgical disease used by Debas to determine an estimated burden of surgical disease in this population. Table 3 on page 16 compares the results of estimated surgical DALYs worldwide with the data on surgical diseases from Accra. Using the mortality data, we have estimated the burden of surgical disease in Accra to be 10.9 percent, as compared with 11.2 percent for the worldwide estimate, which includes mortality and morbidity. Hence, the estimate of the worldwide burden of surgical disease at 11.2 percent may significantly underrepresent the total burden of surgical diseases as estimated by DALYs.

Population-based strategies

In both analyses, trauma was identified as one of the most common surgical conditions. In order for surgery to be included in population-based strategies for the delivery of health care, accurate baseline data are required for the incidence and prevalence of surgical diseases. Data on the global economic burden of surgical diseases are not available, nor are data available for DALYs averted by surgical care for disabilities secondary to trauma or other

common surgical conditions. Accurate information is also needed to measure the cost-effectiveness of the impact of early surgical interventions on readily treated conditions such as hernias and cataracts and the prevention of disabilities created by untreated or inadequately treated injuries.

If the focus is on trauma, population-based strategies should include education and safety at the workplace and the household. Early surgical interventions for trauma, including resuscitation and stabilization, can be performed at the local health care clinic level by measures that would include affordable supplies such as intravenous fluids, splints, and dressings. Evacuations to secondary or tertiary health care facilities for expert surgical management can be performed once an injured person is stabilized. Treatment of survivable injuries reduces complications that may result in chronic disabling conditions. Whereas the treatment may be a personal intervention, the population-based interventions include passable roads and facilities that can provide access to adequate health care. Population-based health care would cover the costs of transportation and the costs of resuscitation rather than placing the burden on the individual.

Cost-effectiveness for treatment

The cost-benefit analysis of various interventions can be expressed as cost-effectiveness. Effectiveness is measured in natural units of deaths averted and years of life saved and in DALYs. Cost-effectiveness is only one measure of how health care services should be allocated for surgical and other medical interventions.¹⁰ Cost-effectiveness ratios can be used to set cutoff points above which an intervention is deemed too expensive for the benefit. Other factors, such as health disparities, equity, medical suitability, and epidemiologic appropriateness should serve

Table 3:
Estimated surgical disease
from Accra, Ghana, mortality study
compared with the estimated surgical DALYs worldwide

Surgical condition	Estimated surgical DALYs as % of total DALYs worldwide	Estimated surgical burden of disease from mortality data, Accra, Ghana, 1999–2002
Injuries	4.3	4.7
Cancers	2.1	5.0
Congenital	1.0	0.3
Obstetrical	0.7	0.8
Cataract	0.5	N/A*
Perinatal	0.5	5.4
Other	2.1	–
Total	11.2	10.9

*Data not available

as guidelines for where funds will be spent most effectively.^{11,12}

Some types of surgery are highly cost-effective components of a country's strategic health plan.² These procedures include early surgical interventions in the form of improved resuscitation and airway control for injury victims, improved fracture management, early treatment of burns less than 30 percent of body surface area, early intervention of obstetric complications, and the surgical treatment of cataracts. Cataracts, a major cause of blindness worldwide, are treated only by surgery, and the surgical treatment of cataracts has been highly cost-effective in different regions. In fact, it is estimated that 1.2 million DALYs can be averted globally by this simple and relatively inexpensive surgical procedure.^{13,14}

Another example of a low-cost opportunity to avert surgical DALYs in sub-Saharan Africa includes reducing traffic accidents by increasing speed bumps, speeding penalties, and law enforcement at a cost of U.S. \$2 to \$12 per DALY averted for a total burden of 6.4 million DALYs averted. The average cost per DALY averted for a representative set of surgical procedures ranges

from U.S. \$70 to \$230. The World Bank has arbitrarily set U.S. \$100 per DALY averted as highly cost-effective in low-income countries.¹⁵ This figure must take into account national income level, budgets, and disease burden.

General surgical procedures are cost-effective at the district level in sub-Saharan Africa and Southeast Asia because of the relatively low costs of infrastructure and the high level of avertable disease burden. It is estimated that the cost per DALY averted for surgical services in a surgical ward for obstetrical and trauma admissions is U.S. \$7 to \$215 for a reduction in the burden of disease of 25 million to 134.2 million DALYs.¹ The cost estimate included staffed community ambulance service and training of lay responders and volunteer paramedics.

Interventions of poor cost-effectiveness in these regions include the surgical management of epilepsy and percutaneous transluminal coronary angioplasty for cardiovascular events. In general, cancer prevention is less expensive than cancer treatment. However, the benefit is greater when the screening is performed when the disease prevalence is high.² Hence, screening measures need to be region-specific if they are to be cost-effective.

Essential provisions to deliver services

A strategic plan should be developed for the provision of surgical services on local, regional, and national levels. When resources are severely restricted as they are in low-income countries, it is unreasonable to expect a local clinic to be able to offer more than basic health care, resuscitation, and stabilizing procedures. Trained personnel paid a fair wage—including surgeons, obstetricians, gynecologists, anesthesiologists, nurses, nonsurgical physicians, and ancillary personnel—are crucial to the success of any health care program. Facilities should be satisfactorily staffed and supplies, equipment, and instruments made available for basic procedures. Transportation to secondary- and tertiary-level health care facilities must be available to care for emergent and urgent care that cannot be provided at the local level. Equally important to the provision of surgical care is the availability of continuing medical education for all medical personnel. Health care quality management should also be

evaluated on a regular basis to ensure the highest quality of care possible is delivered. Volunteer surgeons and surgical teams can assist in the continuing medical education of local surgeons and serve to provide direct health care in areas of personnel shortages. However, volunteer surgical teams are only a temporary measure and should not be viewed as the permanent solution to any regional strategic health care program.¹⁶

Benefits of delivering surgical services

The benefits of making surgical services readily available globally is that surgery does reduce the burden of disease by reducing preventable deaths and thus averting DALYs, reduces the burden of the care of the disabled from birth or untreated surgical diseases when disabilities are treated early, and can improve economic productivity on both the macroeconomic and microeconomic levels by increasing the workforce and decreasing dependency on other family members. Accessibility to surgical services for emergent and readily treatable surgical diseases also reduces the disparities of health care between low-income and high-income countries.

What the College can do

The American College of Surgeons can improve global health by investing in strategies that will reduce the underlying risk factors and conditions leading to mortality and morbidity avoidable through surgery. In some incidences, accomplishing this goal may require campaigning on behalf of safer road transport systems

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or control of small arms to reduce injuries from conflict as well as actions in operating theaters worldwide. Although every tactic has a price, the cost for many of the possible interventions is relatively low. One recommendation is to assist in the continuing medical education of our international surgical colleagues from low-income countries by allowing them to attend the annual Clinical Congress free of charge. Another is to expand the services of the ACS volunteer office by organizing and supporting surgical teams to work, teach, and build lasting relationships in developing countries. The international office could also be expanding to assist with the application process to obtain privileges to practice in the developing countries as well as to assist with the visa processes.

A major contribution of the ACS can be directed at research. Supporting research for determining the global burden of disease in order to significantly influence public health policy will be a major contribution. Engaging the surgical community through the ACS and related international surgical societies may facilitate an extensive assessment of the burden of surgical diseases.

A cost-effective analysis of surgical interventions will also improve global health by documenting the number of DALYs averted by the surgical intervention. Epidemiologic studies to identify risk factors for malignancies, prevalence and incidence of intentional and unintentional trauma including road traffic accidents, and health care disparities between low-income and high-income countries are well within the expertise of the surgical community. Studies on health care delivery and provision of services, such as improving strategies to provide care to those who live in remote areas and the level of services that can be provided at local regional and tertiary care facilities, are critical in an overall assessment of reducing the burden of disease. Quality control studies will be instrumental in assessing adequate surgical care delivery. The key to implementing change in health policy regarding surgical diseases is education and research, reinforced by action. Surgeons are the ultimate action figures.

Conclusion

Surgical services are an integral component of population-based health care strategies. Surgery is not just an expensive intervention that can only

be performed in environments of high technical capacity. Surgery plays an important role in the prevention of unnecessary deaths and in the treatment of acute and chronic illness. Surgeons in general and the ACS in particular need to think more broadly about their potentially large contributions to global health and to be ready to consider population-based interventions to extend their impact more widely. □

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