Chapter 20. Global Surgery and Poverty

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**Introduction**

Good health is a consequence of genetic, emotional, environmental, and behavioral factors. However, poverty increases the risk of disease (Schecter and others 2011). Low- and middle-income countries (LMICs) have 80 percent of the world’s population, but they account for only 20 percent of the world’s gross domestic product (GDP). Inadequate capital and an insufficient medical workforce in societies challenged by political and military instability, dramatic social change due to migration from rural to urban environments, and an increasingly inequitable distribution of wealth exacerbated by corruption have led to an overwhelming disparity between the developed and the developing worlds in the standards of and access to surgical care (Ajayi 1994).

**Defining Poverty**

Wealth is a function of material, emotional, and spiritual factors. Yet, poverty is often measured in other terms, such as absolute income and socioeconomic status.

**Absolute Income**

Poverty is defined in terms of absolute income. The World Bank defines poverty as an income below US$2 a day; 2.7 of the world’s 7 billion people—38 percent—live on less than this amount (Shah 2013). In fact, 80 percent of humanity lives at or below a per capita GDP of US$10 a day (Chen and Ravillion 2005); 965 million people—13.6 percent—are undernourished due to food insecurity (Hunger Notes 2012).

Poverty is defined in the United States as an annual income below the cost of a United States Department of Agriculture (USDA) basic diet multiplied by three, with additional modifiers based on such factors as the number of family members and the inflation rate (Oransky M 1965). Some economists argue that a more accurate multiplier would be five rather than three (Ruggles 1990). The 2012 poverty line for a single person in the continental United States is US$11,170 a year, or approximately US$30 a day (US HHS 2012). Clearly, the US$2-a-day poverty line understates the actual income required to feed a family, educate children, and enjoy a modicum of leisure.

**Socioeconomic Status**

Assessment of socioeconomic status (SES) is another method of measuring poverty. SES is defined as income, education, and occupational status (Adler and others 1994) or the sum of various forms of socioeconomic capital (Adler and others 1994; Alvin and Wray 2005; Oakes and Rossi 2002; O’Rand and Ross 2001), including the following:

- **Human capital** refers to a person’s productive knowledge and skills; it includes education, specialized knowledge, and occupational skills.
- **Material capital** refers to a person’s net financial worth.
- **Social capital** refers to a person’s interpersonal relationships, such as family, social networks, and group memberships.
• *Personal capital* is critically important; it refers to a person’s motivation, resiliency, self-confidence, and self-control—a person’s baseline physical and mental health.

• *Cultural capital* refers to the values and beliefs of individuals and their families and communities. The challenge in measuring the various nonfinancial forms of SES and comparing them across cultures is clear.

### Income Distribution and Health

Although material capital directly influences a person’s ability to obtain quality housing, food, and access to leisure activity (Lynch and Kaplan 1997), there is little direct association between low income and health across countries (McCord and Freeman 1990; Sen 1993) above a per capita GDP of approximately US$20,000 a year (Figure __.1). For example, the per capita GDP of the United States is 10-fold higher than that of Jordan, yet life expectancy in Jordan is actually slightly higher than that in the United States. This nonlinear relationship between life expectancy at birth and GDP (Preston 1995) is caused by the loss of more years of life by people with incomes below the national average than is gained by people with higher incomes (Lynch and Kaplan 1997). In fact, unequal distribution of income adversely affects life expectancy at birth after controlling for mean income (Rodgers 1979). The greater the inequity of income distribution is, the higher the mortality rate is (LeGrand 1987).

**Figure __.1 Life Expectancy From Birth, 2012**
The most widely used measure of income distribution is the Gini coefficient (Schecter 2011). The higher the Gini coefficient, the greater is the inequity of income distribution. Table __.1 compares life expectancy from birth in LMICs and high-income countries (HICs) and correlates these life expectancies with the Gini coefficient and per capita GDP. Figure __.2 demonstrates that the life expectancy from birth decreases as the Gini coefficient increases; increasing inequity in income distribution is associated with a lower life expectancy. If the economies of LMICs grow, and the bounty from such growth is distributed throughout the population, it is likely that significant improvements in health will follow. The solution to the health problems of these countries is primarily a question of political economy and equity rather than medicine.

Table __.1 Comparison of Income Distribution (Measured by Gini Coefficient), Per Capita GDP, and Life Expectance at Birth, Various Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Gini Coefficient</th>
<th>Gini Coefficient Year</th>
<th>Per Capita GDP (US$/Year 2012 est)*</th>
<th>Life expectancy from birth (Year 2012 est)*</th>
</tr>
</thead>
</table>

Source: CIA, various years.

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Bangladesh 0.332 2005 2,000 70.06
United Kingdom 0.34 2005 36,700 80.17
Tanzania 0.376 2007 1,700 53.14
Yemen, Rep. 0.377 2005 2,200 64.11
Malawi 0.39 2004 900 52.31
Jordan 0.397 2007 6,000 80.18
Côte d’Ivoire 0.415 2008 1,700 57.25
Sweden 0.43 2005 41,700 81.18
United States 0.45 2007 49,800 78.49
Mozambique 0.456 2008 1,200 52.02
Rwanda 0.468 2000 1,400 58.44
Haiti 0.592 2001 1,300 62.51
Central African Republic 0.613 1993 800 50.48
Botswana 0.63 1993 16,800 55.74

*Estimated

*Source: CIA, various years.

The 2000 Millennium Development Goals (MDG) provide a broad framework for combating poverty (Table 2). UN 2005 MDG Goals 4, 5, and 6 are public health goals concerning childhood mortality, maternal health, and infectious diseases such as HIV/AIDS and malaria. Conspicuously absent from this list are goals dealing with treatment of noncommunicable diseases, including surgical care of life and function-threatening injuries or infirmities. The economic MDGs, particularly Goal 1—reducing extreme poverty by 50 percent by 2015—depend on improvements in health. A healthy population is required for sustained economic growth but paradoxically, overall health is determined by a minimum per capita GDP and equitable distribution of wealth. A coordinated effort of investment in and development of economic, public health, and clinical care infrastructure is required to address the issue of poverty and health (Sach 2004). Surgery plays an important role in this integrated approach.

Figure 2 Life Expectancy From Birth, 2012
Table 2.2 Millennium Development Goals
1. Eradicate extreme poverty and hunger.
2. Achieve universal primary education.
3. Promote gender equality and empower women.
4. Reduce childhood mortality.
5. Improve maternal health.
7. Ensure environmental sustainability.
8. Develop a global partnership for Development

Source: UN 2005.

Source: CIA, various years.
Poverty and Global Health
The association between poverty and poor health was first documented in the mid-19th century (Mechanic 2000; Oakes and Rossi 2002). Abundant evidence indicates that poverty, in and of itself, is an independent variable adversely affecting health, after controlling for adverse discretionary health related behavior (Schecter 2001). The plight of the two billion impoverished souls in the developing world demands attention and redress.

Sub-Saharan Africa, the home of one billion people, is plagued by war, ethnic violence, and extreme poverty (PRB 2012) Political instability, corruption, and devastation of the working adult population by HIV/AIDS (Mock and others 2004), tuberculosis (Laxminarayan and others 2009), and malaria (Mills, Lubell, and Hanson 2008) discourage a competitive market economy and foreign investment. Proliferation of desert regions and a rapidly growing population have resulted in mass starvation. Quite simply, Sub-Saharan Africa cannot currently feed itself. (UNCCCD 2013)

Surgery and Global Health
Surgically treated disorders represent a significant proportion of the burden of the diseases associated with poverty. Furthermore, surgery is a cost-effective method of reducing suffering, prolonging life, and restoring sick and injured people to health and economic productivity.

Two billion people worldwide lack access to surgical care (Funk and others 2010). The maldistribution of surgical resources is striking. HICs have an average of 14 operating rooms and 45 trained surgeons per 100,000 population. In contrast, LMICs have less than two operating rooms and less than one trained surgeon per 100,000 population (MacGowan 1987). Only 26 percent of the estimated 234 million operations performed annually occur in the poorest countries (less than US$100 per capita per year spending on health care), which account for 70 percent of the global population (Weiser and others 2008).

Many barriers to surgical access exist, including lack of awareness, fear, distance, and cultural beliefs. However, the principal barrier appears to be the cost of care (Malhotra and others 2005). For example, 91 percent of the respondents to a survey of cataract patients in Ghana cited cost as a significant barrier to treatment (Gyasi, Amoaku, and Asamany 2007). Similar barriers have been cited for hospital delivery and access to obstetric services in rural Kenya (Myangome and others 2012).

Many hospitals serving poor people charge a fee for care. Sometimes, the charge is based on the belief that uncompensated services are not valued by those who receive them, although no literature confirms or refutes this hypothesis. More often, the costs of admission, medications, and food are based on the harsh economic realities of the respective impoverished countries. However, even a nominal fee may serve as a major barrier to a destitute patient in need of care.

Impact of Surgical Care on Death and Disability in LMICs
Surgery can have a profound impact on the lives and livelihood of millions of low-income patients worldwide. This section reviews the medical and economic burden of diseases treated...
by selected surgical disciplines in developing countries. A more detailed discussion of these issues appears in the relevant chapters in this book.

**Obstetrics**

Each year, 500,000 maternal deaths occur globally (Dolea 2003; WHO 2005). The reduction of maternal mortality ratios (MMR) has been significantly slower than the MDG targeted annual decline of 5.5 percent (Mbizvo and Say 2012). The deaths are primarily due to obstructed labor and peripartum hemorrhage; the burden of these deaths is born primarily by poor women in developing countries. For example, 99 percent of hemorrhage-related peripartum deaths occur in LMICs (Haeir and Dildy 2012). The key to reducing the MMR is the presence of a trained attendant at every birth and urgent access to obstetric care (Wise and Clark 2010).

Although vesico-vaginal fistulas due to obstructed labor are rare in the developed world, as many as 3.5 million women may suffer from this condition in LMICs (Wall and others 2008). In a recent study of 278 women with genitourinary fistulae in Pakistan, all of the vesico-vaginal fistulae were repaired transvaginally, with success rates of 85 percent, 91 percent, and 96 percent, on the first, second, and third attempts, respectively (Sachdev and others 2009). These procedures require advanced training and experience, and the demand greatly exceeds the supply of surgeons and institutions. The ultimate solution is prevention of the initial damage by providing obstetric services to all pregnant women. In the interim, an organized international effort is necessary to help these women who are socially isolated and stigmatized by incontinence and offensive odor.

**Trauma**

Each year, five million people die of injuries; of these deaths, 95 percent occur in LMICs (Krug, Sharma, and Lozano 2000). Road traffic accidents are the major cause of morbidity and mortality (Hazen and Ehiri 2006). The vast majority of deaths in LMICs occur in the field due to the lack of organized prehospital medical care and transport systems. (World Report on Road Traffic Injury Prevention: Summary 2004). Patients with a lower SES have a greater risk of prehospital death (Mock and others 1998). Table .3 illustrates this preponderance of prehospital trauma deaths in LIMCs compared to HICs.

| Table .3 Proportion of Road Deaths by Setting in Three Cities |
|-------------------|------------------|------------------|------------------|
| Setting           | Kumasi, Ghana    | Monterrey, Mexico| Seattle, United States |
| Prehospital       | 81               | 72               | 59               |
| Emergency Room    | 5                | 21               | 18               |
| Hospital Ward     | 14               | 7                | 18               |

*Source: Mock and others 1998.*
In a 1998 study in LMICs, the mortality rate after serious injury (Injury Severity Score > 9) was nearly double the rate in a HIC (Mock and others, 1998). The risk of death after injury from all causes in Kampala, Uganda, in 2007 was five times higher than in San Francisco, California (Jayaraman and others 2011). Clearly, major disparities exist in the quality of care and the outcomes experienced in resource-challenged environments.

For every trauma death, many more injured patients sustain temporary or permanent disability (Mock and others 2008). Musculoskeletal injuries account for the majority of the disability burden (Peden and others 2004). In most LMICs, musculoskeletal injuries are treated by general surgeons, general practitioners, and nonphysician clinicians (NPC) (Curci 2012; Mock and others 2008). Access to trained orthopedists, image intensification, internal fixation, and myocutaneous flap coverage of exposed bone is extremely limited. The available data indicate that the burden of preventable disability due to musculoskeletal injury in LMICs is substantial (Mock and others 2008).

**Amputation**

Limb amputation is a reconstructive procedure required to treat non-salvageable extremity injuries, uncontrollable extremity infections, gangrene, and certain malignant tumors.

Diabetes is also a major problem in the developing world and is associated with a high incidence of peripheral vascular disease (PVD). PVD education for primary care providers is limited and access to sophisticated diagnostic and therapeutic procedures almost nonexistent. A study of patients with diabetic foot ulcers presenting to the Bugando Medical Centre in Tanzania found that 56 percent required an amputation; 18.8 percent of the amputation patients had a postoperative surgical site infection (Chalya and others 2011). In a study of amputations from the same institution over a similar period, 41.9 percent of the amputations were performed for diabetic foot complications, 38.4 percent for trauma, and 8.6 percent for PVD. The 30-day mortality rate was 16.7 percent for amputation (Chalya PL and others 2012) which compares favorably with a 30-day mortality rate of 33 percent from a recent study from Copenhagen (Kristensen and others 2012). However, the mean age in the Copenhagen study was 75 years, compared to 28 years in the Tanzanian study. All of the Danish patients had PVD or diabetes, as opposed to trauma.

Many of the amputations due to diabetes and PVD in LMICs are potentially preventable with improvements in the education of patients and providers, access to medications that reduce the risk of ischemic complications, and the requisite diagnostic and therapeutic procedures for revascularization. However, these technologies are expensive and require continuous maintenance; realistically, decades will be required for implementation.

One of the most heartbreaking causes of preventable amputation is suboptimal management of extremity injuries. This problem was cited as an important preventable cause of amputation in 1966 in a report from Nigeria (Swann and Walker 1966). Unfortunately, little has improved since that time. In a Nigerian study of 100 major amputations published in 2000, 70 were performed for trauma; 60 of these were deemed to be caused by iatrogenic injury resulting from mismanagement of fractures by traditional bone healers (Onuminya and others 2000). Another
Nigerian study published in 1996 concluded that the most of the amputations were preventable and were caused by “post-fracture splintage gangrene” (Yakuba, Muhammad, and Mabogunje 1996).

Clearly, amputations are, at times, necessary; they should be viewed as a reconstructive procedure with the goal of restoring mobility and function. However, the operation is only part of an organized rehabilitation program that requires active patient participation. The level of the patients’ formal education affects rehabilitation and long-term survival after amputation (Corey and others 2012). Unfortunately, most impoverished amputees in the developing world lack access to rehabilitation programs and artificial limbs. Because they are poor, they lose their extremity, have no access to rehabilitation, and sink deeper into penury.

**Reconstructive Surgery**

A large number of other reconstructive operations are used to avoid amputation and correct congenital or acquired deformities. These correctable problems are a significant source of morbidity in LMICs (Hughes and others 2012). Reconstructive surgery is technically challenging and requires advanced surgical training. Many procedures, however, involve superficial operations on the skin and soft tissue and do not cause a major physiologic insult; they can be performed relatively safely in resource-constrained environments.

Poor patients lack access to institutions and surgeons capable of performing these procedures. The plastic and reconstructive surgery discipline has played a leadership role in addressing the disparity between the need for reconstructive surgery and the availability of reconstructive surgeons. Organizations such as Interplast, Operation Smile, Smile Train and Facing the World (Hachach-Haram and others 2012) have pioneered visits by reconstructive surgeons providing cleft lip and palate (CLP) surgery primarily to impoverished children. Numerous other ad hoc groups sponsor medical missions to provide reconstructive surgery to underserved areas of the world.

**Burns**

Although few data document the epidemiology of burn injuries, there is little doubt that the global burden of burns is significant with the majority of cases occurring in Asia and Sub-Saharan Africa (Burd and Yuen 2005). The reasons for the unequal global distribution of burns are unknown, but they probably include the widespread use of open fires for cooking and heating, the absence of fire codes governing building construction, and inadequate burn prevention knowledge in adults (Olabanji and others 2007). The problem is so significant that the World Health Organization (WHO) included burn care education as part of its course on essential emergency surgical procedures in resource-limited facilities (Cherian and others 2004). Burn care has also been suggested as an essential part of a context appropriate curriculum for surgical residents training in Sub-Saharan Africa (Mutabdzie and others 2004).
Cancer Care

Among the many clinical and sociodemographic factors contributing to disparities in cancer rates, the association between poverty and cancer is so strong that the former Director of the National Cancer Institute, Samuel Broder, likened poverty to a carcinogen (Broder 1991; Greenlee and Howe 2009). Each year, 12.4 million cancer cases are newly diagnosed, and seven million cancer patients die; more than half of these cases occur in LMICs.

The total economic impact of disability and premature death in 2008 was US$895 billion, or 1.5 percent of the world’s GDP (John 2010). The three cancers that account for the highest economic value of DALYS are lung cancer (19.9 percent, US$178 billion), colorectal cancer (11 percent, US$99 billion), and breast cancer (9.8 percent, US$88 billion) (John 2008). The number of new cancer cases diagnosed annually is expected to increase 70 percent by 2030; the largest increases are projected to be in LMICs (Franceschi and Wild 2013). The public health community has traditionally assumed that cancers will remain untreated in poor countries (Farmer and others 2010). However, the economic impact and the degree of human suffering mandate a more aggressive approach.

Women are disproportionately affected by the global burden of cancer due to gender inequality; poverty; and the low priority given to cancer screening, diagnosis, and treatment (Cesario 2012). For example, although many personal, sociocultural, and economic factors are associated with delayed presentation of breast cancer, poverty and low level of education are the common themes (Sharma and others 2012).

Another devastating and largely preventable malignancy in women living in LMICs is carcinoma of the cervix. The annual global burden is 530,000 new cases and 275,000 deaths (Sahasrabuddhe and others 2012). Pap smear screening, which is widely used and effective in the early diagnosis and prevention in HICs, is expensive and difficult to implement in LMICs. Few organized screening programs are available in these countries. As a result, 85 percent of cervical cancers occur in the developing world and account for 15 percent of all cancers in women. (Saleem and others 2009).

The human papilloma virus (HPV) causes cervical cancer, and the development of an HPV vaccine offers the hope of preventing this malignancy, which almost always presents as advanced disease in poor women (Woo and Omar 2011). However, the cultural, religious, educational, and economic barriers to implementation of a worldwide vaccination program, particularly in LMICs, are major challenges.

The paucity of surgeons and operating rooms means that most cancer patients have no access to surgical care. Even when a trained surgeon is available, there is often a lack of required resources such as diagnostic imaging, instruments, blood products, and postoperative intensive care.

The International Atomic Energy Agency (IAEA) has labeled cancer treatment in developing countries a silent crisis (Salminen E and others 2005). Half of the world’s countries have 85 percent of the world’s radiation therapy machines, leaving only 15 percent of these machines for the rest of the world. Tanzania has one radiotherapy unit for the entire country with a population
of 46.2 million people; 22 countries in Asia and Sub-Saharan Africa lack even a single radiotherapy machine (Barton MB and others 2006).

Little is known about the availability and efficacy of chemotherapy for cancer in the developing world due to limited data (Hanna and Kangolle 2010). However, the challenges of treating a potentially curable malignancy in the Sub-Saharan African countryside with expensive and generally unavailable combination chemotherapy have recently been poignantly described by a visiting American internal medicine resident (Postow 2012).

Ophthalmology
Approximately 285 million people are visually impaired; of this number, 39 million are blind, and 246 million have severe or moderate visual impairment. Eighty percent of the burden of global visual impairment is preventable (VISION 2020, 2013). Ninety percent of visually impaired people live in LMICs (VISION 2020), and there is a close correlation between blindness and poverty. In a survey of blind people in Maiduguri, Nigeria, only 8.2 percent were employed, 75.3 percent roamed the streets begging, and 69 percent lived on less than US$1 dollar a day (Ribadu and Mahmoud 2010). In 1999, the WHO and the International Agency for the Prevention of Blindness launched a global initiative to eliminate avoidable blindness by the year 2020: VISION 2020, the Right to Sight (Faal 2012). Reducing the prevalence of blindness is likely to reduce the prevalence of poverty, and reducing the level of poverty is likely to reduce the incidence of blindness.

Eye surgery is a cost-effective method of treating many common forms of visual impairment and blindness. Providing extracapsular cataract surgery to 95 percent of those who need it would avert over 3.5 million DALYs per year globally. The integrated WHO SAFE (surgery, antibiotics, facial cleanliness, and environmental improvement) program for the treatment of trachoma would avert 11 million DALYs per year globally; cost-effectiveness ranges from I$13 to I$78 per DALY averted across regions (Baltussen and others 2005). One I$ is the equivalent of one US$ in the year 2000. Outreach programs to correct refractive errors with inexpensive eyeglasses would also greatly reduce the burden of visual impairment.

Conclusion
Poverty and infirmity are closely interrelated. Significant improvement in global health is dependent on the economic development of LMICs, a more equitable distribution of economic resources, and improved education. Emerging data now indicate that surgery is an essential and cost-effective method of treating a significant portion of the global burden of disease engendered by poverty. The international surgical community has a professional responsibility to address the growing disparity in surgical access and standards through an integrated approach of economic, educational and professional development.
References


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