Operation Smile

GSB Module 1 – Orientation to Global Surgery

Learning Objectives

1. Describe the recent shift in global community's mindset about surgery and its value in the health system.
    a. Explain why surgery has been traditionally ignored and why that thinking is misguided.
2. Be able to name key players in the Global Surgery space (hint: G4 Alliance, ICES, WHO, Safe Surgery 2020, GIEESC)
3. Be able to define key terms and abbreviations – such as SAO, Catastrophic Expenditure, Impoverishing expenditure, Surgical volume, DALYs, Global Burden of disease
4. Be able to explain name crucial statements in the global surgery conversation, such as:
    a. The amount of surgery taking place globally and regionally
    b. Amount of people lacking access to surgery
    c. Amount of people forced into poverty due to seeking surgical care
    d. Amount it would cost to scale up surgery levels to an adequate amount
5. Be able to name the Lancet Commission on Global Surgery (LCoGS) key message 5

Materials

Watch

1. The Lancet, "Surgery in Developing Countries"
2. Global Surgery Student Alliance, "The Evolution of Global Surgery"
3. The Philip R. Lee Institute for Health Policy Studies, "DALYs and QALYs"

Read

4. Meara, et al: "Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development", the **Executive Summary** and **Key Message 5**. (pages 2-8)
5. Farmer and Kim, "Surgery and Global Health: A View from Beyond the OR" (pages 9-12)
6. Elder, "Challenging the Barriers to Accessing Surgery in Low-Resource Settings" (pages 13-16)
7. Roa, "Global Surgery and the Sustainable Development Goals" (pages 17-25)
8. For a deeper dive, check out the Supplemental Materials.

**Please watch the Orientation to Global Surgery Module summary video after working through the above materials.

Things to Think About

- Why has surgery been referred to as "the neglected stepchild of global public health"?
- What misconceptions exist around surgery in resource-limited environments?
- What happens if no additional investments are made in surgical care in low- and middle-income countries?
- What is the relationship between surgery and primary health care? Do you think there is one?
- Imagine you must make a pitch for investment in surgery to the leader of a LMIC. Why should LMICs be investing in surgery?
- Do you see any connections between the readings in this module and the work Operation Smile does?

Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development

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Lancet 2015; 386: 569–624

Published Online April 27, 2015 http://dx.doi.org/10.1016/S0140-6736(15)60160-X

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‡Prof Rodas died March 2, 2015; we dedicate our report to him

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Executive summary

Remarkable gains have been made in global health in the past 25 years, but progress has not been uniform. Mortality and morbidity from common conditions needing surgery have grown in the world's poorest regions, both in real terms and relative to other health gains. At the same time, development of safe, essential, life-saving surgical and anaesthesia care in low-income and middle-income countries (**LMICs**) has stagnated or regressed. In the absence of surgical care, case-fatality rates are high for common, easily treatable conditions including appendicitis, hernia, fractures, obstructed labour, congenital anomalies, and breast and cervical cancer.

In 2015, many LMICs are facing a multifaceted burden of infectious disease, maternal disease, neonatal disease, non-communicable diseases, and injuries. Surgical and anaesthesia care are essential for the treatment of many of these conditions and represent an integral component of a functional, responsive, and resilient health system. In view of the large projected increase in the incidence of cancer, road traffic injuries, and cardiovascular and metabolic diseases in LMICs, the need for surgical services in these regions will continue to rise substantially from now until 2030. Reduction of death and disability hinges on access to surgical and anaesthesia care, which should be available, affordable, timely, and safe to ensure good coverage, uptake, and outcomes.

Despite growing need, the development and delivery of surgical and anaesthesia care in LMICs has been nearly absent from the global health discourse. Little has been written about the human and economic effect of surgical conditions, the state of surgical care, or the potential strategies for scale-up of surgical services in LMICs. To begin to address these crucial gaps in knowledge, policy, and action, the *Lancet* Commission on Global Surgery was launched in January, 2014. The Commission brought together an international, multidisciplinary team of 25 commissioners, supported by advisors and collaborators in more than 110 countries and six continents.

We formed four working groups that focused on the domains of health-care delivery and management; workforce, training, and education; economics and finance; and information management. Our Commission has five key messages, a set of indicators and recommendations to improve access to safe, affordable surgical and anaesthesia care in LMICs, and a template for a national surgical plan. Our five key messages are presented as follows:

- 5 billion people do not have access to safe, affordable surgical and anaesthesia care when needed. Access is worst in low-income and lower-middle-income countries, where nine of ten people cannot access basic surgical care.
- 143 million additional surgical procedures are needed in LMICs each year to save lives and prevent disability. Of the 313 million procedures undertaken worldwide each year, only 6% occur in the poorest countries, where over a third of the world's population lives. Low operative volumes are associated with high case-fatality rates from common, treatable surgical conditions. Unmet need is greatest in eastern, western, and central sub-Saharan Africa, and south Asia.
- 33 million individuals face catastrophic health expenditure due to payment for surgery and anaesthesia care each year. An additional 48 million cases of catastrophic expenditure are attributable to the non-medical costs of accessing surgical care. A quarter of people who have a surgical procedure will incur financial catastrophe as a result of seeking care. The burden of catastrophic expenditure for surgery is highest in low-income and lower-middle-income countries and, within any country, lands most heavily on poor people.
- Investing in surgical services in LMICs is affordable, saves lives, and promotes economic growth. To meet present and projected population demands, urgent investment in human and physical resources for surgical and anaesthesia care is needed. If LMICs were to scale-up surgical services at rates achieved by the present best-performing LMICs, two-thirds of countries would be able to reach a minimum operative volume of 5000 surgical procedures per 100 000 population by 2030. Without urgent and accelerated investment in surgical scale-up, LMICs will continue to have losses in economic productivity, estimated cumulatively at US $12·3 trillion (2010 US$, purchasing power parity) between 2015 and 2030.
- Surgery is an "indivisible, indispensable part of health care."[1] Surgical and anaesthesia care should be an integral component of a national health system in countries at all levels of development. Surgical services are a prerequisite for the full attainment of local and

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global health goals in areas as diverse as cancer, injury, cardiovascular disease, infection, and reproductive, maternal, neonatal, and child health. Universal health coverage and the health aspirations set out in the post-2015 Sustainable Development Goals will be impossible to achieve without ensuring that surgical and anaesthesia care is available, accessible, safe, timely, and affordable.

In summary, the Commission's key findings show that the human and economic consequences of untreated surgical conditions in LMICs are large and for many years have gone unrecognised. During the past two decades, global health has focused on individual diseases. The development of integrated health services and health systems has been somewhat neglected. As such, surgical care has been afforded low priority in the world's poorest regions. Our report presents a clear challenge to this approach. As a new era of global health begins in 2015, the focus should be on the development of broad-based health-systems solutions, and resources should be allocated accordingly. Surgical care has an incontrovertible, cross-cutting role in achievement of local and global health challenges. It is an important part of the solution to many diseases—for both old threats and new challenges—and a crucial component of a functional, responsive, and resilient health system. The health gains from scaling up surgical care in LMICs are great and the economic benefits substantial. They accrue across all disease-cause categories and at all stages of life, but especially benefit our youth and young adult populations. The provision of safe and affordable surgical and anaesthesia care when needed not only reduces premature death and disability, but also boosts welfare, economic productivity, capacity, and freedoms, contributing to long-term development. Our six core surgical indicators (table 1) should be tracked and reported by all countries and global health organisations, such as the World Bank through the World Development Indicators, WHO through the Global Reference List of 100 Core Health Indicators, and entities tracking the SDGs.

At the opening meeting of the *Lancet* Commission on Global Surgery in January, 2014, Jim Kim, President of the World Bank, stated that: "surgery is an indivisible, indispensable part of health care" and "can help millions of people lead healthier, more productive lives".[1]

In 2015, good reason exists to ensure that access to surgical and anaesthesia care is realised for all.

Introduction

The urgent need for surgical care in the world's poorest regions is widely unrecognised. In 2010, an estimated 16·9 million lives (32·9% of all deaths worldwide) were lost from conditions needing surgical care.[2] This figure well surpassed the number of deaths from HIV/AIDS (1·46 million), tuberculosis (1·20 million), and malaria (1·17 million) combined.[3] Each year, at least 77·2 million disability-adjusted life-years (DALYs) could be averted by basic, life-saving surgical care.[4] As with so many global health challenges, the burden of untreated surgical conditions falls heaviest on individuals living in low-income and middle-income countries (LMICs).[4,5] Within LMICs, people with the lowest income, those living in rural areas, and those who are marginalised fare the worst.[6] Although, on average, one procedure is done per ten people living in high-income countries each year (appendix p 8),[7] access to an operating room is out of reach for billions of people worldwide.[8] In the absence of surgical care, common, easily treatable illnesses become diseases with high fatality rates. Yet because conditions needing surgical care have diverse

	Definition	Target
Access to timely essential surgery	Proportion of the population that can access, within 2 h, a facility that can do caesarean delivery, laparotomy, and treatment of open fracture (the Bellwether Procedures)	A minimum of 80% coverage of essential surgical and anaesthesia services per country by 2030
Specialist surgical workforce density	Number of specialist surgical, anaesthetic, and obstetric physicians who are working, per 100 000 population	100% of countries with at least 20 surgical, anaesthetic, and obstetric physicians per 100 000 population by 2030
Surgical volume	Procedures done in an operating theatre, per 100 000 population per year	80% of countries by 2020 and 100% of countries by 2030 tracking surgical volume; a minimum of 5000 procedures per 100 000 population by 2030
Perioperative mortality	All-cause death rate before discharge in patients who have undergone a procedure in an operating theatre, divided by the total number of procedures, presented as a percentage	80% of countries by 2020 and 100% of countries by 2030 tracking perioperative mortality; in 2020, assess global data and set national targets for 2030
Protection against impoverishing expenditure	Proportion of households protected against impoverishment from direct out-of-pocket payments for surgical and anaesthesia care	100% protection against impoverishment from out-of-pocket payments for surgical and anaesthesia care by 2030
Protection against catastrophic expenditure	Proportion of households protected against catastrophic expenditure from direct out-of-pocket payments for surgical and anaesthesia care	100% protection against catastrophic expenditure from out-of-pocket payments for surgical and anaesthesia care by 2030

These indicators provide the most information when used and interpreted together; no single indicator provides an adequate representation of surgical and anaesthesia care when analysed independently.

Table 1: **Core indicators for monitoring of universal access to safe, affordable surgical and anaesthesia care when needed**

causes—including infection, cancer, injury, and disorders relating to reproductive, maternal, and child health—their impact has been poorly captured within present epidemiological frameworks that focus on disease causes, not treatment needs.[3,9–11] Death and disability from conditions needing surgical care in LMICs have received little attention. This is not merely unjust; failure to recognise and address the substantial human and economic toll of untreated surgical conditions in LMICs slows progress towards a diverse range of health and development goals.

Surgical care should be an integral component of health systems for countries at all levels of development.[12] As many LMICs undergo an epidemiological transition over the next 20 years, cancer, cardiovascular disease, and road traffic injuries are poised to surpass previous communicable disease challenges. As a result, the need for equitable access to surgical services in these countries is projected to substantially increase. Yet despite the large and growing unmet need for surgical care worldwide, securing a place for surgery and anaesthesia within the present global health framework of disease-based monitoring and advocacy is still exceptionally difficult.

In response to these challenges, the *Lancet* Commission on Global Surgery was launched in January, 2014, during a crucial transition period in global health. The lead-up to the year 2015 saw a renewed global commitment to the notion of universal health coverage (UHC), a revisiting of strategic investments in global health, and deliberation over how the world's health goals would be represented in the post-2015 Sustainable Development Goals (SDGs). Within this changing global health landscape, we aimed to examine the case for surgery as an integral component of health care, focusing on LMICs; assess the crucial challenges and key opportunities in the development and delivery of quality surgical and anaesthesia services in resource-poor settings; and propose a series of key policy recommendations and indicators to guide future progress. In 2014, three commissioner meetings were held: in Boston, USA; Freetown, Sierra Leone; and Dubai, United Arab Emirates. These meetings brought together an international team of 25 commissioners with skills in the specialties of surgery, anaesthesia, nursing, global health, health policy, and management and finance, and invited advisors, researchers, and contributors, from more than 110 countries. Each commissioner was assigned to one of four working groups providing in-depth analyses into the areas of health-care delivery and management; workforce, training, and education; economics and finance; and information management. We followed a collaborative process and method (appendix pp 3–7) to engage effectively with stakeholders and build an inclusive global surgical movement. Commissioners engaged in direct outreach efforts with ministries of health, front line providers and implementers, global health organisations and funders, professional societies, academia and industry, educators, students, and patients. We also identified knowledge gaps and embarked on collaborative research projects to begin to address them. This research informs all sections of the report and appendices. Web-based platforms and social media promoted global engagement. Lastly, 12 teaching cases were written in collaboration with five business schools and one global health programme in the USA, Australia, and India. These cases were modelled on the business school case-method pedagogy and nested in real country-level examples of surgical and anaesthesia care provision and systems strengthening in LMICs.

Although the need for surgery extends across countries at all stages of development, the largest area of unmet need exists within LMICs. Therefore, surgical care within LMICs, rather than high-income countries, was the primary focus of the Commission. Global surgery, as defined previously,[13] refers to all groups facing inequitable or inadequate surgical care delivery, whether they are chronically underserved populations or those in acute crisis, conflict, or disaster settings. The factors driving surgical need and the mechanisms for improvement of surgical care for these populations, however, are often very different. Therefore, we restricted our work and scope to underserved populations in LMICs, outside of mass conflict and disaster settings (panel 1).

In this report, we present the findings of the Commission. We describe the Commission's key messages, present findings from the four working group areas, outline future research needs, and finally provide a template for the development of a national surgical plan. We conclude each section by outlining policy recommendations for stakeholders involved in the delivery of surgical care at local, national, and global levels.

Our hope is that the Commission's findings will draw attention to the gross disparities that exist worldwide in surgical care, and the far-reaching human and economic consequences that result in lost lives, lost potential, and lost output. We also hope that this report serves as a catalyst and provides an early framework to effect change. The problems are clear. The solutions will need continuing development, testing, and refinement. Only through a unified commitment to research, advocacy, policy development, and investment, accompanied by coordinated local and international action, will this Commission's vision of universal access to safe, affordable surgical and anaesthesia care when needed be realised in our global community.

Key messages of inequity and impact

The complexity of measuring surgical conditions

In this section, we quantify and characterise the burden of surgical conditions. By synthesising existing published work and the results of new primary research, we look at access to surgery and anaesthesia, unmet need for surgical procedures, and the financial effect of seeking surgical services. We then examine the macroeconomic

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See **Online** for appendix

LMICs
Although this term has been used throughout the report for brevity, the Commission realises that tremendous income diversity exists between and within this group of countries

Panel 1: **Definitions**

Global Surgery
An area of study, research, practice, and advocacy that seeks to improve health outcomes and achieve health equity for all people who need surgical and anaesthesia care, with a special emphasis on underserved populations and populations in crisis. It uses collaborative, cross-sectoral, and transnational approaches and is a synthesis of population-based strategies with individual surgical and anaesthesia care.[14]

Surgical care
The provision of operative, perioperative, and non-operative management; anaesthesia; and obstetric care for all surgical conditions.

Surgical condition
Any disease, illness, or injury in which surgical care can potentially improve the outcome.[15]

Surgical provider
Any health worker providing surgical care, including obstetric and gynaecological surgical care, irrespective of level of training or supervision.

Anaesthetic provider
Any health worker providing anaesthetic care, irrespective of level of training or supervision.

The surgical workforce
A network of associated surgical and anaesthetic personnel who work in concert to deliver surgical care. This includes but is not limited to all surgical and anaesthetic providers, nurses, pathologists, radiologists, laboratory technicians, theatre managers, community health workers, rehabilitation specialists, biomedical technicians, and engineers.

Specialist surgical workforce
Fully trained physician surgeons, anaesthetists, and obstetricians, synonymous with consultant and attending surgeon, anaesthetist, or obstetrician.

Associate clinician
A health worker trained specifically to diagnose and manage basic medical and surgical conditions who is not a physician. Some might undertake surgery.[16] They might also be referred to as non-physician clinicians, mid-level providers, clinical officers, or *técnicos de medicina y cirugía*.[17]

First-level hospital
First-referral-level hospital or the district hospital provides a level of care that cannot be obtained at home; acts as a gatekeeper for referral to higher levels of care at a secondary or tertiary hospital.

Essential surgical care
Any and all procedures, contextually and culturally dependent, that are deemed by that region, society, or culture to promote individual and public health, wellbeing, and economic prosperity. The Bellwether Procedures—caesarean delivery, laparotomy and open fracture treatment—serve as a proxy for surgical systems that have the ability to provide a broad range of procedures.

impact of surgical conditions in LMICs. Finally, we outline the fundamental and cross-cutting role of surgery and anaesthesia in the achievement of widespread gains in global health, welfare, and development.

Many challenges to the accurate and comprehensive measurement of the global burden of disease exist.[14,15] In many LMICs, country-specific health data is scarce.[16–20] Most disease burden estimates are not based on gold-standard pathological or even subjective clinical diagnoses; rather, they are extrapolated from various less concrete methods including demographic surveillance systems, household surveys, verbal autopsies, facility-level data inquiries, and a mixture of modelling methods. Although modelling approaches are invaluable methods to understand human health and disease, their results are estimates, and concerns exist about their reliability, applicability, and consistency.[14,15,21]

Unlike a discrete disease entity, surgery is a treatment modality and is needed across the entire range of human disease. The scope of this need further complicates measurement of the prevalence and effect of surgical conditions. Research shows that major procedures are undertaken in every disease subcategory defined by the Global Burden of Disease (GBD) study (figure 1)[9]; at least 15% of pregnancies result in complications that need emergency obstetric care, including surgical management;[22,23] and surgery is responsible for roughly 65% of all cancer cure and control.[24] Although not every trauma patient who has a severe physical injury needs a surgical procedure, care of injured patients almost always needs the skill of a surgically trained provider.

Even when the need for surgery is clearly identified, it is difficult to classify and measure, because no universal nosology for surgical conditions or treatment exists. Surgery's cross-cutting nature means that classification of surgical conditions overlaps with classification of all other disease subsets. For example, is colon cancer—incurable without surgical intervention—characterised as a surgical condition or a malignancy? Is sepsis from an infected diabetic foot wound necessitating amputation an infectious disease, endocrine disorder, or surgical ailment? Is obstructed labour, for which instrumental or operative intervention is the only definitive treatment, considered a maternal health or surgical problem?

Although surgical need transects all disease categories, the necessity for surgery varies from one region to the next depending on disease patterns, social determinants, and the availability and use of medical care. Poor access to care and delayed medical interventions mean that pathological abnormalities generally not needing surgery in settings with strong primary health-care systems might progress to need operative intervention when left unattended. For example, in the post-antibiotic era, pneumococcal pneumonia and tuberculosis are not typically regarded as surgical conditions; neither are many superficial skin infections. However, if not diagnosed and treated promptly, microbial pathogens can lead to serious surgical pathological abnormalities such as empyema, osteomyelitis, and rheumatic heart disease.

Estimates of the global burden of surgical conditions

Despite difficulties in the measurement and definition of the global burden of surgical conditions, three attempts have been made. All attempts rely on the burden of disease methods described in the appendix pp 11–12. The

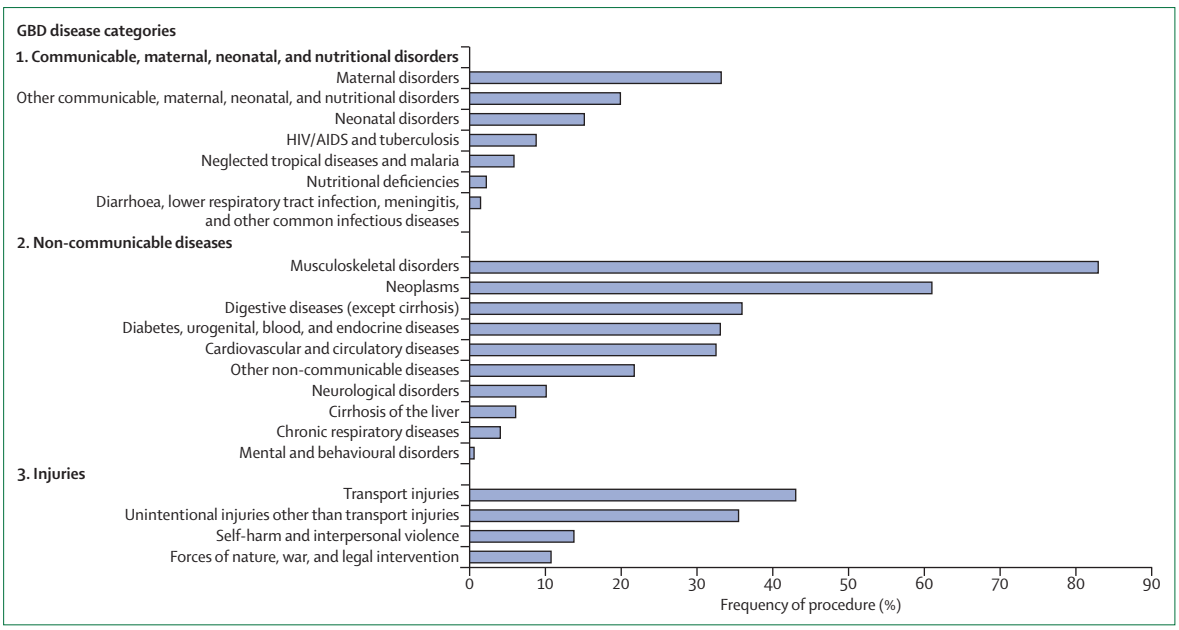

Figure 1: **Frequency of operations done per GBD 2010 disease category for patients admitted to hospitals in a well resourced health system**
Data from Rose and colleagues.[9] GBD=Global Burden of Disease.

first and most widely cited estimate was generated after 18 surgeons from around the world provided estimates for "the proportion of each condition [from the 2002 World Health Report burden of disease estimates] that would require surgery" based on their professional experiences.[5] After excluding the two highest and two lowest estimates, the investigators concluded that at least 11% of global DALYs were surgical.[5]

The second was derived in consideration of the reduction in morbidity and mortality from scaling up a basic surgical package that could be provided at first-level hospitals in LMICs. This package included treatments for four digestive disorders, four maternal–neonatal disorders, and injuries that could be treated with basic interventions.[4] After assuming a counterfactual scenario in which mortality and morbidity were equal to the best performing regions on the basis of the Institute for Health Metrics and Evaluation (IHME) estimates, the researchers estimated that 1·4 million deaths could be prevented annually.[4] The avertable and non-avertable mortality and morbidity from this small number of surgical conditions within the three specific categories examined accounted for 14·2% of the total burden of disease in LMICs.[4]

The third was done as part of this Commission.[2] Surgeons, anaesthesiologists, internists, nurses, and public health practitioners from around the world were surveyed. For each of the 21 IHME cause groups, they were asked: "What proportion of patients with the following conditions would, in an ideal world, require a surgeon for management?" 173 people returned the surveys, including six anaesthesia providers, 36 general surgeons, and 46 specialists. Depending on the method of estimation and definition of burden used (death *vs* DALYs), they reported that surgical conditions account for 28–32% of the overall global burden of disease.

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Key message 1

5 billion people lack access to safe, affordable surgical and anaesthesia care when needed

Access to surgical care is essential for reduction of mortality and morbidity from surgical conditions. Previous estimates reported that more than 2 billion people have no access to surgery and anaesthesia.[8] This figure is probably an underestimate, because it was calculated using just one dimension: operating theatre density.[8] The notion of access to care is multidimensional, encompassing geographic, temporal, structural, socio-cultural, financial, and political components. For a patient to access surgical and anaesthesia care, a delivery system (including trained personnel and physical resources) should first exist. The patient should then be able to reach this system in a timely manner. For the patient to benefit, the care should be safe and effective. Finally, the costs of surgical and anaesthesia services should not act as a barrier to uptake, or result in financial catastrophe for patients and their families. Consideration of these dimensions suggests a greater deficiency of access than previously estimated.

Our vision is universal access to safe, affordable surgical and anaesthesia care when needed. To quantify a more comprehensive assessment of access in terms of this vision, we created a mathematical model to show

	Low-income countries	Lower-middle-income countries	Upper-middle-income countries
Unit cost for surgical procedures	179	219	332
Surgical theatre construction cost	319 002	412 488	1 906 064
Historical rates of increase (5·1% per year)			
Cost of surgical procedures	14	115	86
Costs of operating rooms	6	37	40
Total cost	20	152	126
Annual cost (% of total annual health expenditure)	1 billion (4%)	8 billion (4%)	7 billion (1%)
Mongolian rates of increase (8·9% per year)			
Cost of surgical procedures	31	197	91
Costs of operating rooms	13	50	40
Total cost	44	247	131
Annual cost (% of total annual health expenditure)	2 billion (8%)	14 billion (6%)	7 billion (1%)
Mexican rates of increase (22·5% per year)			
Cost of surgical procedures	76	274	95
Costs of operating rooms	17	50	40
Total cost	93	324	135
Annual cost (% of total annual health expenditure)	5 billion (17%)	18 billion (8%)	8 billion (1%)

Costs are presented per billion 2012 US$. Estimates are from Verguet and colleagues[48] created specifically for this Commission.

Table 3: **Total and annual costs of scaling up basic surgical services from 2012 to 2030 using historical, Mongolian, and Mexican rates of increase for 33 low-income countries, 33 lower-middle-income countries, and 22 upper-middle-income countries**

rates of increase, and $550 billion ($31 billion annually) with Mexican rates of increase.

Although Mexican rates of increase are too ambitious to use as a realistic global target, reaching historical and Mongolian rates is feasible if scaling up of surgical services was prioritised. The historical and Mongolian rates of increase are similar to rates of decline seen in LMICs for under-5 mortality and maternal mortality, two areas of prominent global health focus.[51,52] Although the total costs of scale-up are substantial, research suggests that surgery is a highly cost-effective intervention,[53,54] and the percentage of annual health expenditure is proportionate to the percentage of the total burden of disease that needs surgical intervention in these countries.

Expansion of surgical and anaesthesia care might result in substantial economic returns on investment. Macroeconomic assessment of other global health foci have shown that health improvements lead to both improved life expectancy and improved national income,[55,56] but similar work has not been done for a comprehensive subset of surgical conditions. To assess the economic consequences of untreated surgical conditions, we examined five major disease categories needing essential surgery: neoplasms, injuries, maternal disorders, neonatal disorders, and digestive disorders. Full details of this methodology can be found in the accompanying paper.[57] Briefly, we estimated the total value of lost economic output secondary to these surgical conditions between 2015 and 2030 using the WHO Projecting the Economic Cost of Ill-Health (EPIC) model. The EPIC model projects how disease affects a country's labour supply and capital stock, which in turn are related to aggregate economic output (ie, GDP) over time, thereby linking disease to economic growth.[55] The counterfactual is assumed to be no disease.

The value of lost output secondary to surgical conditions was estimated for 128 countries with a combined population of 6·4 billion people (in 2013), or 90% of the world population. We noted that between 2015 and 2030, surgical conditions will be responsible for a cumulative loss to the global economy of $20·7 trillion or 1·3% of projected economic output. Neoplasms and injuries needing surgical care will have the greatest effect on economic output, followed by digestive diseases. More than half of all losses between 2015 and 2030 will occur in LMICs ($12·3 trillion), particularly in LMIC super-regions of southeast Asia, east Asia, and Oceania ($6·1 trillion; figure 4).

LMICs will bear the brunt of these losses: by 2030 we calculated that surgical conditions in middle-income countries could consume as much as 2% of these countries' projected annual GDP growth. These numbers make the roughly $420 billion investment needed to scale-up services to treat these conditions pale in comparison.

Key message 5 **Read this section.**

Surgery is an indivisible, indispensable part of health care

Universal access to safe, affordable surgical and anaesthesia care is essential for widespread and equitable improvements in global health, welfare, and development. Surgical conditions consist of a large and diverse collection of human ailments. More than 100 000 maternal deaths might be averted by timely intervention, and increased access to caesarean delivery reduces neonatal mortality by 30–70%.[58] Similarly, non-communicable diseases and injuries are already the largest subset of the global disease burden and are set to rise exponentially in coming years.[59] Prevention and treatment of surgical conditions are necessary to improve the health of populations,[10] are fundamental parts of resilient health systems, and are crucial for the achievement of global health goals. Whether to reach unmet targets of Millennium Development Goals (MDGs) 4 and 5, or to combat the rising tide of malignancies, diabetes, and road traffic injuries, the need for integration of surgical services into comprehensive platforms of health-care delivery is clear.

In 1980, the then director-general of WHO Halfdan Mahler referred to surgery's "proper role in bringing the people of the world nearer to the goal of health for all".[60] Nearly 30 years later, improvement of surgical capacity at the district hospital level was identified as one of the 30 top mechanisms for advancement of global welfare,

and particularly the welfare of developing countries, in the problem category of disease at the 2009 Copenhagen Consensus.[61] The integration of surgery into district hospitals acts as an enabler, raising the ability to deliver other health-care services.[62] Because of its complexity,[63] delivery of safe surgery and anaesthesia signals the presence of the "staff, stuff, space, and systems" of a responsive health care system.[64] Such a system is capable not only of delivering surgical care, but also of treating a broad range of health challenges, whether it be a child with malnutrition, a mother dying of post-partum haemorrhage, a family injured in a bus collision, or a community faced with an Ebola outbreak. As World Bank president Jim Kim stated in his address at this Commission's inaugural meeting, "surgery is an indivisible, indispensable part of health care".[2]

Surgical conditions—whether cancers, injuries, congenital anomalies, childbirth complications, or infectious disease manifestations—are ubiquitous, growing, and marginalising to those who are afflicted by them. These conditions are financially devastating for individuals and their families, economically damaging for countries, and disproportionately threaten the welfare of the poorest and most vulnerable people in our societies. The arrival of 2015 brings with it a new set of goals for the ensuing two decades, including commitments to UHC, increased investments in health, and a collection of SDGs that aim to end poverty, promote economic growth, and ensure good health for all. The one proposed health-related SDG—to ensure healthy lives and promote wellbeing for all at all ages—will need widespread and equitable delivery of surgery and anaesthesia, the treatment needed for a third of the global burden of disease.[2] Similarly, the World Bank and WHO have targets for UHC of at least 80% coverage of essential health services, and 100% protection from OOP payments for health services, by 2030.[39] In a world where 70% of the population cannot access essential surgical services, and 50% are at risk for catastrophic expenditure should they need surgical care, fulfilment of UHC will need an expansion of surgical and anaesthesia services and a pro-poor approach to the financing of surgical care. Such a scale-up will need immediate mobilisation of domestic and international health financing, and a commitment to surgical services as an integral component of health systems strengthening.

Surgical and anaesthesia care are fundamental for health-care delivery for any country at any level of development. Broad scale-up of quality surgical services will prevent deaths, limit disability, palliate suffering, promote economic growth, and help achieve maximum gains in health, welfare, and development for all.

End here.

Health-care delivery and management

The surgical system

A common yet erroneous perception is that the surgical system consists of a surgeon and an anaesthetist in a sterile environment. However, a more accurate perspective acknowledges an interdependent network of individuals and institutions all essential to the delivery of safe, timely, and affordable surgical and anaesthesia care (figure 5). Many of these components are not standalone requirements for a surgical system, but rather for a shared delivery infrastructure that is the basis of a functional health system.[65] A blood bank, for example, is equally important for a woman with post-partum haemorrhage as it is for a child with severe malaria. The goals of achieving a functional health system and surgical system are not separate.

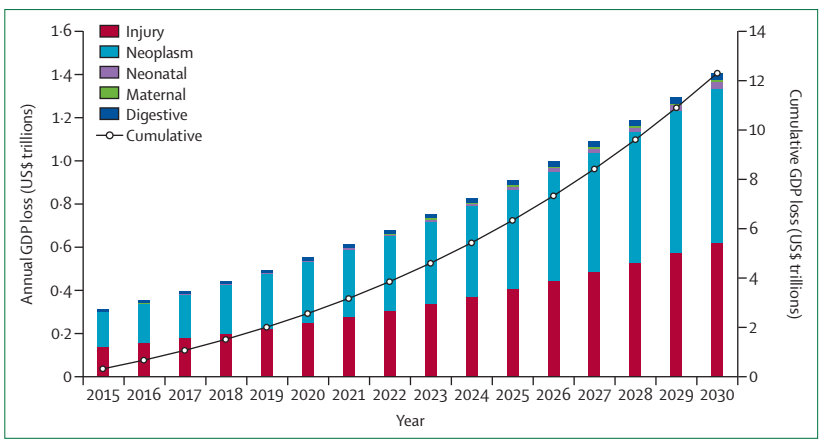

Figure 4: **Annual and cumulative GDP lost in low-income and middle-income countries from five categories of surgical conditions (2010 US$, purchasing power parity)[57]**
Data are based on WHO's Projecting the Economic Cost of Ill-Health (EPIC) model (2010 US$, purchasing power parity). GDP=gross domestic product.

Surgical care begins in the community. Community health workers connect patients in remote areas to providers. They refer surgical patients to the first-level hospital, and provide post-discharge follow-up. First-level hospitals provide the hub for surgical and anaesthesia care, and should be capable of providing most emergent and planned procedures. Tertiary centres can provide specialised care, and serve as hubs for training, research, and system-wide quality improvement.

In most areas, delivery of surgical services consists of a mix between public and private providers.[66,67] Private providers consist of all actors outside the government and can take on many forms, including for-profit providers, not-for-profit providers (eg, non-governmental organisations [NGOs] and faith-based organisations), and informal providers (eg, traditional healers). In some countries, the private sector is responsible for most hospital-based service delivery.[67] All hospitals should connect to the community and to each other through a reliable referral system. Strong clinical leadership, professional management, and government policies should support all levels of care.

In this section we discuss surgical and anaesthesia care delivery at the first-level hospital through the lens of the Three Delays framework often used in the maternal

For **key findings from the health-care delivery and management working group** see appendix p 16

World J Surg (2008) 32:533–536
DOI 10.1007/s00268-008-9525-9

World Journal of Surgery

Surgery and Global Health: A View from Beyond the OR

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Published online: 3 March 2008

The neglected stepchild of global health

In Africa, surgery may be thought of as the neglected stepchild of global public health. There are fewer physicians per population on this continent than on any other; surgeons are rarer still, and almost all of them work in the urban enclaves of what remains a rural region. The story is the same in the poorer parts of Asia and Latin America (with a few exceptions, such as Cuba). Although disease treatable by surgery remains a ranking killer of the world's poor, major financers of public health have shown that they do not regard surgical disease as a priority even though, for example, more than 500,000 women die each year in childbirth; these deaths are largely attributable to an absence of surgical services and other means of stopping post-partum hemorrhage [1]. Equally unattended, among the very poor, are motor-vehicle and farm accidents, peritonitis, long-bone fractures, and even blindness [2-4]. Cardiac disease, congenital or the sequela of infection, is a death sentence for most people—many of them children—so afflicted in the poorest parts of the world [5, 6]. In some settings, surveys reveal that surgical disease is among the top 15 causes of disability [7], and surgical conditions account for up to 15% of total disability adjusted life years (DALYs) lost worldwide [8].

If it is true that surgery is the neglected stepchild of global health, does it follow that there are no surgical services available in the poor world? The truth is even more unpleasant: within poor countries, surgical services are concentrated almost wholly in cities and reserved largely for those who can pay for them. In Haiti, for example, a community-based survey conducted in the 1980s suggested that rates of caesarian section in a large area of southern Haiti were close to zero; maternal mortality was pegged at 1,400 per 100,000 live births [9]. Yet among the affluent of that same country, rates of caesarian section do not vary much from those registered in the United States. Careful scrutiny of local inequalities of risk and access to care reveals that in poor countries, even minor surgical pathologies are often transformed through time and inattention into lethal conditions. Congenital abnormalities such as cleft palate remain life-long afflictions rather than pediatric surgical disease. In addition to surgical abdomens, severe trauma (from road accidents more often than from intentional violence) and other potentially fatal pathologies remain a massive burden of untreated disease that weighs on the lives, and productivity, of the world's bottom billion.

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When we at the non-governmental organization Partners In Health (PIH) asked ourselves, in rural central Haiti, whether or not we would let ability to pay even the smallest fee determine who would have access to surgical care, we decided to approach surgical disease as we did AIDS or tuberculosis. Unless we waived fees, we would most certainly exclude some of the very people we had come to serve in the first place. We were not surprised when we became the region's, then the country's, *de facto* provider of last resort. The only way to decrease the caseload in our hospital would be to strengthen the area's public hospitals and permit them to offer equivalent services, also as a public good for public health [10]. It is noteworthy that the only significant advance in the effort to make surgical care something other than a commodity has been with respect to caesarian sections. In August 2007, the district health commissioner for central Haiti, faced with staggering local inequalities in maternal mortality, announced that all prenatal care and emergency obstetrical services would from then on be available free of charge to the patient.

Accounting for inattention

Why has surgical disease been so neglected in global health? For one thing, international health has been dominated for decades by those concerned with communicable disease, from smallpox to AIDS [11]. This was welcome, even though the majority of premature deaths are not attributable to infections and the distinction between communicable and noncommunicable diseases is not always important: some surgical disease may be classed as communicable, while many infectious diseases are not readily communicable. That said, most pathologies requiring surgical interventions are not transmissible from one person to another and thus do not rank as a public problem necessitating public support. In the absence of public funding or widespread health insurance, the treatment of surgical disease hinges on a means test: can the patient and family pay for the services? As we have learned in Haiti and beyond, fee-for-service surgical care simply removes the poorest sector of the population from the equation, unless the calculus of interest accounts for mortality.

Another reason for the relative inattention to surgery in global health is that only now are significant numbers of surgeons involving themselves in such matters. We need our surgical colleagues to speak fluently about rebuilding infrastructure, training personnel, and delivering high-quality care to the very poorest. It took decades of advocacy to develop funding mechanisms for AIDS prevention and care. Tuberculosis, neglected for decades, was declared a priority by the World Bank only after efforts were made to show that it was in fact a leading killer of young adults worldwide and far from being eradicated. The World Health Organization and the Gates Foundation have announced plans to address malaria and other neglected diseases of poverty. But there is no Global Fund for Surgery, and rare indeed are the foundations willing to support surgery as an important part of global public health. Even efforts to address maternal mortality are too timid if they suggest that anything less than the full panoply of modern obstetrics—including surgery, antihemorrhagics, and blood banking—will reduce deaths during childbirth.

Another reason for reluctance is the simple truth that surgery is most often a highly complex intervention. There are exceptions—innovation in cataract removal is often cited—but surgery usually requires not only a surgeon but anesthesia, an operating room, autoclaves, sutures, drapes, and other supplies, not to mention postoperative care and blood banking. There is no surgical equivalent to a vaccination campaign or a mosquito net. To do surgery properly requires a significant investment in infrastructure and training as well as a steady supply of consumables.

What is to be done?

We have hinted at a long-term vision of the role of surgery in global public health. This vision is ambitious: key surgical services must always be available within the public sector, and free of charge at the point of care if charges can be shown to serve as barriers for the poor. None of this will be accomplished unless we take a series of steps right away. In an article in this issue of the *World Journal of Surgery*, we present our own experience in rural Haiti once user fees for surgery were abolished. This often-painful experience has led us to hold strong views on the role of surgery in global health.

Allow us to offer other suggestions from beyond the OR. Some of these will sound like stop-gap measures, and they are. Many are already underway but need to be improved dramatically. For example, "twinning programs" already link first-world hospitals to those based in poor countries. The problem is that many of the latter do not provide surgical services to the poorest, as anyone can discover merely by examining the hospitals' fee structures and assessing the ability of the region's poorest people to pay. Twinning programs should not be abandoned, since that would further slow the movement of resources down the steep slope of inequality toward those who need such care most. However, donor hospitals, surgeons, and all those involved in efforts to redistribute surgical supplies need to do due diligence and rate their partner institutions in new ways. Do not merely ask about the size and quality of the operating rooms. Ask about your partners' commitment to reaching the poorest.

The growing proximity of rich world and poor has also led to a proliferation of short-term medical missions to address the health problems of those living in extreme poverty. Although we and many others have argued that primary health care, requiring sustained investment of time and resources, cannot be delivered effectively through such missions, this critique does not always hold true for certain surgical subspecialties [12]. Witness the success of what might be termed "vertical" surgical missions focusing on a single pathology, such as cleft palate or cataracts.

Again, we would not suggest abandoning short-term medical missions. Rather, how can we do them better? It is important to integrate vertical surgical programs into broader efforts to improve public health in general. This means, again, doing due diligence. After asking how well partner institutions (hospitals, clinics, medical schools) do in providing, for example, cataract care to the poorest, a second tier of questions follows: How well are partner institutions serving the broader goals of public health? Of the primary health care movement? Of global health equity? [13, 14]. These questions remind us that global health need not be a competitive race for scarce resources. If we join forces with international health experts, with activists, and with those setting health policies, we can build a coherent movement that comes to include surgery. Many issues can unite us; addressing maternal mortality should be a priority that drives forward the broader surgical and public health agendas.

We must also contribute to building or rebuilding infrastructure in the public sector, since a strong public sector is the only guarantor of access to health care as a right. In Latin America and in Africa, we have focused our efforts within the public sector, usually starting at the level of the district (a unit typically containing hundreds of thousands of people). Having an operating room is only the first of several steps; all hospitals with surgical programs need postoperative care and blood-banking. In fact, even a small district hospital needs at least two operating theaters (one for emergencies, usually obstetric, and another for elective cases), a blood bank on site, a laboratory, anesthesia machines and staff who know how to use and repair them, and an uninterrupted source of electricity.

Surgeons who wish to donate their time to the needy in resource-poor settings learn immediately about the need for bricks and mortar, generators, autoclaves, and staff. First-world surgeons are unaccustomed to having to recruit and manage barely literate but well-meaning helpers, much less to build and stock their own operating rooms. Clearly, we do not want surgeons to be dragged out of the operating room to manage logistics, supply chains, the training of paraprofessionals, and financing. But we do need the support and attention of surgeons if progress is to be made.

Global health currently attracts unprecedented interest among surgeons, especially those in training, for whom residency programs and fellowships should be further developed, as is now occurring in medicine [15]. Field experience remains an important teacher. Providing even the most basic surgical services to those previously unserved requires infrastructure, training, supplies, and experienced personnel. The one thing not required is surgical disease, which exists abundantly among the world's poorest. To bring a greater number of surgeons into the campaign for public health unrestricted by ability to pay will involve enlarging the horizons of both the surgical and public-health professions.

Acknowledgment This work was in part supported by National Institute of Allergy and Infectious Disease (K23 AI063998 to LCI).

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Challenging the barriers to accessing surgery in low-resource settings: Lessons learned from burns

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SURGERY IS A NEGLECTED COMPONENT OF PRIMARY HEALTH CARE in many parts of the world, with more than 2 billion people lacking access to essential surgical services.[1] Yet few international initiatives are working to promote surgery as a public health good or to fund capacity building, and even fewer are developing simple, cost-effective models to extend surgical coverage outside capital cities and beyond a limited range of indications. Factors contributing to this neglect range from pragmatic challenges, such as a lack of basic materials and infrastructure and insufficient numbers of trained surgeons,[2] to misconceptions[3] which feed the false notion that these challenges are, practically speaking, insurmountable.

Médecins Sans Frontières (MSF) is an international humanitarian organization that provides medical care in crisis situations, including conflict, natural disasters, epidemics, and failed health systems. Surgical services are deployed typically during the initial response to an emergency, such as an earthquake or violent conflict. If they are maintained after the immediate crisis has eased—a step sometimes taken in contexts with an acute lack of local capacity—then road traffic and domestic accidents, particularly burns, often come to dominate case etiologies. Surgical management of burns remains among the most neglected areas of surgery, and here, too, myths and misperceptions impede efforts to develop sustained capacity for managing this devastating, common injury.

The experience of MSF offering surgical care in low-resource settings (LRS) has shown that burn management and other surgical services seen as "specialized" (and therefore as more difficult to provide) depend on the same fundamental hospital activities and capacities as do general and orthopedic surgery. In this article, we draw upon the work of MSF in burn care[4] to illustrate these parallels and to examine the hurdles encountered and skills required in setting up surgical services in LRS. We also examine some of the misperceptions that impede development of critically needed capacity and describe how we are working to build a burn care model that is efficacious and transferrable in settings where we operate. Our approach draws on lessons learned from developing other types of surgical programs and should help inform efforts to expand both the geographical reach and the range of surgical services in LRS.

BURN SURGERY WITHIN MSF

MSF has always encountered a significant volume of burn patients in its surgical projects and usually accepts burns referrals from what exists of public systems. This influx is to be expected when we are the only surgical care provider, but surprisingly it also occurs in settings with other public and private providers present, where our projects focus on offering a broader array of care. In evaluating local options for burns patients, we realized that burns are a neglected area nearly everywhere we work and that the few existing burn units are usually of poor quality.

For these reasons, MSF assumed the challenge of developing competence in burns management.

Accepted for publication April 5, 2015.

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Surgery 2015;158:33-6.

0039-6060/$ - see front matter

http://dx.doi.org/10.1016/j.surg.2015.04.006

Our approach to adopting new surgical areas is relatively standardized: (1) partner with experts; (2) invest up-front, within an existing project, to develop protocols and technical approaches; and (3) identify ways to simplify these practices for local settings, staff, and infrastructure constraints, so they can be implemented more broadly (here, as standardized burns practice in nonspecialized surgical projects).

For MSF's Operational Center Paris (MSF-OCP; 1 of 5 MSF operational centers), this process began in 2006–2007 with our first burn unit within the surgical program at Trinity Hospital in Port-au-Prince, Haiti. Currently MSF-OCP treats acute burns in 9 projects in 7 countries (Haiti, South Sudan, Democratic Republic of Congo, Central African Republic, Pakistan, Yemen, and Syria). In the first quarter of 2014, we performed nearly 5,000 burn-related procedures—double the volume of Q1 2013.

COMMON MYTHS VERSUS REALITIES OF BURN SURGERY PROGRAMMING IN LRS

In working with local and national stakeholders to establish these programs, we encountered many misconceptions about the potential challenges involved; for the most part, they echoed oft-cited rationales for failure to invest more generally in surgical programs. Here we discuss these perceptions and contrast them with the experiences of MSF in burn projects.

The burden of burns is limited, so there is little need to expand burn care. *Myth.* Burns are extremely common and considered a "serious public health problem" by the World Health Organization. They cause an estimated 265,000 deaths yearly, 95% of them in low- and middle-income countries[5]—a geographic disparity related to factors such as use of open cooking fires, lack of fire safety measures, and crowded living conditions.[6] Burns are also a major cause of disability-adjusted life-years lost in low- and middle-income countries. Children younger than age 5 years are by far the most affected group, and women are also at increased risk.[5,7]

These figures, however, come from estimates and models; few concrete data exist on the burden and typology of burns and burns-related surgical need in LRS and even less on provision of care and outcomes. This speaks to a wider problem: the paucity of medical- and surgery-related data from LRS—a critical gap for policy makers, because quantifying need is key to determining public health priorities and resources. Nevertheless, the experience of MSF is consistent with these high estimates: half of all MSF-OCP surgical activity is related to trauma, half of which are burns (partly reflecting a focus of our projects, but consistent with the literature) (Supplementary Fig).

Treating burns requires modern burn unit technology and infrastructure that is beyond reach for low-income settings. *Myth,* at least in terms of physical infrastructure; what matters more is managing the hospital systems of patient flow and components of care (emergency room−intensive care unit−operating theater−ward). The experience of MSF in Haiti illustrates this point. Immediately after the earthquake, we constructed a 350-bed hospital, with operating theater block, in an inflatable tent.[8] After the emergency phase, when bed needs decreased, we moved to semi-permanent structures but maintained the burn unit, given the strong ongoing need. The inflatable structures were retained to facilitate optimal patient flow, with early isolation and a dedicated burn intensive care unit and operating theater block. As patients progressed with treatment, they were moved into shared rooms.

This experience reinforced a key lesson, one that also applies to other areas of surgery: the surgical act comprises only a fraction of patient care. Although discussions on expanding access to surgery typically devote most attention to the operating theater, the larger challenge has been in hygiene practices, infection control, laboratory and blood bank services, anesthesia, and postoperative care, to name a few; for large burns and some other surgical indications, including trauma, long physical and/or psychological rehabilitation is also critical. Broadly speaking, these services require well-coordinated clinical strategy (protocols, appropriate human resources, equipment, and drugs), rigorous quality control, and dedicated hospital management (although finding experienced hospital managers is a significant challenge in most MSF project contexts).

Collectively, these measures are paying off: implementation of MSF protocols adapted from burn centers plus ongoing integration of more advanced techniques have resulted in improved burn care and patient satisfaction, and fewer complications. For example, performing many dressing changes on the ward during the acute phase has reduced the necessity for operating theater visits every 2 days, which in turn reduces exposure to anesthetic agents and nosocomial infections and eliminates the need for repeated transfers and fasting. The positive impact on patients' nutritional state, physical rehabilitation, and psychological well-being has been striking.

Burns are too complicated to manage. *Myth and reality.* Inadequate treatment and rehabilitation often lead to poor outcomes and long-term functional disability. Furthermore, some important advances in burn care in high-income countries have proven difficult to implement in settings where we work—for example, the use of aggressive surgical strategies for patients with large full-thickness burns, which have lead to markedly improved patient survival in advanced burn units.[9]

In our experience, it is certainly possible to train general surgeons to assess and manage burn wounds and to take more aggressive surgical approaches, notably early excision and grafting. The bigger challenges, however—and greater opportunities for improving care—involve establishing the required infrastructure and support functions outside the operating theater, as described above. As in other areas of surgery, our approach is therefore to make informed trade-offs in techniques, with the aim of optimizing patient outcomes given the resources and infrastructure in place. In our burn treatment settings, less aggressive surgical strategies—combined with careful attention to burn evolution, infection prevention, and other core components of burn care—can result in relatively low mortality for burns involving up to 40% of total body surface area (TBSA) (Fig), comparing favorably with rates reported from similar settings.[10-13]

Burn surgery is unsafe in hospital structures in LRS because of the high risk of hospital-acquired infections. *Myth.* Although bacterial infections—specifically antibiotic-resistant infections—are a substantial threat in burn units and, in LRS, are associated with late deaths from large burns, appropriate hospital practices can reduce this risk and improve outcomes. Although microbiology for individual patient management is not an absolute requirement for providing effective burn care, our experience linking burn units with microbiology services has allowed us to (1) develop active empirical therapies for burn sepsis based on local resistance patterns[14]; (2) identify outbreaks of multidrug-resistant strains; and (3) reduce broad-spectrum antibiotic use. All burn patients showing signs of systemic infection receive early, empirical treatment targeting gram-negative organisms in particular, the most important cause of lethal bacteremia in burn patients; where patient-level microbiology is available, this empirical therapy is adjusted. To reduce the need for systemic antibiotics and to promote wound healing, we also introduced additional, second-line topical agents for burn wound infections. When effective therapies are combined with active approaches to infection prevention involving dedicated human resources (nurse hygienist) and hospital support (routine infection control committee), in-hospital mortality for patients with <40% TSBA has been modest, as shown previously.

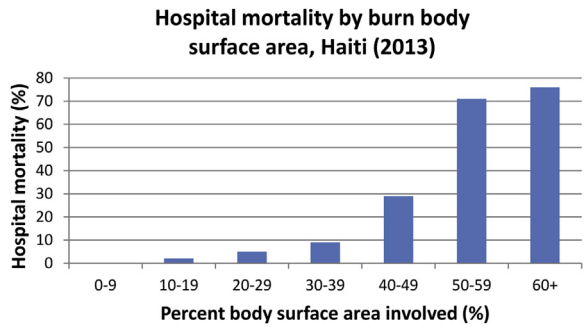

Fig. Routine programmatic data from 224 patients treated for burns during a 6-month period of 2013 at the MSF burn unit in Drouillard Hospital, Port-au-Prince.

Burns are expensive to treat. *Myth and reality.* There is little published information on the cost of treating burns in LRS. In one of few such reports, a small study in Lagos, Nigeria,[15] the authors estimated the average treatment cost per burn patient as $US1,398 ± $518 and average daily cost as US$58, which is in the same range as other published series. Patient cohorts varied widely, however, in terms of burn injury and treatment received, making it difficult to extrapolate to other burn treatment scenarios. In our programs we see no evidence that managing burns is significantly more expensive than managing other types of trauma, although rigorous data is lacking.

In terms of cost efficacy, for example, as assessed by disability-adjusted life-years, burns become more expensive as the result of factors such as their relatively high rates of complications and mortality. Still, the available data do not justify failure to establish burn treatment based on cost. Cost improvements should be achievable—for example, by improvements that allow more dressing changes to be done at the bedside rather than in the operating theater, as mentioned previously. Furthermore, hospitals with a large volume of burns may achieve economies of scale.

In conclusion, just as local community health posts in many LRS have become HIV diagnosis and treatment facilities by adapting the fundamental skills and composition of a standard outpatient department, our experience has shown that even the most basic hospital structure can be readily

adapted to offer general surgery, and that the scope of general surgery can be expanded to encompass common pathologies—such as burns—that are often thought to require specialized (and therefore unavailable) facilities and staff. Furthermore, the same medical systems and hospital management practices employed in general surgical services also support quality care for "specialized surgery" patients. Lessons from MSF's burns projects may therefore be valuable for promoting surgical programming as a public health priority in LRS, commensurate with the high global burden of surgical disease and the life- and function-saving impact of quality surgical services. Surgical services are not a luxury that should wait for another time. The needed investments are not exceptional and the infrastructure constraints are not insurmountable.

We thank Patricia Kahn for critical input into the manuscript, and Carrie Teicher and Richard Gosselin for their insights and helpful discussions.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.surg.2015.04.006.

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Review

Global surgery and the sustainable development goals

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Background: **The field of global surgery has gained significant recent momentum, catalysed by the 2015 publication of the Lancet Commission on Global Surgery, Disease Control Priorities 3 and World Health Assembly resolution 68.15. These reports characterized the global burden of disease amenable to surgical care, called for global investment in surgical systems, and recognized surgery and anaesthesia as essential components of universal health coverage.**

Methods: **A strategy proposed to strengthen surgical care is the development of national surgical, obstetric and anaesthesia plans (NSOAPs). This review examined how NSOAPs could contribute to the achievement of sustainable development goals (SDGs) 1, 3, 5, 8, 9, 10, 16 and 17 by 2030, focusing on their potential impact on the healthcare systems in Ethiopia, Tanzania and Zambia.**

Results: **Due to the cross-cutting nature of surgery, obstetrics and anaesthesia, investing in these services will escalate progress to achieve gender equality, economic growth and infrastructure development. Universal health coverage will not be achieved without addressing the financial ramifications to the poor of seeking and receiving surgical care. NSOAPs provide a strategic framework and a data collection platform for evidence-based policy-making, accountability and implementation guidance.**

Conclusion: **The development and implementation of data-driven NSOAPs should be recognized as a powerful road map to accelerate achievement of the SDGs by 2030.**

Paper accepted 10 October 2018

Published online in Wiley Online Library (www.bjs.co.uk). **DOI:** 10.1002/bjs.11044

Introduction

In 1980 the World Health Organization (WHO) Director-General, Dr Halfdan Mahler, highlighted the importance of surgery within primary healthcare[1]. However, there was no coordinated global effort to strengthen surgical systems until 2015, a pivotal year for global surgery with three major publications: the World Bank's third edition of their Disease Control Priorities (DCP-3)[2], the Lancet Commission on Global Surgery[3] and World Health Assembly (WHA) resolution 68.15[4]. The publication of DCP-3 included, for the first time, a full volume dedicated to essential surgery, a cost-effective priority to address the global disease burden. The Lancet Commission outlined the current global surgery panorama with five key messages. WHA resolution 68.15 was adopted unanimously by all member states of the WHO and emphasized the essential role of surgery and anaesthesia in universal health coverage. The timing and essence of the three publications raised surgery, obstetrics and anaesthesia to recognized global public health priorities. In 2017, the WHA further strengthened the resolve to implement WHA68.15 as part of the WHO's work on universal health coverage through Decision WHA70.22[5].

Sustainable development goals

The 2015 sustainable development goals (SDGs) are a universal call to action to end poverty and ensure prosperity and well-being for all[6]. The 17 goals were adopted by 193 countries as a unified global strategy to ensure development for all by 2030. The transition from eight Millennium Development Goals to 17 SDGs marked a shift in the international community's approach to development, away from vertical disease-specific programmes towards a horizontal intersectoral systems approach[7]. Unlike their predecessor, SDGs emphasize the need to strengthen health systems by building service-delivery capacity and ensuring sustainability.

Table 1 Lancet Commission on Global Surgery indicators and targets for 2030[3]

Indicator	Target
Access to timely essential surgery	Minimum of 80 per cent coverage of essential surgical and anaesthesia services per country by 2030
Specialist surgical workforce density	100 per cent of countries with at least 20 surgical, anaesthesia and obstetric physicians per 100 000 population by 2030
Surgical volume	80 per cent of countries by 2020 and 100 per cent of countries by 2030 tracking surgical volume; minimum of 5000 procedures per 100 000 population by 2030
Perioperative mortality rate	80 per cent of countries by 2020 and 100 per cent of countries by 2030 tracking perioperative mortality rate; in 2020, evaluate global data and set national targets for 2030
Protection against impoverishing expenditure	100 per cent protection against impoverishment from out-of-pocket payments for surgical and anaesthesia care by 2030
Protection against catastrophic expenditure	100 per cent protection against catastrophic expenditure from out-of-pocket payments for surgical and anaesthesia care by 2030

National surgical, obstetric and anaesthesia plans

To address the gaps in health systems for surgical care worldwide, the Lancet Commission proposed six indicators of robust surgical care systems. These indicators (*Table 1*) have been adopted by the World Bank Group as part of their World Development Indicators[8] and by the WHO as part of the 100 Core Health Indicators[9]. The surgery, obstetrics and anaesthesia workforce indicator has also been included in the World Bank's 2018 Atlas of SDGs[10]. Another recommendation from the Lancet Commission was to use baseline indicator collection to inform the development of national surgical, obstetric and anaesthesia plans (NSOAPs) to strengthen the existing health system. The Lancet Commission provided a theoretical framework (*Fig. 1*) for the development of NSOAPs, encouraging engagement of diverse stakeholders under the Ministry of Health to embed NSOAPs into existing National Health Sector Strategic Plans.

Sustainable development goals and national surgical, obstetric and anaesthesia plans

Surgery, obstetrics and anaesthesia are essential to reduce mortality and morbidity at all stages of life (*Table 2*)[11]; hence, to meet the SDGs, their full development and integration into national health agendas is required. Towards the end of the Millennium Development Goals era, it became clear that Zambia would not achieve several of its goals[12]. The lack of accessible surgical care at district level, owing to deficits in infrastructure, equipment, essential medicines and workforce, was identified as an underlying cause of delay in care, as emergency surgical cases were referred to higher centres causing congestion and compromising service delivery. A shift from disease-specific interventions to horizontal planning to develop surgical capacity was proposed as a solution[13]. Zambia's commitment to strengthening surgery, obstetrics and anaesthesia as part of universal health coverage resulted in the Zambian delegation proposing and negotiating resolution WHA68.15. The Zambian government further committed to developing a NSOAP[14] integrated within the country's National Health Sector Strategic Plan.

By 2015, Tanzania had made progress towards the Millennium Development Goal of reducing mortality in children aged under 5 years, but had failed to reduce maternal mortality by 75 per cent (MDG5), which in 2012 remained high at 432 deaths per 100 000 live births[15]. In recognition of the vital need for surgery, obstetrics and anaesthesia care to achieve the SDGs, Tanzania launched its NSOAP in March 2018[16].

To address issues of limited access to surgery for its 100 million population, in 2015 Ethiopia launched its surgical plan, Saving Lives Through Safe Surgery[17,18]. In the following sections, examples are drawn from the Zambian and Tanzanian NSOAPs, and the Ethiopian Saving Lives strategic plan, to illustrate the alignment of surgery, obstetrics and anaesthesia care with the SDGs (*Table 3*) and the comprehensive health systems approach of NSOAPS to achieve health for all.

SDG 3: healthy lives and well-being

The aim of SDG 3 is to ensure healthy lives and promote well-being for all[6]. The Lancet Commission showed that 28–32 per cent of the global burden of disease is amenable to surgical care[3]. Surgery, obstetrics and anaesthesia care is essential to prevent and treat conditions related to reproductive, maternal, newborn and child health, communicable diseases, non-communicable diseases and trauma. Therefore, scaling up surgical care, particularly in low- and middle-income countries (LMICs), is imperative to accelerate progress towards attaining SDG 3.

Reproductive, maternal, newborn and child health

Achieving target 3.1.1 of reducing maternal deaths to fewer than 70 per 100 000 live births will inevitably require scaling up surgery, obstetrics and anaesthesia capacity. Skilled

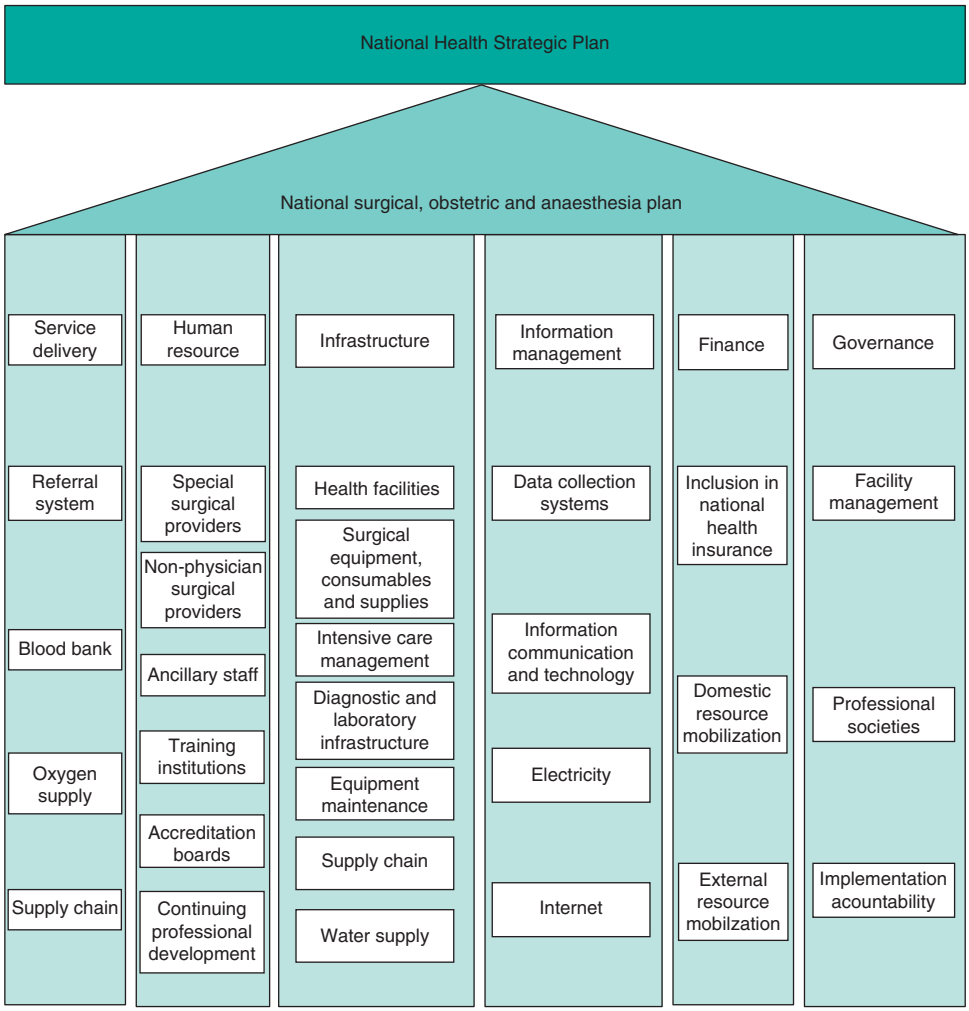

Fig. 1 Modified national surgical, obstetric and anaesthesia plan framework from the Lancet Commission on Global Surgery[3]

attendants at birth and antenatal care are not sufficient to decrease mortality; access to Comprehensive Emergency Obstetric and Newborn Care[19,20] is essential. Obstetric and anaesthesia services must be coordinated to address preventable mortality, as unsafe anaesthesia contributes to 13·8 per cent of deaths after caesarean section[21]. The DCP-3 recommends that eight essential surgical interventions are available at first-level hospitals as they address the substantial burden of disease, are cost effective and feasible to implement[22].

During the situational analysis for Tanzania's NSOAP, limited access to and quality of anaesthesia care, especially in rural areas, were identified as key limitations to a decreased maternal mortality from the current 556 deaths per 100 000 live births (*Table 4*)[23,24]. Tanzania has 50 anaesthetists for a population of 53 million[25], and as a result most anaesthesia care is provided by non-physicians. Consequently, the Tanzanian NSOAP involves training physician and non-physician anaesthetists, to increase their density from 0·09 to 2·23 per 100 000 population by 2025.

Neonatal mortality is inextricably linked to maternal health. The reduction in neonatal mortality to 12 deaths per 1000 live births (target 3.2.1) can be accelerated by increasing timely access to caesarean section, together with high-quality neonatal care. To reduce the number of preventable deaths of children under 5 years old to at most 25 per 1000 live births (target 3.2.2)[6], inclusion of paediatric surgery in NSOAPs and children's health plans will be crucial. Of the estimated five billion people who lack access to surgical care, two billion are children; up to 85 per cent of children may require surgery before the age of 15 years[26]. Coordinated increases in paediatric surgical care are paramount to reduce mortality and lifelong disability.

Table 2 Role of surgical care in attaining good health[11]

Life course approach	Disease burden approach	Level of care approach
Perinatal and infancy (birth asphyxia, gastroschisis) Childhood (hernia, burns, abscesses) Pregnancy and childbirth (obstructed labour, haemorrhage, eclampsia) Women's health (reproductive tract neoplasms, genital prolapse, safe abortion) Men's health (prostatic hypertrophy, hypospadias) Older people's health (cataract surgery)	Trauma, injury or violence (fractures, burns) Obstetric complications (primary postpartum haemorrhage, obstetric fistula) Congenital disease (cleft lip and palate, clubfoot, anorectal malformation) Neoplastic disease (breast, gastric or colorectal cancer) Infection and sepsis (gangrene, abscess, adult male circumcision) General surgical conditions (appendicitis, renal calculi, hernia, cholecystitis) Infectious disease sequelae (bladder cancer (schistosomiasis), rheumatic valvular disease) Reproductive health (adult male circumcision, malignancy) Vision and hearing (cataracts)	Prevention (adult male circumcision for HIV infection, orchidopexy for undescended testes) Screening (adult male circumcision for HIV infection, orchidopexy for undescended testes) Diagnosis (tumour biopsy, diagnostic laparoscopy) Primary treatment (incarcerated hernia) Secondary treatment (contracture release for leprosy or burns) Palliative (stent for obstructed viscus)

HIV, human immunodeficiency virus. Previously published in *Lancet* 2014; **383**: 12–13. Reproduced with permission.

Approximately 25 million unsafe abortions take place yearly, mostly in LMICs[27], contributing to 13·2 per cent of maternal deaths[28]. Hence, to attain universal access to sexual and reproductive health services (SDG 3.7), provision of safe abortion care is vital. Access to permanent fertility control at first-level hospitals would also increase access to contraception and decrease rates of unplanned pregnancy.

Communicable diseases

SDG 3.3 aims to reduce the incidence of human immunodeficiency virus (HIV) infection, tuberculosis, malaria, hepatitis B and neglected tropical diseases. Strengthening of surgery, obstetrics and anaesthesia contributes to this effort by increasing access to circumcision to reduce the risk of HIV transmission, provision of comprehensive maternity care to prevent vertical transmission, access to safe blood banks and water, sanitation and health. Increasing access to safe blood products is a priority outlined in the Tanzanian NSOAP, and this intervention is expected to benefit all patients and prevent transmission of infection. Furthermore, surgery, obstetrics and anaesthesia care is needed to address the sequelae of infectious disease for the millions affected; patients with multidrug-resistant tuberculosis, trachoma and filariasis can benefit from surgical management, ultimately reducing mortality and morbidity from neglected tropical diseases[29–32].

Table 3 Sustainable development goals addressed directly by national surgical obstetric and anesthesia plans

No.	Sustainable development goals	
1	No poverty	End poverty in all its forms everywhere
3	Good health and well-being	Ensure healthy lives and promote healthy well-being for all at all ages
5	Gender equality	Achieve gender equality and empower all women and girls
8	Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all
9	Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
10	Reduced inequalities	Reduce inequalities within and among countries
16	Peace, justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions at all levels
17	Partnerships for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Non-communicable diseases

Target 3.4.1 aims to reduce premature mortality from cardiovascular disease, cancer, diabetes or chronic respiratory disease by one-third by 2030[6]. These diseases account for 43 per cent of all premature deaths[33]. Surgery is crucial to treat cancer as well as complications from diabetes and cardiovascular disease. Surgical interventions sometimes provide the greatest impact at the lowest cost, as is the case for breast cancer surgery compared with radiotherapy and systemic therapy[34]. Zambia's NSOAP identified the need to improve screening capabilities for prostate and cervical cancer, together with more surgery to increase the national capacity for cancer treatment[14].

Injury and trauma

Road traffic injuries are the leading cause of mortality for males between the ages of 15 and 29 years[35]. Surgery,

Table 4 Select SDG 3 indicators with Zambia, Tanzania and Ethiopia 2018 performance and trends[24]

	Zambia		Tanzania		Ethiopia	
	Score	Trend	Score	Trend	Score	Trend
SDG 3 indicator						
Maternal mortality rate (per 100 000 live births)	224·0	=	398·0	↑	353·0	↑
Neonatal mortality rate (per 1000 live births)	22·9	=	21·7	=	27·6	↑
Mortality rate, under 5 s (per 1000 live births)	63·4	↑	56·7	↑	58·4	↑
Incidence of tuberculosis (per 100 000 population)	376·0	=	287·0	↑	177·0	↑
Age-standardized death rate due to cardiovascular disease, cancer, diabetes and chronic respiratory disease in populations aged 30–70 years (per 100 000 population)	17·3	↑	17·9	↓	19·3	=
Traffic death rate (per 100 000 population)	24·7	=	33·4	↓	27·3	↓
Universal Health Coverage Tracer Index (0–100)	45·9	=	49·1	=	41·1	=

↑, On track to achieve goal by 2030; =, score moderately increasing or stagnating; ↓, score decreasing. SDG, sustainable development goal.

along with prevention strategies, is needed to reduce mortality and disability. Target 3.6 aims to halve the number of deaths from road traffic injuries by 2020. Zambia's NSOAP addresses this goal by providing trauma courses at first-level hospitals, ensuring availability of surgical equipment and establishing prehospital emergency services for safe and timely transportation of injured patients. Guided by the Lancet Commission surgical indicator on access to care, the Zambian Ministry of Health plans for all patients to access care within 2 h of injury. Such national-level strategies will ensure that injured patients receive timely care, and reduce premature mortality and morbidity.

Universal health coverage and health system strengthening

Target 3.8.1 is to achieve universal health coverage of essential health services, including reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases, and service capacity and access, among the general and the most disadvantaged populations[6]. Essential and emergency surgery and anaesthesia were recognized as a component of universal health coverage when the WHA passed resolution 68.15. Universal health coverage includes financial risk protection to decrease the proportion of the population with a large household expenditure on health, as a share of total household expenditure or income (target 3.8.2). Although surgical services have been shown to be cost effective, accessing such care can be expensive[36]. Emergency surgery is often costly; as a result, 33 million individuals face catastrophic health expenditure each year[3]. NSOAPs provide the platform for the provision of affordable essential surgery, obstetrics and anaesthesia care to the entire population. Tanzania's NSOAP will address catastrophic expenditure from surgical care by advocating an increase in coverage for surgical procedures within health insurance schemes.

Workforce

Target 3C aims to increase health financing and the recruitment, development, training and retention of the health workforce in LMICs[6]. Addressing the shortage of surgery, obstetrics and anaesthesia specialists requires careful national planning as the training of professionals takes years. The Lancet Commission proposed a target of 20 surgery, obstetrics and anaesthesia providers per 100 000 population to address the unmet surgical need by 2030[3]. Baseline assessment for Zambia's NSOAP led to plans to increase its workforce from 1·1 to 3 surgery, obstetrics and anaesthesia providers per 100 000 population by 2021[14]. In Ethiopia, a national Surgical Workforce Expansion Plan and Anaesthesia Roadmap was developed in close partnership with the College of Surgeons of East, Central and Southern Africa to address training of specialists, continuing education and task-shifting programmes[17].

SDG 5: achieve gender equality and empower all women and girls

Gender inequality deprives women and girls of basic rights; preventable maternal mortality and morbidity must be eradicated to achieve gender equality by 2030 (SDG 5). Target 5.2 aims to eliminate all forms of violence against women and girls. It is estimated that 19 per cent of women have experienced physical and/or sexual violence by an intimate partner[33]; trauma and gynaecological care is crucial to help these women. More than 200 million women have suffered female genital mutilation[37], a harmful practice that the global community aims to eliminate (target 5.3). Access to surgical treatment is imperative to decrease

the risk of infections and childbirth complications, and to address the urological and reproductive sequelae.

Cervical cancer disproportionately affects poor women, with 85 per cent of deaths taking place in LMICs[38]. NSOAPs can coordinate prevention, timely diagnosis and treatment of gynaecological and breast cancers. Access to permanent sterilization and safe abortion will empower women to make decisions about their sexual and reproductive health (target 5.6).

Target 5.5 addresses equal opportunities and education. Women have been under-represented in surgery, obstetrics and anaesthesia specialties[39,40]. To address the specialist workforce shortage, it will be critical to remove societal barriers that have excluded women from training[41]. A comprehensive NSOAP addressing all components of a health system ensures that treatment is available for women, empowering them and reducing gender inequalities.

SDG 1 and 8: poverty, decent work and economic growth

Access to quality health services has long been recognized as a major driver to reducing poverty[42,43]. Access to surgical services may further impoverish patients who have to pay for medical expenses. Therefore, mitigating the financial risk patients face by ensuring coverage of surgical procedures in insurance schemes and increased overall insurance coverage is essential to prevent patients from being pushed into poverty.

SDG 8 aims to promote inclusive and sustainable economic growth, employment and decent work for all[6]. A study[44] found that up to US $6 trillion (approximately €5·2 trillion, exchange rate 21 October 2018) of welfare losses globally were due to avoidable deaths. The potential economic losses attributed to surgical conditions are estimated at €18 trillion or 1·3 per cent of the projected economic output between 2015 and 2030[3]. The Lancet Commission noted that scaling up surgical services in LMICs to meet the target of 5000 surgical procedures per 100 000 population by 2030 would require about €304 billion. Although this amount seems large, the cost of inaction is far greater, potentially resulting in lost output of €10·7 trillion, or a 2 per cent reduction in annual GDP growth[3]. Successful implementation of NSOAPs could prevent these economic losses.

SDG 10 AND 16: reduce inequalities within and among countries, and promote peace, justice and strong institutions

Untreated surgical disease affects impoverished, marginalized and rural populations disproportionately, placing them at higher risk of premature death, chronic disability and loss of economic productivity[2]. Lack of access to quality healthcare services contributes to inequalities within and between countries[45,46]. LMICs with the greatest burden of disease amenable to surgical care have fewer resources than high-income countries[3]. Within LMICs, the disparity between rural and urban access to surgical care is stark. In Tanzania, 67 per cent of the population lives in a rural area[47], 42 per cent of practising doctors are located in major cities[48], and 88 per cent of surgery, obstetrics and anaesthesia specialists are employed by the six largest hospitals[49]. The Tanzanian NSOAP addresses this inequity by increasing specialty training opportunities for physicians in rural areas along with incentives for rural retention[16]. Addressing inequities will contribute to the attainment of SDG 16, which aims to promote peaceful and inclusive societies for sustainable development, access to justice for all, and to build effective, accountable and inclusive institutions[48].

SDG 9: industry, innovation and infrastructure

The aim of SDG 9 is to build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation[50]. Infrastructure is needed to run operating theatres with sterilized equipment, electricity and running water, and roads and ambulances are needed to ensure timely access. Ethiopia's baseline data collection revealed that, of the surgical facilities assessed, 72 per cent consistently lacked running water, 59 per cent had intermittent electricity and 33 per cent did not have a reliable oxygen supply. To address these gaps, the Ministry of Health allocated a budget for the construction and renovation of 370 operating rooms, and partnered with Safe Surgery 2020 to construct new oxygen plants[17]. The development of a NSOAP for the expansion of surgical services is an innovative approach to surgical care[51], as it fosters local advances and opens new markets to promote the expansion of industry.

SDG 17: partnership for the goals

The aim of SDG 17 is to strengthen the means of implementation and revitalize the global partnership for sustainable development[50]. Target 17.9 calls for enhancement of international support for implementing effective and targeted capacity-building in developing countries to support country-specific SDG plans. Partnerships are essential to scale up surgical services through a health systems approach. A core element of Ethiopia's NSOAP was the engagement of a wide range of

stakeholders from policy-makers to clinicians and funders[17]. To supply oxygen reliably, a public–private partnership was established to build and maintain oxygen plants as part of Ethiopia's National Medical Oxygen and Pulse Oximetry Scale Up Road Map[17,52]. Another key partnership in Ethiopia was established between the Ministry of Health, PEPFAR (the US President's Emergency Plan for AIDS Relief), local colleges, universities and the GE Foundation to train biomedical technicians in repair and maintenance of equipment required for provision of essential surgical procedures[17].

Target 17.3 is to mobilize additional financial resources for developing countries from multiple funding sources[6]. The Zambian, Tanzanian and Ethiopian NSOAPs are fully costed, feasible and affordable. The costed plan also places the Ministry of Health in a stronger position during local budget negotiations[53], and provides investment cases for multilateral funders.

Enhancing global macroeconomic stability through policy coordination and policy coherence is target 17.13. To ensure this, Zambia's NSOAP was incorporated into the country's National Health Strategic Plan, which is embedded in the Seventh National Development Plan. This nesting of the plans guarantees coordination of policies and funding to strengthen not only the surgical systems, but the entire healthcare system, and support the overall development agenda.

Target 17.18 calls for capacity-building support to increase the availability of high-quality, timely and reliable data. Surgical indicators of the World Development Indicators serve as a benchmark for countries; however, mechanisms to ensure accurate reporting from the facility level to the Ministry of Health to WHO and on to the World Bank Group are necessary. Ethiopia has developed data collection tools to measure the impact of its NSOAP implementation, including a surgical capacity assessment along with 15 key performance indicators collected at the facility level and reported nationally[17]. Zambia is in the process of piloting the collection of surgical indicators through demographic health surveys. Data-strengthening interventions coordinated at the national level through NSOAPs will build capacity and increase the availability of high-quality, timely and reliable data to inform progress towards the SDGs.

Conclusion

The transition of the Millennium Development Goals to SDGs in 2015 signalled a new focus on systems and partnerships as a strategy for development. As one-third of the global burden of disease is amenable to surgical intervention, access to surgery, obstetrics and anaesthesia care plays a critical, but often undervalued, role in strengthening healthcare systems.

The development and implementation of NSOAPs are crucial to achieve health and well-being for all by 2030. This paper illustrates the cross-cutting nature of surgery, obstetrics and anaesthesia care and its ability to integrate SDGs to strengthen the entire healthcare system. Scaling up of surgery, obstetrics and anaesthesia services can accelerate progress to achieve gender equality, economic growth and infrastructure development. By addressing surgical conditions that lead to lost productivity and catastrophic expenditures, NSOAPs will play an integral part in the eradication of poverty and inequalities, while facilitating partnerships for development and promoting peace.

NSOAPs provide the platform for data collection to encourage transparency, accountability and implementation guidance of surgery, obstetrics and anaesthesia services. With 11 years left to achieve the SDGs, NSOAPs provide a concrete road map for governments in LMICs to strengthen their healthcare system. The WHO, and its member states, professional societies, industry, academic centres and civil society must support and prioritize the integration and scaling up of surgery, obstetrics and anaesthesia services through NSOAPs. This is a crucial strategy to strengthen health systems and achieve the SDG agenda by 2030.

Acknowledgements

L.R. is funded by the Ronda Stryker and William Johnston Global Surgery Fellowship Fund at Harvard Medical School. J.G.M. is supported by a grant from General Electric Foundation.

Disclosure: The authors declare no conflict of interest.

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