Cost-effectiveness of surgery and its policy implications for global health: a systematic review and analysis

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Summary

Background The perception of surgery as expensive and complex might be a barrier to its widespread acceptance in global health efforts. We did a systematic review and analysis of cost-effectiveness studies that assess surgical interventions in low-income and middle-income countries to help quantify the potential value of surgery.

Methods We searched Medline for all relevant articles published between Jan 1, 1996 and Jan 31, 2013, and searched the reference lists of retrieved articles. We converted all results to 2012 US$. We extracted cost-effectiveness ratios (CERs) and appraised economic assessments for their methodological quality using the 10-point Drummond checklist.

Findings Of the 584 identified studies, 26 met full inclusion criteria. Together, these studies gave 121 independent CERs in seven categories of surgical interventions. The median CER of circumcision ($13·78 per disability-adjusted life year [DALY]) was similar to that of standard vaccinations ($12·96–25·93 per DALY) and bednets for malaria prevention ($6·48–22·04 per DALY). Median CERs of cleft lip or palate repair ($47·74 per DALY), general surgery ($82·32 per DALY), hydrocephalus surgery ($108·74 per DALY), and ophthalmic surgery ($136 per DALY) were similar to that of the BCG vaccine ($51·86–220·39 per DALY). Median CERs of caesarean sections ($315·12 per DALY) and orthopaedic surgery ($381·15 per DALY) are more favourable than those of medical treatment for ischaemic heart disease ($500·41–706·54 per DALY) and HIV treatment with multidrug antiretroviral therapy ($453·74–648·20 per DALY).

Interpretation Our findings suggest that many essential surgical interventions are cost-effective or very cost-effective in resource-poor countries. Quantification of the economic value of surgery provides a strong argument for the expansion of global surgery's role in the global health movement. However, economic value should not be the only argument for resource allocation—other organisational, ethical, and political arguments can also be made for its inclusion.

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Introduction

Global health efforts, guided in part by the Millennium Development Goals (MDGs),[1] have focused mainly on the prevention and treatment of malnutrition, obstetric disorders, and communicable diseases.[2] With the exception of a few surgical procedures—eg, caesarean delivery and male circumcision, which have a role in the prevention of maternal and neonatal deaths and the transmission of some communicable diseases—surgical interventions have been largely ignored. However, findings from the Global Burden of Disease 2010 study show that the growing burden of both non-communicable diseases and injuries includes many surgically treatable problems.[3] For example, road-traffic injuries accounted for 75·5 million disability-adjusted life-years (DALYs) in 2010, up nearly 20 million DALYs from 1990. Cancer has caused 76% more disability globally in the same timeframe. Historically, surgically treatable disease was estimated to account for at least 11% of the total global burden of disease,[4] which might be an underestimate because other studies have reported that about 25% of people in Sierra Leone need surgical assessment,[5] and as many as 85% of paediatric patients in Africa have a surgically treatable disorder by the age of 15 years.[6] The substantial and growing burden of surgically treatable disease necessitates careful assessment of a wide range of surgical interventions to establish their priority within the expanding global health movement.[7]

The perception of surgery as an expensive intervention might be a barrier to widespread acceptance of its potential role in achieving global health goals, especially when compared with other public health measures such as vaccines or antiretroviral treatment.[2,8] Assessment of the value of surgery in these settings is further challenged by uncertainty about the epidemiology of met and unmet need worldwide, the effectiveness of surgical intervention in the prevention of death and disability, and established benchmarks for quality of surgical care.[9]

Cost-effectiveness analysis might help to establish the value of surgical intervention because it takes into account both cost and health impact simultaneously in a

validated and transparent framework.[10] Mock and colleagues proposed that cost-effectiveness of surgical procedures be considered, along with burden of disease and success of surgical intervention, to prioritise various surgical interventions in resource-poor countries.[11] Investigators doing cost-effectiveness research have analysed a range of surgery-related expenditures in low-income and middle-income settings, from short-term volunteer-led projects focusing on procedures for single diseases such as cleft palate or cataracts[12–14] to the existence of surgical facilities[15–18] to the potential implementation of surgical interventions internationally.[19–25] Stakeholders and policymakers have to consider a wide variety of factors when allocating funds and resources, and they would benefit from improved estimates of the prevalence of surgically treatable diseases and better information about the cost-effectiveness of surgery.

Various metrics have been proposed to calculate the health-benefit component of the cost-effectiveness equation when assessing a proposed intervention. The simplest is life-years (LY) gained, but this metric does not account for an intervention's ability to reduce morbidity. Summary measures of health that account for both survival and quality-of-life improvements include the quality-adjusted life year (QALY),[26] handicap-adjusted life year (HALY),[27] and DALY.[28] DALYs are calculated by adding the number of years of life lost due to premature mortality to the number of years of healthy life lost related to disability. Thus one DALY is defined as the loss of the equivalent of 1 year of life at full health.[29] The strengths and limitations of the DALY approach have been described previously.[27,30] Nevertheless, DALYs have become the most commonly used metric of health impact[31,32] and have been promoted by both the Disease Control Priorities Project[4] and WHO's Global Burden of Disease project.[7]

The evidence base for the cost-effectiveness of surgery in low-income and middle-income countries[33] is incomplete because no study has incorporated rigorous quality assessment and analysis.[34] We aimed to systematically compile and compare the cost-effectiveness of different surgical interventions, to objectively assess the rigour with which such studies were done, and to do a thorough analysis of existing data to mediate the divergent findings in previous cost-effectiveness studies.

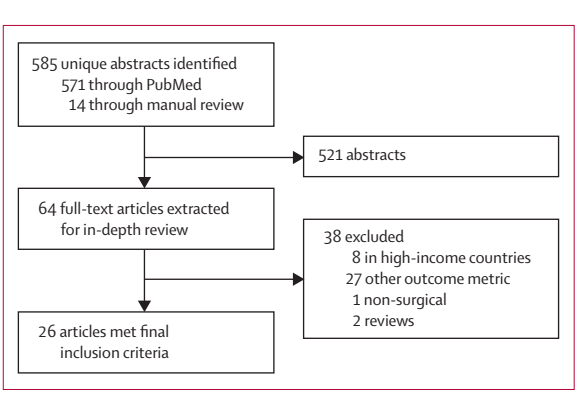

Figure 1: **Study selection**

Methods

Search strategy and selection criteria

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[17] We searched Medline using the following MeSH headings: "Surgical", "Surgery", "Costs and cost analysis", "Cost-benefit analysis" (inclusive of the subheading "cost effectiveness"), "Health care costs", and "Developing countries". We identified more articles by consulting experts and manually reviewing bibliographies of retrieved studies. We did our last search on Jan 31, 2013.

Inclusion criteria were as follows: studies that analysed the cost-effectiveness or cost-benefit of surgical procedures, presence of surgical facilities, or surgical missions; measured health benefit in LYs, QALYs, HALYs gained, or DALYs averted; were done in low-income and middle-income countries as defined by the World Bank;[33] and were published since 1996. Exclusion criteria were as follows: any study consisting of a narrative review or editorial lacking formal analytic methodology or using a different measure of health benefit.

Quality assessment and data extraction

We appraised economic assessments for their methodological quality using the Drummond 10-point checklist, a standard method for the assessment of cost-effectiveness studies.[10] Some checklist items have both cost and consequence components; for these items, each component is weighted at 0·5 times, such that the final denominator is 10. If a component was not applicable, we weighed the complementary component at times 1.

We converted results from all studies that described cost-effectiveness in US$ per DALY, HALY, or QALY from their initial values in the study's reported currency to 2012 US$ using the Consumer Price Index Inflation calculator.[35] In some studies, the currency year was not stated and was therefore assumed to be the year of a study's publication. The studies that used international dollars did not include enough detail about what fraction of costs were non-tradable—we converted these costs into US$ and accordingly compared them using the Atlas method gross domestic product (GDP) per head.

To extract as much information as possible, we separated results from different countries or procedures even if they were reported in the same study; we regarded these results as separate data points when calculating medians. We included values for surgical interventions not combined with medical treatments only. We excluded data points from high-income countries only. Whenever possible, incremental DALY calculations using age weighting and 3% discounting were chosen for point values, and calculations without discounting and age