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Arthroplasty as an essential global surgery

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A call for inclusion of arthroplasty as essential surgery

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Abstract

In 2015, the World Health Assembly and the *Lancet* Commission on Global Surgery affirmed the need for equitable access to essential surgical care. Additionally, the World Bank's Disease Control Priorities project identified 44 essential surgical procedures for health-care systems in low- and middle-income countries. These procedures address the global burden of disease, are cost-effective and are feasible to implement in resource-constrained settings. Notably, arthroplasty was excluded. A decade later, this omission warrants reconsideration. With improved control of communicable diseases, musculoskeletal conditions are now the second leading cause of years lived with disability globally, disproportionately affecting populations of low- and middle-income countries. Arthroplasty meets all the criteria for an essential surgical procedure: it is cost-effective, yields predictable and durable outcomes, and follows standardized clinical pathways suited for large-scale implementation. The cost of arthroplasty per disability-adjusted life year averted is often lower than treatments for chronic medical conditions and communicable diseases. Rates of dislocation and periprosthetic joint infection for arthroplasty in sub-Saharan Africa were comparable to rates in high-income settings, suggesting feasibility when appropriate systems are in place. As life expectancy and the noncommunicable disease burden increase, functional mobility interventions and pain relief will become a public health priority. Integrating arthroplasty into national surgical plans is essential to build resilient surgical systems that respond to evolving demographic and epidemiological trends. We call for the formal recognition of arthroplasty as an essential surgical procedure and for investment in workforce training, supply-chain infrastructure and funding models to meet unmet global surgical needs.

Introduction

In 2015, the World Health Assembly passed a resolution committing to strengthening emergency and essential surgical care and anaesthesia globally (WHA68.15).¹ At the same time, the *Lancet* Commission on Global Surgery published a set of guidelines for achieving equitable surgical delivery within the context of universal health coverage (UHC).²

Supporting the prioritization of surgical capacity-building efforts globally, the *Lancet*

Commission guidelines focused on access to timely and safe surgery, increasing surgical workforce density, increasing surgical volume in low- and middle-income countries, reducing perioperative mortality, and protecting against impoverishing and catastrophic health expenditure.³ The third edition of the World Bank Disease Control Priorities project subsequently defined 44 essential surgical procedures as a starting point for health-care systems in low- and middle-income countries.⁴ Essential surgical procedures are defined as interventions that address a substantial need that can be successfully treated by surgery, are cost-effective and are feasible to implement globally.⁵ Although the authors acknowledged the list was not exhaustive, essential orthopaedic surgical procedures were mainly injury-related, given that a disproportionate share of the global trauma burden occurs in low- and middle-income countries. These procedures include non-displaced fracture management, fracture reduction, irrigation and debridement of open fractures, placement of external fixators, use of traction, fasciotomy and trauma-related amputations. The only non-trauma orthopaedic essential surgical procedures are for acute conditions threatening life or limb such as drainage of septic arthritis and debridement of osteomyelitis. All these procedures were designated to be performed at local hospitals, implying the availability of adequately developed surgical capabilities and doctors with surgical expertise and the need for only basic universal surgical instruments, with the exception of external fixation and traction supplies. The Disease Control Priorities project acknowledged that other procedures for trauma care would need to be performed at higher-level facilities with advanced expertise, including in vascular repair, open reduction and internal fixation, drainage of intracranial haematoma, and exploration of the neck or chest.⁴ However, arthroplasty was omitted from the list of essential surgical procedures.

In the decade since WHA 68.15 and the *Lancet* Commission on Global Surgery recommendations, national surgical, obstetric and anaesthesia plans have been developed in several countries to direct surgical capacity-building efforts.⁶ However, only 26.3% (21/80) of low- and middle-income countries are on track to meet the 2030 access targets, 41.1% (60/146) for the workforce target, and none for the surgical volume target.⁷ As such, there is an unmet need of at least 160 million operations annually based on the *Lancet* Commission benchmark of 5000 procedures per 100 000 population annually.⁷ Although seven multinational studies and 10 national studies reported access across 96 countries, the six *Lancet* Commission surgical indicators: (i) access; (ii) workforce; (iii) operative volume; (iv) postoperative mortality; and (v) protection against impoverishing expenditure and (vi)

protection against catastrophic expenditure, have not been consistently reported by governments.⁷ Without global monitoring, the creation of a global action plan to ensure that the *Lancet* Commission targets are met will not be feasible. Although modelled projections for disparities in surgical access have not been updated since the *Lancet* Commission's landmark publication in 2015, it is likely that no reduction has occurred in the 4.8 billion people lacking access to safe surgery.⁷

Given evolving global demand and the need for an update on the list of essential surgical procedures after 10 years, the addition of arthroplasty should be considered, especially as admissions for musculoskeletal disorders represent the largest proportion of patients requiring some type of surgical procedure. Based on the Disease Control Priorities definition that essential surgical procedures address a global burden of disease, are cost-effective and are feasible to implement even in resource-constrained settings, we aim to show that arthroplasty meets each of these criteria and is a fundamental surgical offering that should be prioritized by policy-makers alongside ongoing global surgical capacity-building efforts.

Global burden of disease

While the global health sector has traditionally prioritized communicable diseases such as human immunodeficiency virus (HIV), tuberculosis and malaria, noncommunicable diseases are now the leading cause of death and disability globally, and this disease burden is disproportionately borne by low- and middle-income countries.⁸ With improved control of communicable diseases, life expectancy in resource-constrained settings has risen significantly, for example, from 52.7 years in 2000 to 66.1 years in 2021 in sub-Saharan Africa.⁹ As a result, an ageing population is increasingly affected by disability from noncommunicable diseases, including musculoskeletal conditions. Acquired musculoskeletal disorders, such as degenerative joint diseases, are now the second leading cause of years lived with disability (YLDs): osteoarthritis accounts for 2.3% (95% uncertainty interval, UI: 1.4–4.5) of all-cause YLDs, while other musculoskeletal disorders account for 4.8% (95% UI: 3.6–6.2). Only low back pain accounts for more, at 7.7% of all-cause YLDs (95% UI: 6.5–9.1).^{4,10} In 2020, 595 million people (95% confidence interval, CI: 535 million–656 million) had osteoarthritis, equating to 7.6% (95% CI: 6.8–8.4) of the global population. This figure is projected to increase by 74.9% (95% CI: 59.4–89.9) for knee and 78.6% (95% CI: 57.7–105.3%) for hip osteoarthritis to nearly 1 billion individuals by 2050.¹¹

For patients with end-stage osteoarthritis, hip and knee arthroplasty remains the most effective intervention to restore function and mobility, yet it is still under-recognized in global health planning. This misalignment is not limited to low- and middle-income countries but also affects high-income countries. For example, in the United States of America in 2019, musculoskeletal conditions affected 127.4 million people and they were the top driver of health-care spending in 2016 (380.9 billion United States dollars, US\$), yet they receive disproportionately low research funding from the National Institutes of Health.¹² Additionally, the global incidence of hip fractures was estimated to exceed 10 million cases in 2018 and is expected to nearly double by 2050.¹³ Even though perioperative delays in hip fracture care longer than 24 hours are associated with significantly higher risks of 30-day mortality, pulmonary embolism, deep venous thrombosis and myocardial infarction, arthroplasty, which is an established treatment for displaced femoral neck fractures, has not been prioritized as it is often viewed as an elective surgical offering.¹⁴ The current spectrum of care for osteoarthritis includes non-pharmacological, pharmacological and surgical management, although no disease-modifying treatments exist. First-line management comprises education, exercise and weight management, and non-steroidal anti-inflammatory drugs.¹⁵ Intra-articular corticosteroid injections are frequently used as a subsequent palliative measure to provide relief, although studies have called into question the efficacy of such treatment. For example, a Cochrane systematic review found low-quality evidence of a small to moderate benefit by 6 weeks that was not sustained.¹⁶ When conservative measures fail to prevent degenerative progression, arthroplasty is indicated to maintain movement and quality of life. Although non-arthroplasty surgical options exist, such as high tibial osteotomies to offload arthritic medial knee compartments and peri-acetabular osteotomies or valgus-producing femoral osteotomies for cases of hip dysplasia to slow degenerative changes and delay arthroplasty, the definitive solution for end-stage osteoarthritis is arthroplasty.

Significant gaps in access to specialists exist in low- and middle-income countries. Therefore, conservative alternatives for osteoarthritis management should be sought and implemented in the short-term. At the same time, global surgical capacity-building efforts should be undertaken to incorporate arthroplasty planning. Currently, surgical conditions are estimated to account for about a third of the global burden of disease. However, around 5 billion people globally lack access to surgery and 1.5 million people die each year from a lack of surgical interventions. Furthermore, an additional 160 million surgical procedures are required annually to meet the current unmet total surgical need.^{2,5,17,18}

Cost-effectiveness

The notion that surgery is too complicated or expensive to implement as a public health measure is changing, as surgery has been found to be cost-effective compared with other public health interventions. However, cost-effectiveness varies widely depending on the intervention performed. When measured using cost per disability-adjusted life year (DALY) averted, cost-effectiveness has been estimated at US\$ 10.93 per DALY averted for emergency obstetric care at a rural hospital in Bangladesh, US\$ 32.78 per DALY averted for all surgical care services in a Sierra Leonean hospital and US\$ 315.12 per DALY averted for caesarean deliveries.^{19–21} In 2014, a systematic review of the cost-effectiveness of surgical interventions in low- and middle-income countries generated a composite cost-effectiveness ratio for orthopaedic surgery using data from different orthopaedic surgery procedures performed in Dominican Republic, Haiti and Nicaragua. These procedures included surgeries for congenital malformations, acute fractures, chronic mal-unions and non-unions, and osteomyelitis with the cost equating to US\$ 381.15 per DALY averted.²¹ Despite the surgical infrastructure requirements, orthopaedic procedures demonstrated value especially when compared with medical treatment for chronic ischaemic heart disease (US\$ 500.41–706.54 per DALY averted) and HIV treatment (US\$ 453.74–648.20 per DALY averted), as surgical patients are less likely to be under continuous monitoring for their disease in contrast to communicable diseases.²¹ The literature on orthopaedic cost-effectiveness analyses in low- and middle-income countries is sparse. Without robust cost-effectiveness data from such settings to generate cost-effectiveness ratios, other than from the Central American and Caribbean study, policy-makers must consider setting-specific factors when assessing local relevance. Alternatively, outcomes from similar settings may provide relevant experience for future cost projections. Malawi, for instance, which is the only sub-Saharan African country with a national joints registry, published its first 10-year outcomes of primary total hip arthroplasty, which provides a benchmark against which policy-makers in other settings may extrapolate or compare results.²²

Elective primary hip and knee arthroplasty also leads to substantially increased patient quality of life in long-term follow-up periods.²³ Most cost-effectiveness studies for primary total hip arthroplasty and total knee arthroplasty use quality-adjusted life years (QALYs) as the main measure of quality of life. One-year QALYs for total knee arthroplasty and primary total hip arthroplasty were 0.768 QALYs and 0.799 QALYs, respectively, while cumulative health gains were 2.8 QALYs (primary total hip arthroplasty) and 2.3 QALYs (total knee

arthroplasty) over 15 years.²⁴ Total hip arthroplasty tends to be slightly more cost-effective than total knee arthroplasty, although total knee arthroplasty is more commonly performed.²⁵ In 2015, the cost of scaling up surgical services globally was estimated to be US\$ 300 billion –420 billion, but costs must also be viewed in terms of their potential economic benefit when justifying future investment in surgical capacity-building, especially for elective surgeries.²⁶ A recent paper argued that surgical investment may unlock a substantial prosperity dividend, as governments across all income settings seek ways to reverse disabling disease and return patients to work as a way of boosting economic productivity.⁷ Arthroplasty has a unique ability to return patients to work; a meta-analysis of 9267 patients having total hip arthroplasty found 28.1% (95% CI: 17.2–42.2) of patients who were not working before surgery began working afterwards.²⁷ Furthermore, total lifetime expenditure on long-term assisted living was estimated to decrease by 28% in patients undergoing arthroplasty for end-stage hip osteoarthritis compared with patients managed without surgery.²⁸

Feasibility of implementation

As the foundation of UHC, primary health care places emphasis on population needs through comprehensive integrated health services, policies addressing upstream determinants of health and community involvement using local resources. With improved control of the communicable disease burden and increasing lifespans in low- and middle-income countries with the consequent higher incidence of musculoskeletal conditions, expanding primary health-care services to include arthroplasty will be needed to address increased patient demand for such conditions. As patents for many successful orthopaedic surgery procedures and products start to expire, manufacturing generic implants with identical design specifications as the most bio-durable hip prostheses will likely reduce costs and improve accessibility of orthopaedic implants.²⁹ A basic arthroplasty package, specifying the minimum criteria to safely perform primary hip and knee arthroplasty, should be defined to facilitate policy planning, cost projections and supply-chain planning. With raw materials available locally, harnessing local means of production will promote primary health care by increasing community involvement.

Surgical volume is large and growing, with 312.9 million total surgeries (95% CI: 266.2 million –359.5 million) performed in 2012 representing an increase from 226.4 million in 2004. The two regions with the greatest surgical need are western and eastern sub-Saharan Africa.¹⁸ The only systematic review of arthroplasty in sub-Saharan Africa included 12 articles comprising 606 total hip arthroplasties and 763 total knee

arthroplasties; osteonecrosis was the most common indication for total hip arthroplasty, while osteoarthritis was most common for total knee arthroplasty, with an HIV prevalence in patients of up to a third.³⁰ The complication profiles reported for the procedures were similar to the arthroplasty complications in high-income countries suggesting feasibility. The estimated dislocation rate with total hip arthroplasty was 1.6% (7/444), while prosthetic joint infections were estimated to have occurred in 0.5% (2/444) of total hip arthroplasties and 1.6% (9/555) of total knee arthroplasties, although reporting bias may have affected these findings.³⁰

Arthroplasty also yields predictable and durable outcomes by following standardized clinical pathways. Standardized pathway procedures make arthroplasty well suited for large-scale worldwide implementation. Additionally, primary total hip and total knee arthroplasty practice has effectively shifted to the ambulatory surgical setting in high-income countries with same-day discharges.³¹ If these surgeries can also be done in outpatient settings in resource-constrained settings, less stress would be placed on the constrained in-patient hospital resources. Despite the potential benefits of expanding arthroplasty to manage the large disease burden by delivering cost-effective outcomes and economic benefits, such as returning patients to productive work and improving quality of life, the implementation of arthroplasty in resource-constrained settings may divert personnel, funding and infrastructure from other essential surgical procedures. This situation presents an ethical and economic trade-off that policy-makers must manage at a local level. We advocate that essential surgical procedures should not be viewed from a zero-sum perspective whereby the addition and promotion of arthroplasty reverses global surgical progress elsewhere, as surgery is a cornerstone of robust health systems that promotes public health.

To formulate, implement and finance surgical capacity-building, some low- and middle-income countries have committed to developing national surgical, obstetric and anaesthesia plans to make progress on development goals.³² These plans aim to scale up surgical systems countrywide through eight steps: (i) health ministry support and ownership; (ii) baseline situational assessments; (iii) stakeholder engagement for priority-setting; (iv) drafting and validation; (v) monitoring for evaluation; (vi) costing; (vii) governance; and (viii) implementation. National surgical, obstetric and anaesthesia plans are meant to define current gaps, develop solutions, and provide an implementation and monitoring plan with a projected cost for six areas of a surgical system: (i) infrastructure; (ii) service delivery; (iii) workforce; (iv) information management; (v) finance; and (vi) governance.³³ Future

national surgical, obstetric and anaesthesia plans should introduce mandatory joint registries to enable accurate monitoring in low- and middle-income countries that are scaling up arthroplasty. Notably, even in high-income countries, demand for joint arthroplasty is projected to outpace the supply of orthopaedic surgeons, with surgeon caseloads expected to double by 2050 unless proactive workforce expansion occurs.³⁴ This projected lack of surgeons underscores the urgency of parallel worldwide investment in surgical training and workforce development.

Future challenges

Surgical care is needed in the treatment of nearly all disease categories within the context of the Global Burden of Disease, which strengthens the argument that these services must be integrated into health systems at all levels and for different clinical problems.³⁵ In sub-Saharan Africa, the district hospital lends itself to feasible integration of essential surgery within comprehensive primary health-care services to contribute to a sustainable reduction in preventable morbidity and mortality.³⁶ However, the most important barrier to the safe provision of preoperative, intraoperative and postoperative surgical and anaesthesia services in low- and middle-income countries is the shortage of trained workers.⁵ Sub-Saharan Africa has less than 1% of the number of surgeons practising in the USA, despite having a population that is three times as large. This gap is due to the low number of medical school graduates, inadequate training, poor salaries and working conditions, and an inability to retain staff in remote and rural regions.³⁷ Additionally, postoperative rehabilitation is essential to achieve the best surgical outcomes after arthroplasty. However, the World Health Organization's (WHO's) *World report on disability* in 2011 noted that data on the unmet need for rehabilitation services were sparse, but estimated that fewer than 10 skilled rehabilitation practitioners per 1 million population were available in low- and middle-income countries.³⁸

Measures to expand surgical access, such as task-sharing, have been shown to be safe and effective while countries make long-term investments in building surgical and anaesthesia workforces.⁵ A systematic review of task-shifting and task-sharing to strengthen the surgical workforce in sub-Saharan Africa found that non-surgeon clinicians were primarily trained in simple general and emergency surgeries, with some having additional subspecialty training in orthopaedics for amputations and fracture manipulation.³⁹ In Malawi, to tackle the lack of orthopaedic specialists, non-surgeon clinicians were trained to undertake some surgery. No differences were found in perioperative outcomes for major amputations

and open reduction internal fixation of acute fractures. At the same time, this approach was highly cost-effective (US\$ 92.06 per DALY averted) and helped transfer orthopaedic skills to rural areas.⁴⁰ Arthroplasty lends itself well to practice by non-surgeon clinicians, given it has a standard, step-wise surgical approach and well established clinical pathways. More evidence is needed to establish the limits of what tasks can be safely shifted to non-surgeon clinicians, but in the short term, practitioners' skills have been effectively upgraded by providing targeted training in key procedures.⁴¹

The supply chain is also a key issue facing global orthopaedic surgery. The availability of surgical equipment is vital to allow hospitals to provide safe surgery and to retain surgical and anaesthesia staff by increasing their work satisfaction.⁴² The availability of pulse oximetry, essential medicines and key infrastructure (water, electricity and oxygen) varies widely between and within low- and middle-income countries. Of the 793 hospitals surveyed in low-income countries, 21.9% (174) operated without running water, 24.0% (190) without an oxygen supply and 31.0% (246) without consistent electricity.^{2,43} Before any capacity-building interventions are implemented, existing surgical capacity must be assessed. Tools to make this assessment include the WHO tool for situational analysis to assess emergency and essential surgical care and the personnel, infrastructure, procedures, equipment and supplies tool.^{42,44} To direct capacity-building efforts, policy-makers must have a basic arthroplasty package that defines the minimum criteria to safely perform primary arthroplasty procedures. The coming expiration of many patents for proven, durable arthroplasty implants will likely lead to the manufacture of generic implants with identical design specifications which will decrease cost and increase accessibility.²⁹

With recent changes in the provision of foreign aid and research funding, ways to obtain capital to expand arthroplasty provision must be reconsidered. Although many global agencies are down-sizing and making cuts to adjust to changes in the availability of funding, reform is needed. Increasing domestic health investments and domestic financing amid shrinking foreign aid must be prioritized to avoid future dependency. Sustainable development assistance requires strategic, government-backed approaches. Although international short-term relief missions have contributed to immediate relief in crisis situations, these missions cannot substitute for capacity-building investment that develops independence, which have shown promise in previous global academic orthopaedic collaborations.⁴⁵

Conclusion

Essential surgical procedures are defined by their ability to address a large burden of disease, deliver high value through cost-effectiveness and remain feasible for implementation even in resource-constrained settings. Arthroplasty fulfils all three criteria as its well established clinical pathways, predictable outcomes and its use of standard surgical procedures make its implementation feasible at the global level. As musculoskeletal disorders (particularly osteoarthritis) emerge as a leading cause of global disability, especially in ageing populations in low- and middle-income countries, access to arthroplasty will become increasingly important. Integrating arthroplasty into future national surgical, obstetric and anaesthesia plans is essential to manage the growing mismatch between surgical demand and workforce capacity in countries of all income levels. Strategic investment in training, infrastructure and sustainable funding mechanisms will be crucial to ensure equitable access to arthroplasty, which transforms lives through restored mobility and function across the globe.

Competing interests:

NSP has editorial and governing board roles in the *Journal of bone and joint surgery* (executive editor) and *Journal of knee surgery* (associate editor). He has stock options in Osteal Therapeutics and has other professional activities in Zimmer Biomet Holdings, Inc., Ethicon Endo-Surgery, Stryker Corporation and Pacira Pharmaceuticals Inc. PGD declares no competing interests.

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