



# Beyond technology: review of systemic innovation stories in global surgery

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**Abstract:** Since the launch of the Lancet Commission on Global Surgery (LCOGS) in 2015, significant attention and interest have been invested in breaking down the barriers that prevent universal access to essential surgical, obstetric and anesthesia (SOA) services. Improving access to surgical care in low-resource areas, whether in low- and middle-income countries (LMICs) or within vulnerable populations in high-income countries (HICs), requires stakeholders to think outside of the box. Innovation, or the process of creatively resolving a problem, is a crucial strategy for addressing complex challenges in global health and global surgery. While technology has traditionally taken the spotlight, novel ideas that support surgical systems strengthening and advance the agenda of achieving access for all should also be highlighted. This narrative review will focus on the principal ideas and trends in global surgery innovation, stretching beyond habitual technological advancements. By centering the narrative around non-technological achievements, we will explore emerging ideas that are transforming infrastructures in health systems strengthening, financial capacity, advocacy, and research and partnerships. From the development of National Surgical, Obstetric, and Anesthesia Plans (NSOAPs) to the creation of collaborative authorship, systemic innovations have and will continue to improve the delivery and quality of essential surgical services in areas of need around the world.

**Keywords:** Global surgery; innovation; low- and middle-income countries (LMICs)

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## Introduction

Innovation typically evokes technological advancements or improvements to address specific problems, although the meaning of this term can be interpreted as liberally as desired (1). Within surgery, technological innovations such as minimally-invasive techniques and robotics have historically received widespread attention (1). However, systems-level innovations warrant discussion as well, especially when approaching the complex challenges present

within the global surgery domain. Healthcare workers practicing in low-resource settings are faced with numerous obstacles, including shortages of specialist physicians, lack of operating room equipment, insufficient funding for research and inefficient information management systems (2). To surmount these challenges, global surgeons from high-income countries (HICs) and low- and middle-income countries (LMICs) have developed original and context-specific solutions that aim to strengthen multiple components of the surgical system, addressing issues

in workforce, service delivery, funding, infrastructure, information management, governance and more (3).

Innovation, viewed through a comprehensive lens, empowers new ideas and champions change that extends beyond technological norms, especially when it comes to implementing sustainable changes in low-resource settings. In this review, we aim to describe complementary innovations for systemic issues that have a direct impact on access to essential surgical care worldwide.

### Global surgery

Global surgery, in essence, works towards achieving universal access to safe and affordable essential surgical, obstetric and anesthesia (SOA) care. While work in global surgery has been ongoing for the past decades, only recently has the world seen a surge of interest from faculty and trainees alike. This increase can be attributed to several events in 2015, considered by many as the “birth year” of global surgery. First, the launch of the Lancet Commission on Global Surgery (LCOGS), the first high-impact document on the disparities in access to essential surgical services worldwide and its socio-economic consequences, drew the World Health Organization’s (WHO) attention to this topic (4). With numbers such as 5 billion lacking access to essential surgical services, 143 million additional surgeries per year needed, and up to 81 million facing financial ruin from surgery and its corollary services, this work provided medical communities, administrators and governments at-large with concrete numbers to illustrate the dire issue (4).

Second, in response to the findings in the LCOGS, members of the WHO unanimously adopted resolution WHA 68.15 “Strengthening Emergency and Essential Surgical Care and Anaesthesia in the context of Universal Health Coverage”, affirming their dedication to invest in SOA services as a means to elevate health care systems (5). This action symbolized an international commitment towards the inclusion of SOA in the healthcare-for-all initiative, addressing both local and transnational disparities. Finally, globalization has brought a paradigm shift, where there is increasing bilateral interest from both LMICs and HICs towards each other. Equitable partnerships between both LMIC and HIC organizations remain paramount for future success (6). Notably, the current generation of young surgeons and aspiring surgeons are exposed to opportunities in global health and social determinants of health through undergraduate medical education, many of whom continue

their involvement once they move on to their respective specialties (7).

While global surgery tends to focus on the unmet needs of people living in LMICs, it is important to note that HICs present similar challenges in terms of inequity in access to essential surgical care. Geographically remote communities, Indigenous peoples, and refugee groups are a few examples of vulnerable populations whose realities do not respect the indicators provided by the LCOGS, despite residing in some of the wealthiest countries in the world. For example, a study on emergency surgical care in the United States showed that hospitals offering such services are over 80% less likely to be present in counties with higher proportions of African-Americans (8). Similarly, surgical treatment for cataracts, the main cause of blindness for many Indigenous populations in Australia and neighboring island nations, could only cater to 68% of the estimated need (9). While historical global surgery initiatives have largely been international, it is imperative for researchers, medical professionals, and stakeholders to also address challenges within their own borders.

### Innovation in low-resource settings

The nature of innovation in low-resource settings, whether in LMICs and select groups in HICs, inherently requires a more utilitarian approach. The objective becomes fulfilling the SOA needs of the highest number of patients while maintaining an acceptable level of outcome, in order to ultimately decrease both morbidity and mortality. In 2015, the World Bank released a list of 44 surgical conditions which, if addressed, could save 1.5 million lives each year (10). These types of operations span multiple surgical and interdisciplinary specialties, from general surgery interventions like intestinal obstruction and perforated ulcers to reproductive health surgeries for family planning. Overall, these surgical procedures stand among the most cost-effective interventions in global health. For example, the treatment of congenital surgical conditions costs approximately 12 to 59 United States Dollars (USD) per disability-adjusted life years averted (DALY), in comparison to HIV prevention efforts, which cost between 103 to 302 USD per DALY averted (10,11). However, while these conditions are often considered “routine” in HICs, the unique realities of each context in each LMIC in terms of logistics, finances, and materials require the creativity of its providers in delivering the appropriate surgical care.

The term “reverse innovation,” a term borrowed from

the business world, came to be known as novel ideas that originate from LMICs that eventually diffuse to HICs, contrary to how “conventional” innovation happens (12). The use of this terminology has known some controversy, as it implies that novel ideas inherently disseminate from high-resource to low-resource settings. Examples of reverse innovation range from a low-cost, electrocardiogram machine to the adoption of the Ponseti technique, now the recommended conservative treatment for congenital clubfoot (12,13). Nevertheless, not every adopted idea in LMICs is translatable to the HIC context, similar to how the opposite is also true. For instance, differences in cultures and beliefs can influence whether an intervention will be socially acceptable in one country compared to another, regardless of how successful it originally was. To palliate this problem, there have been efforts to grade innovations: a multidisciplinary group in Canada has elaborated a set of criteria to estimate how successful an idea would be if taken from the low-resource to the high-resource setting (14). However, the actual use of an objective scoring system in LMICs to HICs innovations seems sparse in the literature.

Another challenge with innovation in LMICs is intellectual property: despite the abundance of useful ideas and successful applications that stem from low-resource communities, patenting or identifying the authors of the project does not seem to be commonplace (12). Some innovations are also low-cost adaptations of existing inventions, which makes official recognition of the idea more difficult (12). Scientific documentation can be an issue, as many projects have not undergone an objective assessment of their effectiveness despite seeing success in the field (12). These issues often prevent ingenious solutions from disseminating beyond the borders of their country of origin.

### **Innovation in healthcare systems**

The importance of a structured and functioning healthcare system is paramount in order to support quality SOA services (15). Global health initiatives, including the structure of the WHO projects, have traditionally been vertical or siloed: with each entity focused on a specific disease and its management (15). It was not until recently that stakeholders realized the need to approach the problem holistically. Catalyst events like the launch of the LCOGS have pushed for a more horizontal approach to global surgery, adding an emphasis on improving health systems as a whole in order to lay a stronger foundation for specific

surgical services to evolve.

The LCOGS defined the importance of investing in healthcare systems, and inspired the development and implementation of National Surgical, Obstetric, and Anesthesia Plans (NSOAPs) (16). NSOAPs, developed by the Ministries of Health in collaboration with local stakeholders are designed to outline a national SOA strategy and to hold governments accountable for advancing surgical services. Championed in line with universal health coverage (UHC), the NSOAP framework involves government ownership, stakeholder engagement, monitoring, and evaluation to improve infrastructures allowing better access to SOA care (17). They have been established in several LMICs, including Zambia and Tanzania, with an emphasis on local buy-in, transparency, and periodic evaluations throughout this innovation process (18,19). Finally, NSOAPs may be seen as a valuable tool to strengthen surgical subspecialty procedures during future SOA planning, as subspecialty needs, resources, and stakeholders are identified during the NSOAP situational analysis (20). In addition, it is good practice that stakeholders' contributions are sought and taken into consideration during the NSOAP drafting and validation, monitoring and evaluation, costing and implementation (3). This ensures collaboration, breaks down silos, promotes local buy-in, and favors sustainability.

Public-private partnerships (PPPs) also represent an important space to consider for surgical services innovation. Success hinges upon several factors, including coordinated goals and efforts between public-private entities, public policy for private sector surveillance, resource availability, and more (21,22). Nevertheless, PPPs, particularly those which address relevant local needs, have proven successful in providing safe, cost-effective solutions to communities (23). This has been evidenced by Safe Surgery 2020, a PPP between individual LMIC governments (Cambodia, Ethiopia, Laos, and Tanzania) and an industry partner (GE Foundation) (24). Safe Surgery 2020 is improving surgical capacity in partner institutions through a package of health systems interventions. For instance, service delivery in these countries was enhanced with simulation-training and the implementation of the World Health Organization surgical safety checklist (25). Furthermore, achievements from Safe Surgery 2020 extended beyond the surgical ecosystem, as the provision of widespread oxygen was beneficial for other healthcare services in local centers as well (26).

However, PPPs need not be all-encompassing: local models serving immediate needs may also prove valuable. For example, a publicly-available vascular surgery

department in Brazil partnered with a local private facility in order to address their high care volumes (27). Establishing a linear referral system between sites, engaging local vascular surgeons, and working with each other, resulted in shorter wait times for patients and improved shared knowledge among vascular surgery stakeholders (27). Even amidst the COVID-19 pandemic, health care providers are developing novel ways to manage the ever-growing backlog of elective surgical procedures, by engaging in PPPs (28). Overall, harmonious collaboration between the public and private health sectors may prove useful for future surgical innovation strategies.

### **Innovation in financial capacities**

While physical distance to a qualified medical center can be a significant obstacle for patients seeking surgical care, the financial burden of the surgery and its collateral services is often a bigger challenge. The possibility of catastrophic health expenditure, defined as a situation where a patient needs to forfeit money for basic needs in order to cover medical costs, deters patients from seeking essential surgical services when needed (29). Given the majority of LMICs work on a pay-for-service system, incurring high out-of-pocket costs, catastrophic health expenditure poses a significant risk, especially for those who live in or on the cusp of poverty. For example, in Madagascar, 75% of its population lives under the threshold of poverty, defined as living with less than 1.90 dollars (USD) per day (30). In this system, where patients are expected to provide the material resources for their surgery and hospital stay, undergoing a surgical procedure can become a huge financial burden where patients are obliged to borrow from their families or seek donations. As a result, 62% of the population in Madagascar are at risk of catastrophic expenditure for seeking surgical services (31).

Innovations aiming to reduce health system expenses and patient impoverishment are essential to building a functional surgical ecosystem. While NGOs are crucial in alleviating the burden of surgical disease worldwide with their free surgical services, grassroots financial solutions are required to ensure the system is financially sustainable in the long run. In the era of digitalization, mobile payment services have become an attractive solution to banking issues. The complexity of creating bank accounts, along with the 2% annual growth of mobile phone usage, especially in LMICs, represent a suitable combination for exploring virtual funds for surgical services payment (32).

For instance, a project in Kenya found the use of financial transactions on mobile phones allowed people living in remote areas to participate in their National Hospital Insurance Fund, simultaneously saving time and money on transport (33).

Furthermore, researchers have looked at the potential use of cryptocurrencies and blockchain technology as platforms to not only securely fund surgical ecosystems, but also to create more innovation opportunities in health data management (34). While this principle holds potential, its adoption by the users can be more complex. Facebook's Libra is an example of a cryptocurrency which failed in LMICs, including huge actors like India, despite the widespread use of this social media platform (35). However, as new systems take time to be accepted within a community, there is hope that such a system will eventually be efficient within low-resource settings and empower more individuals to seek and access essential SOA services.

Finally, leveraging the use of online fundraising platforms, like GoFundMe on an individual basis or Watsi on a global scale, to pay for one's surgery has been a financial lifesaver for many, even in HICs. Since the inception of the internet, crowdfunding has emerged as an online tool for patients seeking financial assistance for medical and surgical expenses (36,37). In the United States, Cohen *et al.* have demonstrated a significant database of cancer patients seeking aid through GoFundMe (38). Patients appear to seek money in order to cover the costs of both direct, medical and indirect, non-medical expenses alike (38). Notably, surgery represented a costly proportion of both past and future unmet financial obligations for US cancer patients (38). Further work has revealed that online requests for financial aid may extend to experimental and "scientifically unsupported" treatment regimens as well (39,40). With the ever-rising costs of medical care and limited insurance availability in some healthcare systems, crowdfunding may provide a lens into national health disparities, including but not limited to, surgical care (41).

### **Innovation in advocacy**

Globalization, with the help of the world wide web, has helped international exchanges and brought awareness of the lack of surgical services across the globe. As advocacy is most efficient with larger networks, the most notable awareness campaigns have often been led by large, internationally-recognized organizations like the WHO, World Bank, and G4 Alliance. In recent years, global

surgery has found a formal place within the WHO's structure, with much of the activity happening under their Global Initiative for Emergency and Essential Surgical Care (GIEESC) (42). Within this designated space, GIEESC advocacy anchors on surgery as an essential component of achieving UHC. This project has also catalyzed surgical subspecialty groups to catapult their own advocacy efforts, such as the creation of a liaison committee to the WHO by the World Federation of Neurosurgical Societies (43,44).

Since the expansion of social media platforms, a new form of advocacy was born: advocating for global surgery on Facebook, Twitter and Instagram opened opportunities for both highly respected experts and the general public to voice their ideas. Social media has served as an equalizer, as high-level advocacy can now be carried out by anyone with access to the internet with no time or space boundaries. For example, the International Student Surgical Network (InciSioN), the world's largest trainee-led global surgery organization, uses Twitter as their main platform for online campaigns for international events, including Global Surgery Day, Maternal Health Day and World Anesthesia day (45). The use of hashtags like #GlobalSurgery on these platforms have allowed new trends and communities to emerge, offering networking opportunities to like-minded individuals (46). Furthermore, it may be valuable to consider innovation opportunities in the context of recent times, as seminars, networking events, and high-level policy meetings that were previously held in-person, are carried out virtually. Transitioning to a virtual work environment may increase opportunities for global interconnectedness and LMIC participation in crafting both advocacy and research initiatives alike.

### **Innovation in research and partnerships**

Equity has not always been a major focus in global surgery partnerships: the long-standing history of power imbalance, stemming from the days of colonialism, have defined collaborations in global health. While heavily criticized today, the essence of global surgery has been fly-in surgical missions for the perceived needs of specific surgical conditions, with little regard to the sustainability of the act (47). Although efforts have been made to establish longitudinal projects, these initiatives could backfire by substituting the existing public health institutions, creating a parallel system that leaves a void when the sponsoring party departs from the host country. Power disparities are also evident in research, where articles

about projects occurring in LMICs include a majority of HIC authors either in number or as first or senior authors, especially when journals restrict the number of authors (48-50). With English as the default scientific language, this can prove to be a barrier for local researchers and professionals to exchange thoughts (51). Even solutions that seemingly promise to promote research accessibility, present challenges to authors without the financial means or sponsorship for publication. For example, while open access seeks to broaden a research paper's audience and visibility, significant barriers remain such as costly submission fees for authors (52). These obstacles encourage LMIC authors to look elsewhere for publication, which can lead them to publish in predatory journals and perpetuate this separation of knowledge sharing between LMICs and HICs (53).

As the recent cultural revolution in global health and global surgery has opened discussions surrounding equity, there have been more conscious efforts from both sides to be more sensitive to power imbalances. An overview of the last three decades of global surgery research has seen a significant increase in LMIC authors, with more and more being credited as major and senior contributors (54). In academic medicine, conferences like the Bethune Round Table in Canada and the InciSioN Global Surgery Conference (IGSS) have taken steps to provide scholarships for participants from LMICs to curb financial barriers and offer researchers opportunities to showcase their work on the international stage (45). Similarly, some open access journals are removing article processing fees and publication fees for accepted articles of authors from LMICs. While these practices represent a step forward in the fight for equity, they do not represent the majority of major academic events and journals. They are not mandated to establish these initiatives, nor are there clear guidelines as to the best practices. Requests for fee waivers for LMIC authors can be a lengthy process, and requirements can be inconsistent.

The concept of collaborative or group authorships offers some resolution to previously mentioned issues. This idea, which grew in popularity since the last decades of the 20th century in several medical journals, was recently popularized in global surgery by large international studies like GlobalSurg and GlobalPaedSurg (55). Group authorship focuses on crediting a sizable number of contributors under a group name, which allows authors to respect the journal's guidelines while recognizing the work of all qualifying researchers. While this method enables better recognition of all deserving contributors, it has been difficult to adopt by several journals for logistical and ethical reasons. Some

critiques include lengthy formatting procedures and the plurality of authors, with no opportunity for individual accountability should research be faulty. Furthermore, this authorship model has been criticized for not always respecting the International Committee of Medical Journal Editors (ICMJE) criteria for authorship (56). In light of these concerns, standardized procedures for authorship reporting among collaborative research groups, have been published by trainee entities (57).

## Conclusions

Unaddressed needs fuel innovation: it is therefore unsurprising that novel ideas have increased exponentially since the LCOGS formally outlined the challenges faced in providing essential SOA services among resource-variable settings worldwide. Although technical and technological innovations are transforming outcomes of specific surgical conditions with lower costs, systemic innovations that strengthen surgical infrastructures, optimize spending, bring awareness to the lack of surgical care, and empower the local workforce complete the story of innovation in global surgery. While problems fuel solution-seeking, an equitable work climate, effective leadership, and strong networks will be essential to ensure new ideas will be explored and eventually adopted (58). The input of local stakeholders is crucial in order to meet the actual need of the population we aim to help, and successful innovations will be expected to be reassessed and modified over the course of their dissemination within their target population (58). Global surgery requires a holistic approach to innovation, from adopting both specific and systemic solutions to levelling all participants in their rightful place, in order to truly provide essential surgical services for everyone, everywhere.

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