



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

My Thoughts / My Surgical Practice

From the first mile to the last: Challenges of the global surgical supply chain



The pandemic has highlighted the importance of surgical supplies and equipment as critical resources to combat COVID-19. Surgical masks prove essential to personal protective equipment, anesthesia machines are used as ventilators, and operating rooms repurposed as intensive care units.^{1,2} COVID-19 has also laid bare the inequities in global public health and the unfair distribution of surgical resources, exacerbated by the suspension of production, export and transport of goods. It has been exceptionally challenging in low- and middle-income countries (LMICs),³ where supply chains and procurement processes are already complex and can vary from region to region. The inefficiencies of the surgical supply chain also affect LMICs differently. Shortages of medical equipment and consumables such as PPE, catheters, sutures and cannulas are the norm in under-resourced regions and contribute to the lack of access to safe surgical care.³ Optimizing the supply chain management (SCM) of surgical products—manufacturing, warehousing, procurement, distribution, and utilization—could help expand fiscal space for health and improve health system performance through enhanced efficiency, effectiveness, and responsiveness of surgical services. We highlight specific challenges in surgical SCM and encourage global surgery partners to improve SCM to enhance health system efficiency, accessibility, and performance.

Surgical SCM refers to a process that optimizes the surgical products' procurement and the supply chains that enable its manufacturing, storage, and distribution (Fig. 1). The overarching goal of surgical SCM is to ensure that quality surgical products are purchased at a reasonable cost and delivered to healthcare facilities promptly. Structural and technical inefficiencies contribute to the inadequate or low-quality supply of surgical products, preventing appropriate surgical care delivery for example in Zimbabwe and Ghana, the quality of orthopedic implants varied depending on how they were acquired.⁴ This requires a better understanding of the barriers and facilitators in the procurement process and supply chain cycle and how it interacts with the health system to produce quality surgical services. Centralized procurement, price negotiation, and simplifying overly complicated supply chains for pharmaceuticals and vaccines have yielded substantial cost savings across LMICs.⁵ Similar observations are likely for surgical consumables, disposables, and equipment.

However, procurement processes are often fragmented, inefficient, prone to corruption, and not transparent. Scant longitudinal data tracks these processes, despite such products' tendency to drive spending inefficiency due to variation in the purchasing price.

For instance, the procurement of high-volume consumables such as surgical sutures can lead to considerable expenditures if not purchased at a reasonable cost. Such expenditures contribute to health inequities as patients may assume responsibility for acquiring these materials and the costs associated with the purchase, leading to direct out-of-pocket expenditures. There is a need to develop a harmonized core registry to track this data and better understand their impact on access to surgical healthcare.

For low-income and lower-middle-income countries, there exists an even less optimal market in which surgical equipment and other resources are transferred from high- and upper-middle-income countries. Transfers may be in the form of donations or at a lower cost. Donations of surgical equipment take place in the absence of sufficient resources for de-novo procurement but are rarely adequately regulated.⁶ Despite providing an immediate solution to an urgent resource gap, donated resources are often already used and may be dysfunctional, outdated, or incompatible, leading to a local accumulation of unusable materials. For example, in sub-Saharan Africa, donated medical equipment accounts for 70% of the total received, but only 10–30% functioning.⁶ Such a system is unsustainable and precarious. The pandemic has also led to reduced donations of equipment, disposables, and consumables, further reducing resource availability when needed most. The tapering of global surgical outreach due to COVID-19 travel restrictions may also disrupt access to surgical equipment and consumables which often accompany visiting teams. Finally, there is a lack of transparency about procurement processes and no easy way to compare prices for a product in different settings over time.

Supply chains are inordinately complex, fragmented, and involve multiple actors. To begin with, manufacturing processes could be markedly improved. A handful of manufacturers produce the bulk of surgical goods and supplies, are far-removed from the facilities that use them, and provide inadequate space for input from surgeons, the users. Surgeons typically only play a minor role in the research and development of patents and products that make it to market; surgeons from LMICs play an even lesser role. The manufacturing and design processes will need to adapt as surgical demand tilts to emerging economies, where the bulk of surgical operative volume will likely occur. Furthermore, the unethical production of surgical goods and workers' exploitation in LMICs is of great concern and compromises the principle of shared value in our interdependent global society.⁷ Warehousing and inventory management can also be improved, together with secure

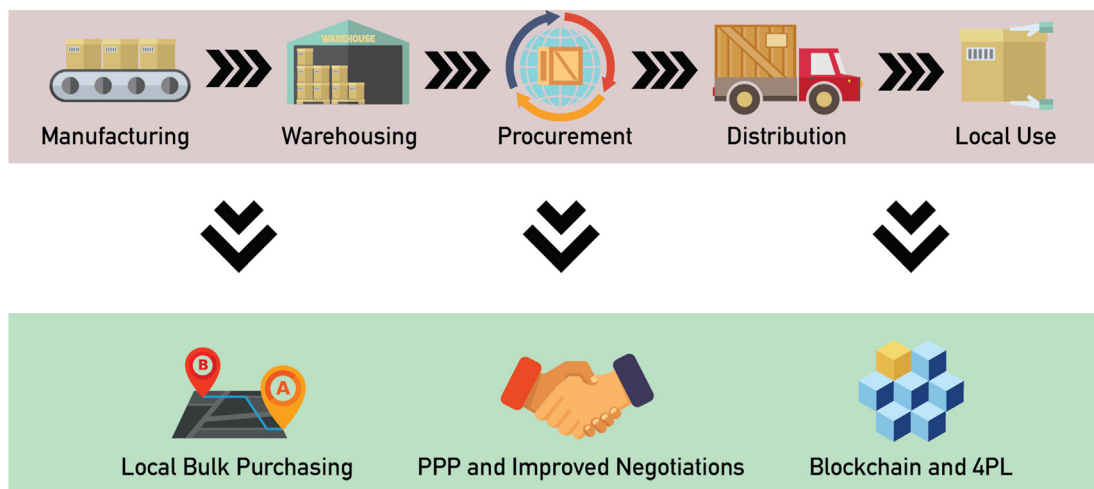


Fig. 1. Strategic opportunities to strengthen the surgical supply chain management process. 4PL.

and fast distribution channels. For example, inadequate diagnostics are a significant cause of delayed surgical care. When imaging equipment malfunctions, spare parts are often not readily available or recorded in inventory management systems. Facilities that order supplies are often left waiting due to multi-tiered distribution networks with limited accountability.

Various opportunities arise to optimize and streamline SCM, focusing on improved surgical product accessibility in LMICs (Fig. 1). First, promoting local suppliers can enable shorter and simpler supply chains, reducing the risk of stockouts, administrative costs, and time along the supply chain. This is crucial for materials traditionally supplied by high-income country suppliers, such as heart valves or prosthetic materials. For example, in China and India, local suppliers and logistics channels were developed to promote economies of scale for purchasing centers and job opportunities for local communities. Second, direct pooled procurement can reduce per-unit costs and reduce the inefficiency of multi-tiered distribution systems that consist of multiple intervening distributors and vendors. Regional entities (e.g., Southern African Development Community) could work with member states to establish a procurement facility for select surgical products. Third, strategic public-private partnerships (PPPs) could address specific issues such as timely replenishment of stockouts in remote areas. PPPs have used SMS or online platforms to track inventories and enable easy communication between facilities and distributors instead of conventional periodical deliveries. Such models have successfully been used for essential medicines⁸ and could be extended for surgical goods at primary care facilities and district hospitals. Last, blockchain and Fourth Party Logistics (4PL) can help to track supplies (e.g., delivery to appropriate facilities), reduce administrative costs, minimize the risk of corruption (e.g., purchases with fake suppliers, money channeled to different recipients), promote transparency and harmonize SCM data with health outcomes (e.g., surgical site infection).⁹

The global pandemic encourages us all to reflect. Surgical goods and supplies have been critical to the pandemic response, but are just as critical to provide emergency and essential surgical healthcare when needed. Sound SCM can enhance health system performance by reducing health expenditure and improving the effectiveness, efficiency, and responsiveness of surgical healthcare. Global surgery partners involved in national health policy and

programming activities could use their platform to design, introduce, and test specific interventions to improve surgical SCM and work with regional entities to scale up workable models, thereby helping to improve surgical resource availability and efficiency from the first mile to the last.

Funding

None.

Declaration of competing interest

None.

References

1. Ma X, Vervoort D, Reddy CL, Park KB, Makasa E. Emergency and essential surgical healthcare services during COVID-19 in low- and middle-income countries: a perspective. *Int J Surg.* 2020;79:43–46.
2. Ma X, Vervoort D. Critical care capacity during the COVID-19 pandemic: global availability of intensive care beds. *J Crit Care.* 2020;58:96–97.
3. Ma X, Lin N, Marinos J, Vervoort D. A right to surgery: navigating global surgery through a human rights lens. *Am J Surg.* 2020;220(2):294–295.
4. Navarro SM, Sibiya A, Nourian MM, Stewart KA, Ottesen TD, Price RR. Addressing supply chain management issues in cost-effective maternal and pediatric global surgery: a call to action. *Int J MCH AIDS.* 2020;9(1):77–80.
5. Seidman G, Atun R. Do changes to supply chains and procurement processes yield cost savings and improve availability of pharmaceuticals, vaccines or health products? A systematic review of evidence from low-income and middle-income countries. *BMJ Glob Health.* 2017;2(2), e000243.
6. Marks IH, Thomas H, Bakhet M, Fitzgerald E. Medical equipment donation in low-resource settings: a review of the literature and guidelines for surgery and anaesthesia in low-income and middle-income countries. *BMJ Glob Health.* 2019;4(5), e001785.
7. Sandler S, Sonderman K, Citron I, Bhutta M, Meara JG. Forced labor in surgical and healthcare supply chains. *J Am Coll Surg.* 2018;227(6):618–623.
8. Barrington J, Wereko-Brobby O, Ward P, Mwafongo W, Kungulwe S. SMS for Life: a pilot project to improve anti-malarial drug supply management in rural Tanzania using standard technology. *Malar J.* 2010;9:298.
9. Till BM, Peters AW, Afshar S, Meara JG, Meara J. From blockchain technology to global health equity: can cryptocurrencies finance universal health coverage? *BMJ Glob Health.* 2017;2(4), e000570.

Anisa Nazir
Institute of Medical Science, University of Toronto, Toronto, Ontario,
Canada

Foundation University Medical College, Islamabad, Pakistan

*Division of Global Surgery, Department of Surgery, University of Cape
Town, Cape Town, South Africa*

Dominique Vervoort*

Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Che L. Reddy

*Program in Global Surgery and Social Change, Harvard Medical
School, Boston, MA, USA*

* Corresponding author. Johns Hopkins Bloomberg School of Public
Health, 615 North Wolfe Street, 21205, Baltimore, MD, USA.
E-mail address: vervoort@jhmi.edu (D. Vervoort).

8 January 2021