Review Article

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Scaling Laparoscopic Surgery in LMICs: Barriers, innovations and Policy Recommendations

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Declaration:

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ABSTRACT

Background: Laparoscopic surgery has transformed surgical care by reducing morbidity, shortening hospital stays, and improving recovery. However, its adoption in low- and middle-income countries remains limited.

Objective: This article assesses the current landscape, challenges, and enablers of laparoscopic surgery in LMICs and provides policy and research recommendations for sustainable expansion.

Methods: A narrative review was conducted across PubMed, Embase, Google Scholar, and institutional/grey literature sources for English-language records between January 2013 and March 2024. Search terms included: ("laparoscopic surgery" OR "minimally invasive surgery" OR "MIS") AND ("low- and middle-income" OR "LMIC" OR "developing country") AND ("training" OR "cost" OR "barrier" OR "implementation"). Titles/abstracts and full texts were screened independently by two reviewers, with discrepancies resolved by consensus. A total of 78 articles met the inclusion criteria. Themes were synthesized using an iterative thematic analysis.

Results: Key barriers identified were limited infrastructure (reported in about 75% of included studies), inadequate training programs (62%), and high equipment costs (65%). Cultural resistance. Ongoing initiatives for locally manufactured or refurbished laparoscopic equipment are emerging in regions like Nigeria and India, helping to mitigate cost barriers. Cultural resistance and weak financing mechanisms were also noted. Promising enablers included low-cost laparoscopic kits, mobile simulation platforms, and NGO-supported programs. Evidence gaps persist in cost-effectiveness research, comparative evaluation of training models, and assessment of policy interventions.

Conclusion: Scaling up laparoscopic surgery in LMICs is an urgent priority. Targeted investments, supportive policies, and cultural engagement are essential to overcome barriers. Closing knowledge gaps and embedding laparoscopic techniques into national surgical plans will reduce disparities and strengthen surgical systems in resource-limited settings.

Keywords: Global Surgery, Healthcare Policy, Laparoscopic Surgery, Low and Middle-Income Countries (LMICs), Minimally Invasive Surgery (MIS), Surgical Training, Policy Implementation, Capacity Building.

INTRODUCTION

Laparoscopic surgery, also known as minimally invasive surgery (MIS), is a modern technique in which operations are performed through small incisions using a camera and specialized instruments. It has become the standard approach in high-income countries (HICs) for procedures such as cholecystectomy, appendectomy, and hysterectomy. Compared with traditional open surgery, laparoscopy offers clear benefits, including reduced postoperative pain, shorter hospital stays, quicker recovery, fewer surgical site infections (SSIs), and improved cosmetic outcomes.

In HICs, more than 80% of common abdominal procedures are now performed laparoscopically. In contrast, in many low- and middle-income countries (LMICs, defined by the World Bank as nations with a gross national income per capita between $1,136 and $13,845), penetration rates remain below 20%, reflecting persistent disparities in surgical access and outcomes. Barriers include inadequate infrastructure, a shortage of trained personnel, financial constraints, and cultural resistance.

Despite these challenges, momentum is building to expand laparoscopic services in LMICs, aligned with global commitments to equitable healthcare and the Sustainable Development Goals (SDGs), with recent global surgery reports (WHO 2022; Lancet Commission 2023) emphasizing minimally invasive surgery as a critical component of universal access to safe, affordable surgical care.

This review aims to assess the current landscape of laparoscopic surgery in LMICs, identify major barriers and enablers, and provide evidence-based recommendations for policy, training, and future research.

METHODOLOGY

A narrative review was conducted using a comprehensive search strategy across PubMed, Google Scholar, Embase, and institutional databases to identify relevant literature published between January 2013 and March 2024. Grey literature, including NGO and government reports, was also reviewed when full texts were available and met inclusion standards.

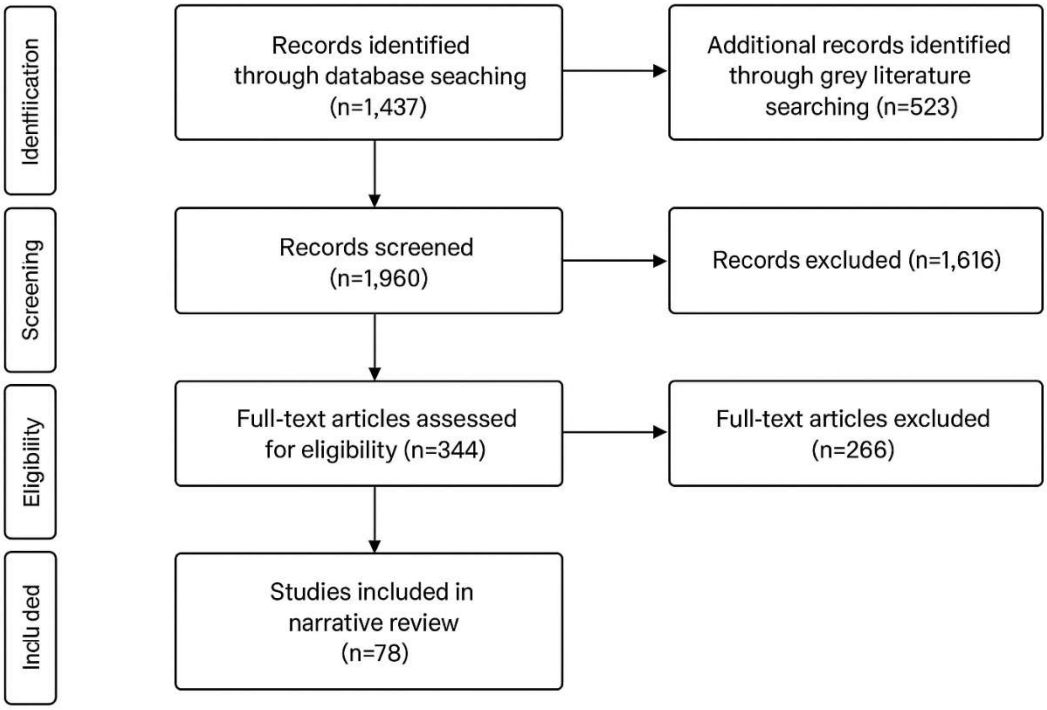
The search strategy combined Medical Subject Headings (MeSH) and keywords, including:

("laparoscopic surgery" OR "minimally invasive surgery" OR "MIS")
AND

("LMIC" OR "low- and middle-income countries" OR "developing countries")
AND

("surgical training" OR "health systems" OR "cost-effectiveness" OR "implementation").

Titles and abstracts were screened independently by two reviewers. Full texts of potentially eligible studies were assessed, with discrepancies resolved through discussion and consensus. A PRISMA-like flow diagram (Figure 1) illustrates the selection process. The final database search was conducted in March 2024, ensuring reproducibility and transparency.



Inclusion criteria:

Peer-reviewed English-language publications

Studies conducted in LMICs or directly comparing LMICs with HICs

Publications addressing at least one of the following: training, cost, outcomes, barriers, or implementation strategies in laparoscopic surgery

Exclusion criteria:

Conference abstracts without accessible full texts

Studies focusing solely on robotic or open surgery without comparative analysis

Opinion pieces or reports lacking original data or methodology

A total of 78 studies were included. Of these, approximately 40% originated from sub-Saharan Africa, 35% from Asia, and 25% from Latin America and the Caribbean. Study designs were diverse, including observational studies (45%), cost-effectiveness analyses (20%), training evaluations (15%), and mixed-methods or qualitative studies (20%).

Data were synthesized thematically under four domains: (1) implementation barriers, (2) cost analyses, (3) training models, and (4) health system integration. This approach enabled a structured yet flexible narrative synthesis aligned with the study objectives.

CLINICAL AND ECONOMIC ADVANTAGES OF LAPAROSCOPIC SURGERY

Laparoscopic procedures are associated with significant patient benefits. These include decreased postoperative morbidity, fewer wound complications, and shortened hospitalizations, all contributing to cost savings for both patients and healthcare systems[1,3]. A study conducted across several African countries reported reduced hospital bed occupancy and improved surgical throughout following the introduction of laparoscopic cholecystectomy[4].

From a systems perspective, the economic efficiency of laparoscopic surgery derives not only from reduced hospital stays but also from quicker return-to-work timelines and decreased caregiver burden[2]. However, most LMICs lack comprehensive cost-effectiveness analyses tailored to their specific health systems, creating a significant gap in local evidence for policymakers.

BARRIERS TO EXPANSION IN DEVELOPING COUNTRIES

1 Infrastructure and Equipment: Laparoscopic surgery requires specialized equipment, including insufflators, laparoscopes, light sources, and electrosurgical devices. Many public hospitals in LMICs lack the infrastructure to support these tools due to frequent power outages, inadequate maintenance systems, and limited access to consumables such as CO_2[3]. In some sub-Saharan African countries, the cost of a standard laparoscopic tower (USD $50,000–$100,000) is equivalent to several times the GDP per capita, making procurement and upkeep prohibitive.

2 Training and Human Resources: A major barrier is the lack of adequately trained surgeons and support staff. Many LMICs lack structured, standardized training programs, resulting in low procedural volumes and poor skill retention[2]. Ghana's experience with overseas training and in-country workshops showed promise, but these initiatives are often donor-dependent and unsustainable without systemic integration[5].

3 Financial and Organizational Constraints: Healthcare financing in many LMICs is heavily reliant on out-of-pocket payments, which discourage patients from opting for laparoscopic procedures that are perceived as costlier than open surgeries.[4] Weak national insurance frameworks and inconsistent governmental support further undermine the scale-up of laparoscopic services. Additionally, decision-making is often centralized and resistant to change, which stifles innovation.[2] For instance, in Nigeria and Kenya, out-of-pocket expenditure accounts for more than 60% of total health spending, making advanced surgical procedures inaccessible for the majority of patients.

4 Cultural and Institutional Resistance:

Ingrained surgical traditions, hierarchical training systems, and skepticism towards new techniques impede the adoption of laparoscopic surgery. Surgeons trained primarily in open techniques may be reluctant to adopt minimally invasive procedures due to concerns about safety, learning curves, and institutional inertia[5]. This reluctance is reinforced by the shortage of skilled mentors, with surgeon-to-population ratios as low as 0.5 per 100,000 in some LMICs, compared with 20–40 per 100,000 in HICs.

INNOVATIONS AND INTERVENTIONS SUPPORTING EXPANSION

Several innovative approaches are helping to mitigate these barriers. Low-cost laparoscopic devices such as the KeySuite have demonstrated safety and feasibility in resource-constrained settings.[3] Compared to traditional laparoscopic towers that cost between USD $50,000–$100,000, the KeySuite and similar portable kits can be acquired for less than USD $5,000, making them up to 90% more affordable while maintaining functionality. Mobile surgical simulation platforms and digital learning tools are also making training more accessible and scalable.[1]

Non-governmental organizations (NGOs) and international collaborations have successfully piloted laparoscopic services in countries like Haiti, Tanzania, and Ghana. In Tanzania, an NGO-supported program trained over 40 surgeons across five hospitals, resulting in a reported 60% increase in laparoscopic cholecystectomies within three years. In India, a partnership between local medical schools and international donors introduced low-cost simulation training, which reduced skill acquisition costs by nearly 70% compared with overseas fellowships. These examples demonstrate that while external support can catalyze progress, sustainable impact depends on integration into national surgical plans and long-term government commitment.[5]

POLICY AND HEALTH SYSTEM RECOMMENDATIONS

To achieve sustainable scale-up of laparoscopic surgery in LMICs, a multifaceted policy approach is required. Organizing recommendations according to the WHO Health System Building Blocks provides clarity and prioritization.

Service Delivery (Immediate win): Integrate laparoscopic procedures into national surgical plans and expand pilot projects in district and teaching hospitals where minimal infrastructure upgrades are needed.

Health Workforce (Immediate win): Embed laparoscopic skills into national surgical training curricula using low-cost simulation platforms and mentorship programs. Continuous professional development can be implemented rapidly and at low cost.

Health Financing (Long-term reform): Develop public–private partnerships and pooled procurement systems to reduce the cost of laparoscopic equipment. Strengthen national health insurance schemes to cover minimally invasive procedures and reduce out-of-pocket expenditure.

Health Governance & Regulation (Long-term reform): Establish standardized accreditation and quality assurance protocols to ensure patient safety, monitor outcomes, and maintain provider competence. National surgical societies should take leadership roles in this process.

Infrastructure and Technology (Long-term reform): Invest in reliable electricity supply, biomedical maintenance systems, and procurement of durable laparoscopic equipment. While costly, these reforms are essential for sustainable expansion.

Cultural and Behavioral Change (Immediate win): Engage surgical leaders and peer influencers to address resistance and encourage adoption of minimally invasive techniques through workshops, role modelling, and early-adopter advocacy.

Combining short-term interventions (training, pilot service delivery, cultural change) with long-term reforms (financing, governance, and infrastructure) allows LMICs to progressively and sustainably scale laparoscopic surgery.

Table 1: Summary of Barriers, Solutions, and Recommendations

Barrier	Solution/Innovation	Recommended Action	Evidence/Examples
Inadequate equipment	Low-cost laparoscopic tools (e.g., KeySuite)	Government procurement and pooled purchasing	KeySuite trial in Ghana showed safety and feasibility
Lack of structured training	Digital simulations, hybrid training models	Integrate MIS into national curricula; local mentorship	Mobile simulation platforms used in Tanzania and India
High out-of-pocket patient costs	Subsidies, insurance expansion, pooled financing	Strengthen national health financing schemes	In Nigeria, laparoscopic procedures remain mostly out-of-pocket
Cultural/institutional resistance	Peer mentorship, surgeon advocacy, leadership engagement	Launch behavioral change campaigns targeting surgical societies	Case study: peer-led adoption in Kenya improved uptake
Weak regulation/accreditation	National standards and credentialing frameworks	Develop and enforce quality assurance protocols	WHO Global Surgery guidelines recommend standardized accreditation

KNOWLEDGE GAPS AND FUTURE RESEARCH

Although interest in laparoscopic surgery in LMICs is growing, several critical gaps remain. Addressing them requires not only identifying missing evidence but also proposing rigorous, context-appropriate study designs.

Safety and Effectiveness Data: Current evidence is limited to small-scale studies with short-term follow-up. *Future priority:* multicenter prospective cohort studies and pragmatic randomized controlled trials (RCTs) in LMIC hospitals to evaluate long-term complication rates, reoperation needs, and patient-reported outcomes.

Cost-Effectiveness and Cost-Utility: Few studies comprehensively assess affordability and value. *Future priority:* economic evaluations using cost-utility analyses (e.g., quality-adjusted life years [QALYs] or disability-adjusted life years [DALYs]) tailored to LMIC-specific health budgets and procurement models.

Training Model Comparisons: Evidence on how different modalities affect skill retention is sparse. *Future priority:* cluster RCTs comparing simulation-only, hybrid (simulation + supervised surgery), and mobile training platforms, with follow-up testing at 6–12 months to assess skill decay and patient outcomes.

Policy Impact Evaluations: There is little empirical evidence on how surgical policies influence adoption. *Future priority:* mixed-methods evaluations combining interrupted time-series analyses of service uptake with qualitative interviews of policymakers, surgeons, and patients.

Cultural and Behavioral Barriers: Adoption is shaped by institutional norms and professional hierarchies. *Future priority:* ethnographic studies and organizational behavior research to understand resistance or enablers, complemented by implementation science trials testing behavior-change interventions (e.g., peer champion models, incentives).

CONCLUSION

Laparoscopic surgery offers a viable pathway to improving surgical care quality and efficiency in low- and middle-income countries. Overcoming current barriers will require targeted investments in infrastructure, workforce training, financing models, and policy reforms. At the same time, closing key knowledge gaps through rigorous, context-specific research will build the evidence needed for scale-up. Ministries of health, academic institutions, and non-governmental organizations should act collaboratively to integrate laparoscopic surgery into national surgical plans, ensuring that its benefits reach patients equitably and sustainably.

ETHICS STATEMENT

This study is a narrative review and did not involve human or animal subjects. Ethics approval was not required.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest related to this work.

AUTHOR CONTRIBUTIONS

Oluwatobiloba O. Aweda conceptualized the study and led the writing process. Emmanuel A. Owolabi contributed to the literature review and drafting. Olorunwa B. Alalade participated in data synthesis and critical revisions. All authors reviewed and approved the final manuscript.

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