NARRATIVE REVIEW

Impact of surgical training on patient safety in low-middle-income countries

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Abstract

Surgical training is a critical determinant of patient safety, especially in low- and middle-income countries. The current narrative review was planned to discuss the role of surgical training in low- and middle-income countries, specifically the quality of training, availability of resources and gaps in systems, to show how inadequacies in structures, supervision and compliance with standard operating procedures make patients vulnerable to unsafe care. Alternative strategies, including simulation training, public-private partnerships and task-sharing, were analysed for their effectiveness in addressing specific problems. Country-specific efforts from Pakistan, Kenya and Nigeria reported certain achievements as well as challenges in the way of meeting international practices. The role of global instruments, such as World Health Organisation Surgical Safety Checklist and Accreditation Council for Graduate Medical Education core competencies on surgical practice's safety, was also assessed to bolster surgical training in low- and middle-income countries as a means of improving health outcomes, securing fairness in healthcare, and achieving designated aims of international health strategies.

Keywords: Surgical training, Patient safety, Simulation training, WHO safety checklist, Low- and middle-income countries, Global health..

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Introduction

Patient safety is of utmost importance for the provision of high-quality healthcare, particularly in surgical specialties where minor errors can even lead to life-threatening complications.[1] Adverse events up to 38% have been reported from high-income countries (HICs), with more than half of them being either probably or definitely preventable.[2] Hospital-related harm is more pronounced in low- and middle-income countries (LMICs), where the burden of surgical diseases is high, with limited resources and absence of mechanisms to ensure safe practices.[3]

LMICs, such as Pakistan, face unique challenges in maintaining patient safety during surgical care.[3] These include inadequate health infrastructure, advanced disease presentation, limited access to healthcare, workforce shortages, and lack of access to advanced technology.[3] Furthermore, poorly structured training programmes exacerbate the risk of complications, as trainees often lack appropriate supervision, as well as lack of exposure to standardised protocols and recommended methods to refine their skills.[4]

The current narrative review was planned to explore the relationship between surgical training and patient safety in LMICs, emphasising the impact of resource constraints, training modalities, and cultural factors. By examining international and national benchmarks, the review aimed at providing actionable insights into improving surgical education, and, consequently, patient outcomes in these regions.

Patient Safety in the Surgical Context: Patient safety aims at minimising risks, errors and harm to patients during surgical procedures.[1] Globally, surgical care is associated with substantial risks. The World Health Organisation (WHO) reports that at least 7 million people annually experience surgical complications, with a significant proportion resulting in permanent disability or death.[5] In LMICs, the situation is particularly concerning due to limited access to safe surgical care. Moreover, only 6.3% surgical procedures worldwide are conducted in LMICs, indicating a significant gap in surgical service provision.[6]

The WHO has developed frameworks and tools to improve surgical safety in the form of the WHO Surgical Safety Checklist (SSC), a 19-item tool designed to improve communication and consistency among surgical teams, thereby reducing errors and adverse events.[1,7] This checklist is implemented at three critical phases of surgery; before anaesthesia induction, before skin incision, and before the patient leaves the operating room (OR).[1,7] Global studies show that implementing the

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SSC reduces surgical mortality and complications by 37%, highlighting its effectiveness in addressing safety gaps.[7] Incorporating the SSC within surgical training programmes and equipping surgical teams to adapt the checklist to local conditions ensure efficiency without compromising safety, especially in environments with limited resources and workforce shortages.[5,7]

Surgical Training Models: Teaching and learning methods in surgery have changed significantly in the last decade. The traditional approach of training was by apprenticeship model where the trainee learnt "by doing", referred to as the "see one, do one, teach one" model.[8,9] The apprenticeship model was proposed by William Halsted in 1889 and was later replaced due to modern pressures, including the European worktime directive, with the desire to improve OR efficiency and intolerance of error. There has been a significant switch in the training of surgical residents from the traditional "apprenticeship" model to supervised surgical training models, involving simulation-based teaching and learning.[10]

In surgical practice, innovative methods of training have been introduced and adopted not only to improve patient outcomes, but also to improve patient satisfaction. It also allows development of a new well-structured training curriculum by merging both traditional and modern methods to teach and learn surgical skills.[10] To achieve a seamless transition in surgical training to modern methods, there is a need to develop a structured programme to overcome the gaps in terms of efficiency, safety and ethics during the training process.[10]

Simulation-based training is a key aspect of medical education and is becoming the standard practice in different postgraduate residency programmes, specifically in surgical sub-specialties, owing to the demand for shifting basic skill acquisition out of ORs into surgical skill laboratories.[11] High-fidelity surgical simulators have been widely used, and are constantly evolving and improving. Deliberate practice is implemented with simulation, that aims at enhancing certain skills and improve performance through formal extensive training. The process of deliberate practice involves repetition, evaluation and the delivery of constructive feedback, all of which contribute to enhanced performance.[11,12] In surgery, simulation-based teaching offers trainees the chance to practice surgeries in a safe, supportive learning environment while also delivering structured training for developing technical skills. Another advantage of simulation-based training in surgery is that educators can teach in a less stressful environment, promoting a better understanding of skills as well as retention.[11,12]

The "Hands-On" method is an alternative approach for training as it allows interaction between residents and experts at different levels, including residents, junior and senior surgeons with several years of surgical practice. This teaching strategy varies from other methods as trainees are directly and actively involved in the procedure and doing hands-on practice. Trainees are expected to observe all steps of a procedure, and perform the steps in a logical order. This supervised teaching and training can be done without urgency of time.[12]

Dry and wet laboratory simulations are the most widely used methods of simulation where virtual reality (VR) simulation allows monitoring of important surgical features, like tissue handling and economy of movement.[13] Wet labs involve animal-based modules that can be adjusted according to the trainees' competence level and objectives, with skill development achieved through repeated practice and constructive feedback from supervisors, whereas dry labs provide opportunity to work in a simulated environment by using task trainers or VR simulators designed to rehearse multiple times, receive timely feedback, and achieve the desired competence.[13]

Many surgical training programmes have incorporated robotic-assisted simulations into their curriculum due to the growing use of robotics. However, despite the rising popularity of robotic-assisted surgeries and simulations, there is a shortage of validated simulation modules tailored to specific procedures.[14]

International Benchmarks and Best Practices:: Accreditation councils, such as the Accreditation Council for Graduate Medical Education (ACGME), the American Board of Surgery (ABS), the Royal College of Physicians and Surgeons of Canada (RCPSC), etc., have established standards for surgical safety and entrustable professional activities (EPAs), focusing on reducing perioperative morbidity and mortality.[15-17] Training programmes aligned with these benchmarks emphasise competency based curricula, simulation-based learning, and inter-professional collaboration to achieve surgical proficiency.[12,15-17] Innovative practices, such as multidisciplinary team training and morbidity and mortality (M&M) meetings, enhance communication and reflective learning, reducing the likelihood of adverse events.[18] Simulation drills replicating complex surgical scenarios offer trainees a controlled environment to hone their skills without risking patient safety. These methods highlight the value of incorporating evidence-based practices into global

surgical training programmes.[8,12]

Global Surgery Initiatives: Organizations, such as the Lancet Commission on Global Surgery, emphasise the importance of surgical training in enhancing patient safety worldwide.[19] Their vision for universal access to safe and affordable surgical and anaesthesia care by 2030 positions training as a fundamental component of this goal.[19] By integrating safety protocols into surgical education, the commission advocates for comprehensive strategies that include task-shifting, simulation training, and workforce development in LMICs.[19]

Accreditation Council for Graduate Medical Education (ACGME): The ACGME sets and monitors professional educational standards for the provision of safe and high-quality medical care during the period of residency and fellowship.[15] It developed core competencies in 1990 and implemented specific resident duty hour requirements in 2003, with the goal of improving quality of care.[15,20] The strategies used to comply with the ACGME requirements are cross-coverage of patients, night float system, and adding more physician assistants and nurse practitioners.[20] To comply with duty hour regulations and to improve patient safety, these strategies have been used by various surgical programmes across the globe.[20]

National Perspectives and Practices: There are several ways through which surgical training can be improved in an LMICs, such as Pakistan. Capacity-building partnerships between organisations in HICs and LMICs have increasingly been a feature of global health programmes over the last two decades, with the aim of providing development support in response to LMIC needs. Partnerships between institutions across the globe foster and facilitate cross training in different cultural environments. Unfortunately, graduates from LMICs often do not return after their postgraduate qualification for several reasons, including professional opportunities and income avenues.[21,22] In a survey from six African countries, 40% of all trainees showed interest in leaving Africa, but this increased to nearly 70% for non-South African trainees.[21,22] Provision of secure job opportunities for candidates can help in overcoming attrition and promote safe healthcare availability.[22]

Examining national perspectives and practices in Pakistan reveals diverse approaches and challenges in enhancing surgical education. The launch of Pakistan's National Vision for Surgical Care (NVSC) in 2018 marked a pivotal step towards improving surgical services nationwide.[23] This initiative aims at integrating surgical care into the broader health system, addressing workforce shortages and infrastructure deficits to enhance patient safety. Accreditation of training programmes by ACGME across the country have resulted in a remarkable improvement of competence-based surgical training strategies, developing and incorporating EPAs, and strictly monitored resident duty hours to prevent burnout.[15]

Impact of Training on Patient Safety: Training has long been recognised as a cornerstone of patient safety in healthcare, particularly in surgical settings. Numerous studies demonstrate a direct correlation between structured training programmes and reduction in adverse surgical events. For example, a recently published systematic review found that simulation-based training significantly reduced technical errors during surgery, improving outcomes for patients undergoing high-risk procedures.[11] Similarly, a multicentre study reported that hospitals with robust training initiatives for surgical teams had 25% fewer postoperative complications compared to those with less comprehensive training protocols.[19] Another notable example is the introduction of the WHO SSC in training curricula. A study showed a 37% reduction in surgical mortality rates when trainees were systematically taught to use the checklist.[7] This highlights the importance of embedding patient safety tools into formal training programmes.

A tertiary care hospital in South Africa integrated simulation-based surgical training into its residency programme. The initiative included mock surgeries, crisis management drills, and team communication exercises. The programme led to a 30% reduction in intraoperative errors, and improved overall surgical outcomes within two years of implementation.[23] Trainees reported increased confidence in handling complex cases, while patients experienced shorter recovery times and fewer complications.[23] In a resource-limited setting in Kenya, a mentorship-driven training programme for junior surgeons significantly improved patient safety. The programme paired trainees with experienced mentors who provided real-time feedback during procedures, and the initiative led to a 20% decline in surgical site infections (SSIs) and fostered a culture of accountability and continuous learning among the trainees.[24] The Safe Surgery Collaborative in the United States serves as another example of training's impact on patient safety. This initiative involved regional hospitals sharing best practices and providing joint training sessions for surgical teams. Over three years, the participating hospitals reported a 15% reduction in preventable adverse events, and improved adherence to safety protocols.[25]

Trainees often emphasise the critical role of mentorship and supervision in fostering patient safety. A 2023 survey found that 85% surgical residents attributed their ability

to manage complications to the guidance of senior mentors. The study highlighted the importance of structured mentorship programmes, where trainees can learn from real-world experiences under the watchful eye of seasoned surgeons.[26] Additionally, supervision ensures that the trainee surgeons develop skills without compromising patient safety. A study revealed that procedures performed under direct supervision had a 40% lower complication rate compared to those where trainees operated independently.[27] This underscores the dual benefit of supervision: it protects patients while enabling trainees to refine their techniques.

Mentorship also plays a pivotal role in addressing the emotional and psychological challenges of surgical training. Trainees reported that regular feedback and emotional support from mentors enhanced their decision-making and resilience, both critical for maintaining patient safety during high-pressure situations.[26]

The Way Forward: Advancing surgical training to improve patient safety in LMICs necessitates strategic action that combines innovation, adaptation of global best practices, and investment in local capacity. The future must include integration of simulation-based training into existing residency programmes, thus enabling safe skill acquisition outside ORs. By adopting simulation tools like high-fidelity task trainers and wet-lab environments, healthcare providers can refine their techniques through deliberate practice, ultimately minimising errors and enhancing surgical outcomes. Leveraging technological advancements, like VR simulations and tele-mentoring, can democratise access to quality surgical training.

Based on the WHO SSC[1,7] and the Lancet Commission on Global Surgery[19] report, policy-level interventions, such as establishing national surgical safety frameworks, are critical. LMICs must prioritise structured curricula emphasising patient safety and competence. Partnerships with HICs can provide valuable technical expertise and mentorship, enabling LMICs to build capacity sustainably.

Efforts should also focus on workforce retention by creating pathways for professional growth within LMICs. Addressing challenges, like limited infrastructure and career progression opportunities, will encourage surgeons to remain in the environment and contribute locally, ensuring long-term sustainability. Together, these measures can pave the way for safer surgical care and improved health outcomes globally.

Conclusion

Training is an essential element of patient safety in surgical care, with empirical evidence, case studies and trainee perspectives underscoring its impact. Structured programmes, simulation-based education, mentorship and supervision are proven strategies for reducing adverse events and enhancing surgical outcomes. As healthcare systems continue to prioritise patient safety, investing in comprehensive training initiatives will remain an essential approach to achieving a better surgical care worldwide.

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