

REVIEW ARTICLE

ANAESTHESIA SAFETY IN LOW-VOLUME CAPF HOSPITALS IN INDIA: SYSTEM GAPS AND PRACTICAL SOLUTIONS

Dr. USSV Meher¹ and Lt Col Preeti Bhatt, BSc, MPH²

Associate Professor, Guru Ram Dass College of Education, GGSIPU, Delhi

ARTICLE INFO

Article History:

Received 19th April, 2026

Received in revised form

25th May, 2026

Accepted 29th June, 2026

Published online 31st August, 2026

Keywords:

CAPF, low-volume surgery, anaesthesia safety, India, workforce, infrastructure.

*Corresponding author: Dr. USSV Meher

ABSTRACT

Central Armed Police Forces (CAPF) hospitals in India provide care to personnel, families, and in some places nearby communities. Many of these hospitals run low surgical volume but still face major emergencies such as trauma, obstetric crises, and acute abdominal conditions. This mix puts anaesthesia services under strain. Evidence from low- and middle-income countries (LMICs) and non-operating room anaesthesia (NORA) shows that anaesthesia outside well-equipped operating theatres carries higher risk when basic equipment, monitoring, and staffing are weak. (Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025) CAPF hospitals share many of these features, including aging machines, limited monitoring, frequent referrals, and a shortage of trained staff. This article adapts lessons from NORA and LMIC perioperative safety literature to the specific context of low-volume CAPF hospitals, using five headings—technical, Organisational, economic, educational, and workforce—to describe key risks and propose practical system-level steps to restore safety. The central argument is that low case numbers are not the core problem; based on evidence from LMIC perioperative systems and our experience in CAPF hospitals, lack of steady investment and weak governance are likely to contribute more to risk than volume alone.

Copyright©2026, USSV Meher and Preeti Bhatt. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Dr. USSV Meher¹ and Lt Col Preeti Bhatt, BSc, MPH². 2026. "Leveraging IoT-Enabled Smart Classrooms for Teacher Training: Real-Time Insights into Teaching Practices", *International Journal of Recent Advances in Multidisciplinary Research*, 13,(08), 12773-12777.

INTRODUCTION

Central Armed Police Force (CAPF) hospitals occupy a unique position within the Indian health system. They are embedded in the security sector but function as referral and primary care facilities for a defined beneficiary population, including serving personnel, retirees, and their families. A substantial proportion of these hospitals are located in remote, border, or semi-urban settings, where travel to large tertiary referral centres is time-consuming and often logistically challenging. In this context, CAPF hospitals are expected to provide a broad range of surgical services, including emergency laparotomies, caesarean sections, and trauma care, frequently under conditions of clinical urgency and limited external support. Despite this mandate, many small- and medium-volume CAPF hospitals now conduct relatively few elective operations. Procedures such as routine hernia repair, cholecystectomy, and elective orthopaedic surgery are increasingly outsourced to empanelled private facilities or larger government institutions. This reconfiguration of service delivery reduces the volume and diversity of cases managed locally, particularly by anaesthesiologists. Consequently, anaesthesia providers in smaller CAPF hospitals continue to bear responsibility for infrequent but potentially life-threatening emergencies, while having diminished

opportunities for regular exposure to a wide case mix and for maintaining hands-on skills through elective practice. This pattern parallels the challenges described in non-operating room anaesthesia (NORA) in low- and middle-income countries (LMICs), where teams frequently work in environments with heterogeneous infrastructure, variable staff expertise, and limited organisational support (Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025). Evidence from NORA settings and resource-constrained operating theatres indicates that perioperative morbidity and mortality increase when essential components of safe practice—such as reliable monitoring, uninterrupted oxygen supply, and structured post-anaesthesia recovery systems—do not meet accepted standards (Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025). In parallel, global workforce analyses highlight a substantial shortfall in trained anaesthesia providers in many countries, including India, relative to population need and surgical burden (World Federation of Societies of Anaesthesiologists, 2017; World Federation of Societies of Anaesthesiologists, 2017). CAPF hospitals sit at the intersection of these two trends: they operate within potentially fragile perioperative systems while relying on a numerically limited and often overstretched anaesthesia workforce.

This combination raises important questions regarding system resilience, clinician preparedness, and patient safety in low-volume CAPF surgical units, which have received little dedicated attention in the anaesthesia literature. In this article, we synthesize existing evidence and practitioner experience to outline these challenges and propose a practical, system-level improvement agenda for low-volume CAPF hospitals. These interacting technical, organisational, economic, educational, and workforce domains are summarised in Figure 1.

Technical Challenges: Safe anaesthesia depends on a small number of essential components: a functional anaesthesia machine, a reliable oxygen source, appropriate airway equipment, adequate monitoring, and systems for regular maintenance. In many CAPF hospitals, however, based on our clinical experience, anaesthesiologists still work with older Boyle's machines, often using ageing breathing circuits and with limited facilities for gas analysis. Capnography is not routinely available in every operating theatre, which weakens early detection of airway and ventilation problems. Intensive care ventilators may be scarce or absent, restricting options for postoperative ventilation and the care of critically ill patients.

These shortcomings are consistent with reports from district and public hospitals in several low- and middle-income countries (Adams, 2019; Zha, 2021; Law, 2019). Facility surveys from such settings describe frequent lack of pulse oximeters, unreliable or absent oxygen supplies, and inconsistent availability of essential anaesthetic drugs (Adams, 2019; Zha, 2021; Law, 2019). In some studies, a considerable proportion of anaesthetic procedures were conducted without continuous pulse oximetry or a secure backup source of oxygen.^(6,7) Working under these conditions increases the risk of unrecognised hypoxaemia, delays recognition of clinical deterioration, and reduces the chance of timely intervention when airway obstruction, equipment failure, or haemodynamic collapse occurs.

In smaller CAPF hospitals, organisational and administrative arrangements further constrain the technical environment. Procurement and maintenance usually proceed through slow, centralised pathways, with limited scope for local decision-making. Equipment that is outdated or prone to malfunction often remains in use because tendering and replacement processes are prolonged. Routine tasks such as vapouriser servicing, leak testing of circuits, and calibration of monitors may not follow a formal preventive maintenance schedule and are instead initiated when an obvious problem arises. Access to biomedical engineering support is often episodic, with visits driven by breakdowns rather than planned oversight. Taken together, these factors narrow the safety margin when managing high-risk situations such as a difficult intubation, major haemorrhage, or unexpected intraoperative cardiac arrest.

Despite these constraints, defining a realistic technical baseline is both possible and necessary. All CAPF operating theatres where general anaesthesia is provided should have, at a minimum, continuous pulse oximetry, non-invasive blood pressure monitoring, electrocardiography, and a reliable oxygen source, with capnography available wherever feasible, in keeping with global standards for safe and accessible anaesthesia care.⁽¹¹⁾ Each theatre should also maintain a fully stocked difficult airway trolley, reliable backup suction, and basic transport monitors for intra- and inter-facility transfers.

These items should be present, functional, and checked systematically at the start of each operating list, with simple documentation and clear pathways for rapid escalation and correction when deficiencies are identified.

Organisational Challenges

Organisational choices shape risk as much as machines do. In many CAPF hospitals, the easy solution is to refer patients out rather than strengthen local services. Insurance schemes and empanelled private hospitals make this model more attractive to administrators.

Over time, this pattern feeds a decline cycle. As more cases leave, local surgical and anaesthesia teams lose practice. Morale drops. Administrators then see little reason to invest in theatre renewal. Referrals rise again. Similar patterns appear in surgical systems in LMICs when national plans favour urban tertiary centres and neglect district hospitals.^(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025; Adams, 2019; Zha, 2021; Law, 2019)

Internally, many low-volume CAPF hospitals lack strong standard operating procedures for pre-anaesthetic assessment, emergency response, and recovery care. Morbidity and mortality meetings, if they occur, may not involve nursing and technical staff. NORA and perioperative safety literature stress the value of simple cognitive aids, checklists, and regular team reviews to prevent repeat errors.^(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025)

Frequent transfers of medical officers and administrators in the CAPF add to the problem. New leaders may not remain long enough to see quality projects to completion. This weakens continuity of policy and delays system fixes.

Economic Constraints

Finance decisions decide whether theatres stay safe or slide into disrepair. When a large share of the medical budget goes to referral payments, fewer funds remain for local equipment, maintenance, and training. This is a common pattern in health systems that rely on insurance schemes or contracting-out at the cost of public hospital renewal.^(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025)

Low volume can mislead planners; in our experience, there is a risk that hospitals with small surgical lists are seen as not needing modern monitors or ventilators. However, these centres still face trauma, ruptured ectopics, or emergency laparotomies. Reviews of non-operating room anaesthesia show that these rare but severe events carry higher risk when infrastructure is weak.^(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025)

In addition, many systems track drug and consumable costs well but treat capital equipment and maintenance as one-off or negotiable items. This view hides the long-term cost of preventable complications, transfers, and loss of trust. When patients and staff lose confidence in a hospital, they bypass it. This wastes sunk investment and increases load on already crowded tertiary centres. CAPF planning can take a different path. Modest but steady capital budgets for anaesthesia machines, monitors, oxygen systems, and biomedical support can stabilise services and reduce avoidable transfers

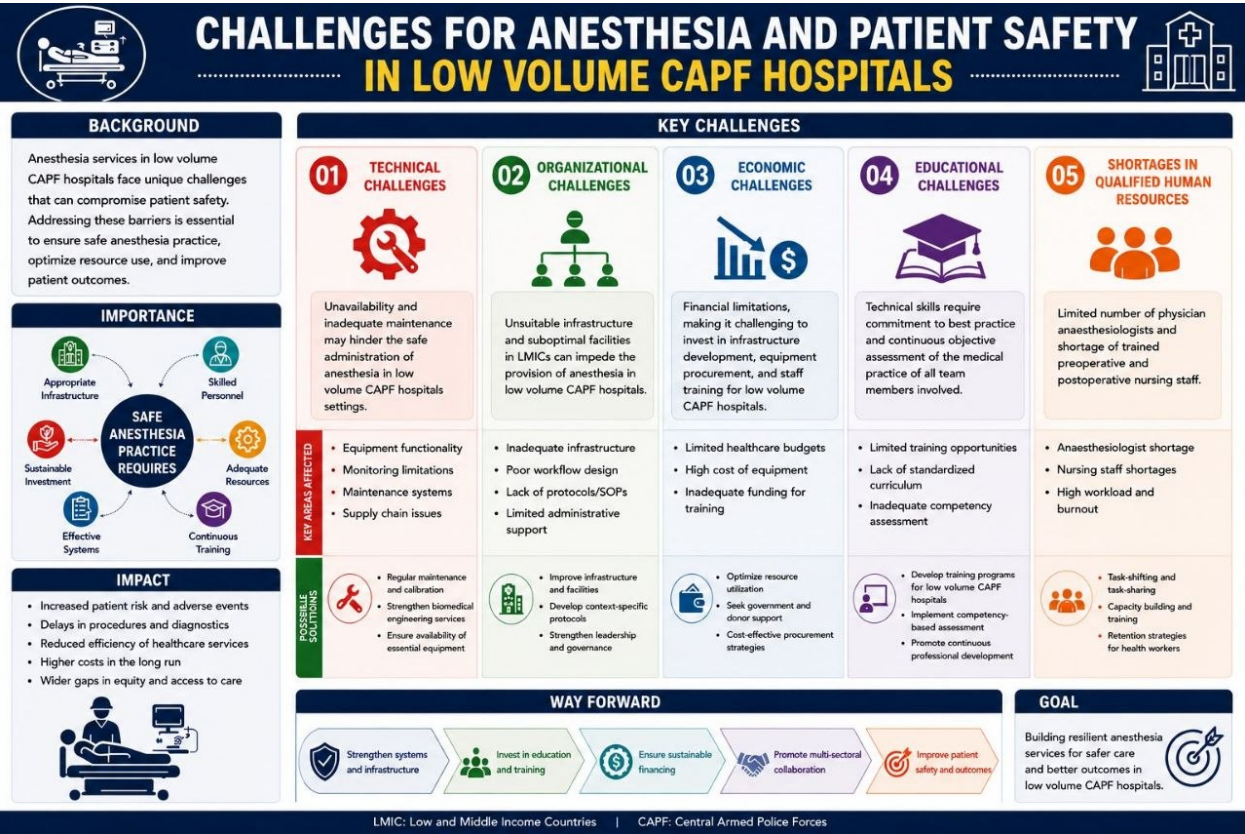


Figure 1. Critical dimensions affecting anaesthesia safety in low-volume CAPF hospitals

Table 1. Critical dimensions affecting anaesthesia safety in low-volume CAPF hospitals

Dimension	Key issues
Technical	Ageing machines, limited monitoring, weak maintenance, fragile oxygen supply (6,7,11)
Organisational	High referral dependence, weak SOPs, limited audit and feedback.(1-4,6,7,11)
Economic	Budget diversion to referrals, low capital renewal, underfunded maintenance.(1-4,6,7)
Educational	Skill fade, scarce CME, little simulation or mentorship.(6-8,11)
Workforce	Solo specialists, burnout, high turnover, limited career structure.(2-5,9-11)

Table 2. Suggested action plan for systematic improvement

Domain	Short-term actions	Medium-term actions
Technical	Provide basic monitors, check equipment daily.(6,7,11)	Renew machines, secure biomedical contracts.(6,7,11)
Organisational	Start M&M meetings, adopt WHO checklist.(1-4,6-8,11)	Build SOPs, integrate anaesthesia in hospital planning.(1-4,6-8,11)
Economic	Create small dedicated equipment budget.(1-4,6,7)	Protect maintenance lines and plan replacements.(1-4,6,7,11)
Educational	Run local workshops and drills.(6-8,11)	Establish regular rotations and tele-mentoring.(6-8,11)
Workforce	Limit unsafe solo coverage where possible.(2-5,9-11)	Align staffing with national workforce plans.(5,9,10)

(Adams, 2019; Zha, 2021; Law, 2019) Clear, ring-fenced funds for maintenance and annual safety checks can protect these investments.

Educational and Skill-Maintenance Gaps: Low case numbers make skill maintenance hard. Anaesthesiologists in small CAPF hospitals may give anaesthetics on only a few days each week. They still need to manage a difficult airway at three in the morning, or a crash caesarean section after a placental abruption. Studies from low- and middle-income countries describe similar patterns. Anaesthesia providers in district settings report limited access to continuing medical education, workshops, or simulation.(Adams, 2019; Zha, 2021; Law, 2019) The non-operating room anaesthesia literature also notes that teams in remote or out-of-theatre locations need specific training in sedation, rescue, and patient selection.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025).

For CAPF hospitals, field postings and non-clinical duties further disrupt learning. Officers may rotate between hospital work, battalion medical duties, and training centres. This movement builds broad experience but breaks continuity in theatre. Without a plan for skill refresh, competence in regional blocks, fiberoptic intubation, or crisis management will fade (8,11). Practical options exist. Short, focused courses on airway management, obstetric anaesthesia, trauma resuscitation, and safe sedation can run in regional hubs.(6-8,11) Simulation, even with low-cost manikins and scenario checklists, can help teams rehearse rare events.(8) Online modules and tele-mentoring platforms now support case discussions and debriefs between small hospitals and teaching centres (8). Taken together, these four quality-of-care challenges show how system design and training patterns can undermine anaesthesia safety, even when individual clinicians are committed and hard-working. Addressing them will require not only more staff and equipment, but also clearer

referral policies, a broader perioperative role for anaesthetists, routine quality-assurance processes, and accessible continuing education for those working in smaller and more remote hospitals.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025,6–8,11)

Quality-of-care challenges

The final theme related to preoperative and intraoperative training gaps, based on our clinical experience and informal accounts; these observations are not based on systematic sampling and may not capture the full diversity of CAPF and public hospital experiences. Continuous medical education was often described as both insufficient and underused, with peripheral anaesthetists working for many years without structured updates or hands-on training in new techniques.(6–8,11) This is especially important for preoperative risk stratification and intraoperative crisis management, which depend on updated knowledge, team drills, and clear protocols rather than isolated technical skills. Global guidance highlights the value of common accreditation processes, such as national or regional examinations, to standardise training and give programmes a strong incentive to improve education quality.(8,11) Free, high-quality online education resources, together with local simulation, workshops, and mentoring, can support isolated providers and should form a core part of any quality-improvement strategy in low-volume CAPF hospitals.(Adams, 2019; Zha, 2021; Law, 2019)

A third theme was the perceived near absence of formal quality-assurance processes, based on our observations and informal accounts. Regular morbidity-and-mortality meetings, incident reporting, and audit cycles were rare or limited, and when they did occur they often focused on surgical rather than anaesthetic events. Few hospitals have collected detailed perioperative data or used it to drive change.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025,Adams, 2019; Zha, 2021; Law, 2019) Without routine monitoring of cancellations, complications, and critical incidents, teams receive little feedback on their performance and have weak evidence to support advocacy for system improvements. Lack of formal quality-assurance structures also discourages open discussion of errors and perpetuates a culture where individuals feel blamed rather than supported when problems arise. Many participants stressed that most hospital work needs anaesthesia input across the whole perioperative pathway, not only in the operating theatre. Pre-operative assessment and optimisation, intraoperative management, postoperative monitoring, and pain control are all part of the anaesthetist's role.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025,11) Yet, many government and security-sector hospitals still treat anaesthesia as a narrow intraoperative service, with anaesthetists called mainly to administer the anaesthetic and then move on to the next case. This intraoperative focus means that preoperative clinics, post-anaesthesia care units, and ward-based pain services often receive little specialist attention. Opportunities to optimise high-risk patients before surgery, to detect deterioration early after surgery, and to organise multimodal analgesia are missed. In our clinical experience, unnecessary referrals were a major system flaw. Patients were often sent to tertiary centres for conditions that a modestly equipped district or CAPF hospital could manage safely if minimum standards and processes were in place. This practice burdens referral hospitals, delays surgery, and increases morbidity and

mortality, especially for patients who travel long distances or wait in crowded facilities.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025,Adams, 2019; Zha, 2021; Law, 2019) Some anaesthetists and surgeons pointed to maldistribution of staff and high workload in small hospitals, which left teams without the time, backup, or confidence to treat high-risk cases locally.(5,9,10) Others acknowledged that referral could become an escape route from responsibility where infrastructure was weak and medico-legal fear was high.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025)

Drawing on published literature and practitioner reflections, we group recurring issues into four linked themes that affect anaesthesia quality of care in low-volume public and security-sector hospitals: unnecessary referrals, an intraoperative focus, lack of quality assurance, and preoperative and intraoperative training gaps. These themes sit within a broader problem: health systems often focus on inputs such as staff, drugs, and machines, but neglect the processes, standards, and governance that actually turn these inputs into safe care. Safe anaesthesia requires adequate infrastructure and reliable processes for education, supervision, and quality control.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025,6–8,11)

Workforce and Governance Issues

Anaesthesia workforce shortage is a central barrier. The World Federation of Societies of Anaesthesiologists has reported that many countries fall below the recommended five physician anaesthesiologists per 100,000 people, and India sits below this mark with large gaps between urban and rural areas.(5,10)

Within this context, CAPF hospitals compete with state services and the private sector for a small pool of specialists. Solo anaesthesiologists are common. They may cover theatres, intensive care, pain clinics, and emergency calls. This pattern raises fatigue and stress. Reviews link such conditions to burnout and higher error risk among anaesthesia providers (2–4)

Some systems use task-sharing, where trained non-physician providers deliver parts of anaesthesia care under supervision. This can extend coverage but needs clear scopes of practice, good supervision, and strong quality control.(9,11) In unregulated settings, task-sharing can increase risk instead of reducing it.(9)

Governance reforms can support staff. These include transparent posting policies, minimum tenure in one hospital, protection of time for clinical work and continuing education, and participation of anaesthesiologists in hospital planning.(5,9–11) Aligning CAPF workforce policies with national surgical and anaesthesia plans would help secure more predictable staffing and training support.(5,9,10)

Opportunities and Way Forward

Despite current gaps, low-volume CAPF hospitals hold real potential. Experience from non-operating room anaesthesia and surgical programmes in LMICs shows that small, steady system changes can improve safety.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025; Adams, 2019; Zha, 2021; Law, 2019) Building on these experiences, we outline a

CAPF-specific package of infrastructure, governance, and workforce measures that could realistically be implemented within existing security-sector structures.

Key steps include setting basic equipment standards, investing in maintenance, strengthening governance, building education networks, and planning the workforce.(5–8,10,11) A minimum package for all CAPF operating rooms should include a working anaesthesia machine, oxygen with backup, pulse oximeter, non-invasive blood pressure, ECG, and capnography where general anaesthesia is given.(Adams, 2019; Zha, 2021; Law, 2019)

Hospitals should fund biomedical support, routine calibration, and preventive servicing, not just crisis repairs.(Adams, 2019; Zha, 2021; Law, 2019) They should introduce standard pre-anaesthetic assessment forms, the World Health Organization surgical safety checklist, emergency algorithms, and regular morbidity and mortality meetings with full team participation.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025,6)

CAPF hospitals can link to academic centres for rotations, workshops, and simulation, and use online platforms for remote teaching and case review.(6–8,11) Treating anaesthesia posts as critical positions, supporting longer tenures, and ensuring safe workloads will help.(5,9–11) Using task-sharing only within a strong regulatory and supervision framework is also important.(9,11)

Conclusion

Low-volume CAPF hospitals in India occupy a distinctive position: they are embedded within a disciplined security force yet face resource and workforce constraints comparable to those of many small public hospitals. These facilities are expected to manage high-risk emergencies with limited support and redundancy. The primary challenge appears to be less the low procedural volume itself and more the gradual deterioration of equipment, weak organisational processes, and unstable staffing patterns.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025,6–8,11)

Evidence from non-operating room anaesthesia and perioperative care in low- and middle-income countries indicates that targeted, system-level interventions can reduce risk and improve patient outcomes.(Romero, 2024; Herman et al., 2021; Woodward, 2017; Kaye, 2025,6–8,11) For CAPF hospitals, although direct outcome data are limited, a focused strategy that strengthens basic infrastructure, governance mechanisms, planned educational activities, and workforce stability has the potential to restore safe anaesthesia services and better protect personnel who serve in these settings.(5–11)

Limitations

This article is based on a narrative synthesis of published literature, policy documents, and our own clinical experience and informal observations in CAPF hospitals, rather than on a systematic review or primary data collection. The qualitative accounts and facility descriptions discussed may not be fully representative of all CAPF or public hospitals, and detailed perioperative outcome data from CAPF settings are scarce. Our recommendations should therefore be interpreted as a pragmatic starting point for discussion and further empirical work rather than as definitive prescriptions.

Author Contributions

Dr USSV Meher conceived the article, synthesised the literature and clinical experience described, and drafted the manuscript. Lt Col Preeti Bhatt contributed to proofreading and language review of the manuscript. Both authors approved the final version for submission.

Funding

This work received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The authors declare no conflicts of interest.

Word Count

Abstract: 179 words. Main text (excluding abstract, tables, and references): approximately 2,636 words.

REFERENCES

1. Romero CS, Ashok V, Echeto-Cerrato MA, Luedi MM. Safety in non-operating room anaesthesia in low- and middle-income countries: challenges and opportunities. *Update in Anaesthesia*. 2024.
2. Herman AD, Jaruzel CB, Lawton S, et al. Morbidity, mortality, and systems safety in non-operating room anaesthesia: a narrative review. *Br J Anaesth*. 2021;127(5):729-744.
3. Woodward ZG, Urman RD, Domino KB. Safety of non-operating room anaesthesia: a closed claims update. *Anesthesiol Clin*. 2017;35(4):569-581.
4. Kaye AD, Rogers BN, Mashaw S, et al. Safety of non-operating room anaesthesia: a narrative review. *Curr Opin Anaesthesiol*. 2025;38(4):425-434.
5. World Federation of Societies of Anaesthesiologists. Global Anaesthesia Workforce Survey. *Anesth Analg*. 2017;125(3):981-990.
6. Adams CE, Dobson M. Anaesthetic equipment in low- and lower-middle-income countries. *Anaesthesia & Intensive Care Medicine*. 2019;20(9):518-521.
7. Zha Y, Truché P, Izquierdo E, et al. Assessment of anaesthesia capacity in public surgical hospitals in Guatemala. *Anesth Analg*. 2021;132(2):536-544.
8. Morris WW, Milenovic MS, Evans FM. Education: the heart of the matter. *Anesth Analg*. 2018;126(4):1298-1304.
9. Roy N, Bhushan P, Mohan M, Paonaskar A. The task-sharing path to safe and accessible anaesthesia care in India: role of professional associations. *Public Health Challenges*. 2024;3(2):e205.
10. World Federation of Societies of Anaesthesiologists. *Impact Review, 2017–2021*. London: WFSA; 2021. Available from: https://wfsahq.org/wp-content/uploads/WFSA_Annual-review-2021_WEB-FINAL-1.pdf
11. Law T, et al. Safe and accessible anaesthesia care: standards, training, equipment and human resources. *Indian J Anaesth*. 2019;63(12):966-973.