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Research Article

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Tailoring Perioperative Care for the Aging Population in Low-Resource Settings: Balancing Surgical Innovation with Anesthetic Safety

Habiblah Jagunmolu[1*], Emmanuel Oyetola[1], Samuel Oyelude[1], Precious Adegbosin[1], Yusuff Lawal[1], Samson Fakojo[1], Goodness Fagbemi[1], Yusuff Olaore[1], Dhikrat Ajibade[1], Kamil Ajagbe[1], Muminat Jubreel[2], Dorcas Olapido[3] and Abdullah Oseni[4]

[1]*Ladoke Akintola University of Technology (Department of Medicine),Ogbomoso (Oyo), Nigeria*

[2]*Ladoke Akintola University of Technology (Department of Nursing), Ogbomoso (Oyo), Nigeria*

[3]*Redeemer's University, Ede (Osun), Nigeria*

[4]*Uniosun Teaching Hospital, Osogbo (Osun), Nigeria*

[*]Corresponding author

Habiblah Jagunmolu, Ladoke Akintola University of Technology (Department of Medicine), Ogbomoso (Oyo), Nigeria.

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ABSTRACT

Background: As the world's population grows, the percentage of elderly people also increases. With the adult population aging, the prevalence of surgical procedures among adults aged 65 years and older is rising, thereby placing increased pressure on healthcare systems. Although surgery can enhance quality of life and results, aftercare morbidity and mortality are high among older adults having surgery, especially those who are frail. In low-resource settings, where safe perioperative care is hindered by inadequate infrastructure, a shortage of workforce, and limited anesthetic capacity, the risks for elderly patients are increased.

Objective: This study review aims to examine perioperative care in the aging population within Low-Resource Settings and explore strategies for balancing surgical innovation with anesthetic safety.

Method: A literature review was conducted using PubMed and Google Scholar to identify the relevant studies on perioperative care, Aging population, Low-resource setting, Anesthetic safety, and Surgical innovation in low-resource settings.

Result: Findings indicate that the safety of anesthesia in high-income countries today cannot be compared with low-resource settings. Inadequate infrastructure, shortages of anesthesia providers, and a lack of well-trained anesthesia providers are major obstacles to patient safety. The cost of interventions and a lack of resources were the two most frequently mentioned implementation obstacles. Surgical services are impacted by these system limitations, especially for older adults and other populations.

Conclusion: This study emphasizes the significance of a noticeable balance between surgical innovation and anesthetic safety while also improving knowledge of perioperative care for older adults in low-resource settings. To improve perioperative outcomes, multidisciplinary management must be strengthened. As a result, anesthesia and surgical services need to be provided safely in addition to being accessible.

List of Abbreviations

AJOL	:	African Journals OnLine
APC	:	Article Processing Charge
ASA	:	American Society of Anesthesiologists
BP	:	Blood Pressure
CAM	:	Confusion Assessment Method
CGA	:	Comprehensive Geriatric Assessment
CFS	:	Clinical Frailty Scale
CO2	:	Carbon Dioxide
CRT	:	Capillary Refill Time
ECG	:	Electrocardiogram
ERAS	:	Enhanced Recovery After Surgery
GA	:	General Anesthesia
GFR	:	Glomerular Filtration Rate
HR	:	Heart Rate
ICU	:	Intensive Care Unit

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LMICs	:	Low- and Middle-Income Countries
LRS	:	Low-Resource Settings
MeSH	:	Medical Subject Headings
MIS	:	Minimally Invasive Surgery
mHealth	:	Mobile Health
MNA-SF	:	Mini Nutritional Assessment Short Form
MSF	:	Médecins Sans Frontières (Doctors Without Borders)
NCDs	:	Non-Communicable Diseases
NPCs	:	Non-Physician Clinicians
NRS-2002	:	Nutritional Risk Screening 2002
OR	:	Operating Room
POD	:	Postoperative Delirium
POCUS	:	Point-of-Care Ultrasound
POPC	:	Postoperative Pulmonary Complications
RA	:	Regional Anesthesia
SBP	:	Systolic Blood Pressure
SI	:	Shock Index
SSA	:	Sub-Saharan Africa
WHO	:	World Health Organization

Keywords: Surgical Innovation, Low-Resource Settings, Perioperative Care, Aging Populations, and Anesthetic Safety

Introduction

The global population is rapidly aging, placing an unprecedented pressure on surgical systems in low-resource settings (LRS), particularly Sub-Saharan Africa (SSA). Currently the aged makes up 44.8% of the SSA's population, individual aged 60+ numbers about 57 million and are projected to triple to over 150 million by 2050, this is influenced by decline in fertility, improved child survival, and increase in life expectancy from 61 to 70 years [1]. This global aging accelerates the epidemiological transition from infectious diseases to non-communicable diseases (NCDs) like cancers, cardiovascular diseases, hypertension and diabetes, pathologies disproportionately requiring surgical intervention among older adults. In Sub-Saharan Africa, NCDs account for 29% of deaths already, with surgical needs increasing as increased age increases the operative risks [2]. MSF humanitarian facilities across SSA geriatric patients (≥65 years) constituting 6-11% of operative caseloads, with annual operation rates as high as 1744 per 100,000 elderly in Ghana, 1217 per 100,000 in Sierra Leone District hospitals, SSA's surgical backbone performs 239-5233 operations yearly, see elderly patients forming about 31% of admissions in Ethiopia, having 3x higher postoperative mortality compared to younger patients alongside pervasive unmet need (27.8% in Uganda) [3,4]. Emergency procedures dominate most geriatric cases (71%) increasing complications from dehydration, malnutrition and polypharmacy , while comprehensive geriatric assessment (CGA)- demonstrating 30-50% complication reduction in high resource settings remains infeasible amid geriatrician shortages [2]. WHO projects a 50% surge in LMIC geriatric surgical volume by 2030, threatening a system collapse without adaptation. This demographic tsunami collides with the paradox in LRS: aggressive pursuit of modern surgical innovations clashes with profound constraints in anesthetic. Laparoscopy and robotics offer minimally invasive precision, reduce blood loss and reduce recovery time, and lifesaving for elderly patients that are intolerant of prolonged open surgical procedures or immobility Pilot study in SSA demonstrate feasibility for cholecystectomies and hysterectomies, yet widespread adoption fails due to delayed presentations, co-morbidities and infrastructural problems [5,6]. Most district facilities lack capnography, arterial lines, or depth of anaesthesia monitors, which force reliance on non-physician anesthetists. [7,8]. Regional anesthesia which reduces systemic exposure and is ideal for geriatric physiology encounters training gaps, local anaesthetic shortage and ultrasound scarcity [9]. Preoptimization protocols targeting reversible deficits such as anaemia, hyperglycemia yielded 20-30% risk reductions across economic strata but demand scalable diagnostics that are absent LRS [10]. Portable laparoscopy risks hemodynamic catastrophe without safeguard as evidenced by 32% morbidity and 17% mortality in Cote d'Ivoire elderly emergency laparotomies. Innovations amplify inequalities: advanced cases migrate to urban centres, stranding rural elderly, while pediatric-focused advances overlook geriatric needs [11]. This narrative review defines a perioperative framework for optimizing care of the aging population in LRS, reconciling surgical advancement with anesthetic safety [10]. Drawing SSA-specific epidemiology and global evidence, we propose tiered interventions: simplified CGA via mHealth screening, task-shared prehabilitation emphasizing nutrition and mobility, monitoring minimal protocols prioritising spinal/epidural procedures and innovation appropriate case selection. [2,5,8,9]. Implementation strategies leveraging on existing task-sharing successes, workforce upskilling through simulation, and context-adapted outcomes metrics (e.g disability-free survival over 30-day mortality) [7]. By prioritizing equity, scalability, and multidisciplinary approach, this framework equips LRS to harness the aging demographics constructively rather than catastrophically

Methodology

This narrative review utilized a structured search of PubMed, Google Scholar, and African Journals OnLine (AJOL) to identify relevant literature published between 2010 and 2026. The search strategy employed MeSH terms and keywords including "geriatric surgery," "low-resource settings," "anesthetic safety," and "minimally invasive surgery." Studies were selected based on their clinical relevance to patients aged >60 years in resource-constrained environments, with a specific focus on Sub-Saharan Africa. Inclusion prioritized primary research and reviews discussing adapted protocols, such as gasless laparoscopy and "resource-lite" preoperative screening, while exclusion criteria focused on high-technology interventions (e.g., robotic surgery) with limited scalability in LMICs. Data were qualitatively synthesized into a tiered perioperative framework covering preoperative risk stratification, intraoperative innovation, and postoperative rehabilitation, with a final emphasis on the ethical and infrastructural barriers unique to low-resource health systems.

Preoperative Risk Stratification in Lrs

Beyond Chronological Age: Implementing Frailty Scores (e.g., Clinical Frailty Scale) vs. Traditional ASA Physical Status

Chronological age is an imprecise surrogate for perioperative risk. Ageing is inherently heterogeneous; individuals of identical

age frequently differ in functional capacity, physiological reserve, and tolerance of surgical stressors [12]. In low-resource settings (LRS), where perioperative safety margins are narrowed by limited monitoring and restricted critical care capacity, accurate characterisation of vulnerability assumes particular clinical significance. The ASA Physical Status Classification System, although globally entrenched and modestly predictive of postoperative morbidity, primarily reflects disease burden rather than biological resilience [13,14]. It does not systematically capture frailty-associated domains including functional decline, sarcopaenia, diminished physiological reserve, and nutritional vulnerability, each of which independently influences surgical outcomes in older adults [12,14]. Consequently, elderly patients in LRS cohorts may experience complication profiles disproportionate to their assigned ASA grades, a discordance more plausibly attributable to structural limitations of the framework than to deficiencies in clinical assessment [14,15].

Frailty operationalises the concept of diminished physiological reserve by shifting perioperative evaluation from static disease classification towards stress-response capacity [12]. This construct is particularly relevant in environments where postoperative rescue and escalation options remain constrained. Unlike fixed demographic variables, frailty represents a dynamic and partially modifiable state, rendering its identification both prognostically informative and therapeutically consequential. The Clinical Frailty Scale (CFS) holds particular relevance for LRS perioperative practice [16]. Its nine-point ordinal continuum relies on structured clinical judgement, requires no equipment or laboratory investigation, and can be completed rapidly following appropriate training, supporting scalability across district and regional hospital environments [16]. A CFS score of 5 or above, denoting at least mild frailty, should prompt reconsideration of procedural aggressiveness, modification of anaesthetic strategy, and enhanced perioperative surveillance [16,17]. Frailty instruments nonetheless remain susceptible to inter-observer variability, particularly across culturally diverse settings. Structured training and periodic calibration are therefore essential to ensure reliable classification [16,17]. Where clinician-led assessment is impractical, the self-reported FRAIL scale offers a pragmatic adjunct with minimal workforce demands [17].

The "Resource-Lite" Workup: Prioritising High-Yield, Low-Cost Diagnostics (ECG, Basic Labs, Bedside POCUS) Over Advanced Imaging

Comprehensive technology-intensive preoperative investigations are frequently infeasible in LRS due to financial, infrastructural, and logistical constraints [15,18]. The operative priority is therefore strategic diagnostic prioritisation, emphasising modalities capable of identifying clinically consequential abnormalities with maximal efficiency. The 12-lead electrocardiogram (ECG) remains among the most valuable and accessible diagnostic tools in elderly perioperative assessment. It facilitates detection of atrial fibrillation, conduction disturbances, ventricular hypertrophy, and ischaemic patterns, each bearing direct implications for anaesthetic planning and intraoperative haemodynamic management [13,14]. Its diagnostic yield is amplified in LRS populations, where undetected cardiovascular pathology remains prevalent owing to limited routine healthcare engagement [14].

Basic laboratory investigations including full blood count, serum electrolytes, urea, creatinine, and random glucose provide substantial diagnostic value relative to cost. Anaemia warrants particular emphasis, given its high prevalence among elderly LRS patients and its established association with reduced physiological reserve and adverse perioperative outcomes [15,18]. Where surgical timelines permit, targeted iron supplementation constitutes a feasible corrective strategy with potential to meaningfully optimise haemoglobin concentration prior to elective procedures [18]. Creatinine-based estimation of glomerular filtration rate similarly informs drug dosing, fluid management, and postoperative monitoring, considerations of amplified importance where advanced biochemical profiling is unavailable [15]. Bedside point-of-care ultrasound (POCUS) represents a transformative diagnostic adjunct within LRS perioperative practice [19]. Focused cardiac assessment enables rapid appraisal of ventricular function, volume status, and pericardial pathology, while lung ultrasound supports identification of pleural effusions, consolidation, and pneumothorax [19]. Although studies report high diagnostic accuracy across diverse clinical applications, POCUS remains inherently operator-dependent. Diagnostic reliability is contingent upon structured training and competency maintenance, and it should be regarded as a complement to rather than a replacement for comprehensive imaging where available [19].

Nutritional and Cognitive Screening: Addressing the High Prevalence of Malnutrition and Undiagnosed Dementia in Rural Surgical Cohorts

Malnutrition and cognitive impairment are prevalent, prognostically significant, and frequently underrecognised determinants of perioperative risk in elderly LRS surgical populations. Their systematic assessment is essential for comprehensive vulnerability characterisation. Malnutrition within this cohort is multifactorial, driven by poverty, food insecurity, chronic infectious disease burden, and age-associated anorexia. Its perioperative consequences are clinically substantial, encompassing impaired wound healing, attenuated immune competence, reduced respiratory muscle strength, and prolonged recovery [20]. Multinational data from gastrointestinal cancer surgery across LMICs identify severe malnutrition as an independent predictor of early postoperative mortality, underscoring its gravity in resource-constrained surgical environments [20]. The Nutritional Risk Screening (NRS-2002) and Mini Nutritional Assessment Short Form (MNA-SF) are validated, paper-based tools permitting reliable identification of at-risk patients without laboratory dependence [21]. Nutritionally vulnerable patients should receive prompt oral supplementation and protein-focused dietary counselling. Where surgical timelines allow, structured nutritional optimisation may enhance postoperative functional recovery [21].

Preoperative cognitive impairment, encompassing undiagnosed dementia and mild cognitive impairment, independently predicts postoperative delirium (POD), a complication associated with functional decline, prolonged hospitalisation, and long-term cognitive deterioration [21,22]. In rural LRS communities, dementia frequently remains undetected owing to limited specialist access and the sociocultural normalisation of cognitive decline in older age [22]. The Mini-Cog, comprising a three-

item word recall task and clock-drawing test completable in under three minutes without equipment, is the most operationally appropriate screening instrument for this context, having demonstrated applicability across low-literacy and culturally diverse populations [22]. It must be acknowledged that formal cross-cultural validation data for the Mini-Cog in certain LRS populations remain limited, warranting cautious interpretation of screening results and underlining the need for locally adapted validation studies [22]. A positive screen should prompt documentation of baseline cognitive status, engagement of family caregivers, avoidance of deliriogenic medications, and enhanced postoperative vigilance for early POD recognition [21,22]. Nutritional and cognitive vulnerabilities frequently coexist within the same patient, exerting compounding effects on physiological reserve and recovery potential. Their integration into routine preoperative assessment reframes perioperative risk stratification from an exclusively disease-based paradigm towards a multidimensional vulnerability model that is scientifically defensible, clinically relevant, and operationally feasible within LRS constraints.

Surgical Innovation: Adoption vs. Adaptation

Minimally Invasive Surgery (MIS): Benefits for the Elderly vs. the Physiological Stress of Pneumoperitoneum

Aging is associated with impaired wound healing and a high burden of comorbidities, which increase peri-operative risk and this is not far-fetched since older patients have reduced physiological reserve [23,24]. It then follows that minimally invasive surgery (MIS) would be better tolerated in elderly patients than traditional open surgery particularly because of its association with smaller incisions, reduced blood loss, lower post-operative pain and reduced rates of wound complications like surgical site infections and incisional hernias [25]. Patients undergoing laparoscopic procedures experience shorter hospital stay and faster recovery compared to those undergoing open surgery, these benefits are particularly relevant in low-resource settings where prolonged hospital stay predisposes to nosocomial infections, also post-operative costs and dressing requirements would be reduced [26]. The benefits of MIS must be weighed against the physiological stress imposed by pneumoperitoneum. Laparoscopy influences peritoneal integrity and can alter the immune system by CO2 insufflation and its influence on microcirculation, also CO2 insufflation increases intra-abdominal pressure which can reduce venous return and as such reduce cardiac output [27]. These changes can precipitate haemodynamic instability or respiratory embarrassment in older adults, especially those with prior cardiovascular or pulmonary disease. Additionally, CO2 absorption can predispose during laparoscopy can predispose to hypercapnia and respiratory acidosis further worsening operative outcomes [28]. As a result, the use of MIS in the elderly should be viewed as a context-dependent intervention rather than a universal superior option. Careful patient selection, lower insufflation pressures, shorter operative time, are essential to maximize benefit and reduce harm in elderly patients [29]. In frail elderly patients, particularly those with significant cardiopulmonary disease, the physiological burden of pneumoperitoneum may outweigh the advantages of laparoscopy, necessitating modified techniques or alternative approaches [30].

Cost-Effective Innovation in Low-Resource Settings: Gasless laparoscopy or Single-Port Adaptations

Since its inception, laparoscopic surgery is a promising development in surgical practice globally, its practice has demonstrated many advantages including bettering patient outcomes, lowered the risk of postoperative infection, and displayed economical affluence. However, its implementation in low-resource settings still faces various challenges, including high equipment costs, poor infrastructure, scarce training programs, and lack of expert training personnel alongside financial boundaries [31]. To address this, innovation has shifted from complete adoption of high-tech MIS to adaptation methods that maintain patient benefit while reducing cost and complexity. Two prominent adaptations include gasless laparoscopy and single-port surgery [32,33]. Gasless laparoscopy like the name implies avoids CO2 insufflation by mechanically lifting the abdominal wall, creating an operating space without increasing intra-abdominal pressure [32]. Comparative studies show that this may potentially avoid ventilatory and circulatory problems associated with CO2 insufflation while also maintaining the benefits of conventional MIS (smaller incision, reduced post-operative pain and lower wound complication rates) [34]. It has also been demonstrated that gasless procedures provide normal acid-base balance and a lesser degree of hormonal stress responses, it maintains urine output, and it avoids derangement of pulmonary mechanics [35].

Beyond patient safety, gasless laparoscopy is also cost effective in that it eliminates the need for CO2 insufflators and advanced monitoring equipment making it a pragmatic option for hospitals in low resource settings where equipment maintenance and access to specialized anaesthetic care may be limited as shown in an economic evaluation from rural North-East India [36]. Single-port surgery further exemplifies cost-conscious interventions in that by limiting access to a single incision, surgeons reduce the number of trocars required and limit tissue trauma while maintaining most of the advantages of MIS [37]. Additionally, a lower number of trocars and cannulas can also directly reduce patient health care costs [38].

Although this could be more challenging and experienced surgeons would be required, single-port procedures can be performed using conventional instruments rather than expensive, dedicated single-port devices in low resource areas, this represents a practical compromise between innovation and resource constraints [39]. When combined with gasless methods, single-port adaptations can provide a safe low-cost alternative for minimally invasive procedures in elderly patients [33]. To summarize, gasless techniques and single-port techniques adaptations exemplify the concept of "adaptation over adoption" in that they allow elderly patients to access the benefits of MIS while addressing economic constraints, thus providing a pragmatic model for sustainable surgical innovation in resource limited environments.

Procedure Selection: When "Less is More" Choosing Palliative vs. Curative Surgery in Elderly Oncology

It is crucial in management of elderly oncology patients to understand that surgical decision making requires balancing potential benefits with risks of physiological stress, frailty and comorbidities. Elderly patients, unlike younger counterparts

often have limited reserve and a higher likelihood of peri-operative complications [23,24]. These considerations are further compounded by limited access to critical care and financial limitations [40]. Generally, curative surgery is performed with the intention of disease eradication and may involve extensive procedures, prolonged anaesthesia and higher peri-operative risk. Elderly patients, particularly with advanced age multiple comorbidities or frailty may develop disproportionate surgery without significant survival benefit with aggressive surgery [12, 41]. Individualized assessment incorporating performance status, comorbidity burden and certain geriatric assessment tools improve outcomes and helps to identify patients who would likely benefit from curative surgery [42,43].

Palliative surgery, on the other hand, emphasizes symptom relief and quality of life. Common examples include bowel bypasses, tumor debulking to relief obstruction or pain relief procedures. In elderly oncology patients, particularly in low-resource settings, palliative approaches may prevent hospitalization, reduce the need for intensive care, and minimize postoperative complications while still achieving significant improvements in well-being [44]. Factors guiding decision making include frailty and functional status, life expectancy and disease stage, resource availability and patient preferences, this approach improves prediction of treatment tolerance [45]. Implementing a "less is more" strategy while individualizing management plan promotes rational use of resources while benefiting elderly patients and reducing harm, especially in low-resource settings [46].

Anesthetic Safety and Precision

Regional vs. General Anesthesia: Mitigating Respiratory and Cognitive Risk

In low resource settings (LRS), general anesthesia (GA) often faces practical challenges such as unreliable oxygen supplies and functional ventilators are not always available. These limitations increase the risk of post operative pulmonary complications (POPC) for elderly surgical patients, also make it a major cause of death within 30 days of surgery in Sub Saharan Africa. Regional anesthesia (RA), particularly spinal or epidural blocks, offers a safer alternative by allowing patients to breathe on their own, eliminating the need for intubation and muscle relaxants. This is important in elderly patients whose liver and kidney function decline with age, making it harder to clear these drugs from the body. The impact of RA on delirium is more complex than previously thought. For years, many clinicians assumed that using regional anesthesia during surgery would prevent postoperative delirium. The RAGA trial in 2021 challenged this assumption in a study that looked at 950 elderly hip fracture patients and found that spinal anesthesia without sedation had nearly the same delirium rates as general anesthesia (24% versus 23%, p=0.92) when RA was only used during the operation itself [47].

Additionally Subsequent meta-analyses confirmed no consistent delirium benefit when regional anesthesia serves only as the primary anesthetic and the true benefit emerges when RA is utilized for postoperative analgesia. Meta analyses, such as those by Fanelli et al. (2022), confirm that neuraxial or peripheral nerve blocks, when added to systemic analgesia, can halve delirium risk compared to pure opioid based regimens [48]. Umbrella reviews in hip fracture populations demonstrate that combining spinal anesthesia with femoral or fascia iliaca compartment blocks significantly reduces pain scores, opioid requirements, and delirium incidence [49]. In the LRS context, the awake patient under regional block also acts as their own cerebral monitor. Being able to talk with an awake patient gives free, instant feedback about brain perfusion. If someone under spinal anesthesia suddenly gets agitated or confused, it serves as a real time warning that their blood pressure might be too low or they are not getting enough oxygen. This kind of warning is lost when patients are deeply sedated under GA, especially in settings with no advanced monitoring equipment. Regional anesthesia has its own risks because the sympathetic nerve block can drop blood pressure significantly in frail elderly patients whose hearts cannot compensate well.

Pharmacological Stewardship: The Delirium Genic Avoidance Strategy

The aging physiology is defined by a resource lite metabolic profile: reduced glomerular filtration rates (GFR), decreased total body water, and diminished hepatic blood flow, which mandates a start low, go slow approach to drug delivery. Pharmacological stewardship in the OR is not merely about dose reduction but about the strategic avoidance of delirium genic agents. The Beers Criteria and the American Geriatrics Society strongly advise against the use of benzodiazepines like diazepam in the elderly. While meta-analyses suggest benzodiazepines may not consistently increase delirium in all populations, head-to-head comparisons reveal significantly higher delirium rates when compared to dexmedetomidine [50]. Anticholinergic drugs are another overlooked problem in low resource settings. Medications like promethazine (for nausea) and atropine, commonly used in Nigerian ORs, can cause severe confusion in elderly patients. Pethidine is also widely available, but its breakdown product, norpethidine, can cause seizures and brain toxicity in older adults. A multimodal, opioid sparing approach using scheduled intravenous paracetamol combined with local anesthetic infiltration (wound docking) or fascia iliaca compartment blocks is recommended. This approach provides superior pain relief while minimizing the cognitive fog and respiratory depression associated with high dose opioids [51]. In low resource settings where advanced medications may not be available, a practical bundle includes: using non sedative analgesics, performing preoperative medication review to remove unnecessary anticholinergics, and allowing family members into the recovery area early to provide familiar faces and help with reorientation.

Hemodynamic Monitoring: Redefining Precision with Bedside Markers

While anesthesiologists use arterial lines and central venous pressure monitors to track patient stability during surgery in high income countries, these tools are either too expensive or simply not available in rural and low resource hospitals. In such environments, hemodynamic precision must be redefined through high yield clinical markers. Capillary Refill Time (CRT), when standardized, provides robust perfusion data at zero cost. As validated by Hernández et al. (2024), the technique involves applying firm pressure to the fingertip for five seconds; a return to baseline color exceeding 3 seconds indicates impaired peripheral perfusion and serves as a trigger for fluid or vasopressor intervention [52]. International sepsis guidelines and

the World Health Organization endorse CRT as a core clinical assessment tool, particularly valuable in resource constrained environments, though clinicians must account for confounding variables including ambient temperature, inadequate lighting, and preexisting peripheral vascular disease.

Complementing CRT with urine output monitoring (targeted at ≥0.5 ml/kg/hr) provides a window into renal perfusion, though clinicians must be wary of its limitations in patients with pre existing chronic kidney disease. Another useful bedside tool for the physically monitored OR is the Shock Index (SI), which is the ratio of Heart Rate to Systolic Blood Pressure (SI = HR/SBP), and can reveal hidden problems in elderly patients. Because many older adults have chronic high blood pressure, what looks like a normal reading of 120/80 mmHg might actually be too low for someone whose usual pressure is 170/90. An SI greater than 0.9 serves as a critical red flag for occult hypovolemia even when absolute BP values appear stable [52]. In elderly patients, careful fluid management is as important as drug management. Aging hearts are stiffer and struggle to relax between beats, making older patients prone to diastolic heart failure. Giving IV fluids too fast can push fluid into the lungs. Using the Shock Index and CRT to guide mini fluid boluses (250 ml at a time) helps to balance between too little fluid and too much [52].

Postoperative Care and Rehabilitation

Postoperative care significantly influences surgical outcomes in geriatric populations, particularly in low-resource settings (LRS), where infrastructural limitations, workforce shortages, and limited access to specialised rehabilitation services amplify risks of morbidity, delayed recovery, and functional decline [53,54]. Elderly surgical patients frequently exhibit diminished physiological reserve, impaired immune responses, and heightened susceptibility to complications, including postoperative delirium (POD), suboptimal pain management, and delayed mobilisation [55,56]. In LRS, where intensive monitoring and geriatric expertise are often scarce, postoperative strategies must prioritise scalable, cost-effective, and culturally appropriate interventions to preserve functional independence and facilitate early recovery.

Managing Postoperative Delirium

Postoperative delirium is among the most common complications in older surgical patients, with reported incidence ranging from 13% to 50%, and up to 80% in high-risk groups such as intensive care or hip fracture populations [55,57]. Meta-analyses estimate global rates of approximately 13–25% following non-cardiac surgery, while studies from low- and middle-income countries (LMICs) report higher incidence (20–41%), reflecting under-recognition, limited screening capacity, and workforce constraints [57,58]. Recent African and Ethiopian cohorts have documented rates approaching 40%, highlighting the disproportionate burden in resource-constrained environments where validated tools such as the Confusion Assessment Method (CAM) or 4AT are not routinely implemented [57,59]. Non-pharmacological prevention strategies represent the most feasible and evidence-based approach in LRS. Early mobilisation improves sleep–wake cycles, enhances pulmonary function, and mitigates functional decline and sarcopenia [55,59]. Environmental optimisation including adequate lighting, minimisation of nocturnal disturbances, and provision of sensory aids such as spectacles or hearing devices further reduces delirium risk at minimal cost [60,61]. Pharmacological therapy should be reserved for severe hyperactive delirium that threatens patient or staff safety, given older adults' vulnerability to oversedation and prolonged cognitive impairment [55,60]. Frailty has emerged as a major predictor of POD and poor postoperative outcomes. Incorporating simple frailty screening into perioperative workflows may improve risk stratification; however, high-quality randomised evidence from LMIC settings remains limited, representing an important research gap [53,60].

Pain Management

Effective postoperative analgesia in older adults requires balancing adequate pain relief against risks of respiratory depression, renal dysfunction, and cognitive deterioration [56]. Multimodal analgesia is a practical and cost-effective strategy for LRS, combining systemic medications with local or regional techniques to reduce opioid exposure [56,62]. Paracetamol should form the foundation of therapy due to its favourable safety profile, affordability, and availability [56]. Non-steroidal anti-inflammatory drugs (NSAIDs) may provide additional benefit but should be used cautiously and for short durations because of increased risks of renal injury, gastrointestinal bleeding, and cardiovascular events in elderly patients [62]. Where feasible, local anaesthetic wound infiltration and regional techniques reduce pain, decrease opioid requirements, and facilitate early mobilisation without advanced equipment [48,63]. Opioid stewardship is critical. Protocols should prioritise short-acting agents at the lowest effective dose, as excessive opioid use increases the risk of delirium, respiratory depression, and prolonged hospitalisation [56]. Emerging evidence supports opioid-sparing or dexmedetomidine-based strategies to improve recovery profiles and reduce delirium risk [63]. Although strong evidence exists from high-income settings, LMIC data remain largely observational, highlighting the need for pragmatic context-specific trials [53].

Enhanced Recovery After Surgery Protocols in LRS

Enhanced Recovery After Surgery (ERAS) programmes reduce complications, length of stay, and healthcare costs across surgical specialties [54]. However, conventional ERAS pathways depend on multidisciplinary teams, advanced monitoring, and reliable supply chains, which are often limited in LRS. Pragmatic adaptation rather than direct implementation is therefore required [54]. High-impact, low-resource components should be prioritised. Early enteral feeding improves immune function, reduces infectious complications, and accelerates recovery [63]. Additional core elements include avoidance of prolonged fasting, early catheter removal, defined mobilisation targets, and simplified multimodal analgesia protocols. Standardised care bundles improve consistency despite staffing constraints [54,64]. Patient and caregiver education is a critical low-cost intervention. Clear discharge instructions regarding wound care, medication adherence, nutrition, and mobility reduce complications and readmissions. In rural settings, integration of community health workers into postoperative follow-up improves early detection of complications and supports rehabilitation continuity [64]. Systematic reviews indicate that adapted ERAS implementation in LMICs reduces postoperative morbidity and hospital stay without increasing mortality, although evidence quality remains moderate and heterogeneous [64].

Barriers and Ethical Considerations

Infrastructure Gaps: Shortage of ICU Beds and Oxygen Supply

An important challenge facing older adults during surgery in poor-equipped regions lies in the lack of good intensive care services [65]. Notably, access to Quality medical oxygen remains unreliable across many areas. Across low-income nations, intensive care units always operate at or near capacity limits. Where available, ICU beds are frequently stretched thin due to limited infrastructure. This strain becomes especially evident after complex operations involving elderly patients. In the advent of high-risk procedures, older individuals may require quality intensive monitoring and good life-supporting interventions. Yet Health Materials, supplies, staffing, and technology are rarely up to standard and date. When complications arise post-operatively, rescue options are often thin. Research into healthcare delivery under pressure confirms these shortages occur most sharply where surgical caseloads are heaviest. Older patients, carrying multiple health conditions, face steeper recovery trajectories within such constrained environments [66]. When hospitals need more than usual, problems in infrastructure show up clearly - this happened during major crises such as the COVID-19 outbreak, where oxygen and intensive care unit limits made surgical challenges even harder to manage. Without sufficient oxygen and monitoring devices, giving anesthesia safely becomes tough, which also affects good quality recovery after surgery, especially for older people whose bodies respond inadequately under stress. Even though the World Health Organization now classifies oxygen as a fundamental treatment, uneven access to it across countries still stands out as a barrier ; many in low-income and middle-income nations depend on mostly unstable or unavailable sources, a key part of emergency medical care, particularly vital for seniors who face much greater risks of low oxygen levels and breathing or cardiac-related issues [67].

What's missing goes far beyond buildings and machines. Trained staff in intensive care units often seem out of reach, especially when gear breaks down or isn't checked regularly. Surgery routes meant to work together too frequently fall apart, leaving patients exposed. When it comes to handling emergencies before or after operations, systems in poorer nations keep showing weak spots - resources run thin, teams aren't ready, coordination stalls. Older people facing surgery face higher chances of problems because of these ongoing issues [65]. When hospitals run low on supplies, doctors face tough choices rooted in reality but tangled in moral weight. Picture an ICU during surge - beds scarce, oxygen stretched thin. In such moments, aging becomes a factor in access, since older adults carry more health complexities by virtue of time and condition. Yet who gets treated stays unclear, since rules rarely exist to guide such decisions. Fairness slips into doubt when limits tighten.

Ethical Decision-Making: Balancing Aggressive Surgical Intervention with Quality of Life and Cultural Attitudes Towards Aging

Elderly patients do encounter tough decisions during surgery, not just because of limits imposed by the system but also due to deep moral questions. When procedures carry high risks and recovery seems unlikely to improve daily living, doctors wrestle with balancing effort versus restraint. Instead of pushing full throttle, teams must weigh what is fair and meaningful given scarce supplies and uncertain results. For seniors dealing with multiple health issues or weak stability, talks about treatment goals gain sharper meaning when value systems are considered alongside real health trajectories. When choices get tough, these approaches push for joint decisions that honor personal control but still balance gain against strain - especially hard where wishes aren't written down and relatives step in quietly [68].

When it comes to getting older or facing death, what a culture values makes a big difference in how people make choices about care. In poorer areas, doctors might see surgery as useless - or essential - based on beliefs passed down through tradition and community roles. Sometimes, loved ones want more than the body can handle, even if medicine clearly cannot deliver good results. That gap - between what experts advise and what families insist on - often grows wider when procedures promise little real benefit. When supplies run short, doctors face tough choices about where to help first. They must weigh helping more people against protecting those already at risk. This kind of decision pulls at two essential duties - one to benefit, one to harm least. As challenges grow, so does the weight of staying true to both rules without favoring one over the other [66]. What stands out is how fairness can slip when older patients are seen as less important because of their age. Sometimes decisions reflect broader biases instead of personal needs. A closer look at values helps reveal whether choices stem from real limitations or unfair assumptions. Ensuring respect remains key in shaping outcomes for older surgical candidates.

Conclusion and Future Directions

In low resource-settings (LRS), there is a necessity to design a practical and realistic perioperative model that combines moderate surgical innovations, economic reality and safety. This model focuses on patient-specific risk analysis (application of frailty scales and other screening tools to assess post-operative complications) and precision-guided minimally invasive interventions both of which serves to reduce post operative complications and convalescence [25, 69]. Also, it should feature the administration of cost-effective and short-acting spinal/epidural anesthesia before surgery which significantly lowers postoperative delirium [70]. Post operative measures which include contextual adoption of enhanced recovery after surgery protocols (ERAS), administration of non-opioid analgesia and utilization of the family to provide care and prevent ward-based delirium [71].

Adoption of this model should be complemented with an overall improvement in the funding of geriatric care. LMICs should refrain from viewing the aged as an economic burden and should begin to include them in their national budget. Consequently, these challenges highlight an imperative need to restructure the Surgical Residency Programs in LRS to accommodate specialized geriatric training modules. An integrated curriculum that includes specific competencies in comprehensive medical history, frailty assessment, geriatric pharmacology, low-cost anesthesia techniques and resource-based decision-making [72]. However, due to the dire shortage of surgeons and anesthesiologists, the provision of essential surgery in remote and rural areas of low- and middle-income countries remains totally inadequate and poses great challenges. This translates to task shifting and the inclusion of geriatric competencies into the training modules of non-physician clinicians (NPCs) as they perform the bulk of surgeries in LRS [73].

Evidence has shown that the needs of the geriatric surgical patient has been repeatedly neglected, and as the demographic transition continues to occur in Low to Middle income countries (LMICs), it will be important to tailor specific plans to meet their surgical needs. By incorporating geriatric principles into the training and research of physicians, this will ensure that as populations age, effective surgical care to elders can be delivered

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Author Contribution

H.J & E.O conceptualized the study and did initial literature search. All authors were involved in writing the initial draft of the manuscript. All authors read and approved the final manuscript.

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