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Anaesthesia in Low-Resource Settings: A Concept Analysis

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Abstract:

The study analysed the concept of anaesthesia in low-resource settings (ALRS), establish a standardised definition, delineate its defining attributes, and provide conceptual clarity for anaesthesia education, health policy, and global health research. The design involved concept analysis using the eight-step method of Walker and Avant (2005). A systematic literature search of PubMed, CINAHL, and Google Scholar (2000–2024) using terms including anaesthesia, low-resource settings, task-shifting, nurse anaesthetist, global surgery, and perioperative care. Five defining attributes were identified: (1) context adaptation and resource optimisation, (2) resilience and resourcefulness, (3) task-sharing and expanded scope of practice, (4) prioritisation of essential and robust techniques, and (5) heightened clinical acumen and vigilance. Antecedents include systemic resource scarcity and a critical physician anaesthetist workforce deficit. Consequences encompass enabling life-saving surgical access while simultaneously exposing patients and providers to elevated perioperative risk, occupational burnout, and systemic fragility. Model, borderline, related, and contrary cases illustrate the concept's boundaries and application. ALRS is a distinct, specialised practice domain defined by a unique skill set deployed under conditions of profound systemic constraint. This analysis provides a conceptual foundation for developing targeted curricula, context-appropriate technologies, and supportive policies to strengthen global anaesthesia equity.

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Introduction

Safe anaesthesia is an essential part of universal health coverage, it is vital for essential and emergency surgical services and it is a key measure of the effectiveness of a health system (Meara et al., 2015). The current burden of lack of access to safe, timely and affordable surgical and anaesthetic care is estimated to be five billion people globally, with the vast majority of this burden falling in LMICs (Albutt et al., 2023). The World Federation of Societies of Anaesthesiologists (WFSA) 2021 global workforce survey found that the median density per 100,000 recorded for low-income countries (LMICs) is 0.6 physician anaesthetists, compared to 18.6 in high-income countries (HICs) (Kempthorne et al., 2021). Nigerian Medical Association (2020) estimated that in Nigeria with a population of over 200 million, about 250 physician anaesthetists are in practice, which makes the availability of physician-led anaesthetic services extremely low and thus structurally unavailable to the majority of the population.

Low resource setting is not merely a classification of the economy of the nation. It is a term used for specific clinical settings, such as rural, remote, peri-urban and/or chronically under-resourced settings, which are characterised by systemic limitations of human resources, essential equipment, reliable medicines and stable infrastructure (Dubowitz et al., 2020). This rarity gives rise to a unique clinical situation where providers are constantly required to make adaptions, improvise and compromises that are evidence-based in order to provide care (Law et al., 2021). The impact is tangible and dire: Biccard's (2021) groundbreaking African Surgical Outcomes Study showed that BSSA rates of perioperative mortality are significantly higher than the international standard, and resource constraints were identified as playing a role. These vulnerabilities were further highlighted during the COVID-19 pandemic when essential supplies such as oxygen, personal protective equipment and ventilators were in short supply, severely impacting anaesthesia/surgical services across the continent (Semple et al., 2022).

Operational experiences of anaesthesia in these settings are growing more commonplace but anaesthesia in low resource settings may still be a poorly defined and conceptualised concept. This ambiguity has real world implications. Complex, technically unsupported equipment donations that end up unused and training programmes that focus on techniques requiring non-existent technology are expensive and are common issues that arise from a lack of understanding of the basics of what is required for ALRS (Hodges et al., 2021; Haylock-Vize et al., 2022). Thus, a standardised conceptual understanding is essential for all teachers who want to develop relevant curricula, for policy makers who want to make plans for health system strengthening, and researchers who want to develop and evaluate context-appropriate innovations. The fact that most of these non-physician anaesthetists (NPA) work with great autonomy in the clinical setting and have high rates of occupational burnout further highlights the need for this conceptual work (Turkson et al., 2023; Tuyishime et al., 2022).

This paper employs the eight-step method of Walker and Avant (2005) to conduct a rigorous concept analysis of anaesthesia in low-resource settings. The aim is to achieve conceptual clarity, establish a standardised working definition, delineate essential characteristics, and provide a conceptual model to guide training, innovation, and policy in global anaesthesia.

Aim and Purpose of the Analysis

The primary aim is to achieve conceptual clarity and establish a standardised definition of anaesthesia in low-resource settings grounded in the contemporary literature and applicable across clinical, educational, and policy domains. Specific objectives are to delineate the essential defining attributes of ALRS; to distinguish it from anaesthesia practice as conceptualised in high-resource settings; to identify its antecedents and consequences; to illustrate its conceptual boundaries through model, borderline, related, and contrary cases; and to identify empirical referents enabling the concept to be studied in the real world. These objectives serve multiple practical ends: enabling nurse anaesthetist educators to design genuinely contextually relevant training; providing policymakers with a conceptual framework for evaluating anaesthesia services within national surgical, obstetric, and anaesthesia plans; and equipping researchers with a precise theoretical anchor for developing and evaluating context-appropriate innovations.

Method

This study employed the concept analysis method of Walker and Avant (2005), a structured, eight-step framework for clarifying complex, multifaceted concepts central to a discipline. The eight sequential steps applied were: selection of the concept; determination of the purpose of the analysis; identification of all uses of the concept; determination of defining attributes; construction of a model case; identification of borderline, related, and contrary cases; identification of antecedents and consequences; and definition of empirical referents.

A systematic literature search was conducted across PubMed/MEDLINE, CINAHL, and Google Scholar. Search terms included: anaesthesia, low-resource settings, resource-limited, global surgery, task-shifting, task-sharing, nurse anaesthetist, non-physician anaesthetist, safe surgery, perioperative mortality, and anaesthesia workforce. English-language publications from 2000 to 2024 were reviewed, supplemented by seminal works regardless of date. Source disciplines included anaesthesia, surgery, nursing, public health, health systems research, and global health policy. Reference lists were hand-searched for additional relevant sources. Attributes, antecedents, consequences, and empirical referents were identified inductively through iterative thematic review, consistent with Walker and Avant's (2005) interpretive approach.

Definitions and Conceptual Uses of Anaesthesia in Low-Resource Settings

Etymological and Dictionary Foundations

Anaesthesia is derived from the Greek word anaisthēsia (Farlex Partner Medical Dictionary, 2012), which means to be without the sense of pain, the key step in any surgical procedure. In modern medical terms, anaesthesia refers to the temporarily induced lack of sensation or consciousness for medical reasons, which can be either general which involves unconsciousness, analgesia, amnesia and immobility, or regional which involves blocking a specific area of the body with a spinal, epidural or peripheral nerve block (American Heritage Medical Dictionary, 2007). Low-resource refers to settings with a systemic lack of resources for healthcare – such as a lack of trained staff, essential medicines, working equipment, and good infrastructure – that are needed to achieve healthcare goals (Mkony et al., 2021). The whole idea to provide a state of insensibility with systemic lack sets the conceptual field for this analysis.

Use as a Clinical Practice Defined by Constraint and Adaptation

The most common application relates to the day-to-day reality of clinical anaesthetic practice in conditions of limited resources in terms of drugs, equipment and manpower. Alemayehu et al. (2023) described the situation in Ethiopia, whereby providers rely mostly on ketamine and spinal anaesthesia to avoid risks of safety issues and minimal infrastructure, and Biccard et al. (2023) developed a pan-African survey around the constellation of barriers that directly inform clinical decision-making, including the absence of monitoring, unreliability of drug supply, and inadequate staffing. In this use, ALRS is more of a problem space with adaptive responses that need to be put into practice.

Use as a Patient Safety and Perioperative Risk Domain

ALRS is a second thread that views patient safety as a problem of resources, as an element that is directly related to poor outcomes of surgery. Peri-operative deaths in sub-Saharan Africa are significantly higher than global standards, low monitoring capacity, limited availability of oxygen and medicines are significant contributors to this (Biccard, 2021). In order to provide a global indicator of the level of anaesthetic services delivered, Watters et al. (2015) used the perioperative mortality rate, which is directly related to resource constraints faced by LMICs. In this usage, ALRS is not simply a description of usage, but is an independent determinant of patient risk.

Use as a Health Systems and Workforce Function

The third use examines ALRS in the prism of configuration of workforce and sharing of tasks. The concept was used in the WFSA 2021 survey (Kempthorne et al., 2021) to provide a good quantitative measure of the dramatic shortage of physician anaesthetists and the resultant dependence on non-physician providers. According to Mkony et al. (2021), nurse anaesthetists in Tanzania are the 'workhorses' of surgical service provision, which involves not only giving anaesthetic but also maintenance of equipment, team management, training of junior staff and more. In this context ALRS is as much a concept of the workforce and governance as a clinical concept.

Use as a Marker of Global Health Inequity and Policy Domain

The concept is used in policy documents as a sign of stark inequities in access to safe surgeries, and as a field for targeted investments. WHO sees investing in capacity to provide anaesthetic services in LMICs as a health equity imperative and a cost-effective development opportunity (WHO, 2023; Meara et al., 2015). The equity argument is expanded to the paediatric surgical domain by Seyi-Olajide et al. (2021, 2023) (focusing on Nigeria and Africa) reporting the lack of paediatric surgeons and physician anaesthetists in health systems in these countries.

Use as a Domain for Innovation and Education

A more recent usage views ALRS as a process for locally innovative thinking and action. Haylock-Vize et al. (2022) proved that Virtual Simulation is a viable way of training providers in remote areas. The WHO-WFSA international standards are a normative framework intentionally crafted to be attainable in all resource settings, and provide a measure by which ALRS can be evaluated (Gelb et al., 2021). Study on low cost monitoring devices and strong anaesthesia delivery systems are likewise based on this novel approach towards the concept.

Use as a Source of Professional Identity and Occupational Strain

A growing body of literature interacts with ALRS as a formative and identity construction and psychological well-being. The authors have identified that these places of work not only brought a sense of pride to their profession, as they had an exceptional degree of autonomy to

develop, but also a sense of psychological strain, as it would be difficult to maintain their moral integrity when practising in a work environment where patient safety was compromised (Law et al., 2021). Turkson et al. (2023) and Tuyishime et al. (2022) put a number to this strain, with high burnout levels reported among providers of anaesthetic services in both Ghana and Rwanda respectively, with both citing inadequate resources, excessive workload and moral distress as contributing factors.

Defining Attributes

Defining attributes are the features that most commonly occur in the literature and the ones which are required for the concept to be correctly identified (Walker & Avant, 2005). Five aspects of ALRS were determined based on an iterative process of examining the collected literature.

Context Adaptation and Resource Optimisation

Local challenges, such as the availability of equipment, facilities and personnel, greatly influence the practice, providing practitioners with the opportunity to constantly adjust techniques and make evidence-based compromises that will still give the patient the best possible outcome given the often limited resources. It's not passive coping with shortage of resources, it's an active expert process of optimisation. In Biccard et al's (2023) pan-African survey, physician anaesthetists reported a consistent order of greatest problems to safe care as equipment and drugs shortages, which consistently resulted in the systematic modification of technique. This is the case with ketamine, which is used as an effective stand-alone agent, due to its stability, effective pain management and not requiring a sophisticated delivery system (Alemayehu et al., 2023). Deliberate maintenance and repair of existing equipment and improvisation of monitoring solutions where standard technology does not exist, are also included in the resource optimisation.

Resilience and Resourcefulness

This attribute includes the ability to deliver uninterrupted safe care in the face of often unreliable and failing infrastructure – power failures, oxygen failures, equipment failures etc. It involves competency in low-technology and no-technology monitoring (palpation of peripheral pulse, use of auscultation techniques to replace capnography, visual assessment of chest excursion, and mucous membrane colour) and troubleshooting with basic equipment with minimal assistance. In their qualitative study of providers in LMICs, Law et al. (2021) found resilience to be one of the key professional qualities, with providers implementing systematics to overcome frequent equipment failures and an attitude of 'don't stop, just keep going', which would otherwise be necessary in a high-resource setting. Dohlman et al. (2020) put this in the context of workforce sustainability, which includes a call to action to ensure that providers are not continuously required to work with the same resilience that supports them in taking care of others, without having a system in place to support them.

Task-Sharing and Expanded Scope of Practice

This attribute mirrors that most LMICs have primarily non-physician clinicians (nurse anaesthetists, clinical officers, anaesthetists assistants) trained for and practising anaesthesia with high levels of clinical autonomy, often away from physician supervision. This is actually a conscious effort to serve as a workforce strategy based on evidence, and not a deficit (Watters et al., 2015). According to the WFSA 2021 survey, the number of NPAs is an increasing number in many countries in sub-Saharan Africa and they offer the majority of anaesthetic care (Kempthorne et al., 2021). One of the peculiarities of ALRS as a model of

practice is nurse anaesthetists' frequent involvement in departmental management, equipment maintenance, mentorship and training; a role which is both necessary and has been shown to be commonplace among Tanzanian nurse anaesthetists (Mkony et al., 2021).

Prioritisation of Essential and Robust Techniques

This attribute requires a conscious, philosophical approach to learning the fundamentals of anaesthetic practice which are effective, and rely less on expensive or unreliable technology or supply chains. This strategic prioritisation is reflected in high use of spinal anaesthetic for lower abdominal and obstetric procedures, the use of ketamine anaesthetic in a wide variety of settings (Hailu et al., 2023; Hodges et al., 2021). These are the preferred techniques not because of a lack of other options, but because of the fact that working in practice contexts in this way is a positive competency, that requires no technology. This attribute implies pedagogical implications directly: training programmes that are not explicitly targeted and focused on these techniques are fundamentally misaligned with the graduates' realities at work (Haylock-Vize et al., 2022).

Heightened Clinical Acumen and Vigilance

This characteristic is a measure of the "compensatory" intensification of direct clinical observation in environments where higher level monitoring is unavailable or is not reliable. In absence of continuous capnography, arterial line monitoring or neuromuscular monitoring, providers must engage in continuous, active clinical assessment as a functional alternative to technological monitoring, including regular palpation of the pulse, auscultation of the chest, visual assessment of the respiratory status and haemodynamic assessment using clinical signs. In a survey of facilities across Africa, Biccard et al. (2023) reported that capnography was often not available even when basic pulse oximetry was available, thus supporting their finding that providers get really good at using it out of necessity. This defining attribute is assessed and measured in simulation-based training that tests management of critical events, without electronic monitors (Haylock-Vize et al., 2022).

Model, Borderline, Related, and Contrary Cases

Model Case

A model case provides an illustration of all the characteristics in one situation (Walker & Avant, 2005). The 24 year old woman is admitted to the district hospital in rural Malawi in active labour with foetal distress. Only nurse anaesthetist is available as a provider. The theatre is only sometimes equipped with electricity, a draw over vaporiser containing halothane, a manual BP apparatus, a pulse oximeter (which does not always work) and a stethoscope; the back up generator is not always reliable and the closest referral centre is a four hour drive on poor roads. Nurse anesthetist choose spinal anesthesia. He has come to a point in his career where he has been able to practice context adaptation and optimise his resources, for instance, when trying to use bupivacaine, which he prefers to use, but can't get his hands on, he calculates and adapts an appropriate dose of lidocaine according to the time of the procedure. He does positioning of the patient on his own without the assistance of a theatre assistant. When the operation is half way through, there is a power failure and the theatre becomes dark. He carries his own personal headlamp which he uses for this purpose and continues to monitor. During the failure of the pulse oximeter, he switches completely to assessing ventilation by palpating the pulse and by listening for it with the stethoscope and manually controls the oxygen delivery via the Ambu bag (resilience and resourcefulness; heightened clinical acumen). Infant is born alive with mother being haemodynamically stable.

Task sharing such as autonomous non-physician practice; emphasis on sound technique; adaptability in the context of the situation; resilience; and increased sharpness are all displayed throughout the case.

Borderline Case

A borderline case is one that does not have all of the defining features, but does have some (Walker & Avant, 2005). A doctor anaesthetist gets ready for an elective laparosopic cholecystectomy in a modern private hospital in Lagos. The theatre is equipped with a working anaesthetic machine, multiparameter monitoring and has an adequate supply of drugs. But, capnography is not available because of cost factors. The physician anaesthetist continues, augmenting clinical monitoring with listening and watching the breath. Nothing much happened with the case. This is an example of partially adapted context and partially enhanced skill, but not fully resilient and resourceful (the environment is otherwise resource-rich), partially shared tasks (the role of the carer is physician-led with a traditional division of labour), and not necessarily prioritisation of robust techniques (the technique is a standard volatile-based general anaesthesia, not a specifically chosen equipment-light approach). This is a borderline case as the majority of the features are not present in a predominantly mixed resource setting.

Related Case

A related case has similar surface features, but a lack of key antecedents or attributes (Walker & Avant, 2005). An international NGO sets up a field hospital with a number of portable anaesthetic machines, a reliable source of solar power, a sufficient supply of medicines and portable monitors after a large earthquake. High Volume Trauma Surgery is provided by a team of visiting expatriate physician anaesthetists and nurse anaesthetists. The surroundings are harsh, but the field hospital is a deliberately 'self contained' clinical unit. Adaptation to the tent culture is available, but, providers do not live in a state of chronic, embedded, systemic lack of resources; resources are provided from outside and have limited duration. The necessary pre-condition for engaging in under resourced, local practising is missing. When task-sharing takes place, it is a temporary deployment not a solution to the workforce. The latter is a related rather than a model case as the five attributes of adaptation are not sustained and institutionalised at the level of the surface features.

Contrary Case

A contrary case was chosen to show that it lacks the attributes, to shed light on the concept through its polar opposite (Walker & Avant, 2005). A 65-year old patient is to be operated with a radical prostatectomy at a university hospital in Zurich with a combined anesthesia of general anesthesia and epidural anesthesia. At the pre-induction checklist, you check the capnography module and find that it is not working. A second identical workstation is immediately available, but according to the hospital's protocol, the workstation needs to be completely functional when the induction happens. The case is postponed and a biomedical engineer replaces the module within 45-minutes and the case continues. The problem with equipment failure is that it is not an opportunity for adaptation and improvisation, it is an opportunity for stopping and replacing, the latter of which is enabled by redundant technology and immediate support. There is no context adaptation; no need for resilience; no task-sharing needed within a well-defined professional hierarchy; no need for advanced technique prioritisation (when all advanced techniques are guaranteed to be available); and no need for increased clinical acumen as a substitute for technology when it is safe because of

redundancy and protocol. All the conceptual characteristics are lacking and it is indeed a contrariety case.

Antecedents and Consequences

Antecedents

Antecedents are the conditions that have to occur in order for the concept to happen (Walker & Avant, 2005). There were five antecedents to ALRS that were identified. Its basic underlying cause is the lack of material and infrastructural resources, or a healthcare environment that lacks basic infrastructure, reliable power supply, drug supply and adequate equipment to do the job. Biccard et al. (2023) reported that the most common limitations in the provision of safe care in facilities in Africa were equipment shortages and a lack of drugs, including a lack of capnography and even pulse oximetry. COVID-19 highlighted the corollary infrastructure gap, as there were severe shortages of oxygen for anaesthetic services in LMICs (Semple et al., 2022; Ekezie et al., 2021).

Second is the lack of doctor anaesthetists, which calls for task sharing. Physician-led anaesthesia is structurally impossible for most surgical cases as densities of physician anaesthetists were below 1 per 100,000 across most of sub-Saharan Africa in the WFSA 2021 survey, compared to the medians of more than 15 per 100,000 in the high-income regions (Kempthorne et al., 2021). The third is the high unmet need for surgical care at the population level that cannot be deferred to higher level facilities: In LMICs, ~90% of people don't access timely, safe surgical care (Seyi-Olajide et al., 2021). The fourth is a trained anaesthetist, physician and/or non-physician, with the skills necessary to work independently under constraint. Previous studies in Tanzania also reveal that nurse anaesthetists can provide safe anaesthetic services in a broad spectrum of procedures with structured contextual training (Mkony et al., 2021). The fifth is where there is no effective referral pathway, either because of financial, geographical or systemic constraints, forcing the provision of the care in the local, less resourced facility, instead of a referral to a specialised facility (Abantanga, 2022).

Consequences

Consequences are what comes out of the occurrence of the concept (Walker & Avant, 2005). The main positive impact at an individual patient level is provision of potentially life-saving surgery in areas where there is no other choice. In peripheral facilities in sub-Saharan countries, emergency caesarean sections, laparotomy, trauma surgery and other essential procedures are only possible through the actions of non-physician anaesthetists who are the sole providers of anaesthetic services to populations with no realistic access to higher level facilities (Mkony et al., 2021). The impact on the patient is not insignificant either: Systemic issues that make ALRS necessary result in a measurable increase in risk of adverse outcomes following surgery. In Africa, Biccard (2021) reported the mortality rates in operating rooms are much higher than the rest of the world, and that the most important factors are a lack of monitoring, poor oxygen quality, and lack of medications.

ALRS for providers leads to the positive consequence of becoming an outstanding clinician, problem-solver, and resilient individual while at the same time, it also leads to the negative consequence of occupational burnout and moral injury. According to Turkson et al. (2023), Ghanaian anaesthetists are suffering from burnout syndrome with strong reduction in the availability of resources, overload in workload and moral distress as the main causes. A similar result was found by Tuyishime et al., (2022) in Rwanda. Professional emigration by trained providers to better-resourced environments and the resulting loss of providers

further reduces the provider workforce on which ALRS depends (Dohlman et al., 2020). This has a positive health system-level impact on cost-effective service delivery via task-sharing models, but on the other side, it has a negative health system-level impact in terms of system fragility and vulnerability to external shocks, which was seen during the COVID-19 pandemic when anaesthesia service capacity was rapidly reduced (Semple et al., 2022). The upside is that, for global health, this means faster innovations at the local level, for instance, virtual simulation training, low-cost monitoring devices and powerful anaesthesia delivery systems, that are forced from necessity (Haylock-Vize et al., 2022; Hodges et al., 2021).

Empirical Referents

Empirical referents are measurable categories or observable phenomena that illustrate how the attributes of a concept are manifested in real world situations and that "make it possible for the concept to be recognized and studied empirically" (Walker & Avant, 2005 p. 129). There were five empirical referents that emerged for ALRS. The first is measurable, the high utilisation rates of robust, equipment-light drugs and techniques, for context adaptation, resource optimisation and prioritisation of essential techniques. The systematic preference for ketamine, spinal anaesthesia and draw over vaporiser systems over technology-dependent system is directly quantifiable measure of these attributes (Alemayehu et al., 2023; Hailu et al., 2023; Biccard et al., 2023).

The second referent is workforce proportion data – the rate of surgical procedures undertaken by NPAs vs physician anaesthetists, and the measured breadth of scope of NPA practice, which includes management and training roles (Kempthorne et al., 2021; Mkony et al., 2021; Seyi-Olajide et al., 2023). The third referent, for resilience, resourcefulness, and increased clinical awareness, is documented use of low-technology monitoring as the primary way of keeping track of patients—the obvious use of manual blood pressure cuffs, continuous palpation of a patient's pulse, and ability to maintain safe anaesthesia in the absence of electricity (Biccard et al., 2023; Law et al., 2021). The fourth referent is the implementation of facility assessment tools that have been validated and specifically developed for assessing the anaesthetic capacity (including workforce, infrastructure, equipment and service delivery) using the WHO-WFSA Anaesthesia Facility Assessment Tool (AFAT) and the PIPES framework (Gelb et al., 2021; Sneag et al., 2021). The fifth one is the performance in simulation-based evaluation of the management of critical anaesthetic events without advanced monitoring, which directly assesses provider ability to diagnose and manage deterioration, using physical examination alone (Haylock-Vize et al., 2022).

Proposed Definition

Using the synthesis of the eight analytical steps, it is proposed that the operational definition of anaesthetic in low resource settings can be:

Anaesthesia in low resource settings is a unique, specialised area of anaesthetic practice where safe, context-adapted, perioperative care is provided in a setting where human, material and infrastructural resources are limited as a whole. It can be recognized by five key features, which differ from standard anaesthesia practice: use of basic techniques that are robust and require less equipment than technology-dependent ones; the necessity of adapting and optimizing techniques and equipment continuously to the local constraints, with resourcefulness and resilience to maintain care despite failure of infrastructure and equipment; the use of task sharing models in which non-physician anaesthesia workers practice with high clinical autonomy and an expanded professional scope; and the use of

greater direct clinical acumen and vigilance to compensate for the absence of advanced monitoring technologies. It stems from factors of systemic resource limitation, shortage of doctors, unmet surgical need, trained non-physician providers with surgical skills, and lack of viable referral pathway and leads to outcomes that can both provide greater access to lifesaving surgery and contribute to increased perioperative risk and occupational strain for both patients and providers.

Discussion

With this concept analysis, it is determined that ALRS is not a limited form of conventional anaesthetist practice, but a true domain with a positive cluster of specialised attributes. This difference has significant implications for education and policy, and for research. The robustness of adaptation, resilience, task-sharing, technique prioritisation and increased clinical acumen as the key skills suggests that training programmes need to be clearly focused on these skills instead of using curricula developed for high resource settings. The most common issue with training providers is training them on techniques that do not exist or are not suitable for the training context, which directly relates to the lack of reconceptualisation of ALRS as conceptually different (Hodges et al., 2021; Haylack-Vize et al., 2022).

Importance of the centrality of the task-sharing attribute for professional recognition and governance. Non-physician anaesthesia providers are the contextually appropriate and sustainable, permanent primary workforce in the majority of LMICs and not a temporary solution whilst waiting for adequate physician staffing. Conceptually, policy frameworks are misaligned with ALRS in the workforce unless they are properly formally regulated, there are pathways for career development, or investments in NPA training institutions are made. The WFSA data on the numerical dominance of NPA in anaesthesia services across sub-Saharan Africa (Kempthorne et al., 2021) indicates that this numerical dominance needs to be recognized and embraced by governance frameworks, and not viewed as a transitory situation to be overcome as part of a drive to a physician-led vision of health services.

Burnout and moral injury being recognized as important outcomes have implications for sustainability of the workforce. The psychological price of the resilience that is required as an attribute is illustrated by Turkson et al. (2023) and Tuyishime et al. (2022) who show that when it is practised continuously without institutional support. The difference between the standards of care that ALRS providers hope to achieve and that they can achieve under the current resource constraints is a key source of moral distress, and improving ALRS provider well-being through increased staffing, peer support mechanisms, clear institutional recognition of having fewer resources and career progression opportunities is not simply a welfare issue, but a strategic investment in workforce sustainability. As professional emigration is also a compounding risk (Dohlman et al., 2020), this is a health systems priority rather than an individual issue. Finally, by reframing ALRS as a field of expertise and innovation and not just a field of deficit, providers and researchers in these places can be seen as producers of context-specific knowledge, with important implications for research funding priorities, global health partnerships and the equitable production of anaesthesia science.

Conclusions

This concept analysis demonstrates that anaesthesia in low-resource settings is a unique, specialised practice domain which encompasses a positive cluster of key attributes, including adaptation, resilience, task-sharing, prioritisation of techniques and increased clinical competence, rendering it a more complex and specialised professional skill than a deviation

from some global standard that is reflected in the presence or absence of these attributes. The proposed operational definition offers a conceptual anchor for those who are working to improve the status of anaesthesia services worldwide, including researchers, educators, decision-makers and clinicians. The analysis calls for context-appropriate rather than context-transferred technologies and training models to be developed; calls for health policies that formally recognise, regulate and sustainably support the non-physician anaesthesia workforce as the provider of the bulk of anaesthetic services in most LMICs; and calls for training curricula to be explicitly designed for the five defining attributes. Making ALRS strong and equitable, and fulfilling the international vision of universal access to safe surgical and peri-operative care, requires a clear and precise understanding of what ALRS is, much more than a list of gaps but a field of specific competencies, specific identity, and professional practice.

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