

Paediatric anaesthesia care in Africa: challenges and opportunities

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In 2015, the World Health Organization and member states recognised surgery and anaesthesia care as a component of universal health coverage, yet 1.7 billion children and adolescents continue to lack access to safe surgical care. An overwhelming proportion of these children are from low- and middle-income countries (LMICs).^{1,2} In Africa, where almost 50% of the population is under the age of 15, children are disproportionately affected. Without sustained global efforts, these inequities and injustices will persist.¹ Findings from previous studies suggest a 10–100 times increase in paediatric perioperative mortality in children in LMICs as compared to high-income countries (HICs).^{3,4} While pieces of the puzzle may be missing, it is clear that not only is access a problem, but also the safety and quality of the perioperative care provided is of concern.

In this edition of the South African Journal of Anaesthesia and Analgesia (SAJAA), Chaïbou et al. provide insights into perioperative outcomes in children in Niger, a small landlocked low-income country (LIC) in Africa.⁵ They undertook a three-month prospective, observational study of 231 ASA I and II paediatric patients ≤ 15 years old undergoing elective surgery at a tertiary referral hospital in Niger to evaluate for perioperative critical incidents. The mean age was 6 ± 4 years, and the majority (96%) received general anaesthesia. All anaesthetics were delivered by nurse anaesthetists supervised in a ratio of 3:1 by an anaesthesiologist. While all patients were monitored intraoperatively with pulse oximetry, only 22.9% were monitored with non-invasive blood pressure (NIBP). A critical incident, the primary outcome, occurred in 27 (11.7%) cases. These were most commonly a cardiovascular or respiratory event occurring either at induction or in the postoperative period. One patient died in the postoperative period.

The authors are to be commended for accomplishing this challenging study evaluating critical incidents in paediatric surgical patients in an LIC. The reported incidence of critical incidents most likely underestimates the true occurrence in the paediatric surgical population in Niger. The study included

predominantly low-risk patients, and surgical care for neonates and emergency surgeries were excluded. Higher ASA physical status, younger age and emergency surgery were not included in the study, and have all been previously identified as contributing to increased risk for perioperative morbidity and mortality.^{4,6-8}

Prospective monitoring of critical incidents is an essential component of safety and quality improvement.⁹ The importance of this study lies not just in the willingness of the authors to report their outcomes, which reinforces previous concerns about anaesthesia safety on the African continent, but also in the implications conveyed. Findings from studies done in LMICs have shown that critical incidents are a concern across the paediatric age spectrum, and even low ASA physical status children are at high risk.^{5,8} Despite published standards guiding the safe practice of anaesthesia as well as perioperative care for children,^{10,11} norms such as standard intraoperative monitors are often not achieved in some settings.^{5,12}

As National Surgical Obstetrics and Anaesthesia Plans (NSOAPs) are developed across the continent, including in South Africa, it is essential that paediatric surgeons and anaesthesia leaders, skilled in the care of children, be involved in this process at the highest level.¹³⁻¹⁵ Nigeria and Pakistan exemplify this effort as the needs of children have been successfully integrated into their NSOAPs due to strong advocacy efforts from local paediatric surgical care providers and others.^{16,17} Involvement at this level will help to ensure that appropriate human resources (adequate numbers and training), infrastructure and equipment to support the provision of safe surgical care for children are embedded in national policy.

The study by Chaïbou and colleagues reports a team-based approach to anaesthesia care led by an anaesthesiologist supervising nurse anaesthetists in a 3:1 ratio; however, the reality in many LMICs is that there are not enough anaesthesia providers for this to occur.¹⁸ The majority of care, especially outside the urban areas, is provided solely by non-physician anaesthesia providers (NPAPs). These individuals often work in

relative isolation, sometimes under extreme pressure and with few opportunities for continuous professional development (CPD).

To improve access to safe surgical and anaesthetic care for children living in many LMICs, we must increase the number of anaesthesia providers while ensuring quality education and training. Opportunities for CPD for existing providers is essential. Several short courses have been designed or adapted for delivery in the LMIC setting. The Safer Anaesthesia from Education (SAFE)[®] Paediatrics course (SAFE Paeds) developed by the World Federation of Societies of Anaesthesiologists (WFSA) and the Association of Anaesthetists is one such effort. Participants have been found to demonstrate improvement in knowledge and skills that were retained over time as well as positive changes in workplace behaviour.¹⁹ While originally designed with NPAPs in mind, the SAFE Paeds course is adaptable and has been well received by non-specialist physician anaesthesia providers in South Africa. Other short courses such as Managing Emergencies in Paediatric Anaesthesia (MEPA) as well as the Vital Anaesthesia Simulation Training (VAST) course have been successfully implemented in the low-resource setting. Both courses deliver high quality simulation-based medical education through the use of simulation with scenarios contextually relevant to the LMIC setting.^{20,21} Simulation courses such as these are especially useful in crisis resource management of critical incidents in paediatric anaesthesia.

While short courses are useful for CPD of trained anaesthesia providers, more teachers and educators in paediatric anaesthesia are needed to ensure quality training for the new cadre of anaesthesia providers. Formal paediatric fellowship training on the African continent is limited and is currently only available at the University of Nairobi in Kenya, funded through the WFSA. Since the fellowship started in 2013, 20 paediatric anaesthesiologists have graduated from this fellowship programme and have all returned to their home countries on the African continent to be leaders in paediatric anaesthesia.

Increasing the number of local experts in paediatric anaesthesia through advanced training will be central to any broad plan to improve outcomes in paediatric anaesthesia in LMICs. Despite findings from a previous study that suggests perioperative complications are fewer when the provider has advanced training in paediatric anaesthesia,²² the ability to deliver anaesthesia to all children by a paediatric subspecialist is not a practical solution, whether in an LMIC or HIC.

Advanced training in paediatric anaesthesia is needed in Africa to build a new generation of subspecialists who are not only clinical experts in providing anaesthetic care to children, but also leaders and educators. These subspecialists should not be expected to perform every paediatric anaesthetic that is required in their region. Instead, they should be viewed as leaders and educators in their countries. Their responsibilities should include helping to set local standards ensuring safe anaesthetic care for children, advocating for appropriate infrastructure, equipment

and training as well as lead research efforts aimed at improving the overall quality and safety of paediatric perioperative care.

It will take some time to solve the anaesthesia workforce crisis and expand the number of anaesthesia providers and leaders skilled in the care of children. In the meantime, models of anaesthesia care must be explored to support the existing anaesthesia workforce during this transition to ensure safe perioperative care for children regardless of geographical location. Chaïbou et al. in their study describe the use of a team-based anaesthesia approach to providing anaesthesia care at their hospital (known by some as a hub and spoke model) in a 1:3 ratio of anaesthesiologist to nurse anaesthetist. A similar team-based model is used in the United States. In locations where there are only a few specialist anaesthesiologists, it offers the opportunity to maximise their influence in the clinical space.

This concept of hub and spoke can also be applied at a national level in an effort to assure that all children receive safe and quality paediatric anaesthesia care regardless of geographic location. For example, in New Zealand a formalised network, Paediatric Anaesthesia Network New Zealand (PANNZ), links centres with specialist paediatric anaesthesia expertise with generalist physician anaesthesiologists performing paediatric anaesthesia across the country.²³ It aims to support collaboration and knowledge sharing among all anaesthesiologists caring for children. There is a central governance structure that includes representation from each hospital in New Zealand as well as a representative from the national paediatric anaesthesia society (SPANZA). This allows collective policy development, uniform messaging as well as a formal system for knowledge dissemination across the country. It also includes a WhatsApp chat group for bidirectional exchange between individual anaesthesiologists. Formal recognition of a network and its integration into the healthcare system such as PANNZ can help to improve access to advanced paediatric anaesthesia expertise for all providers, ensuring that all children who require surgical care benefit, regardless of geographic location.

Conclusion

The study by Chaïbou et al. is one of a few that highlight the disparity that still exists for children having surgical care in LMICs vs HICs. Studies such as this are important to highlight the problem, but it is time to start focusing on the solutions. There will not be a one-size-fits-all solution; however, developing local leaders and educators in paediatric anaesthesia is a necessary first step as we need these individuals to guide this process.

References

1. Mullapudi B, Grabski D, Ameh E, et al. Estimates of number of children and adolescents without access to surgical care. *Bull World Health Organ.* 2019;97(4):254-8. <https://doi.org/10.2471/blt.18.216028>.
2. Meara JG, Leather AJM, Hagander L, et al. Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *Lancet.* 2015;386(9993):569-624. [https://doi.org/10.1016/s0140-6736\(15\)60160-x](https://doi.org/10.1016/s0140-6736(15)60160-x).
3. Torborg A, Cronje L, Thomas J, et al. South African Paediatric Surgical Outcomes Study: a 14-day prospective, observational cohort study of paediatric surgical patients. *Br J Anaesth.* 2019;122(2):224-32. <https://doi.org/10.1016/j.bja.2018.11.015>.

4. Newton MW, Hurt SE, McEvoy MD, et al. Pediatric perioperative mortality in Kenya: a prospective cohort study from 24 hospitals. *Anesthesiology*. 2020;132(3):452-60. <https://doi.org/10.1097/aln.0000000000003070>.
5. Chaïbou MS, Daddy H, Dan Mallam MK, et al. Prospective, observational study of perioperative critical incidents, anaesthesia and mortality in elective paediatric surgical patients at a national referral hospital in Niger. *South Afr J Anaesth Analg*. 2022;28(1):XXXX. <https://doi.org/10.36303/SAJAA.2022.28.1.2462>.
6. Global PaedSurg Research Collaboration. Mortality from gastrointestinal congenital anomalies at 264 hospitals in 74 low-income, middle-income, and high-income countries: a multicentre, international, prospective cohort study. *Lancet*. 2021;398(10297):325-39. [https://doi.org/10.1016/s0140-6736\(21\)00767-4](https://doi.org/10.1016/s0140-6736(21)00767-4).
7. PaedSurg Africa Research Collaboration. Paediatric surgical outcomes in sub-Saharan Africa: a multicentre, international, prospective cohort study. *BMJ Glob Health*. 2021;6:e004406. <https://doi.org/10.1136/bmjgh-2020-004406>.
8. Cronjé L, Torborg A, Meyer H, et al. An evaluation of severe anesthetic-related critical incidents and risks from the South African Paediatric Surgical Outcomes Study (SAPSOS): a 14-day prospective, observational cohort study of pediatric surgical patients. *Anesth Analg*. 2021. [pub ahead of print]. <https://doi.org/10.1213/ane.0000000000005796>.
9. Mahajan RP. Critical incident reporting and learning. *Br J Anaesth*. 2010;105(1):69-75. <https://doi.org/10.1093/bja/aeq133>.
10. Gelb AW, Morriss WW, Johnson W, et al. World Health Organization–World Federation of Societies of Anaesthesiologists (WHO–WFSA) International Standards for a Safe Practice of Anesthesia. *Anesth Analg*. 2018;126(6):2047-55. <https://doi.org/10.1213/ane.0000000000002927>.
11. Global Initiative for Children's Surgery. Global Initiative for Children's Surgery: A model of global collaboration to advance the surgical care of children. *World J Surg*. 2019;43:1416-25. <https://doi.org/10.1007/s00268-018-04887-8>.
12. Hodges SC, Mijumbi C, Okello M, et al. Anaesthesia services in developing countries: defining the problems. *Anaesthesia*. 2007;62(1):4-11. <https://doi.org/10.1111/j.1365-2044.2006.04907.x>.
13. Seyi-Olajide JO, Anderson JE, Kaseje N, et al; on behalf of the Global Initiative for Children's Surgery. Inclusion of Children's Surgery in National Surgical Plans and Child Health Programmes: the need and roadmap from Global Initiative for Children's Surgery. *Pediatr Surg Int*. 2021;37:529-37. <https://doi.org/10.1007/s00383-020-04813-x>.
14. Landrum K, Cotache-Condor CF, Liu Y, et al. Global and regional overview of the inclusion of paediatric surgery in the national health plans of 124 countries: an ecological study. *BMJ Open*. 2021;11(6):e045981. <https://doi.org/10.1136/bmjopen-2020-045981>.
15. Wasserman I, Peters AW, Roa L, Amanullah F, Samad L. Breaking specialty silos: improving global child health through essential surgical care. *Glob Health Sci Pract*. 2020;8(2):183-9. <https://doi.org/10.9745/ghsp-d-20-00009>.
16. Peters AW, Fatima I, Vervoort D, Shoman H, et al. Pakistani national vision for surgical care 2025: a series of firsts. *J Am Coll Surg*. 2019;229(4):e135.
17. National Surgical, Obstetrics, Anaesthesia & Nursing Plan (NSOANP) for Nigeria [Internet]. Federal Ministry of Health. Available from: <https://www.health.gov.ng/doc/NSOANP.pdf>. Accessed 16 Dec 2021.
18. Kempthorne P, Morriss WW, Mellin-Olsen J, Gore-Booth J. The WFSA Global Anesthesia Workforce Survey. *Anesth Analg*. 2017;125(3):981-90. <https://doi.org/10.1213/ane.0000000000002258>.
19. Boyd N, Sharkey E, Nabukenya M, et al. The Safer Anaesthesia from Education (SAFE)[®] paediatric anaesthesia course: educational impact in five countries in East and Central Africa. *Anaesthesia*. 2019;74(10):1290-7. <https://doi.org/10.1111/anae.14778>.
20. Mossenson AI, Tuyishime E, Rawson D, et al. Promoting anaesthesia providers' non-technical skills through the Vital Anaesthesia Simulation Training (VAST) course in a low-resource setting. *Br J Anaesth*. 2020;124(2):206-13. <https://doi.org/10.1016/j.bja.2019.10.022>.
21. Everett TC, MacKinnon R, De Beer D, Taylor M, Bould MD. Ten years of simulation-based training in pediatric anesthesia: The inception, evolution, and dissemination of the Managing Emergencies in Pediatric Anesthesia (MEPA) course. *Paediatr Anaesth*. 2017;27(10):984-90. <https://doi.org/10.1111/pan.13224>.
22. Habre W, Disma N, Virag K, et al. Incidence of severe critical events in paediatric anaesthesia (APRICOT): a prospective multicentre observational study in 261 hospitals in Europe. *Lancet Respir Med*. 2017;5(5):412-25. [https://doi.org/10.1016/s2213-2600\(17\)30116-9](https://doi.org/10.1016/s2213-2600(17)30116-9).
23. Paediatric Anaesthesia Network New Zealand (PANNZ) [Internet]. Available from: <https://anaesthesia.nz/community/paediatric-anaesthetist-network-new-zealand-pannz/>. Accessed 20 Dec 2021.