



## ORIGINAL ARTICLE

# Pediatric procedural sedation in African clinical settings: A mixed methods study of African providers' sedation practices

Megan L. Schultz<sup>a,\*</sup>, Andrew Melby<sup>b</sup>, Rebecca Gray<sup>c</sup>, Faye M. Evans<sup>d</sup>, Sarah Benett<sup>e</sup>, Michelle L. Niescierenko<sup>f</sup>

<sup>a</sup> Department of Pediatrics, Division of Emergency Medicine, Medical College of Wisconsin, Milwaukee, WI, USA

<sup>b</sup> Department of Emergency Medicine, Medical College of Wisconsin, Milwaukee, WI, USA

<sup>c</sup> Department of Anaesthesia and Peri-Operative Medicine, Division of Global Surgery, University of Cape Town, Cape Town, South Africa

<sup>d</sup> Department of Anesthesiology, Critical Care, and Pain Medicine, Boston Children's Hospital and Harvard Medical School, Boston, MA, USA

<sup>e</sup> Department of Pediatrics, Johns Hopkins University, Baltimore, MD, USA

<sup>f</sup> Department of Emergency Medicine, Boston Children's Hospital and Harvard Medical School, Boston, MA, USA



## ARTICLE INFO

## Keywords:

Pediatric

Procedural sedation

Anesthesia

Resource-limited

## ABSTRACT

**Background:** Little is known about the practice of pediatric procedural sedation in Africa, despite being incredibly useful to the emergency care of children. This study describes the clinical experiences of African medical providers who use pediatric procedural sedation, including clinical indications, medications, adverse events, training, clinical guideline use, and comfort level. The goals of this study are to describe pediatric sedation practices in resource-limited settings in Africa and identify potential barriers to the provision of safe pediatric sedation.

**Methods:** This mixed methods study describes the pediatric procedural sedation practices of African providers using semi-structured interviews. Purposive sampling was used to identify key informants working in African resource-limited settings across a broad geographic, economic, and professional range. Quantitative data about provider background and sedation practices were collected concurrently with qualitative data about perceived barriers to pediatric procedural sedation and suggestions to improve the practice of pediatric sedation in their settings. All interviews were transcribed, coded, and analyzed for major themes.

**Results:** Thirty-eight key informants participated, representing 19 countries and the specialties of Anesthesia, Surgery, Pediatrics, Critical Care, Emergency Medicine, and General Practice. The most common indication for pediatric sedation was imaging (42%), the most common medication used was ketamine (92%), and hypoxia was the most common adverse event (61%). Despite 92% of key informants stating that pediatric procedural sedation was critical to their practice, only half reported feeling adequately trained. The three major qualitative themes regarding barriers to safe pediatric sedation in their settings were: lack of resources, lack of education, and lack of standardization across sites and providers.

**Conclusions:** The results of this study suggest that training specialized pediatric sedation teams, creating portable "pediatric sedation kits," and producing locally relevant pediatric sedation guidelines may help reduce current barriers to the provision of safe pediatric sedation in resource-limited African settings.

## African Relevance

- Procedural sedation is an incredibly valuable tool in pediatric emergency medicine, as it decreases pain and anxiety in children, and improves procedural time and safety. There are currently little data from resource-limited settings in Africa regarding the clinical practice of pediatric procedural sedation.
- Data on current pediatric sedation practices in Africa would identify current barriers and help inform the development of pediatric procedural sedation programs, guidelines, and training initiatives specific to African clinical settings.

- Current data suggest that African providers believe pediatric procedural sedation is an important clinical skill, but face barriers in implementation due to scarcity of pediatric equipment and medications, limited clinical guideline use, and lack of pediatric training.

## Introduction

The emergency care of children sometimes requires diagnostic and therapeutic procedures that are anxiety-inducing, prolonged, and/or painful. The ability to safely sedate children is incredibly beneficial, as children are developmentally incapable of remaining calm and mo-

\* Corresponding author.

E-mail address: [mlschultz@mcw.edu](mailto:mlschultz@mcw.edu) (M.L. Schultz).

<https://doi.org/10.1016/j.afjem.2023.06.005>

Received 12 December 2022; Received in revised form 12 June 2023; Accepted 25 June 2023

2211-419X/© 2023 The Authors. Published by Elsevier B.V. on behalf of African Federation for Emergency Medicine. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

tionless while undergoing such procedures as laceration repair or brain magnetic resonance imaging (MRI) [1]. Procedural sedation been shown to decrease pain and anxiety in children, while increasing procedural safety and success rates [2,3]. Without procedural sedation, children may be unnecessarily traumatized, inhumanely physically restrained, transferred to other clinical sites, or discharged home without the appropriate care [1,3]. While pediatric procedural sedation is considered routine in emergency departments (EDs) in high-income countries (HICs), [4,5] in African low- and middle-income countries (LMICs), this is often not the case [3,6]. Nearly half of the population in Africa is under the age of 18, [7] and many of their injuries and illnesses requiring procedures could likely be performed using sedation instead of general anesthesia [8,9]. This is particularly important given high surgical costs and the limited anesthesia provider workforce in many African countries [10]. Training other pediatric providers to be competent and comfortable providing procedural sedation to children can help meet this identified need [11].

There is currently limited information on procedural sedation practices in LMICs, with published research on pediatric procedural sedation in Africa almost non-existent. A recent prospective observational study at Red Cross War Memorial Children's Hospital in Cape Town, South Africa reported performing ~200 pediatric procedural sedations per month [12]. However, the study was limited to one city in one country, at one of the largest children's hospitals in Africa. A greater understanding of pediatric sedation practices across Africa is necessary to identify potential barriers and future directions. The aims of this mixed methods study are to describe the practice of pediatric sedation in African clinical settings and identify potential barriers to the provision of safe pediatric sedation, which may then be used to inform educational interventions, program development, and clinical guidelines specific to resource-limited settings.

## Methods

This is a mixed methods study to identify the barriers to providing safe pediatric procedural sedation in Africa. This study was approved by the Institutional Review Board (IRB) of Medical College of Wisconsin (protocol number 00031106). Permission for data collection at the African Federation of Emergency Medicine (AFEM) Conference in Kigali, Rwanda was requested and obtained via written consent from the President of AFEM. Verbal informed consent was obtained from all key informants (KIs); the need for written informed consent was waived by the IRB.

Purposive sampling was used to identify KIs from all five regions of Africa as well as a variety of medical specialties known to provide procedural sedation (Pediatric Surgeons, Anesthesiologists, non-physician Anesthetists, Pediatricians, General Practitioners, and Emergency Medicine Physicians). Recruitment emails were sent to medical providers from the Pan African Pediatric Surgery Association, the World Federations of Societies of Anesthesiologists (WFSA), and the African Pediatric Fellowship Program listservs. Finally, providers attending the AFEM Conference in Kigali, Rwanda in 2018 were randomly invited to participate via in-person interview. Participants were deemed eligible for the study if they were medical providers who answered, 'yes,' to the question, "Do you use procedural sedation in children?"

Semi-structured interviews of KIs were conducted in both English and French (Appendix 1). Interviews were conducted either in-person, or virtually using Zoom or Skype. Interviews were performed by authors SB, FE, RG, AM, and MS, as well as CN. All in-person interviews were audio-recorded, and all virtual interviews were video-recorded. All recordings were stored on password-protected devices as well as the encrypted data storage repository Dropbox. French interview recordings were professionally translated to English, and all recordings were transcribed by SB, AM, and MS. Using Braun and Clarke's six-phase framework for thematic analysis [13], AM and MS individually familiarized themselves with the datasets, created open codes, and searched

for themes. AM and MS then defined the themes together to make an initial codebook. The codebook was tested by SB, AM, and MS, and iteratively refined until inter-rater reliability scores among the three coders achieved Cohen's kappa coefficient 0.82. Coding was performed with Dedoose software (Dedoose Version 9.0.46 Los Angeles, CA: SocioCultural Research Consultants, LLC).

## Results

Fifty-six medical providers were identified and recruited via email or in-person at AFEM. Thirty-eight KIs responded and agreed to be interviewed (68% response rate); seven KIs were recruited and interviewed in-person at AFEM, and 31 KIs were recruited via email and interviewed virtually via Skype or Zoom. Interviews were conducted over 18 months, from November 2018 to April 2020. Thirty-seven interviews were conducted in English and one in French. KIs worked in all five geographic regions of Africa as defined by the United Nations. Altogether, KIs reported working in nine low-income countries, eight lower-middle income countries, and two upper-middle income countries (19 total). Most KIs (95%; 36/38) worked at a tertiary hospital/national referral center and four KIs (10%; 4/38) worked in district hospitals. A majority of KIs (76%; 29/38) reported working at a public hospital, while 16% (6/38) worked at private hospitals. Several providers reported working in different hospitals and/or different countries concurrently. Specialty and geographic distribution of KIs are listed in Table 1.

The four indications for pediatric procedural sedation that were most reported were imaging studies, burn dressing changes, orthopedic reductions, and obtaining vascular access. When discussing adverse events during sedation, KIs reported hypoxia as the most common (61%; 23/38), followed by hemodynamic instability (42%; 16/38), vomiting (39%; 15/38), and laryngospasm (39%; 15/38). KIs reported multiple types of sedation providers at their sites, including trainees (residents/registrar) (29%; 11/38), and nurses (13%; 5/38); the specialties most mentioned as providing pediatric sedation were Anesthesiologists (63%; 24/38) and non-physician Anesthetists (50%; 19/38).

Three major qualitative themes were identified: resource limitations, lack of education, and lack of standardization across sites and providers. Specific quoted excerpts on these major themes are provided in Table 2.

### Major theme: equipment and medication limitations

KIs were asked about their access to the following equipment: stethoscope, bag valve mask, pulse oximeter, endotracheal tubes, blood pressure cuffs, end-tidal carbon dioxide monitors, and ventilators. All KIs (100%; 38/38) reported being able to obtain a stethoscope and a bag valve mask, and the majority had access to pulse oximeters (97%; 37/38), endotracheal tubes (92%; 35/38), and blood pressure cuffs (84%; 32/38). Access to ventilators (76%; 29/38) and end-tidal carbon dioxide monitors (47%; 18/38) was less consistent. Many KIs reported that they do not have single-use equipment available at the bedside, which led to sedation providers carrying equipment with them from patient to patient.

Lack of pediatric-specific equipment was common and often led to sedations with minimal monitoring (Table 2). The use of only a pulse oximeter and a stethoscope to monitor children undergoing procedural sedation was common. Lack of equipment across hospital departments was also common; multiple KIs reported that only ORs had consistently available monitoring and resuscitation equipment, so sedations were most frequently performed there as opposed to at the bedside. This led to unnecessary delays in diagnosis and/or treatment. Multiple KIs stated they frequently did not perform procedural sedation in children because they lacked the supplies necessary to safely do so.

Medications used by KIs for pediatric sedation included: benzodiazepines, chloral hydrate, clonidine, dexmedetomidine, etomidate, ketamine, phenobarbital, and propofol. Ketamine (92%; 35/38) and benzodiazepines (82%; 31/38) were the medications used most often. Anes-

**Table 1**  
Regions and specialties of key informants.

	North	West	Central	East	South	TOTAL
Anesthesiologist Physician	1	4	1	5	1	12
Non-Physician Anesthetist		1	1	3		5
Critical Care Physician	1	2		1	1	5
Emergency Medicine Physician	1	1		1	1	4
Surgeon	1	3	1	1		6
Pediatrician	1	1		2	1	5
General Practitioner				1		1
<b>TOTAL</b>	<b>5</b>	<b>12</b>	<b>3</b>	<b>14</b>	<b>4</b>	<b>38</b>

**Table 2**  
Key Informant excerpts describing major themes.

<b>Resource Limitations</b>	
Equipment Availability	<p>“Pulse oximeters are available, but not enough.”</p> <p>“You have to find the equipment and take a kit with you.”</p> <p>“At the moment we do not have a pulse oximeter on the ward... [or] a pediatric cuff. In the theater it's available.”</p> <p>“Sometimes monitoring during the sedation or immediately after is a big challenge when they are on the ward or in the emergency room, because of inadequate monitors.”</p> <p>“The vast majority of sedations that we do is actually in the operating room, for children anyways, largely because of the limited space where we have monitors. If I'm going to do something, it's generally in the operating room...for space and availability of equipment.”</p>
Lack of Pediatric Equipment	<p>“There is one ventilator in Reanimation [Critical Care] ...but it is for adults, not children.”</p> <p>“Something like having a basic amount of pulse oximeters, especially for kids, would make it a little bit easier, because I work in areas where you've got access to maybe one or two pediatric cuffs, so if you've got a two-year-old, and you've got to do a procedural sedation... you've got a bit of a problem.”</p> <p>“One thing I have commonly seen is that our administrators...don't consult us when they want to buy monitors... they should get us a pediatric component of the monitor, but usually adult monitors they will bring and most of the time we don't have the pediatric components.”</p> <p>“A child who was undergoing a circumcision was sedated...and then the airway was – I don't know what happened. They were not able to monitor...and they lost the child.”</p> <p>“In my facility, it's not safe at all, because...if you want to intubate, then you don't have enough space, you cannot put your anesthesia machine in [MRI], so I always tell them it's not possible, it's not safe, we will let the children rest a bit so that we can do it...when he will be more bigger.”</p>
Difficulty Obtaining Medications	<p>“I need to suture some lacerations, then I need to tell the nurse to go and find it in the pharmacy, so there may be a delay of two to three hours waiting to have a sedation.”</p> <p>“When we have stock-out of some [sedation medications], we prefer to transfer...”</p> <p>“The pharmacy calls me and says, “You have to stop the midazolam. Please try to shift to thiopental. And then I shift to thiopental because of money.”</p>
Medication Costs	<p>“They don't have money. They cannot afford the drug... we go ahead and do the procedures and the kids cry their heads off.”</p> <p>“There are times when the parent cannot go buy it and that can effectively block the medical care being given.”</p> <p>“The anesthesia drugs are in the operating room and the parents don't have to go buy them. However, in Reanimation [Critical Care] ...the parents must often go buy the sedatives to sedate the children.”</p>
<b>Lack of Education</b>	
Motivation to Learn More	<p>“In my experience, because of lack of training and because of lack of available reference material...there are a lot of procedures that are done on children without sedation, and I think that's quite inhumane... The experience is very negative on the parents, on the staff, as well as on the children – for example, when there are extensive burns and there is a dressing change, there is usually wailing and screaming, and I think we can benefit from a directed approach to empowering and equipping people in the use of sedation safely for invasive procedures.”</p> <p>“Certainly, anesthesia itself is such a huge limited resource in this region, pediatric anesthesia even more so... the operating room is such a great resource of time and availability, it would be a great benefit...to educate my entire team so that we could do more of those things outside the operating room, but to do them well.”</p>
Fear of Treating Children	<p>“I've worked in systems where pediatrics is not at all included within emergency training... so you can essentially become a... trained emergency physician, and only have done three months of peds. I think a little bit more collaboration with the peds department is needed so [there's] a demystification around the care of children.”</p> <p>“I discovered that people thought children didn't have blood pressures. So even in the ICU you would have to remind the nurses that no, we need to monitor blood pressure... I think culturally, there's still a lot of work we need to do.”</p> <p>“People are not trained properly how to do basic pediatric resuscitation.”</p>
Fear of Sedation	<p>“Being conscious with me while I'm doing something – this really gives me some relief that I'm not losing my patients. If we have to use sedation, yes, I'll use them, but I will not use them with the maximum doses... I usually do it very much cautious, very little.”</p> <p>“Nurses and junior doctors are very scared; they would rather have a child scream and be held down then actually administer a small dose of the drug and just do the procedure.”</p>
<b>Need for Standardization</b>	
	<p>“Like in the cardiology clinic, when they want to do echocardiography and they use chloral hydrate – I saw so many cardiac arrests from this medicine. It's oral, easily available. Usually, we give the syringe to the mom and she's the one who gives it, and then suddenly we have a blue baby. And the set-up of the place is not ready to deal with those arrests. So she has to run to the Emergency Department, so it takes a few minutes.”</p> <p>“So number one is the education, and [number two] to have clear guidelines for our institution and how pediatric sedation should be done. Number three, there needs to be ownership for who is actually responsible for pediatric sedation.”</p> <p>“One of the things you can do is to share... the existing protocols to the context of developing countries. So this is the best you are doing for humanity.”</p> <p>“I travel a lot, I join lots of conferences abroad, I went around the world to see what people do. But to be honest with you, sometimes I go back not really happy, because what I saw is not helpful for me, because they don't have the same problems I do.”</p>

thesiologists were the most likely to have access to propofol, with 75% (9/12) citing regular use. Nitrous oxide was the least commonly available medication and varied by discipline (most common among surgeons).

The processes to obtain a sedation medication were described as frustrating (Table 2). KIs reported that sedation medications often had to be specially ordered from the pharmacy, which could take hours. KIs also described national medication shortages, hospital stock-outs, and needing to use expired drugs. At times these stock-outs led to unnecessary patient transfers to other hospitals. Medication shortages also led to unnecessary therapeutic adjustments, shifting from the ideal sedation medication to whatever was available. When sedation medications were not available at the hospital, patients' families were often expected to obtain it themselves. KIs described procedural sedation being perceived as optional: when a child needed a general anesthetic in the operating room (OR), it was supplied by the hospital, but when a child needed a sedation medication, parents had to pay. When families were unable to pay for a sedation medication, sometimes the entire procedure was abandoned.

#### *Major theme: lack of education in pediatrics and/or sedation*

A belief in the importance of pediatric procedural sedation and a desire to learn more was nearly universal. Despite all KIs stating that they use procedural sedation in children, and the vast majority reporting sedation to be critical to their practice (92%; 35/38), only half reported feeling adequately trained in pediatric sedation (53%; 20/38). KIs from every specialty except Emergency Medicine reported feeling inadequately trained in pediatric sedation: Anesthesiologists (42%; 5/12), non-physician Anesthetists (67%; 2/3), Critical Care Physicians (40%; 2/5), General Practitioners (100%; 1/1), Pediatricians (75%; 3/4), and Surgeons (67%; 4/6). Of the four Emergency Medicine Physicians interviewed, all reported feeling adequately trained in pediatric sedation. Most KIs reported learning procedural sedation during their post-graduate training (63%; 24/38) and “on-the-job” in their current position (61%; 23/38). Few KIs described learning sedation via textbooks (8%; 3/38) or online training modules (5%; 2/38). All KIs stated that more pediatric sedation training was needed in their setting, and/or that they are personally interested in receiving additional training.

Many KIs described a lack of pediatric knowledge leading to fear and hesitation around pediatric sedation (Table 2). Pediatric anatomy and physiology was reported as a major knowledge gap, as well as pediatric resuscitation skills. KIs reported that the fear of side effects from sedation medications often led to underdosing and/or avoidance of sedation.

#### *Major theme: need for standardization*

The location within a hospital where pediatric sedation was performed varied by profession. Surgeons reported procedural sedation occurring in the OR (100%; 6/6), while Emergency Medicine Physicians reported providing sedation in the ED (100%; 4/4) and Critical Care Physicians in the Intensive Care Unit (ICU) (100%; 5/5). Most Anesthesiologists stated that procedural sedations most frequently occurred in the Radiology Department (75%; 9/12), while none of the non-physician Anesthetists sedated in the Radiology Department. Overall, the most common location for pediatric sedations, among all providers, was the OR, with 63% (24/38) of KIs reporting sedations most frequently occur there. The department in which procedural sedation occurs affected the safety of the sedation immensely. In departments without regular access to monitoring and resuscitation equipment, KIs were less comfortable providing sedation, with outpatient departments identified as particularly dangerous.

Most KIs (84%; 32/38) stated they were unaware of any national guideline on pediatric procedural sedation in the country in which they practiced. Nearly a third (29%; 11/38) did not use any clinical guideline

in their sedation practice. Across the different specialties represented, Surgeons and Emergency Physicians were the most likely to use a pediatric sedation guideline. The use of sedation guidelines from other countries, including Great Britain, France, Germany, Canada, Australia, the United States, and India, was reported. South Africa and Kenya were the only African countries identified by KIs as having nationally developed sedation guidelines. Several KIs mentioned the need for departmental ownership of a procedural sedation program to set local policy and guidelines (Table 2).

#### *Suggestions to improve pediatric sedation*

All KIs were asked for recommendations on how to improve pediatric procedural sedation in their settings (Table 2). The most common suggestions were increased pediatric sedation education, increased use of guidelines, and increased availability of sedation medications and equipment. Nearly everyone mentioned a desire for more pediatric-specific education and resuscitation skills training. There was also interest in learning about non-pharmacological interventions to decrease pain and anxiety in children, such as distraction, family involvement, and virtual reality. Several providers mentioned wanting to learn more about pain scales so they could assess pediatric pain more objectively. One KI stated that a greater understanding is needed among medical providers in how children experience pain and fear.

The need for guidelines specific to resource-limited settings was mentioned multiple times, as KIs felt that providers practicing in HICs did not face the same challenges, and thus their protocols did not apply to LMICs. Multiple KIs suggested the creation of a specialized pediatric sedation team within their facility to ensure sedation providers are adequately trained and comfortable managing adverse events.

## **Discussion**

This mixed methods study explores current pediatric procedural sedation practices in Africa by gathering insight from 38 providers across seven specialties and all five regions of Africa. These interviews reveal indications for procedural sedation in children, as well as medications used, adverse events encountered, types of sedation training, hospital departments where sedations occur, use of clinical guidelines, and provider comfort level in providing pediatric sedation. Three major themes emerged as current barriers to safe pediatric sedation in resource-limited settings: lack of consistently available sedation equipment and medication, lack of education in pediatrics and/or sedation, and lack of standardization across sites and providers.

KIs described specific solutions to address these three major barriers. Multiple KIs reported that ORs had the most consistently available monitoring and resuscitation equipment, so sedations were most frequently performed there. However, limiting pediatric sedation to the OR solely for its equipment led to unnecessary patient transfers and treatment delays as providers had to wait for an open theater. To manage this equipment scarcity, one approach for hospitals in resource-limited settings is to create “pediatric sedation kits,” portable boxes or bags equipped with reusable, sterilizable equipment necessary for pediatric sedation. These kits could travel around the hospital with the sedation provider, so that all necessary monitoring and resuscitation equipment is readily available and pediatric-specific. Alternatively, high acuity beds or procedure rooms outside the OR may be specially equipped for pediatric sedation.

KIs from every specialty except Emergency Medicine reported feeling inadequately trained in pediatric sedation. This could be due to the relatively recent creation of Emergency Medicine residency programs in Africa, which are perhaps more likely to teach pediatric procedural sedation as a core competency [14,15]. The wide distribution of medical specialties reporting inadequate sedation training and a desire



to learn more suggests a need for a multi-specialty approach to training initiatives in Africa. It may be helpful for resource-limited hospitals to create specialized teams of pediatric sedation providers, as multiple KIs suggested. This may also encourage a credentialing process and/or protocolized adverse event reporting, which may help to improve the quality and safety of pediatric sedations. The identified lack of context-specific sedation guidelines could be addressed through regional multi-disciplinary workshops, bringing clinical leaders and/or “pediatric sedation champions” together to adapt existing sedation guidelines to their unique settings. These workshops could be developed by regional pediatric sedation working groups, professional societies such as AFEM or the WFSA and its member societies, and/or multi-professional groups such as the Global Initiative for Children’s Surgery.

While a lack of consistently available, appropriately sized equipment in LMICs has been described elsewhere,[3,6] this study offers insight into how much equipment availability varies by department within a single hospital; KIs frequently noted limitations in monitoring and resuscitation equipment outside the OR. Previous studies have demonstrated a need for clinical guidelines specific to resource-limited settings, [6] as well as a need for increased training in procedural sedation and anesthesia [8]. This study is unique in that it recommends locally developed clinical guidelines and educational initiatives for pediatric procedural sedation, based on the specific experiences and suggestions of sedation providers currently working across Africa.

The clinical implications of building pediatric sedation capacity across Africa are broad. Procedural sedation alleviates pain and distress for patients, families, and medical providers in the short-term, and may reduce the risk of increased pain sensitivity and medical care avoidance in the long-term [16,17]. Procedural sedation clearly decreases pain and anxiety in children, thus improving quality of care and increasing the likelihood that parents will seek care for their children in the future. Additionally, increased use of procedural sedation over general anesthesia for minor pediatric procedures could improve safety, timeliness, and cost-effectiveness. Pediatric surgical need is great – it has been estimated that 85% of children in LMIC will require a surgical procedure by the age of 15 years - but many of these procedures are minor enough that procedural sedation would suffice [18]. Studies in Uganda and Malawi have shown that up to 45% of cases performed under general anesthesia were for minor procedures such as wound debridement, abscess drainage, laceration repair, and foreign body removal [19,20]. It is likely that procedural sedation, which is safer, faster, and cheaper than general anesthesia, would be sufficient for many of these minor procedures.

There are several limitations of this study. The use of self-reported data using face-to-face interviews has inherent risks of recall bias and interviewer bias. Every effort was made to ensure confidentiality, communicate in the KI’s primary language, and build trust during interviews to facilitate open and honest dialogue. Another limitation is that the majority of the KIs work at tertiary care/national referral hospitals, which may have different resources, medical staff, and patient populations than smaller regional hospitals and outpatient clinics. More work needs to be done to identify the specific needs of rural hospitals and smaller medical centers and assess how they may differ from those of larger national hospitals. Finally, while this study reached saturation of themes, given the large geographic area, as well as the political, economic, and linguistic heterogeneity of Africa, it is possible that there may be additional perspectives on pediatric sedation that are not represented.

Procedural sedation vastly improves the quality of care in pediatric emergency medicine and is a clearly identified clinical gap in Africa. This mixed methods analysis describes the clinical practice of sedation providers in Africa, and identifies several barriers, including limited pediatric-specific equipment and medications, lack of pediatric sedation and resuscitation skills training, and lack of pediatric sedation guidelines specific to resource-limited settings. The results of this study suggest that addressing these three areas with solutions specific to the operating con-

straints of resource-limited settings could improve and standardize the quality of pediatric procedural sedation in Africa.

## Dissemination of results

Results from this qualitative study were shared with faculty and medical students at the Medical College of Wisconsin Scholarship Forum in June 2022. Results will be shared with all key informants by sending them the published manuscript via email.

## Authors’ Contribution

Authors contributed as follows to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: MS contributed 40%; AM contributed 25%; FE, RG and MN contributed 10% each; and SB contributed 5%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

## Declaration of Competing Interest

The authors declared no conflicts of interest.

## Funding

This work was supported by a small grant from the [Medical College of Wisconsin](#), The Jon E. Vice Chair for Emergency Medicine Innovation Award.

## Acknowledgements

We thank Dr. Heike Geduld, Past President of AFEM, who generously allowed us to recruit and interview conference attendees about their sedation practices. Dr. Claude Nganzeu’s assistance with KI interviews and French translation is also appreciated.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.afjem.2023.06.005](https://doi.org/10.1016/j.afjem.2023.06.005).

## References

- [1] Kaplan RF, Cravero JP, Yaster M, Coté CJ. Sedation for diagnostic and therapeutic procedures outside the operating room. In: *A practice of anesthesia for infants and children*. Elsevier Inc; 2009. p. 1023–48. doi:[10.1016/B978-141603134-5.50052-4](https://doi.org/10.1016/B978-141603134-5.50052-4).
- [2] Procter C, Buys H, Carrara H, Thomas J. Risk factors for unsuccessful lumbar puncture in children. *S Afr Med J* 2016;106(12):1230–5 Dec. doi:[10.7196/SAMJ.2016.V106I12.10703](https://doi.org/10.7196/SAMJ.2016.V106I12.10703).
- [3] Schultz ML, Niescierenko M. Guidance for implementing pediatric procedural sedation in resource-limited settings. *Clin Ped Emer Med* 2019;20(2):116–22 Jun. doi:[10.1016/j.cpem.2019.06.004](https://doi.org/10.1016/j.cpem.2019.06.004).
- [4] Kamat PP, McCracken CE, Simon HK, Stormorken A, Mallory M, Chumtipatzi CE, et al. Trends in outpatient procedural sedation: 2007–2018. *Pediatrics* 2020;145(5):e20193559 May 1. doi:[10.1542/peds.2019-3559](https://doi.org/10.1542/peds.2019-3559).
- [5] Burger RK, Taylor TR, Chumtipatzi CE, Robinson LC, Sims MJ, Tunc EM, et al. Pediatric emergency medicine fellowship procedural sedation training: consensus educational guidelines. *Pediatr Emer Care* 2022;38(4):162–6 Apr 1. doi:[10.1097/PEC.0000000000002568](https://doi.org/10.1097/PEC.0000000000002568).
- [6] Amornyotin S. Pediatric sedation and analgesia in a developing country. *J Anesth Res* 2011;S12:001. doi:[10.4172/2155-6148.S12-001](https://doi.org/10.4172/2155-6148.S12-001).
- [7] [United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2017 Revision](#). NY, NY: United Nations; 2017.
- [8] Parkes J, Hess C, Burger H, Anacak Y, Ahern V, Howard SC, et al. Recommendations for the treatment of children with radiotherapy in low- and middle-income countries (LMIC): A position paper from the Pediatric Radiation Oncology Society (PROS-LMIC) and Pediatric Oncology in Developing Countries (PODC) working groups of the International Society of Pediatric Oncology (SIOP). *Pediatr Blood Cancer* 2017;64(Suppl 5). doi:[10.1002/pbc.26903](https://doi.org/10.1002/pbc.26903).
- [9] Bowman KG, Jovic G, Rangel S, Berry WR, Gawande AA. Pediatric emergency and essential surgical care in Zambian hospitals: a nationwide study. *J Pediatr Surg* 2013;48(6):1363–70 Jun. doi:[10.1016/j.jpedsurg.2013.03.045](https://doi.org/10.1016/j.jpedsurg.2013.03.045).

- [10] Meara JG, Leather AJM, Hagander L, Alkire BC, Alonso N, Ameh AE, et al. Global surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *Lancet* 2015;386:569–624. doi:[10.1016/S0140-6736\(15\)60160-X](https://doi.org/10.1016/S0140-6736(15)60160-X).
- [11] Kempthorne P, Morris WW, Mellin-Olsen J, Gore-Booth J. The WFSA global anesthesia workforce survey. *Anesth Analg* 2017;125(3):981–90. doi:[10.1213/ANE.0000000000002258](https://doi.org/10.1213/ANE.0000000000002258).
- [12] Lapere C, Gray R, Wilson G. Paediatric out-of-theatre procedural sedation at a tertiary children's hospital: a prospective observational study. *S Afr J Child Health* 2020;15(1):33–7. doi:[10.7196/SAJCH.2020.v15i1.1775](https://doi.org/10.7196/SAJCH.2020.v15i1.1775).
- [13] Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psych* 2006;3(2):77–101. doi:[10.1191/1478088706qp063oa](https://doi.org/10.1191/1478088706qp063oa).
- [14] Sawe HR, Akomeah A, Mfinanga JA, Runyon MS, Noste E. Emergency medicine training in Africa: overview of curriculum. *BMC Med Ed* 2019;19:294–9. doi:[10.1186/s12909-019-1729-1](https://doi.org/10.1186/s12909-019-1729-1).
- [15] The African federation for emergency medicine emergency care curriculum. <http://afem.co.za/wp-content/uploads/2017/10/AFEM-Curriculum.pdf> Accessed November 4, 2022.
- [16] Fein JA, Zempsky WT, Cravero JP. Relief of pain and anxiety in pediatric patients in emergency medical systems. *Pediatrics* 2012;130(5):e1391–405. doi:[10.1542/peds.2012-2536](https://doi.org/10.1542/peds.2012-2536).
- [17] Ali S, McGrath T, Drendel AL. An evidence-based approach to minimizing acute procedural pain in the emergency department and beyond. *Pediatr Emerg Care* 2016;32(1):36–42. doi:[10.1097/PEC.0000000000000669](https://doi.org/10.1097/PEC.0000000000000669).
- [18] Bosenberg AT. Pediatric anesthesia in developing countries. *Curr Opin Anaesthesiol* 2007;20(3):204–10. doi:[10.1097/ACO.0B013E3280C60C78](https://doi.org/10.1097/ACO.0B013E3280C60C78).
- [19] Walker IA, Obua AD, Mouton F, Ttendo S, Wilson IH. Paediatric surgery and anaesthesia in south-western Uganda: a cross-sectional survey. *Bull World Health Organ* 2010;88(12):897–906 Dec 1. doi:[10.2471/BLT.10.076703](https://doi.org/10.2471/BLT.10.076703).
- [20] Hayton RA, Donley DK, Fekadu A, Woods BK, Graybill CK, Fitzgerald TN. Surgical volunteerism as a collaborative teaching activity can benefit surgical residents in low-middle income countries. *Int J Surg* 2017;48:34–7. doi:[10.1016/j.ijsu.2017.08.589](https://doi.org/10.1016/j.ijsu.2017.08.589).