





Environmentally sustainable anaesthesia in Africa: A scoping review of current knowledge, practices and challenges

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Background: Climate change is one of the greatest threats to global health, and anaesthesia contributes via inhalational anaesthetic gases (IAGs), intravenous agents, disposable equipment, and reprocessing of reusable equipment. Africa faces unique healthcare challenges, yet the extent to which environmentally sustainable anaesthesia has been studied on the continent remains unclear. Understanding existing knowledge and practices is crucial to developing context-specific strategies.

Aim: This scoping review aimed to map existing literature on environmentally sustainable anaesthesia in Africa, identifying current knowledge, practices, and implementation challenges.

Setting: The study was conducted on research findings in Africa.

Methods: A scoping review was conducted using the Arksey and O'Malley framework and PRISMA-Scoping Review guidelines. Databases searched included PubMed, EBSCOhost, Scopus, Web of Science, and the Environmental Science Collection. Eligible studies were peer-reviewed, English-language articles published between 2000 and 2025, focusing on environmentally sustainable anaesthesia in Africa. Data were charted using an extraction form and underwent thematic analysis.

Results: Sixteen studies met the inclusion criteria. Most were cross-sectional and descriptive, with research largely conducted in South Africa. Key barriers included limited education and training, financial constraints, and the absence of formal institutional policies on environmental sustainability. Resource limitations influenced practice patterns, with increased reliance on total intravenous anaesthesia and regional techniques, both with relatively lower environmental footprints. Waste management practices were inconsistently implemented and often poorly understood. Anaesthetists generally showed limited awareness of the environmental impact of IAGs, and the reuse of equipment – frequently driven by necessity – raised ongoing concerns about infection control.

Conclusion: Research on environmentally sustainable anaesthesia in Africa is largely confined to South Africa, with scarce data from the rest of the continent. Clinical practice is heavily shaped by resource scarcity.

Contribution: This is the first synthesis of environmentally sustainable anaesthesia practices in Africa, highlighting resource-driven environmentally sustainable techniques, gaps in knowledge and policy.

Keywords: anaesthesia; Africa; environmental sustainability; climate change; challenges.

Introduction

Climate change is a global threat to sustainability.¹ In anaesthesia, using inhalation anaesthetic gases (IAGs), intravenous agents, disposable equipment, consumables, as well as the cleaning and sterilisation of reusable equipment, all contribute significantly to the healthcare sector's environmental impact.¹ Sulbaek-Andersen et al.² estimated that the total emissions from IAGs used in 30 million anaesthetic procedures per year are equivalent to producing 660 000 tonnes of carbon dioxide (CO₂). The use of IAGs can be reduced by up to 80% by using low fresh gas flows (FGFs) and total intravenous anaesthesia (TIVA) exclusively.^{1,2} In addition, reusing devices and implementing effective waste management practices may reduce anaesthetists' environmental impact.³

Note: Additional supporting information may be found in the online version of this article as Online Appendix 1, Online Appendix 2, Online Appendix 3, and Online Appendix 4.

International anaesthetic organisations recognise their profession's environmental impact and have extensively studied this. Gaps in knowledge contributing to unsustainable practices among anaesthetists have been identified.

The extent to which environmentally sustainable anaesthesia has been studied in Africa remains limited. Africa has unique healthcare challenges embedded in resource scarcity, with a disproportionate impact of climate change on its population.⁴ A scoping review methodology was deemed most appropriate as research on environmentally sustainable anaesthesia in Africa remains limited. Unlike systematic reviews that synthesise evidence to answer specific questions, scoping reviews map existing literature, delineate key concepts, and identify knowledge gaps in emerging fields. Given the early stage of this research area and the diversity of contexts across Africa, this approach enabled a comprehensive overview without restricting study design.

Research question

What is the current state of environmentally sustainable anaesthesia in Africa, specifically regarding existing knowledge, clinical practices, and implementation challenges?

Objectives

The Population, Concept, and Context (PCC) framework⁵ was used to guide the objectives of the study. The population of interest, namely, anaesthetists and anaesthetic practice in Africa, was reviewed. The concept focuses on environmentally sustainable anaesthetic practices, existing knowledge, and associated challenges. The context encompasses healthcare and anaesthesia systems across Africa.

The objectives of this scoping review are:

- To explore the concept of environmentally sustainable anaesthesia within the African healthcare landscape.
- To map existing African research on environmentally sustainable anaesthesia.
- To synthesise available evidence on current knowledge, clinical practices, and operational challenges in promoting environmental sustainability in anaesthetic practice within Africa.

Research methods and design

The Arksey and O'Malley framework⁶ and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines for scoping reviews (PRISMA-Scoping Review)⁷ were followed.

Protocol

A protocol of the study was developed and is stored in the University of Cape Town online archives.

Eligibility criteria

Inclusion criteria:

- Peer-reviewed articles, reviews, and consensus documents.
- English-only articles.
- Publication dates between 2000 and 2025.
- Focus on anaesthesia practice in Africa.
- Full-text availability.

Exclusion criteria:

- Non-anaesthesia focused studies.
- Conference abstracts without full text.
- Articles not available in English.
- Publications outside the date range.

Identification of information sources

PubMed, EBSCOhost (Africa-Wide Information, Index to Nursing and Allied Health Literature [CINAHL], GreenFILE), Scopus, Web of Science and the Environmental Science Collection were selected. Using the PCC framework⁵ and the research question, key search terms related to environmentally sustainable anaesthesia were identified. Search terms combined keywords and controlled vocabulary related to anaesthesia, environmental sustainability, and geographic identifiers for all African countries, as seen in Online Appendix 1. Studies were considered relevant if they examined anaesthetic practices with implications for environmental sustainability, even if not explicitly framed as such. Examples of this include resource optimisation, waste management, or energy use. The search took place in May 2025.

Search strategy

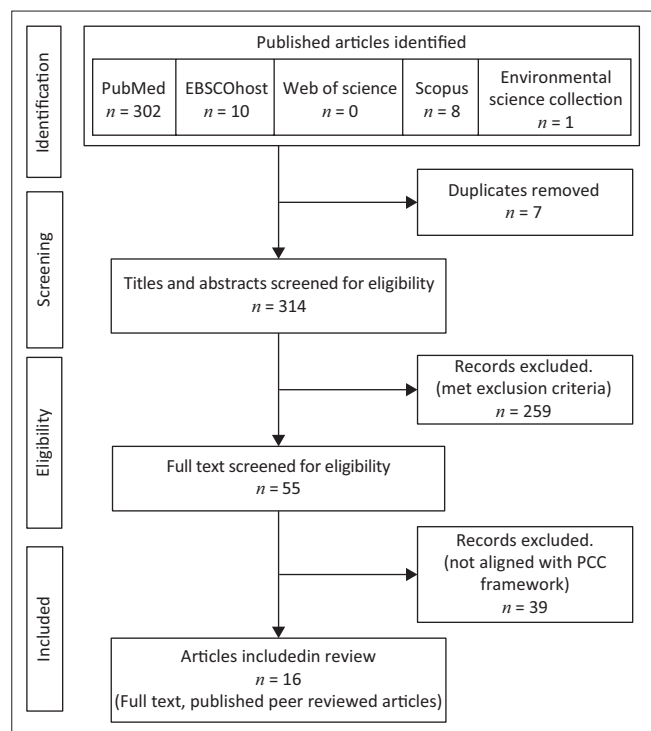
Tailored searches of the databases were developed using Medical Subject Headings (MeSH) terms (Online Appendix 1). A librarian was consulted to assist with creating Boolean strings for each database and to facilitate obtaining full-text articles where necessary.

Screening and selection

The database searches found a total of 321 articles. These were then loaded onto Rayyan⁸ for screening, selection, and removal of duplicates. Alessio P. Giuricich conducted initial screening based on each article's title and abstract. The second reviewer, Munira Guzgay, blindly screened the titles and abstracts in duplicate. Discrepancies were discussed until consensus was reached. Using the PRISMA-Scoping Review framework⁷ (Figure 1), 16 articles remained eligible for further analysis. The full-text articles were downloaded into the reference manager tool Zotero[®].

Charting and synthesis of the data

Quantitative analysis of the chosen articles was performed by means of a predefined data extraction form



PCC, population, concept, and context.

FIGURE 1: Preferred Reporting Items for Systematic reviews and Meta-Analysis flow diagram of scoping review.

(Online Appendix 2). The form was used to systematically chart characteristics and key variables, as seen in Table 3. Variables extracted included each article's authorship, study title, study design, database, and region. Alessio P. Giuricich and Mithasha Gayaparsad independently extracted data from the included full texts.

Qualitative analysis was conducted by importing full-text articles into NVivo 15 (QSR International, United States) for reading and coding. Both reviewers, Alessio P. Giuricich and Munira Guzgay, coded the data independently, and thematic categories were discussed. Data from the articles were grouped based on thematic categories relating to key aspects of knowledge, practices, and challenges of environmentally sustainable anaesthesia. Initial codes were compared, discrepancies discussed, and a final coding framework agreed upon. Coded data were then grouped into thematic categories and sub-themes and made into tables. Thematic results are presented in Table 3 and Table 4, with narrative synthesis organised by theme to address each research objective. Coded data were then grouped into thematic categories and sub-themes. Thematic results are presented in Table 3 and Table 4, with narrative synthesis organised by theme to address each research objective.

Data items simplification and assumptions

Table 1 explains data items used in the summary.

Critical appraisal of data

The Joanna Briggs Institute (JBI) critical appraisal tools were used, with study design-specific checklists (cross-

TABLE 1: Explanation of data items used in the thematic summary.

Theme	Data item	Explanation
Knowledge	Inhalation anaesthetic gas	Relates to the knowledge of low flow anaesthesia, Desflurane use, other IAGs use
	Intravenous anaesthetic agent	Relates to concepts surrounding TIVA and exclusive ketamine use
	Financial impact	Addresses knowledge of the financial implications of equipment reuse, recycling, and cost-saving techniques
	Waste management	The knowledge of waste management includes theatre waste
	Global warming	Comprises items relating to anaesthetists' knowledge and practices regarding climate change
Practice	Inhalation anaesthetic gas	Relates to the practice of low flows, Desflurane use, and other IAGs use
	Waste management	Describes actual waste management practices
	Reuse of equipment	Reports on the reuse of equipment in clinical settings
	Intravenous anaesthetic agents	Relates to the practice of TIVA and exclusive ketamine use
	Policies	Relates to the policies available on sustainability, waste management, low flows, and equipment reuse
Challenges	Educational gaps	Identifies teaching material or training gaps among anaesthetists
	Attitudinal barriers	Healthcare workers' beliefs or resistance within the context of sustainability
	Socio-economic factors	Incorporates financial constraints, structural and political issues that affect healthcare systems
	Lack of policy	Mentions the absence of policy or institutional guides

IAG, inhalational anaesthetic gas; TIVA, total intravenous anaesthesia.

sectional studies, case reports, reviews, cohort studies, mixed-methods, audits). Both reviewers (Alessio P. Giuricich and Munira Guzgay) independently appraised all 16 articles. Disagreements in appraisal scores were resolved through discussion until consensus was reached. Appraisal results informed our interpretation of study quality and guided the discussion section's commentary on strengths and limitations of the evidence base. Complete appraisal results are presented in Online Appendix 3 and Online Appendix 4.

Ethical considerations

Ethical clearance to conduct this study was obtained from the Faculty of Health Sciences, University of Cape Town Research Ethics Committee (No. 304/2025).

Results

Selection of articles

In total, 16 articles were selected using the PRISMA-ScR⁷ (Figure 1).

Characteristics of articles

The articles reflect a growing body of research on environmentally sustainable anaesthesia. Table 2 highlights the characteristics and data items of each article. Most of the authors were from Africa; however, three articles had authors from Canada, Spain, and the United States, and two articles

TABLE 2: Methodologies used in included articles.

Type of study	<i>n</i>
Cross-sectional descriptive	7
Prospective cohort	1
Explanatory mixed method	1
Observational descriptive	1
Case reports	1
Prospective observational	1
Audit	1
Review	3
Total	16

spanned multiple countries in Africa (Figure 2). Research on sustainability has been conducted predominantly by anaesthesia departments. A range of methodologies was employed in the included articles (Table 1), with the most common being cross-sectional and descriptive ($n = 7$), conducted in South Africa. Most of the articles were published from 2021 to 2025 (Figure 3). Limited data were published before 2021.

Synthesis of results

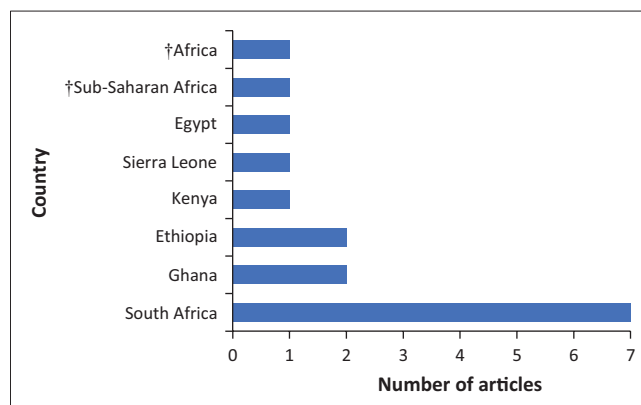
The research question and objectives of the scoping review informed how the thematic summary and qualitative framework were developed.

Discussion

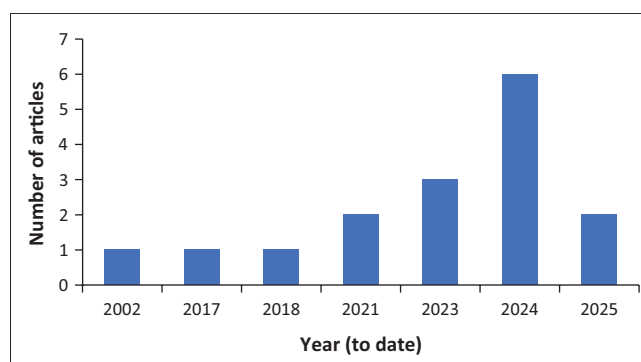
This scoping review set out to map existing knowledge, clinical practices and implementation challenges related to environmentally sustainable anaesthesia in Africa, and to identify priority areas for development. The findings show that, although research is emerging, particularly from South Africa, evidence is fragmented, geographically concentrated, and rarely framed explicitly around environmental sustainability. As a result, the current state of environmentally sustainable anaesthesia in Africa can be characterised as predominantly driven by resource constraints rather than intentional climate-aware practice. Figure 4 was developed to visually synthesise the results, mapping the origin and data to support the interpretation of patterns across regions.

Knowledge

There is a paucity of literature from Africa about the levels of knowledge regarding environmentally sustainable anaesthesia. This section aims to address all the objectives of the scoping review. In South Africa, anaesthetists lack the knowledge required to guide them towards more sustainable practice.¹³ Financial impact and resource scarcity were reported in almost all included articles, whereas explicit awareness of global warming and IAG emissions was described in only a minority. This mismatch suggests that sustainability knowledge remains superficial, limiting clinicians from being more environmentally sustainable.



†, 'Africa' and 'Sub-Saharan Africa' indicate articles that included multiple countries within these regions.

FIGURE 2: Number of articles per country.**FIGURE 3:** Number of articles published per year.

Inhalation of anaesthetic gases

In South Africa, specifically, the environmental impact of IAGs was widely known among anaesthetists.¹⁵ No significant association was found between knowledge and anaesthetists' years of experience.¹⁵ Three articles (two from South Africa and one from Egypt) highlighted the effect of IAGs on the environment.^{14,15,24} A lack of IAGs' availability in resource-constrained environments often means anaesthetic providers are not accustomed to IAG use.^{10,11} In some contexts, anaesthetic practice has shifted towards the use of regional anaesthesia (without general anaesthesia), which is an environmentally sustainable alternative.¹¹ In Sierra Leone, new anaesthesia technology for low-resource environments, using IAGs, is being piloted.²⁰ While the environmental impact of the technologies is not fully researched, they present an opportunity to promote appropriate education toward sustainable practices.

Intravenous anaesthetic agents

Awareness of the environmental impact of intravenous anaesthetic agents appears to be limited among anaesthetists in Africa.^{15,21} In South Africa, only 5.60% of anaesthetists interviewed were aware of propofol's impact on marine life.¹⁵ Burke et al.¹⁰ showed that in resource-constrained environments, educating anaesthetists to use ketamine as the sole anaesthetic in emergency surgery was

TABLE 3: Thematic summary of articles included in scoping review.

Author	Country	Title	Database	Study design	Knowledge				Practice				Challenges				
					Inhalation anaesthetic gases	Intravenous anaesthetic agents	Financial impact	Waste management	Global warming	Inhalation anaesthetic gases	Waste management	Reuse of equipment	Intravenous anaesthetic agents	Policies	Educational gaps	Attitudinal barriers	Socio-economic factors
Abanyie ⁹	Ghana	Healthcare waste management in the Tamale Central Hospital, northern Ghana. An assessment before the emergence of the COVID-19 pandemic in Ghana	PubMed	Cross-sectional, descriptive	-	-	✓	✓	-	-	✓	✓	-	-	✓	✓	✓
Burke ¹⁰	Kenya	Safety and Feasibility of a Ketamine Package to Support Emergency and Essential Surgery in Kenya when NO Anaesthetist is Available: An Analysis of 1216 Consecutive Operative Procedures	PubMed	Prospective cohort	-	✓	-	-	-	-	-	-	✓	-	✓	-	-
Chen ¹¹	Ghana	Building Surgical Capacity Sustainably in Resource-Constrained Ghanaian Hospital A 7-Year Update on the Creation of an Outpatient Local Anaesthetic Operating Room	PubMed	Cross-sectional, descriptive	✓	✓	-	-	-	✓	-	-	-	-	✓	✓	✓
Chibane ¹²	Africa	An audit of the carbon footprint of travel for the Canadian Anaesthesiologists' Society International Education Foundation partnerships	PubMed	Audit	-	-	✓	-	✓	-	-	-	-	-	✓	-	✓
Frewent ¹³	South Africa	Mostly harmless? A survey of South African anaesthetists' knowledge and attitudes regarding environmental sustainability in the operative theatre	EBSCOhost	Cross-sectional, descriptive	✓	✓	-	-	-	-	✓	✓	-	-	✓	-	✓
Giuricich ¹⁴	South Africa	Green Anaesthesia in a developing country: a narrative review	EBSCOhost	Review	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓
Giuricich ¹⁵	South Africa	Anaesthetists' knowledge and practices of environmentally sustainable anaesthesia in an academic department of anaesthesiology	Scopus	Cross-sectional, descriptive	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓

Table 3 continues on the next page →

TABLE 3 (Continued ...): Thematic summary of articles included in scoping review.

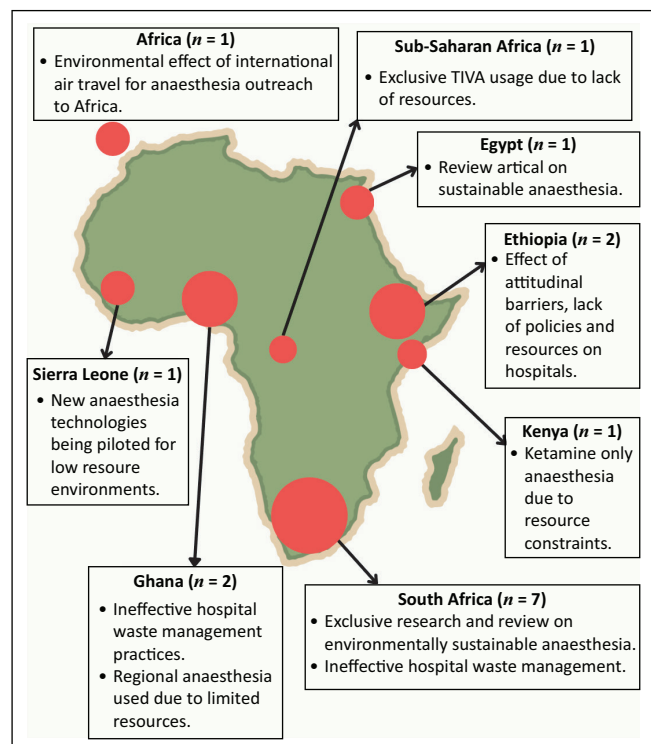
Author	Country	Title	Database			Study design			Knowledge			Practice			Challenges					
			Inhalation anaesthetic gases	Intravenous anaesthetic agents	Financial impact	Waste management	Global warming	Inhalation anaesthetic gases	Waste management	Reuse of equipment	Intravenous anaesthetic agents	Policies	Educational gaps	Attitudinal barriers	Socio-economic factors	Lack of Policy				
Hailemariam ¹⁶	Ethiopia	Perioperative capacity and contextual challenges in teaching hospitals of southern Ethiopia: explanatory sequential mixed-methods research	-	-	✓	✓	-	-	-	-	✓	✓	-	-	-	✓	✓	✓		
Weintjes ¹⁷	South Africa	An evaluation of anaesthetic waste generation at a Johannesburg Academic Hospital	-	-	✓	✓	✓	-	-	-	✓	✓	-	-	-	-	-	-	✓	
Mihretu ¹⁸	Ethiopia	The current state of anaesthesia safety in a third world country: a cross-sectional survey among anaesthesia providers in Ethiopia	-	-	✓	✓	-	-	-	-	✓	✓	-	-	-	✓	✓	✓	✓	
Ramsey ¹⁹	Sub-Saharan Africa	Total intravenous anaesthesia in rural sub-Saharan Africa: report of 25 cases	-	✓	-	✓	-	-	-	-	✓	✓	-	-	-	✓	✓	-	✓	
Sampson ²⁰	Sierra Leone	Bridging the mismatch: observing the introduction of new anaesthesia technology for a low-resource environment	✓	-	✓	✓	-	-	-	-	✓	✓	-	-	-	✓	✓	✓	✓	
Vorster ²¹	South Africa	Sustainability in anaesthesia are South African anaesthesia providers doing their part	✓	✓	-	-	-	-	-	-	✓	✓	✓	-	-	✓	✓	-	✓	
Olaifa ²²	South Africa	Knowledge, attitudes, and practices of health care workers about healthcare waste management at a district hospital in KwaZulu-Natal	-	-	✓	✓	-	-	-	-	✓	✓	-	-	-	✓	✓	✓	✓	
Weicht ²³	South Africa	Low flow anaesthesia (how to do it)	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓	-	✓	
Abdalla ²⁴	Egypt	Implementing sustainable anaesthesia: challenges and opportunities in education	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: Please see the full reference list of the article Giuricich AP, Gayaarsad M, Green-Thompson L, Guzgay M. Environmentally sustainable anaesthesia in Africa: A scoping review of current knowledge, practices and challenges. South Afr J Anaesth Analg. 2026;32(1), a1506. <https://doi.org/10.4102/sajra.v32i1.1506>, for more information

TABLE 4: Qualitative framework from thematic analysis of coding of articles.

Knowledge	Practice	Challenges
Inhalation anaesthetic gases (<i>n</i> = 8)	Use of inhalation anaesthetic gases (<i>n</i> = 7)	Educational gaps (<i>n</i> = 15)
Intravenous anaesthetic agents (<i>n</i> = 8)	Waste management (<i>n</i> = 7)	Attitudinal barriers (<i>n</i> = 12)
Financial impact (<i>n</i> = 15)	Reuse of equipment (<i>n</i> = 7)	Socio-economic factors (<i>n</i> = 10)
Waste management (<i>n</i> = 7)	Intravenous anaesthetic agents (<i>n</i> = 6)	Lack of policy (<i>n</i> = 15)
Global warming (<i>n</i> = 6)	Policies (<i>n</i> = 2)	-

n, number of articles referring to the theme.



TIVA, total intravenous anaesthesia.

FIGURE 4: Geographic distribution and data summaries of included studies.

effective, and this is environmentally sustainable. Socio-economic factors force different anaesthetic regimes to be created.

Financial impact

Most articles (*n* = 15) highlighted the importance of economic barriers to the provision of anaesthesia in Africa. Environmentally sustainable practices can be more financially viable.^{1,14} Because of the lack of resources to fund IAGs in regions in Africa, regional anaesthesia techniques, such as Wide-Awake Local Anaesthesia No Tourniquet (WALANT) technique, have been born out of necessity in parts of Africa and are also cheaper.¹¹ Although these practices reduce the environmental impact, they are cost-driven adaptations instead of intentional sustainability initiatives. In sub-Saharan Africa, Ramses et al.¹⁹ revealed that propofol-based TIVA is a viable option in resource-constrained hospitals. However, Mihretu et al.¹⁸ and Hailemariam et al.¹⁶ revealed that anaesthetists in Ethiopia also acknowledge the impact of financial constraints on the implementation of TIVA-based techniques and that this could negatively affect doctors

and patient care. Although financial constraints create opportunities for more sustainable practices, this needs to be balanced against providing the best care.

Equipment use and waste management

Hospital waste management has been well-explored in certain parts of Africa. In South Africa, two studies found that the knowledge of healthcare waste management among healthcare workers is generally low, but of these, nurses have the highest levels of knowledge.^{17,22} These findings align with Abayie et al.⁹ in Ghana, who highlighted that healthcare workers were not aware of how to segregate waste correctly. In addition, equipment reuse, an important strategy in resource-limited settings, was studied by Giuricich et al.¹⁵ in South Africa, who found that anaesthetists perceive reuse as an infection risk.

Global warming

There is a lack of research in Africa on anaesthetists' knowledge of global warming. Organisations, such as the Canadian Anesthesiologists' Society International Education Foundation, have assessed the carbon footprint of educational anaesthesia programmes delivered in Africa.¹² The findings highlight the significant environmental impact of educational travel because of extensive air travel and recommend virtual education programmes as a sustainable alternative.¹² The contrast between limited knowledge in Africa and growing international attention to the environmental impact underscores the need for further research.

Practice

Anaesthetic practices in Africa are influenced considerably by financial constraints and socio-economic factors.^{16,18} This section aims to answer all three of the study objectives. South Africa is the only country to report on practices relating specifically to environmentally sustainable anaesthesia and there is insufficient knowledge to guide practices to be more environmentally sustainable.^{13,15} The drive to find alternative, cheaper practices has coincidentally resulted in more sustainable practices, where environmental benefits are secondary to service delivery, and are rarely captured in local policies.

Use of gases

Inhalational anaesthetic gases, without nitrous oxide (N₂O), are commonly used both in the South African public and private healthcare sectors.¹⁵ Desflurane, the least environmentally favourable IAG, is less frequently used in the South African public and private sectors.¹⁵ A review article from South Africa and Egypt on low-flow anaesthesia highlights efforts to educate anaesthetists on more sustainable practices in Africa.^{23,24} In Ghana, because of limited access to IAGs, regional anaesthesia is a common alternative.¹¹ In Sierra Leone, the rollout of anaesthesia technology for

low-resource environments increases IAG usage, but the extent of the environmental impact is unknown.²⁰ Economic constraints and infrastructural issues are common themes that need to be considered when analysing practices.

Waste management

Healthcare waste management practices in Africa are generally unsustainable. A study in Ghana found that 82% of workers mentioned there was poor waste management, and 76% of patients were not satisfied with the waste management practices they observed during their hospital stay.¹¹ Waste was being burned on site at the hospital because the incinerator was not functional, which posed a health and environmental risk on the premises.¹¹ Two studies in South Africa found that hospital waste was not being correctly segregated and disposed of.^{17,22} This led to environmental contamination. The recommendations of these studies refer to the need for better waste management education.

Reuse of equipment

Although the reuse of equipment was included in the search, few studies addressed this issue directly ($n = 7$). A review from Egypt highlighted the need for greater reuse.²⁴ Giuricich et al.,¹⁵ in South Africa, found that the reuse of some equipment occurred because of resource shortages. Sustainable practices are formed out of need, not necessarily motivated by sustainability itself.

Intravenous anaesthetic agents

Total intravenous anaesthesia is successfully used for surgical procedures in sub-Saharan Africa.¹⁹ Unreliable anaesthetic machines and power cuts are common occurrences, making the delivery of IAGs difficult.¹⁹ In Kenya, exclusive ketamine use for emergency surgeries was found to be safe and feasible in resource-limited areas.¹⁰ This was developed because of the shortage of anaesthetists and equipment.¹⁰ These practices are environmentally sustainable, even if arising from a lack of resources.

Policies

No formal policy document on environmentally sustainable anaesthesia exists in Africa. However, the South African Society of Anaesthesiology (SASA) has issued a position statement on the environmental impact of IAGs and nitrous oxide.²⁰ This statement broadly refers to the safe and sustainable use of IAGs.²⁰ Some policies on correct healthcare waste management and safe anaesthesia practices do exist, but anaesthetists do not always comply with local guidelines.⁹ Furthermore, there is variation in the policies and a lack of implementation by hospitals.⁹ This demonstrates a need for more uniform, environmentally sustainable policies.

Challenges

While anaesthetists may want to change their practice to an environmentally sustainable one, there are multiple challenges that prevent change.¹⁸ This section aims to answer

the third objective of the study. Socio-economic factors, resource constraints and a lack of policies are the central issues that affect anaesthetists, which prevailed in all the themes relating to environmentally sustainable anaesthesia.¹⁸ To create more sustainable practices, anaesthetists need to be able to adapt and change their anaesthetic technique, appropriate to the context in which they practice.

Educational gaps

No formal training guideline on environmentally sustainable anaesthesia was found. The three review articles shared knowledge on low-flow anaesthesia and some aspects of sustainable anaesthesia.^{14,23,24} The sustainable use of IAGs was not widely known among anaesthetists. However, education on performing regional anaesthesia, exclusive ketamine uses, and other TIVA-based techniques was adequate in resource-constrained areas.¹⁰ Although not explicitly stated for environmentally sustainable anaesthesia, these practices should be incorporated into creating an educational guide.

Africa's role in green anaesthesia

African contexts often adopt sustainable practices out of necessity because of resource constraints rather than environmental awareness. Anaesthetists demonstrate adaptability to change, given the variety of contexts present in Africa. There are significant educational gaps, policy limitations and infrastructural challenges that prevent the implementation of environmentally sustainable practices. This context means that simply importing first-world guidelines is unlikely to succeed; instead, African-led frameworks must explicitly integrate equity, service delivery and environmental goals.

Africa contributes a small but distinctive body of work on environmentally sustainable anaesthesia, characterised by resource-driven practices occurring in the absence of robust sustainability policies or education. By systematically mapping knowledge, practices and challenges, the objectives of the study were met. Professional societies and policymakers need to co-design context-appropriate strategies that both maintain safe perioperative care and reduce the speciality's contribution to climate change.

Study's limitations

Restricting inclusion to English-language publications may have excluded relevant French, Portuguese, or Arabic literature, potentially biasing findings towards English-speaking countries. Other discipline-specific databases might have identified further relevant articles. The emerging nature of environmental sustainability in anaesthesia meant that many included articles addressed related practices (e.g. resource-constrained anaesthesia) without explicit sustainability framing, requiring interpretive decisions about relevance that could introduce classification bias. The heterogeneity in study designs, outcome measures, and reporting quality across included studies limited our ability

to draw definitive conclusions about the state of sustainable anaesthesia practices. Finally, the concentration of research in South Africa (7 articles, 44%) means that findings may not be representative of other African regions with different healthcare contexts and resource availability.

Conclusion

This scoping review addressed three research objectives about environmentally sustainable anaesthesia in Africa. Regarding knowledge, awareness remains limited, with specific gaps in understanding IAG's environmental impact and waste management practices. Regarding practices, resource scarcity inadvertently drives environmentally favourable approaches, although not motivated by environmental concerns. Regarding challenges, educational gaps, absence of formal policies, and socio-economic constraints are primary barriers. This review reveals both opportunities (existing resource-efficient practices) and needs (education, policy development and research expansion beyond South Africa) for advancing sustainable anaesthesia in African contexts.

Acknowledgements

This article is based on research originally conducted as part of Alessio Giuricich's master's thesis titled 'Environmentally sustainable anaesthesia in Africa: A Scoping Review of Current Knowledge, Practices and Challenges', submitted to the Department of Anaesthesia, University of Cape Town. The thesis is currently unpublished and not publicly available. The thesis was supervised by Mithasha Gayaparsad, Lionel Green-Thompson, and Munira Guzgay. The thesis was reworked, revised and adapted into a journal article for publication. The author confirms that the content has not been previously published or disseminated and complies with ethical standards for original publication.

During the preparation of this work, the authors used ChatGPT Plus to check language and syntax only. The content was reviewed and edited by the authors, who take full responsibility for its accuracy.

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

CRedit authorship contribution

Alessio P. Giuricich: Conceptualisation, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualisation, Writing – original draft, Writing – review & editing. Mithasha Gayaparsad: Supervision. Lionel Green-Thompson: Supervision. Munira Guzgay: Formal analysis, Investigation, Methodology, Project administration, Visualisation, Writing – original draft, Writing – review & editing. All authors reviewed the

article, contributed to the discussion of results, approved the final version for submission and publication, and take responsibility for the integrity of its findings.

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Data availability

This scoping review did not generate any primary data. All data analysed consisted of previously published studies that are publicly available through academic databases and journal websites. The full search strategy, including databases searched and search terms used, is provided in the methods section. As this review synthesises information from publicly accessible sources, no accession codes or raw datasets are applicable. There are no restrictions on data availability.

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