



The Operating Room Global Journal (TORGJ)

<https://torgjournal.org/>

ISSN: 3105-3262



Factors Affecting the Implementation of Enhanced Recovery After Surgery (ERAS) Protocols in Pediatric Surgery Practice in Sudan - 2026: A mixed methods study

Hani E. Bilal^{1,2*}, Megbar Dessalegn^{2,3}

¹ University of Khartoum- Faculty of Medicine, Khartoum, Sudan

² The Operating Room Global (TORG)

³ Department of Surgery, Debre Markos University, Debre Markos, Ethiopia

*Corresponding Author:

Dr. Hani E. Bilal

hanielhaj1@gmail.com

Declaration:

Authors' Contributions:

Dr. H. E. B.: Conceptualization, methodology, investigation, data collection, formal analysis, interpretation, and writing, original draft. Dr. M. D.: Supervision, methodology, interpretation, writing, review and editing. Both authors reviewed and approved the final manuscript.

Conflict of Interests: None

Funding: No funding received.

Article History:

Received: 11-10-2026

Accepted: 14-10-2026

Available Online: 25-10-2026

QR access this Article



ABSTRACT

Background: Enhanced Recovery After Surgery (ERAS) is an evidence-based perioperative care pathway designed to reduce surgical stress, complications, and hospital stay. However, implementation in pediatric surgery remains limited in low- and middle-income countries, including Sudan.

Objective: To assess factors affecting ERAS implementation in pediatric surgical practice in Sudan, focusing on knowledge, perceptions, barriers, and facilitators.

Methods: A convergent mixed-methods cross-sectional study was conducted among pediatric surgery stakeholders in Sudan. Quantitative data were collected through structured questionnaires and analyzed using descriptive and inferential statistics. Qualitative data from focus group discussions and key informant interviews underwent thematic analysis, with findings integrated through triangulation.

Results: Among 72 participants, 48.6% demonstrated good ERAS knowledge, 37.5% moderate knowledge, and 13.9% poor knowledge, while 66.7% reported positive perceptions. Major barriers included absent ERAS protocols and national guidelines, limited pediatric-specific knowledge, inadequate monitoring, poor multidisciplinary coordination, and financial constraints. Qualitative findings highlighted willingness to adopt ERAS despite institutional, workforce, infrastructure, training, and policy limitations.

Conclusion: Despite positive perceptions and moderate knowledge, pediatric ERAS implementation in Sudan faces significant institutional and systemic barriers. National guidelines, multidisciplinary collaboration, workforce training, and institutional support are essential for sustainable implementation.

Keywords: Enhanced Recovery After Surgery (ERAS); Pediatric Surgery; Implementation; Knowledge; Barriers; Sudan.

INTRODUCTION

Enhanced Recovery After Surgery (ERAS) is a multimodal, evidence-based perioperative care pathway designed to attenuate surgical stress, reduce complications, shorten hospital stay, and optimize resource use(1). While ERAS is well established in many high-income settings, implementation in pediatric surgery and in low- and middle-income countries (LMICs), including African contexts, remains limited and heterogeneous. Although the safety and efficacy of implementing ERAS protocols have been reported recently, a broad consensus and a guideline for a common pediatric ERAS protocol is not yet available (1,2). Studies conducted internationally from pediatric and adult services consistently show that gaps in knowledge, suboptimal perceptions of ERAS benefits, and system-level constraints are major barriers to implementation (2,3).

While evidence supporting ERAS effectiveness is substantial, there is a paucity of high-quality literature evaluating implementation of ERAS in pediatric populations. Previous studies have been conducted in high-income countries, limiting generalizability to resource-constrained settings. Furthermore, pediatric ERAS research remains less developed than adult ERAS research despite increasing recognition of its potential benefits. In addition, African evidence remains sparse and geographically concentrated in a small number of countries (6). this study comprises the first mixed-methods study assessing pediatric ERAS implementation readiness in Sudan to provide a measurement and contextual understanding of implementation factors for context-appropriate ERAS adaptation, guideline development, and training for pediatric surgery in Sudan (5).

Aim and Objectives

Aim

This study aimed to study the factors affecting the implementation of pediatric Enhanced Recovery after Surgery (ERAS) protocols in Sudan, 2026.

Objectives

- To assess the level of knowledge of ERAS principles and key protocol components among pediatric surgery practitioners in Sudan.
- To study the perception of pediatric surgery stakeholders regarding the benefits, risks, and applicability of ERAS in the Sudanese pediatric surgical context.
- To identify the perceived individual, institutional, and system-level barriers and enablers to implementing ERAS protocols in pediatric surgery service in Sudan.

METHODOLOGY

Study Design and Setting

A mixed-method study (cross-sectional quantitative and qualitative) was conducted in seven currently functioning pediatric surgery centers in Sudan including public (Khartoum, Omdurman, Kassala, Karima, Atabara, Gedarif, Shendi, Dongola) and private facilities. The study was conducted from February to September 2026.

Study Population

Pediatric surgery stakeholders working in Sudan at the time of data collection were included in the study. This included pediatric surgery consultants, fellows, specialists, nurses, anesthesiologists, anesthetists, and hospital administrators.

Eligibility Criteria

Pediatric surgery consultants, fellows, specialists, nurses, anesthesiologists, anesthetists, and hospital administrators with clinical relevance. The study excluded pediatric practitioners who are not directly involved in perioperative care, medical students or trainees without clinical responsibilities, and administrative staff without clinical roles.

Sampling and Sample Size

In the absence of prior pediatric surgery-specific data from Sudan; the sample size was initially calculated using the single population proportion formula, assuming a 50% proportion of adequate ERAS knowledge, using a 95% confidence level ($Z = 1.96$), and a margin of error of 7%. The minimum calculated sample size was 196 participants. However, a total of 76 responses were received during the study period. Following data cleaning and quality assessment, four responses were excluded because of incomplete questionnaires and substantial missing data that could compromise the validity of the analysis. Consequently, the final study sample comprised 72 participants. The lower-than-target sample size was primarily attributable to the limited number of pediatric surgery stakeholders in Sudan, workforce disruption related to the national healthcare context and the ongoing conflict, and challenges in participant recruitment during the study period. Although the achieved sample size reduced the statistical power of subgroup analyses and limited the generalizability of some findings, it nevertheless provided valuable exploratory data and represents one of the first mixed-methods assessments of pediatric ERAS implementation readiness in Sudan.

Data Collection Tools

A Structured online questionnaire (Google Form) with four sections, informed by previous ERAS surveys and contextualized to Sudan. The qualitative component included 2 Focus Group Discussions (FGDs) and 2 in-depth interviews (IDIs) with key informants.

Validity and Reliability of the Study Instruments:

To guarantee clarity and consistency, the quantitative questionnaire was developed following a comprehensive review of the literature on Enhanced Recovery After Surgery (ERAS), it's then modified to align with the study objectives and the constructs identified within the Consolidated Framework for Implementation Research (CFIR). A pilot study was conducted among approximately 10% of the target population selected from a pediatric surgical unit that was not included in the main study. The reliability of the questionnaire was assessed using Cronbach's alpha coefficient to evaluate the internal consistency of the knowledge, perception, barrier, and facilitator scales. A value of 0.70 or greater was considered indicative of acceptable reliability. For the qualitative component, trustworthiness was enhanced through the use of standardized interview guides, triangulation of data sources, member checking, and maintenance of a comprehensive audit trail.

Data Collection procedure:

The online questionnaire was distributed through the social media platforms of the professional associations. In addition, the questionnaires were filled on-site directly from the target population. The qualitative component included 2 Focus Group Discussions (FGDs) with 6–8 participants for each one, and 2 in-depth interviews (IDIs) with key informants. All were led by the principal investigator until data saturation was reached.

Data Processing and Statistical analysis:

The quantitative data were cleaned and entered an Excel sheet, then analysed using SPSS version 25 with both descriptive and inferential statistics. Means, Medians and standard deviations described continuous variables that were normally distributed. Categorical bivariable comparisons utilized Pearson's chi-square test. The final results were constructed into composite scores with categorization of knowledge and perception being either good or poor using predefined cut-offs. Analytical statistics; Chi-square and Welch's ANOVA tests were used to explore associations between categorical variables. The significance level was set at $p < 0.05$. Audio recordings from FGDs and IDIs were obtained, anonymized, and analyzed using thematic analysis. Developed a codebook, with discrepancies resolved through discussion. Themes were mapped to the socio-ecological model (individual, institutional, system levels). eventually, a mixed-methods integration (Triangulation) was done using a convergent parallel design and a joint display matrix.

Ethics Approval and consent to participate:

Ethical approval was obtained from TORG-IRB (reference number TORG-IRB/2026/032801) and the Sudan Federal Ministry of Health National Research Ethics Committee (RA017082026). Furthermore, a written informed consent was

obtained from each participant. Qualitative transcripts have had all identifiers been coded. The confidentiality of the information provided was ensured, as all details were kept strictly confidential and were used only by the researchers. In addition, each participant could withdraw and there were no financial temptations for those participating in the research. Finally, the study did not involve any significant risks to the participants. All data collected were secured and available only to the researchers.

RESULTS

Participants Demographic Characteristics

The final analysis comprised 72 participants, most of them were women (61.1%), fell within the age range of 30 to 34 years (38.9%), and were serving as pediatric surgery fellows (36.1%). Regarding their previous exposure to ERAS, 41.7% had received informal exposure, 31.9% had no prior exposure, and only 23.6% had undergone formal training. Detailed characteristics are shown in table 1.

Table 1: Demographic Characteristics (n = 72)

Characteristic	Category	n	%
Age (years)	25–29	21	29.2
	30–34	28	38.9
	35–39	17	23.6
	40–44	3	4.2
	≥45	3	4.2
Gender	Female	44	61.1
	Male	28	38.9
Profession	Pediatrics Surgery Fellow	26	36.1
	Specialist	17	23.6
	Anaesthesia	16	22.2
	Consultant	3	4.2
	Medical Officer	3	4.2
	Nursing	3	4.2
	Admin	1	1.4
	Other	1	1.4
	Pediatrics Surgery Resident	1	1.4
	Surgeon	1	1.4
Experience	<5 years	52	72.2
	5–10 years	17	23.6
	>10 years	3	4.2
Institution	Public instructional	58	80.6
	Public non-instructional	8	11.1
	Private	4	5.6
	Mixed	1	1.4
	Tertiary government	1	1.4
Country	Sudan	69	95.8
	Outside Sudan	3	4.2
Monthly case volume	<50 cases	22	30.6
	<25 cases	20	27.8
	<100 cases	18	25.0
	>100 cases	12	16.7
Prior ERAS experience	Informal exposure	30	41.7
	No exposure	23	31.9

	Formal training	17	23.6
	Other	2	2.8
Documented ERAS protocol	No	49	68.1
	Uncertain	14	19.4
	Yes	9	12.5

Primary Findings:

Knowledge of ERAS

The mean scores varied between 3.32 and 4.32 when using the five-point scale. The greatest level of agreement was found for the statements concerning a reduced length of hospital stay (mean 4.32) and early mobilization (mean 4.22). The mean of the total knowledge score was 58.2 (standard deviation 12.0) as shown in table 2.

Table 2: Knowledge Categories

Knowledge Category	n	%
Good (≥ 60)	35	48.6
Moderate (45–59)	27	37.5
Poor (< 45)	10	13.9

Using a predetermined cutoff point (Good ($\geq 80\%$), Moderate (60–79%), or Poor ($< 60\%$)), 48.6 per cent of the participants showed good knowledge, 37.5 per cent had moderate knowledge and 13.9 per cent had poor knowledge as illustrated in Figure 1.

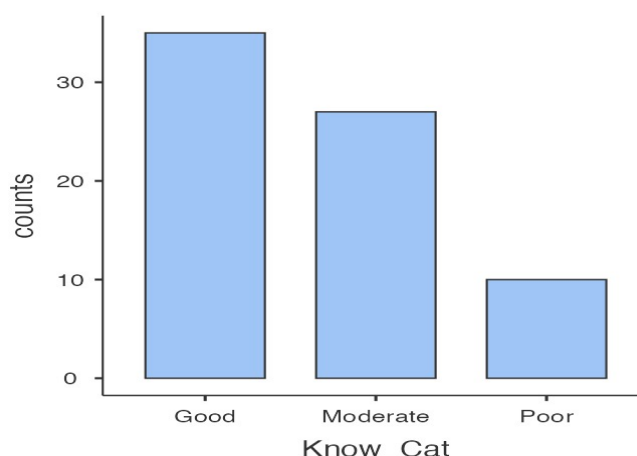


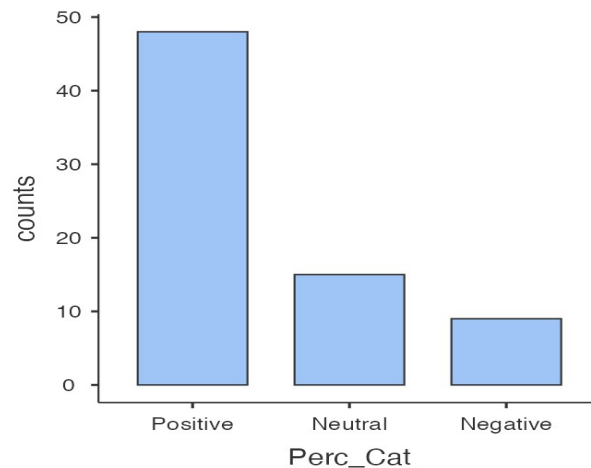
Figure 1. Distribution of ERAS knowledge categories among pediatric surgery practitioners in Sudan (n = 72).

Perceptions towards Enhanced Recovery After Surgery

Perception scores consisted of four subdomains; benefits, feasibility, safety, and willingness. The highest level of agreement was found regarding the statement that ERAS improves outcomes in pediatric surgery (mean 4.38). The lowest level of agreement was recorded for the practicality of ERAS in the Sudanese context (mean 3.15).

The mean of the composite perception score was 55.0 (standard deviation 11.1) and the scores ranged from 24 to 70. The composite perception score showed that two thirds of the participants (66.7 per cent) had a positive perception, 20.8 per cent were neutral and 12.5 per cent had a negative perception. These categories are illustrated in Figure 2.

Figure 2: Distribution of ERAS perception categories among pediatric surgery practitioners in Sudan (n = 72).



Perceived Barriers towards Implementation of Enhanced Recovery After Surgery

The three most highly ranked barriers were the lack of documented ERAS protocols (mean 4.01), limited knowledge of the ERAS evidence specific to children (mean 3.81), and the absence of national guidelines (mean 3.79). The three lowest ranked barriers were parental resistance to early discharge (mean 2.54), cultural norms regarding the length of hospital stay (mean 2.92), and resistance to change among surgeons (mean 3.19). The institutional level barriers generally obtained higher scores than those at the individual and patient or family level.

TABLE 3: Barriers to ERAS Protocol Implementation Ranked by Mean Score Among Pediatric Surgery Stakeholders in Sudan, 2026 (n = 72)

Rank	Item	Level	Mean $\pm$ SD
1	B5. Absence of documented ERAS protocols	Institutional	4.01 $\pm$ 1.13
2	B2. Limited knowledge of pediatric-specific evidence	Individual	3.81 $\pm$ 1.11
3	B15. Absence of national guidelines	System	3.79 $\pm$ 1.29
4	B10. Lack of audit and monitoring systems	Institutional	3.78 $\pm$ 1.45
5	B6. Insufficient multidisciplinary coordination	Institutional	3.71 $\pm$ 1.27
6	B14. Financial limitations	System	3.69 $\pm$ 1.39
7	B1. Insufficient ERAS training	Individual	3.63 $\pm$ 1.22
8	B8. Inadequate nursing staff	Institutional	3.60 $\pm$ 1.46
9	B11. Scarce hospital resources	System	3.60 $\pm$ 1.25
10	B9. Excessive workload and time limitations	Institutional	3.56 $\pm$ 1.40
11	B13. Inadequate infrastructure	System	3.50 $\pm$ 1.38
12	B4. Apprehension about early feeding/discharge	Individual	3.39 $\pm$ 1.03
13	B12. Absence of institutional leadership support	System	3.33 $\pm$ 1.42
14	B7. Limited support from anesthesia	Institutional	3.25 $\pm$ 1.38
15	B18. Ineffective follow-up systems	Patient/Family	3.25 $\pm$ 1.38
16	B3. Resistance to change among surgeons	Individual	3.19 $\pm$ 1.16
17	B17. Cultural norms about hospital duration	Patient/Family	2.92 $\pm$ 1.23
18	B16. Resistance from parents to early discharge	Patient/Family	2.54 $\pm$ 1.26

Association Between Knowledge of ERAS and Profession

Of the pediatric surgery fellows, 38.5% possessed good knowledge. Of the specialists, 64.7% had good knowledge. Among the anaesthesia personnel, 50.0% had good knowledge but 31.3% had poor knowledge. The chi-square test revealed that there was no statistically significant association between profession and knowledge category (chi-square 16.6, df 18, p 0.548). As shown in table 4.

Table 4. Distribution of ERAS Knowledge Categories by Professional Group Among Pediatric Surgery Stakeholders in Sudan, 2026 (n = 72)

Profession	Poor n (%)	Moderate n (%)	Good n (%)	Total n (%)
Pediatrics Surgery Fellows	4 (15.4)	12 (46.2)	10 (38.5)	26 (100)
Specialists	1 (5.9)	5 (29.4)	11 (64.7)	17 (100)
Anaesthesia	5 (31.3)	3 (18.8)	8 (50.0)	16 (100)
Consultant	0 (0.0)	2 (66.7)	1 (33.3)	3 (100)
Medical Officer	0 (0.0)	1 (33.3)	2 (66.7)	3 (100)
Nursing	0 (0.0)	2 (66.7)	1 (33.3)	3 (100)
Admin	0 (0.0)	1 (100)	0 (0.0)	1 (100)
Other	0 (0.0)	0 (0.0)	1 (100)	1 (100)
Pediatrics Surgery Resident	0 (0.0)	1 (100)	0 (0.0)	1 (100)
Surgeon	0 (0.0)	0 (0.0)	1 (100)	1 (100)
Total	10 (13.9)	27 (37.5)	35 (48.6)	72 (100)

Association Between Knowledge of ERAS and Years of Experience

Welch's ANOVA revealed that there was no statistically significant difference among the experience groups ($F = 0.126$, $df1 = 2$, $df2 = 5.00$, $p = 0.884$). The group with less than five years' experience obtained the highest mean score (58.7 ± 10.9), then came the group with five to ten years (58.1 ± 12.3), and lastly the group with more than ten years (50.3 ± 28.0).

Table 5. ERAS Knowledge Scores by Years of Professional Experience Among Pediatric Surgery Stakeholders in Sudan, 2026 (n = 72)

Experience	n	Mean $\pm$ SD
<5 years	52	58.7 $\pm$ 10.9
5–10 years	17	58.1 $\pm$ 12.3
>10 years	3	50.3 $\pm$ 28.0

NARRATIVE ANALYSIS OF QUALITATIVE FINDINGS

Two focus group interview with pediatric surgeons and fellows and two in-depth interviews were conducted to examine topics of policy and readiness, implementation, barriers, enablers, and the sustainability of pediatric ERAS in Sudan and results were categorized under three themes; a system that is willing but not prepared, the gap between awareness and formal adoption, and the need for a structured, multidisciplinary approach to implementation.

Theme One: Willingness Without Structure

Clinicians were willing to implement ERAS. However, there is no formal framework to enable them to do so. The participants pointed out that there is a shortage of suitable facilities, such as neonatal intensive care units, specialized hospitals for children and regular multidisciplinary coordination. The hospital manager agreed with this, stating that some aspects of ERAS are already in place despite the lack of clear written guidelines which match that just 12.5% of the people who took the survey stated that they had a documented ERAS protocol.

Theme Two: Workforce and Resource Constraints

The interviews pointed to serious shortcomings in terms of resources and staffing, consisting of a lack of pediatric anaesthesia personnel, insufficient ventilator capacity, an inadequate number of nursing staff, and frequent power cuts in the nursery. These results support the quantitative list of barriers, in which insufficient nursing staff and a lack of hospital resources were among the top ten obstacles.

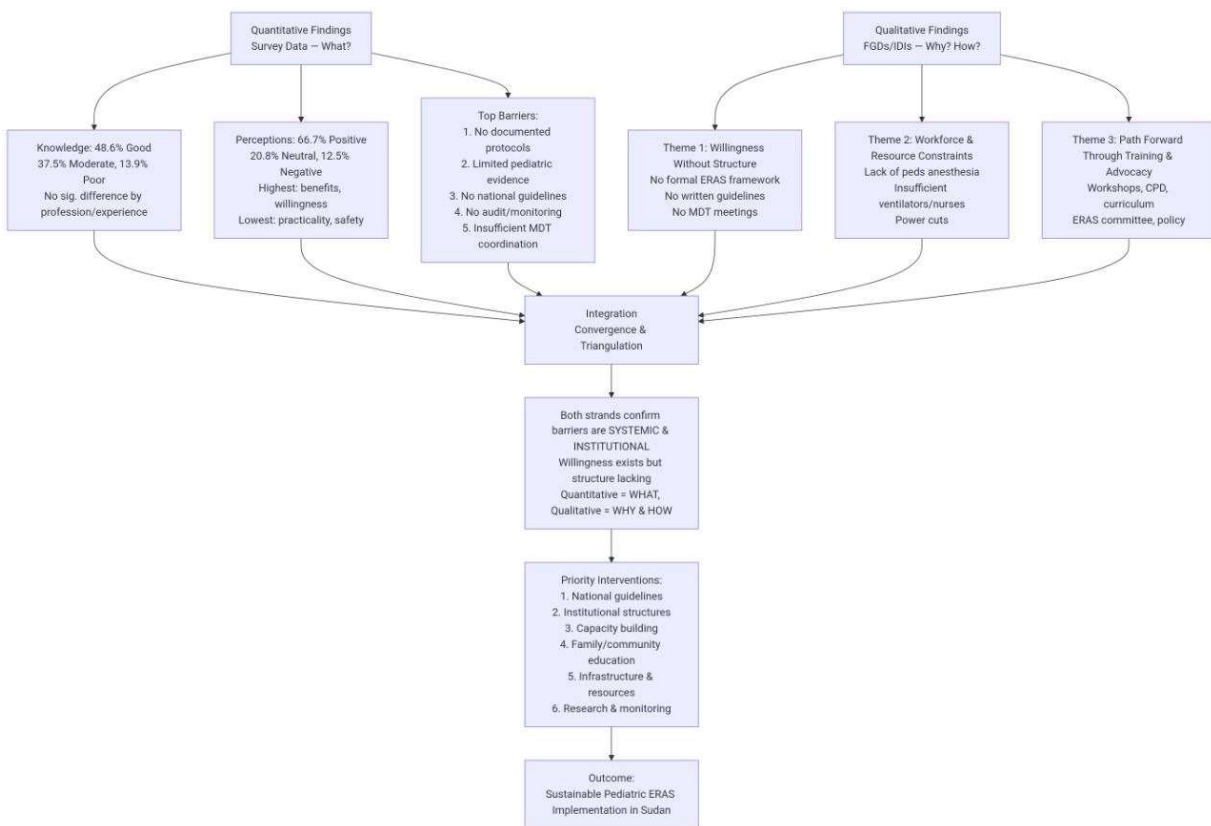
Theme Three: The Path Forward Through Training and Advocacy

All qualitative sessions provided specific recommendations regarding implementation and sustainability that included: frequent workshops on pediatric ERAS, expansion of training to include general surgeons who carry out operations on children, and that caregivers and families should be involved. The IDIs highlighted various factors that facilitate success, such as staff who are cooperative and motivated, and proposed incentives like the awarding of continuing professional development points and the organisation of structured workshops, to involve senior surgeons and anaesthetists by means of grand rounds and academic meetings, to encourage research and authorship as a form of incentive, to foster an ERAS culture in all academic activities, to get the Federal Ministry of Health involved, to engage the community by means of health education, to set up an ERAS committee as a monitoring body, and to reward departments that comply with the principles by giving them the opportunity for overseas training.

Integration of Quantitative and Qualitative Findings

Put together, the results of the quantitative survey indicate a moderate level of knowledge, and generally favourable perception, and barriers which are most pronounced at the systemic and institutional levels. The qualitative data explained the mechanisms that account for these patterns. While the quantitative data identified the state, the qualitative data stressed the necessity to produce and spread a national paediatric ERAS guideline and set up official multidisciplinary teams and audit systems at the hospital level. Moreover, the findings suggested a need to devote resources to training, especially that of anaesthesia and nursing staff, and to incorporate ERAS into the paediatric surgery curriculum. Finally, the need to involve policymakers and hospital leadership so that ERAS is no longer viewed as an optional clinical preference but rather as a standard of care.

Figure 3. Integration of Quantitative and Qualitative Findings on Factors Affecting ERAS Protocol Implementation in Pediatric Surgical Practice in Sudan, 2026



DISCUSSION

The aim of this study was to look at the factors influencing the implementation of pediatric Enhanced Recovery After Surgery protocols in Sudan, with a specific focus on the knowledge, attitudes, and perceived difficulties held by the various members of a multidisciplinary team. The results show that the workforce is generally aware of ERAS and mostly in favour of its principles but is hindered by structural and institutional restrictions which stop the protocols from being formally adopted. This is in broad agreement with what is already known from the literature. In Pakistan, Ahmad and colleagues found that 85% of clinicians were aware of ERAS but only 61% had put it into practice [7].

Likewise, Shamsaldeen and colleagues stated that 58.1% had only a limited level of practice, with 38.8% not being familiar with the ERAS guidelines [8]. Participants had positive perception. The barriers, on the other hand, were mainly at the system and institutional levels, especially due to the lack of written protocols, the limited availability of evidence that is specific to children, and the absence of national guidelines. This is in keeping with the findings of Haid et al, who observed that paediatric ERAS concepts are still not widely incorporated into routine training and that awareness of protocol elements tends to lag behind general familiarity with the ERAS label [2]. Which are also aligning with those of Haseeb et al, who found that clinicians in similar resource settings are often familiar with the general ERAS concepts but not with the specific protocol components [8]. The study revealed no statistically significant link between knowledge category and profession or years of experience, the same pattern was noted by Shinnick et al, who maintained that the implementation of pediatric ERAS is more limited by the availability of pediatric-specific evidence and training than by the capacity of individual clinicians [94].

The perception of the participants regarding ERAS was generally positive, which match the results of Davis et al, who found that clinicians always saw ERAS as being of benefit even if its implementation had been limited [10]. Also, Wang et al. found that clinicians generally supported ERAS but were reluctant to put it into practice [11]. Our results indicate that a similar situation exists in Sudan.

The barrier analysis yielded that the top three barriers were the lack of documented ERAS protocols, limited knowledge of the ERAS evidence specific to children, and the absence of national guidelines. Which agrees with Riad et al. Findings that identified structural factors rather than by resistance from clinicians [18]. The findings correspond with the views of Balfour et al, who claimed that nursing shortages and workload are among the most overlooked obstacles to the implementation of ERAS [3]. The scores for barriers at the patient and family level were relatively low. Similar conclusions were reached by Perez and Raval, stressing the importance of family-centred communication in paediatric ERAS [13].

The qualitative data showed a few important enablers, namely; cooperative and motivated staff, the possibility of offering incentives for continuing professional development, and regular workshops. That is in line with Smith et al findings that ERAS implementation succeeds only when it is embedded in the institutional culture [14]. The study endorsed the importance to start with the smallest number of resources and then check the experience as time goes on. Ljungqvist et al. who have stated that ERAS should not be seen as a fixed protocol but rather as a flexible framework which can be adapted to the local situation while keeping its essential features [15].

IMPLICATIONS

This study has several practical implications. Nationally, there is a clear requirement for a Sudanese paediatric ERAS guideline and support individual hospitals to draw up written ERAS protocols, set up multidisciplinary teams, and establish audit and feedback systems. On an individual basis, training programmes should be widened with special attention being paid to anaesthesia and nursing staff who are frequently underrepresented in ERAS education. Furthermore, resources should be allocated to educating caregivers via outpatients' departments and through community channels.

LIMITATIONS

The study limitations include the small sample size this reduces the statistical power of the inferential analyses; the cross-sectional design that is unable to show any changes in knowledge, perception or implementation over time; self-reported data that could be subjected to bias. Although thematic saturation had been achieved, a bigger qualitative sample would have increased the depth of the findings. lastly, the ongoing conflict in Sudan and the resulting instability of the healthcare infrastructure might have influenced the results.

CONCLUSION

Knowledge and attitudes are generally positive, but that implementation is hindered by structural and institutional obstacles. The qualitative data give a clear plan of action that involves training, multidisciplinary cooperation, policymaking, and carrying out implementation in a step-by-step manner making use of the resources at hand. These results form the basis for the development of national guidelines, for reforming the curriculum, and for advocacy activities intended at improving surgical outcomes for children in Sudan and in other low-resource settings.

RECOMMENDATIONS

Based on the findings of this study, several recommendations are proposed: For clinical practice, Hospitals should establish multidisciplinary pediatric ERAS teams, develop and implement written pediatric ERAS protocols adapted to local resources and practice settings with regular audit to evaluate compliance with ERAS components and identify areas requiring improvement. In education, Structured ERAS training programs, workshops, and continuing professional development activities should be conducted. Institutional leadership should prioritize ERAS implementation. Further multi center studies with larger samples, qualitative research to explore parent and caregiver perspectives.

ACKNOWLEDGEMENTS

I am deeply grateful to The Operating Room Global (TORG) for providing an enriching research fellowship platform that fostered learning, collaboration, mentorship, and professional development. I would like to express my sincere and profound gratitude to my mentor, Dr. Megbar Dessalegn, for his invaluable mentorship, professional guidance, continuous encouragement, and unwavering support throughout the TORG Research Fellowship journey. My heartfelt appreciation is also extended to Dr. Myada Ibrahim for her insightful guidance, thoughtful recommendations, and generous support throughout the development of this research.

AUTHOR CONTRIBUTIONS (CRediT)

Dr. Hani E. Bilal participated in the conception and design of the study, data collection, data analysis, interpretation of the results, and preparation of the manuscript. Dr. Megbar Dessalegn, who supervised, provided guidance throughout the research process, participated in the design of the study and the interpretation of the results, and critically revised and reviewed the manuscript. Both authors approved the final version of the manuscript.

CONFLICT OF INTERESTS

The authors declare no conflicts of interests.

FUNDING STATEMENT

This work did not receive any grant from funding agencies in the public, commercial or not-for-profit sectors.

AVAILABILITY OF DATA AND MATERIAL

The data sets used and analyzed during the study are available from the corresponding author on reasonable request.

LIST OF ABBREVIATIONS AND ACRONYMS

ANOVA; Analysis of Variance, CFIR; Consolidated Framework for Implementation Research, CPD; Continuing Professional Development, ERAS; Enhanced Recovery After Surgery, FGD; Focus Group Discussion, IDI; In-Depth Interview, LMICs; Low- and Middle-Income Countries, PI; Principal Investigator, SPSS; Statistical Package for the Social Sciences, TORG; The Operating Room Global, TORG-IRB; The Operating Room Global Institutional Review Board, WHO; World Health Organization, SMSB; Sudan Medical Specialization Board, SAPS; Sudan Association of Pediatric Surgeons.

ETHICAL APPROVAL

The study received ethical approval from the TORG Institutional Review Board (Reference No. TORG-IRB/2026/032801; 04 June 2026) and local authorization from the Sudan National Research Ethics Committee (Reference No. RA017082026). Informed consent was obtained from all participants. For online surveys, consent was indicated electronically by selecting "I Agree," while written or recorded verbal consent was obtained for FGDs and IDIs. Participant data were anonymized and handled confidentially. Participants were informed of a complaints mechanism through which they could contact the Principal Investigator or the TORG-IRB Ethics Chair.

ARTIFICIAL INTELLIGENCE USE DECLARATION

Generative AI tools were applied to the manuscript during preparation for the purposes of language refinement, grammatical correction, clarification of sentence construction, and assistance with the organisation of the written content. The design of the research, data collection, statistical analysis, interpretation of data, scientific conclusions, and final intellectual content are undertaken and verified by the author of this manuscript. The author is solely responsible for the accuracy of this work.

REFERENCES

1. Zhu W, Lai H, He Z, Zhang Y, Guo Q, Zhong W, Ye L, Qiu J, Wang D. Obstacles and sustainability of enhanced recovery after surgery in pediatric laparoscopic pyeloplasty. *Front Pediatr*. 2024 Dec 3;12:1437262. doi: 10.3389/fped.2024.1437262. PMID: 39691385; PMCID: PMC11651159.
2. Haid B, Lusuardi L, Oswald J. „Enhanced recovery after surgery“ – ein Konzept auch im Kindesalter [Enhanced recovery after surgery-a concept, also in pediatrics]. *Urologe A*. 2020 Mar;59(3):294-299. German. doi: 10.1007/s00120-020-01114-y. PMID: 31980855.
3. Balfour A, Amery J, Burch J, Smid-Nanninga H. Enhanced recovery after surgery (ERAS®): Barriers and solutions for nurses. *Asia Pac J Oncol Nurs*. 2022 Feb 22;9(7):100040. doi: 10.1016/j.apjon.2022.02.002. PMID: 35647226; PMCID: PMC9130527.
4. Shinnick JK, Short HL, Heiss KF, Santore MT, Blakely ML, Raval MV. Enhancing recovery in pediatric surgery: a review of the literature. *J Surg Res*. 2016 May 1;202(1):165-76. doi: 10.1016/j.jss.2015.12.051. Epub 2016 Jan 12. PMID: 27083963.
5. Suliman A, Ali S, Suliman H, Mohammed L, Ahmed M, Hamza A. Transforming surgical outcomes in conflict zones: A closed-loop audit of ERAS protocols for emergency laparotomy. *Curr Probl Surg*. 2026 Mar;76:101983. doi: 10.1016/j.cpsurg.2026.101983. Epub 2026 Jan 13. PMID: 41796524.
6. Kifle F, Kenna P, Daniel S, Maswime S, Biccadd B. A scoping review of Enhanced Recovery After Surgery (ERAS), protocol implementation, and its impact on surgical outcomes and healthcare systems in Africa. *Perioper Med (Lond)*. 2024 Aug 2;13(1):86. doi: 10.1186/s13741-024-00435-2. PMID: 39095850; PMCID: PMC11297632.
7. Ahmad H, Shehdio W, Tanoli O, Deckelbaum D, Pasha T. Knowledge, Implementation, and Perception of Enhanced Recovery After Surgery Amongst Surgeons in Pakistan: A Survey Analysis. *Cureus*. 2023 Sep 26;15(9):e46030. doi: 10.7759/cureus.46030. PMID: 37900487; PMCID: PMC10602762.
8. Shamsaldeen A, Mohd Taha A, Mohammed A, Alsidig S, Ibrahim M. Knowledge, attitudes, and practices of Sudanese doctors regarding enhanced recovery after surgery protocols in elective abdominal and pelvic surgery: a cross-sectional study. *Ann Med Surg (Lond)*. 2026 Jan 21;88(2):1338-1345. doi: 10.1097/MS9.0000000000004722. PMID: 41675907; PMCID: PMC12889500.
9. Rincon Mora SA. Enhanced Recovery After Surgery Protocols in Pediatric Surgery: A Narrative Review of Current Evidence. *Cureus*. 2026 Jan 4;18(1):e100748. doi: 10.7759/cureus.100748. PMID: 41640930; PMCID: PMC12867072.
10. Davis TL, Schäfer WLA, Blake SC, Close S, Balbale SN, Perry JE, Zarate RP, Ingram M, Strople J, Johnson JK, Holl JL, Raval MV. A qualitative examination of barriers and facilitators of pediatric enhanced recovery protocol implementation among 18 pediatric surgery services. *Implement Sci Commun*. 2022 Aug 18;3(1):91. doi: 10.1186/s43058-022-00329-8. PMID: 35982503; PMCID: PMC9389824.
11. Wang D, Liu Z, Zhou J, Yang J, Chen X, Chang C, Liu C, Li K, Hu J. Barriers to implementation of enhanced recovery after surgery (ERAS) by a multidisciplinary team in China: a multicentre qualitative study. *BMJ Open*. 2022 Mar 14;12(3):e053687. doi: 10.1136/bmjopen-2021-053687. PMID: 35288383; PMCID: PMC8921855.
12. Smith TW Jr, Wang X, Singer MA, Godellas CV, Vaince FT. Enhanced recovery after surgery: A clinical review of implementation across multiple surgical subspecialties. *Am J Surg*. 2020 Mar;219(3):530-534. doi: 10.1016/j.amjsurg.2019.11.009. Epub 2019 Nov 16. PMID: 31761300.
13. Gottumukkala V, Joshi GP. Challenges and opportunities in enhanced recovery after surgery programs: An overview. *Indian J Anaesth*. 2024 Nov;68(11):951-958. doi: 10.4103/ija.ija_546_24. Epub 2024 Oct 26. PMID: 39659530; PMCID: PMC11626874.
14. Taylor CM, Weisberg EL, Doyle NM, Glenski TA. Error Traps in Developing a Pediatric Enhanced Recovery After Surgery (ERAS) Program. *Paediatr Anaesth*. 2025 Mar;35(3):199-206. doi: 10.1111/pan.15042. Epub 2024 Nov 23. PMID: 39579001.
15. Arena S, Di Fabrizio D, Impellizzeri P, Gandullia P, Mattioli G, Romeo C. Enhanced Recovery After Gastrointestinal Surgery (ERAS) in Pediatric Patients: a Systematic Review and Meta-analysis. *J Gastrointest Surg*. 2021 Nov;25(11):2976-2988. doi: 10.1007/s11605-021-05053-7. Epub 2021 Jul 9. PMID: 34244952.

16. Haseeb A, Zeb M, Darain K, Ali H, Ahmad R, Shah J, Bakhtiar Khan H, Raheel M, Muhammad D. Understanding Perceptions, Knowledge and Implementation Barriers of Enhanced Recovery After Surgery Among Surgeons and Anesthesiologists. *Cureus*. 2025 Feb 24;17(2):e79595. doi: 10.7759/cureus.79595. PMID: 40151758; PMCID: PMC11947496.
17. Ljungqvist O, Scott M, Fearon KC. Enhanced Recovery After Surgery: A Review. *JAMA Surg*. 2017 Mar 1;152(3):292-298. doi: 10.1001/jamasurg.2016.4952. PMID: 28097305.
18. Meara JG, Leather AJ, Hagander L, Alkire BC, Alonso N, Ameh EA, Bickler SW, Conteh L, Dare AJ, Davies J, Mérisier ED, El-Halabi S, Farmer PE, Gawande A, Gillies R, Greenberg SL, Grimes CE, Gruen RL, Ismail EA, Kamara TB, Lavy C, Lundeg G, Mkandawire NC, Raykar NP, Riesel JN, Rodas E, Rose J, Roy N, Shrimel MG, Sullivan R, Verguet S, Watters D, Weiser TG, Wilson IH, Yamey G, Yip W. Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *Lancet*. 2015 Aug 8;386(9993):569-624. doi: 10.1016/S0140-6736(15)60160-X. Epub 2015 Apr 26. PMID: 25924834.
19. Riad AM, Barry A, Knight SR, Arbaugh CJ, Haque PD, Weiser TG, Harrison EM. Perioperative optimisation in low- and middle-income countries (LMICs): A systematic review and meta-analysis of enhanced recovery after surgery (ERAS). *J Glob Health*. 2023 Oct 3;13:04114. doi: 10.7189/jogh.13.04114. PMID: 37787105; PMCID: PMC10546475.
20. Perez MN, Raval MV. Evolution of enhanced recovery for children undergoing elective intestinal surgery. *Semin Pediatr Surg*. 2024 Apr;33(2):151400. doi: 10.1016/j.sempedsurg.2024.151400. Epub 2024 Mar 28. PMID: 38608432.
21. Alemam A, Abosheisha M, Tamanna R, Abdelglil M, Ali M, Swealem A, Bin Halim S, Samad Hasan MA, Ismaiel M. Innovative Techniques and Outcomes in Pediatric and Neonatal Thoracic Surgery: A Comprehensive Narrative Review of Current Practices and Future Directions. *Cureus*. 2025 Aug 30;17(8):e91294. doi: 10.7759/cureus.91294. PMID: 41030723; PMCID: PMC12478633.

CITE THIS ARTICLE:

- **APA (7th edition):** Bilal, H. E., & Dessalegn, M. (2026, October 25). Factors affecting the implementation of enhanced recovery after surgery (ERAS) protocols in pediatric surgery practice in Sudan – 2026: A mixed methods study. *The Operating Room Global Journal (TORGJ)*, 2(4), 77–89. <https://doi.org/10.64573/torgj2610006>
- **Harvard:** Bilal, H.E. and Dessalegn, M., 2026. Factors affecting the implementation of enhanced recovery after surgery (ERAS) protocols in pediatric surgery practice in Sudan – 2026: A mixed methods study. *The Operating Room Global Journal (TORGJ)*, 2(4), pp. 77–89. Available at: <https://doi.org/10.64573/torgj2610006>
- **Vancouver:** Bilal HE, Dessalegn M. Factors affecting the implementation of enhanced recovery after surgery (ERAS) protocols in pediatric surgery practice in Sudan – 2026: a mixed methods study. *The Operating Room Global Journal (TORGJ)*. 2026 Oct 25;2(4):77–89. <https://doi.org/10.64573/torgj2610006>
- **MLA (9th edition):** Bilal, Hani E., and Megbar Dessalegn. "Factors Affecting the Implementation of Enhanced Recovery After Surgery (ERAS) Protocols in Pediatric Surgery Practice in Sudan – 2026: A Mixed Methods Study." *The Operating Room Global Journal (TORGJ)*, vol. 2, no. 4, 25 Oct. 2026, pp. 77–89. <https://doi.org/10.64573/torgj2610006>
- **Chicago (Author-Date):** Bilal, Hani E., and Megbar Dessalegn. 2026. "Factors Affecting the Implementation of Enhanced Recovery After Surgery (ERAS) Protocols in Pediatric Surgery Practice in Sudan – 2026: A Mixed Methods Study." *The Operating Room Global Journal (TORGJ)* 2 (4): 77–89. <https://doi.org/10.64573/torgj2610006>