

Predictors of mortality and short-term outcomes after emergency pediatric abdominal surgery in South-Western Uganda

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To cite: Okello JA, Oyania F, Dreque CC, *et al.* Predictors of mortality and short-term outcomes after emergency pediatric abdominal surgery in South-Western

Uganda. *World J Pediatr Surg* 2026;**9**:e001112. doi:10.1136/wjps-2025-001112

► Additional supplemental material is published online only. To view, please visit the journal online (<https://doi.org/10.1136/wjps-2025-001112>).

Received 1 October 2025

Accepted 19 January 2026

ABSTRACT

Background Emergency abdominal surgeries (EASs) in children are often necessary to address life-threatening congenital and acquired conditions. This study aimed to determine short-term outcomes and predictors of in-hospital mortality after EAS in children at Mbarara Regional Referral Hospital (MRRH), South-Western Uganda.

Methods This prospective study was conducted from June to September 2024 and included children aged 0–17 years who underwent EAS at MRRH. Outcomes measured were 30-day in-hospital mortality, complications, and length of hospital stay. Overall survival after EAS was plotted using Kaplan-Meier curves. Cox regression analysis was used to determine predictors of in-hospital mortality after EAS.

Results The 30-day mortality rate for all pediatric abdominal surgery was 152 per 10 000 person-days of hospitalization. Among 96 children who required EAS at MRRH, the risk of death was significantly increased in those who had hypoxemia (adjusted hazard ratio (aHR) 12.4, $p=0.011$) and hypokalemia (aHR 5.02, $p=0.044$). Forty-one patients (42.7%) developed postoperative complications, the most common being surgical site infection (14.58%) and pneumonia (5.2%).

Conclusion The 30-day mortality rate after pediatric EAS in our setting is high and children who present with hypokalemia and hypoxemia are at increased risk of mortality after EAS.

INTRODUCTION

Globally, 2.4%–3.1% of all admissions in children under 18 years are due to abdominal surgical emergencies.¹ In sub-Saharan Africa, pediatric emergency abdominal surgeries (EASs) account for 6%–12% of all emergency surgical conditions, with an even higher prevalence in rural areas.¹ Common indications for EAS include intussusception, anorectal malformation and Hirschsprung's disease, incarcerated or strangulated inguinal hernia, typhoid intestinal perforation, appendicitis, abdominal trauma, and adhesive bowel obstruction.^{2 3} Postoperative complications include respiratory tract infection, paralytic

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Mortality following pediatric emergency abdominal surgery is higher in developing compared with developed countries.

WHAT THIS STUDY ADDS

⇒ Presurgical hypokalemia and hypoxemia independently increased the risk of mortality after pediatric abdominal surgery in South-Western Uganda.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study highlights the importance of incorporating pediatric critical care services to all pediatric surgical units in low-middle-income countries. This requires the implementation of a 'preoperative resuscitation bundle' including electrolyte correction, assessment of oxygen saturation, and routine monitoring of these parameters for all surgical admissions.

ileus, anastomotic leaks, surgical site infection (SSI), and multiple organ failure, with an overall mortality rate of 10.1% associated with EAS in children in Nigeria.^{3 4} The high mortality after EAS is linked to factors such as neonatal age, admission to surgical intervention time >72 hours, severe postoperative complications, limited access to timely healthcare, a shortage of skilled medical professionals, inadequate infrastructure, primary pathology requiring surgery, electrolyte imbalance in the form of hypokalemia and hyponatremia, and also low hemoglobin (Hb) levels.^{1 4 5}

Whereas outcomes in children after EAS may vary from center to center, for Mbarara Regional Referral Hospital (MRRH), this remains undocumented. The factors associated with in-hospital mortality at MRRH after EAS have not been studied. Therefore, we aimed to determine both the short-term outcomes and predictors of in-hospital



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mortality after EAS in children at MRRH. We believe these data will inform decision-making to reduce morbidity and mortality by helping hospital staff better anticipate and manage these cases. It will also identify areas for improvement in the response of MRRH to pediatric abdominal surgical emergencies.

METHODS

We conducted a prospective cohort study at the Accident and Emergency surgical unit, pediatric surgical and general surgical wards of MRRH. This study included all children 0–17 years of age who underwent EAS at MRRH between June and September 2024 whose parents or carers had consented to be included in our study.

Sample size

The postoperative mortality rate was estimated using the formula for estimation of a proportion from a single population (Cochran, 1963): $n = Z^2 pq/d^2$. Where: n =the minimum required sample size; Z =standard normal deviation at the desired confidence interval (95% CI), so Z was 1.96; p =Proportion of the children who die within 1 month after EAS (6% estimated from a study in rural Ghana)⁶; q =Proportion of the population without the desired characteristic ($1-p$); d =the level of precision (margin of error). We desired to have a 5% precision. Substituting the formula above using the Open-Epi online calculator gave a sample size of 87 children. Adjusting for a 10% expected loss to follow-up or attrition gave a sample size of 96 participants.

Study procedures and data collection

Participants were recruited by trained staff as soon as the decision to perform EAS was made by a surgeon. For children in a critical condition, consent was sought from parents or carers after resuscitation and with appropriate carer reassurance. Researchers were trained by a clinical psychologist to recognize signs of emotional distress and how to appropriately counsel anxious carers prior to data collection. Where this was not possible, participants were enrolled within 24 hours from the time the decision to perform surgery was made.

A structured questionnaire-guided interview was conducted to obtain demographic information and duration of symptoms before admission. Participant medical files were reviewed to collect the following data: preoperative clinical information, American Society of Anesthesiologists (ASA) classification, complete blood count, serum electrolytes, supportive treatment in the preoperative period, and indication for EAS. In addition, data on type of surgery performed and intraoperative findings were extracted from the operative notes.

Each participant was followed up until discharge, referral out, or in-hospital death with a maximum follow-up time of 30 days. Hospital follow-up or observation continued up to 30 days post-EAS for the participants who remained hospitalized.

Outcome measurements

Primary outcome was a 30-day in-hospital mortality. This was determined by calculation of Kaplan-Meier estimates of the failure function at 30 days after EAS. Observation started on the date of surgery and ended at death or discharge. Those who were still hospitalized beyond 30 days were censored on the 30th postoperative day. Survival time was measured in days. Those who self-discharged or were referred out of the hospital were censored on the date of discharge.

Our secondary outcomes were complications and length of stay (LOS). Complications associated with EAS (surgical site infection and paralytic ileus) were summarized in frequencies and proportions. LOS was calculated from survival analysis because for some participants, discharge was treated as the outcome event and death was a competing event. Participants were observed from the date of surgery to the date of discharge alive. Those who were discharged or referred were counted on the days they were last seen in hospital, while those who died were counted at the end of the observation period (30 days) since death was a competing event to discharge from the hospital.

Definitions for diagnostic thresholds of key variables

1. Pulse rate normal range; 0–28 days (100–205 bpm), 1 month to 1 year (100–180 bpm), 1–3 years (98–140), 3–5 years (80–120 bpm), 5–12 years (75–118 bpm), 13–17 years (60–100 bpm) taken by pulse oximetry.
2. Normal oxygen saturation (SpO_2), considered to be 90% and above; hypoxemia is considered as $SpO_2 < 90\%$ taken by pulse oximetry.
3. Normal serum potassium is considered to be: 0–1 month (3.9–5.9 mmol/L), 1 month to 1 year (4.1–5.3 mmol/L), 1–17 years (3.4–4.7 mmol/L).
4. Normal white cell count (WCC) ($\times 10^9$ cells/L) is considered to be: 0 day to 1 week (9–34), 1 week to 1 month (5–19.5), 1 to 23 months (5–17.5), 2 to 5 years (6–15.5), 6 to 12 years (4.5–13.5), 13 to 17 years (4.5–11).

Statistical analysis

STATA V.17.0 software (Stata) was used for cleaning and analysis. Baseline participant data was summarized in the form of proportions and frequency tables for categorical variables. For continuous variables, data were reported as median and interquartile range (IQR). Normality of continuous data was assessed using the Shapiro-Wilk test with a p value of 0.05 along with inspection of box plots.

Factors associated with in-hospital mortality after EAS were determined using Cox regression analysis. Bivariable analysis was performed to determine crude hazard ratio (HR) for each putative factor associated with in-hospital mortality. Those with a p value of 0.2 and below and/or those that were deemed to have high scientific plausibility were taken to the multivariable level for analysis. Those whose adjusted HRs had p values of 0.05 and below were taken as significant. The proportionality of

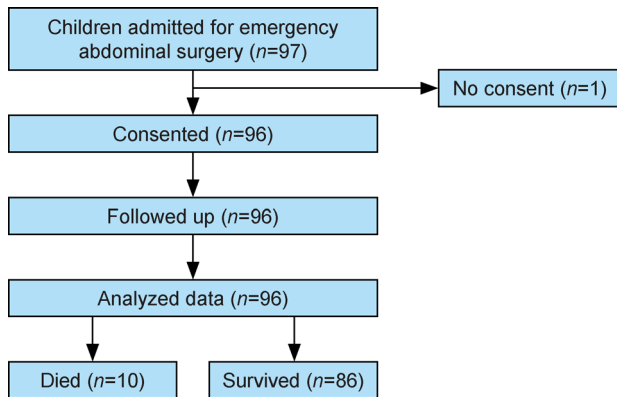


Figure 1 Study flow chart.

hazard assumptions was checked by plotting the Schoenfeld residuals as a function of time for each variable. The Proportionality of Hazards test was run for the overall chosen model with a global test p value threshold of 0.05. Multicollinearity was checked for in the final model from a postestimation correlation matrix.

RESULTS

Baseline sociodemographic characteristics of participants

The overall study flow is summarized in the Consolidated Standards of Reporting Trials (CONSORT) diagram (figure 1). Among 96 included patients, 58 (60.4%) were male, and the majority (67%) were 5 years of age and below. The median age was 1 year (IQR: 2–84 months). The youngest participant was 1 day old, while the oldest was 204 months (17 years) old. Eighty-two (85.42%) were from the Ankole region (table 1).

Surgical characteristics of participants

The majority of the patients (58.3%) were referrals from other health facilities. Median duration of symptoms before presenting to our facility was 72 hours (IQR: 24–96 hours). The shortest duration was 2 hours, while the patient with the longest symptom duration took 336 hours (14 days) before presenting to our facility. 73.95% of patients were operated on within 24 hours of arrival, and 49% of the surgeries were performed by an attending general surgeon or pediatric surgeon as the main surgeon. Ten (10.42%) were operated on without administration of preoperative antibiotics (Table 2). All patients were administered postoperative antibiotics.

The most common indication for EAS was intussusception (33.33%), followed by anorectal malformations (14.58%) and appendicular abscess (10.42%).

Mortality after pediatric EAS at MRRH

Of the 96 children whose records were reviewed, 10 died, giving a crude mortality of 10.42% (table 3). Kaplan-Meier estimator of the 30-day in-hospital cumulative mortality rate was 19.54%. We identified a mortality rate of 15 deaths per 1000 person-days of hospitalization after EASs for a total time at risk of 658.56 days (table 3). The

Table 1 Baseline characteristics of study participants

Characteristic	Frequency, n (%)
Sex	
Male	58 (60.40)
Female	38 (39.60)
Age	
<1 month	22 (22.92)
>1–11 months	25 (26.04)
1–5 years	17 (17.70)
>5 years	32 (33.30)
Location	
Rural	81 (84.40)
Urban	15 (15.60)
Region	
Ankole	82 (85.42)
Others	14 (14.58)
Caregiver	
Mother	77 (80.21)
Father	14 (14.58)
Others	5 (5.21)
Caregiver education	
No formal education	23 (23.96)
Primary	42 (43.75)
Secondary	21 (21.87)
Tertiary	10 (10.41)

Kaplan-Meier survival curve after pediatric EAS shows that most deaths occurred within a week post-EAS (figure 2).

Complications of pediatric EAS at MRRH

The overall incidence for all postoperative complications was 42.71%. The most common postoperative complication was SSI, which involved 14 of the 96 participants (14.58%), followed by pneumonia with 5 participants (5.2%). Two participants developed paralytic ileus, two developed postoperative intra-abdominal abscess, and two developed respiratory failure of unknown or undocumented cause prior to death (all 2.1%). One of these patients was anemic preoperatively and died after receiving a postoperative blood transfusion. None of the participants developed an anastomotic leak during the study period.

Predictors of in-hospital mortality after pediatric EAS at MRRH

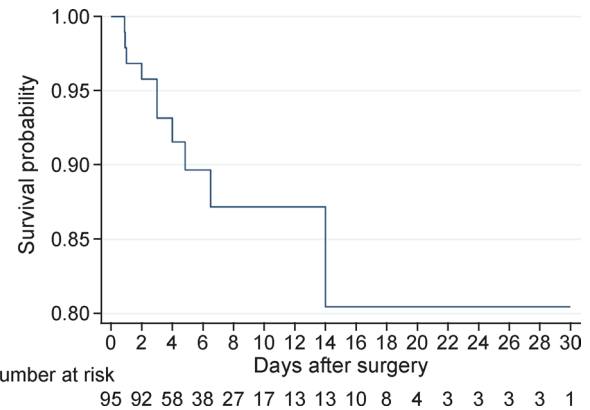
Bivariable analysis

Preoperative hypokalemia increased the risk of mortality by more than three-fold (crude HR (cHR) 3.65, 95% CI 1.05 to 24.19, $p=0.042$). Low preoperative Oxygen saturation (SpO_2) also increased the risk of postoperative death by more than ten-fold (cHR 14.67, 95% CI 3.75 to 57.48, $p<0.001$). In addition, preoperative fever also increased

Table 2 Surgical characteristics of study participants

Characteristic	Frequency, n (%)
Referral status	
Referred	56 (58.33)
Non-referred	40 (46.67)
Duration of symptoms	
Within 24 hours	27 (28.13)
After 24 hours	69 (71.88)
Admission to surgery time	
Within 24 hours	71 (73.95)
After 24 hours	25 (26.04)
Main surgeon	
Resident	46 (47.92)
Fellow	1 (1.04)
Attending	49 (51.04)
Preoperative antibiotic	
No	10 (10.42)
Yes	86 (89.58)
Postoperative blood transfusion	
No	60 (62.50)
Yes	36 (37.50)
ASA grade	
1 or 2	51 (53.13)
3 or 4	45 (46.88)
Wound type	
Clean	0 (0.00)
Clean contaminated	52 (54.17)
Contaminated	13 (13.54)
Dirty wound	31 (32.29)

ASA, American Society of Anesthesiologists.

**Figure 2** Survival curve after emergency pediatric abdominal surgery at MRRH. MRRH, Mbarara Regional Referral Hospital.

the risk of postoperative death by more than four-fold (cHR 4.52, 95% CI 1.16 to 17.56, $p=0.029$). Age, sex, rural home location, duration of symptoms before surgery, qualification of the main surgeon performing the procedure, preoperative pulse rate, Hb, WCC, bowel gangrene, and bowel perforation category did not significantly alter the risk of death (online supplemental table 1).

Multivariable analysis

For multivariate analysis, referral status, education level of caregivers, admission to surgery interval, fever, ASA category, pulse oximetry, bowel gangrene, bowel perforation, Hb, and presence of hypokalemia were fitted to a Cox-proportional hazards regression model. Referral status, education level of caregivers, and bowel perforation categories were dropped from the final model because of multicollinearity.

Patients who presented with preoperative hypokalemia were at five-fold greater risk of death compared with those who did not have hypokalemia before surgery (adjusted HR (aHR) 5.02, 95% CI 1.04 to 24.19, $p=0.044$). Similarly,

Table 3 Disease-specific mortality after pediatric emergency abdominal surgery at MRRH

Condition	Followed up	Died	Case fatality rate (%)	Mortality rate (95% CI)	Person-time
Overall	95	10	10.42	0.01520 (0.0082 to 0.0282)	658.56
Intussusception	31	2	6.45	0.01360 (0.0033 to 0.0543)	147.14
Appendicitis	2	0	0.00	0	18.33
Appendicular abscess	3	0	0.00	0	75.17
Small gut perforation (of all etiologies)	15	3	20.00	0.0155 (0.0050 to 0.0480)	193.91
Colonic perforation	2	1	50.00	0.0444 (0.0060 to 0.3155)	22.50
Hirschsprung	7	2	28.60	0.0400 (0.0100 to 0.1601)	49.96
Bowel gangrene (all etiologies)	10	1	10.00	0.0170 (0.0024 to 0.1205)	58.92
Anorectal malformation	14	0	0.00	0	48.54

CI, confidence interval ; MRRH, Mbarara Regional Referral Hospital.

hypoxemia increased the risk of postoperative mortality by more than 10-fold (aHR 12.46, 95% CI 1.77 to 87.85, $p=0.011$) (online supplemental table 1).

DISCUSSION

Mortality outcomes

The 30-day in-hospital mortality after emergency pediatric surgery at our site seems to be relatively high. One reason could be that many of our patients arrive at our facility late. We noted that, on average, patients presented after 72 hours of symptom onset. This is too long for most conditions requiring EAS. Delay in care has been documented to be associated with worse perioperative morbidity and mortality.⁷ Late presentation could be attributed to poor recognition of illness due to lack of awareness, delay in seeking and access to care due to financial issues, lack of adequate transportation, poor parental motivation, and delay in referral from primary first contact physicians due to delay in diagnosis.⁸

Many patients were also at high risk of perioperative morbidity and mortality at arrival, with almost half in ASA category three and above; a predictor of poor postoperative outcomes.^{9,10} The implication of these findings for surgical practice is that any interventions aimed at improving perioperative mortality in children should not only focus on surgical procedures but rather adopt a multipronged approach. This should include addressing bottlenecks for timely access to safe surgical care, improving anesthetic care and perioperative stabilization. These improvements can only be attained through concerted multidisciplinary approaches, as advocated by the Global Initiative for Children's Surgery.¹¹

Mortality of 10.42% in our study is similar to that reported by Kevin Emeka in Nigeria of 7.9%.² The observed similarities may be attributable to comparable case mixes and standards of care between their site and our own. Given that their study was undertaken in a country with similar healthcare resources and population demographics, it is plausible that prognostic patterns and perioperative morbidity and mortality would align with those seen in our facility. Moreover, their patients presented after a similar duration to the majority of ours (about 3 days). In contrast to the present study, their study reported very high mortality in neonates, up to 87.55%. In our study, only 9.09% of neonates died after surgery. This difference could be explained by the fact that they also included neonates with congenital abdominal wall defects, as this is associated with a higher mortality. The majority of our neonates had anorectal malformations and Hirschsprung, which have better survival.¹²

Molla *et al.* reported a lower perioperative mortality of 2.99% in children undergoing emergency surgery, with an incidence of 1.11 deaths per 1000 person days.¹⁰ Their much lower mortality could be due to better standards of perioperative care and the fact that they had a much larger sample of 1171 children; this could have enabled more precise estimates.

A systematic review reported a much lower perioperative mortality of 0.3%–1.5% in children undergoing emergency surgery and 3.6% in neonates.¹³ Moreover, a study also reported much lower perioperative mortality of 13.1 per 10 000 children.¹⁴ Another study in a large pediatric surgical center in South Africa reported a lower mortality of 55.3 per 10 000 cases.¹⁵ This could conceivably be a reflection of the stark contrast in quality, access, and availability of surgical care between high-income countries (HICs) and a resource-limited setting like ours, leading to a reduced postoperative mortality rate in children in their setting. A critical shortage of pediatric intensive care unit beds with inadequate capacity for mechanical ventilation, continuous cardiorespiratory monitoring, low nurse-to-patient ratios, low anesthesia provider-to-patient ratios, and inconsistent serum electrolyte monitoring infrastructure in low-middle income countries (LMICs) results in poor outcomes. By contrast, HICs maintain dedicated pediatric critical care units with high staffing ratios, subspecialty support, and rapid access to advanced interventions capable of advanced monitoring and perioperative optimization, which improves perioperative safety. These differences not only influence mortality but also affect perioperative decision-making,^{12,16,17} with a resulting high difference in postoperative mortality rate compared with resource-poor settings, especially in developing countries, as previously observed in other studies.^{8,18,19} Cronje reported this difference to be as high as 10-fold.²⁰

In contrast, some studies have reported much higher mortality. A study in Nigeria by Talabi *et al.* reported higher mortality rates compared with our study. Indeed, the 30-day mortality of 320 per 10 000 person-days¹⁹ was almost double the 15 deaths per 1000 person-days reported in our study. A possible source of this difference is the inclusion of neonates with congenital defects like gastroschisis, while our study had mainly neonates with Hirschsprung and anorectal malformations; these are associated with lower mortality.¹⁸ The high mortality observed in our study underscores how perioperative resource gaps fundamentally shape pediatric abdominal surgical outcomes in LMICs.

Length of stay

The median hospital LOS was 6 days. We think this is an acceptable duration of hospitalization for EASs in general, as many of these conditions usually require postoperative antibiotics to achieve good postoperative outcomes. In addition, the case mix could have contributed to LOS because the majority of intussusception cases underwent manual reduction. This is associated with fewer complications compared with those with perforations and bowel gangrene. A diverting colostomy in anorectal malformation is usually associated with fewer complications; hence, patients are discharged from the hospital early. Most studies have reported a similar duration of hospitalization in children.²

A much lower LOS of 1 day (range 1–5) compared with our study was reported by Torborg *et al.* in the South African Pediatric Surgical Outcomes study.²¹ We attribute this to differences in institutional management protocols and practices and a lower complication rate in their study. Moreover, there were inter-protocol variations as they followed up the children for a shorter duration than in our study.

Short-term complications

The postoperative complication rate in this study of more than 40% was high. This is likely because the majority (58%) of the children who come to our center for surgery are referrals from other facilities and, therefore, more likely to have complex conditions or delayed presentation. They often arrive more than 24 hours after the onset of symptoms when the early pathophysiologic changes that precipitate complications are already underway. The majority of our clients also presented with conditions that would be classified as dirty or contaminated wounds with expected high levels of postoperative wound complications. We noted that the majority of complications seen after emergency pediatric abdominal surgeries are postoperative wound-related complications.

Kevin Emeka reported a lower complication rate of 22.4% in a Nigerian Teaching Hospital.² This was similar to our study, and they also found SSI to be the most common postoperative complication (11.22%). The South African Pediatric Surgical Outcomes study also identified infective complications or SSI as the most common postoperative complication in Pediatric emergency surgery.²¹ This underscores the observation that most EASs are already potentially infected surgical incisions where integrity of the mucosal barrier of the gut and viscera could already be compromised.

There were no cases of postoperative anastomotic leaks or perforation repair leaks. Many of the children with perforations or gangrenous gut and edema were managed by stoma creation, which could explain the observed favorable outcome. Other studies in Africa have reported higher rates of anastomotic leaks compared with our site, with rates as high as 20.5%.²²

We also observed that some postoperative mortality followed respiratory complications. 5.2% were diagnosed with pneumonia and 2.1% developed unexplained respiratory failure. Respiratory complications are common in children who receive general anesthesia,²³ mostly due to atelectasis and pneumonia. Children with signs of respiratory complications need critical respiratory monitoring and multidisciplinary care, including timely investigation like X-rays to detect complications at the onset.

Predictors of in-hospital mortality

We found that preoperative hypokalemia and hypoxemia are associated with increased postoperative

mortality during hospitalization. The presence of hypokalemia increased the risk of postoperative death fivefold, while low pulse oximetry readings were associated with a more than ten-fold increase. Hypokalemia in the context of abdominal surgical emergencies is known to result from excessive gastrointestinal loss either through vomiting due to bowel obstruction or diarrhea. Hypokalemia can lead to cardiac arrhythmias, muscle weakness, cramping, and paralysis, which can complicate recovery after surgery. Previous studies have documented hypokalemia as a predictor of perioperative mortality in children.^{5 24}

Hypoxemia is a complication of severe sepsis.²⁵ Therefore, hypoxemia is probably a sign of sepsis, complicating a condition requiring EAS. Sepsis had been identified as a major cause of perioperative mortality in African children.

Different studies in Nigerian children have documented sepsis as the major cause of perioperative death.¹⁹ Indeed, Bonasso *et al.* identified sepsis as a major cause of mortality in children operated for necrotizing enterocolitis.¹⁷ The increased mortality seen in children with signs of sepsis at our facility could be an indicator of inadequate detection and/or management of a well-known and usually slowly progressive complication of many abdominal surgical conditions like intestinal obstruction, appendicitis, and abscesses. This is measured using an indicator of the quality of perioperative care: ‘*Failure to Rescue*’. This is the proportion of patients who die after developing a given complication in the perioperative period.²⁶

Delay in accessing healthcare, limited resuscitation resources at lower-level facilities, and constraints in perioperative optimization at the surgical center are all system deficiencies that potentiate hypoxia and hypokalemia. In these situations, underlying conditions like peritonitis and intestinal obstruction can progress to sepsis, dehydration, and respiratory compromise. The eventual consequence for these children may be hypovolemia, acidosis, and hypoxia that predispose to electrolyte derangements like hypokalemia. Routine perioperative pulse oximetry, essential for detecting hypoxemia, is inconsistently available throughout LMIC surgical systems. Similarly, access to timely serum electrolyte testing is often limited by laboratory turnaround times, cost barriers, equipment downtime, or lack of reagents. In HIC settings, point of care blood gas analyzers, continuous oximetry, and immediate electrolyte testing are standard of care, enabling rapid optimization before induction of anesthesia. The inability to identify and correct hypoxemia and hypokalemia in LMIC increases the risk of perioperative arrhythmias, respiratory failure, hemodynamic instability, and untimely death. There is an urgent need to conduct routine continuous medical education with clear

and easy-to-master guidelines where sepsis and septic shock are recognized early by critical care pediatric nurses to mitigate the complications of late recognition. Further studies are needed to investigate and quantify the magnitude of FTR attributable to perioperative sepsis and other complications. There should also be regular mortality and clinical audits to continuously improve outcomes of infectious complications.

In an Ethiopian study by Molla *et al.*,¹⁰ the predictors of mortality after pediatric emergency surgeries were found to be neonatal age, blood transfusion, and an ASA score of three or above. A multicenter study looking at pediatric surgery outcomes in 51 sub-Saharan African countries also noted that blood transfusion and ASA categories were predictive of mortality after pediatric EAS.¹² Higher ASA status and younger (neonatal) age groups were also identified as predictors of perioperative mortality in Nigerian children.¹⁹

In this study, we have also noted that younger age groups, higher ASA scores, and postoperative blood transfusion are associated with increased risk of postoperative death, but these did not achieve statistical significance, most likely due to small sample size. In contrast, the earlier studies had much larger sample sizes and were therefore better powered. In addition, some of these studies looked at all pediatric emergency surgical cases, while our study recruited only children who underwent EASs.

In conclusion, the short-term (30-day) perioperative mortality after pediatric EAS in our setting is high. Children who present with hypokalemia and hypoxemia are at increased risk of perioperative mortality after EAS. Implementation of a 'preoperative resuscitation bundle' including electrolyte correction and assessment of oxygen saturation. Routine monitoring of pulse oximetry and electrolytes in all pediatric surgical units in LMICs is needed. There is a need to establish a multicenter pediatric surgical outcomes registry to track both favorable and unfavorable outcomes after EASs in all pediatric surgical units.

Contributors JAO contributed to conceptualization, data curation, investigation, and methodology. JAO is also the guarantor for this manuscript, and he is also the corresponding author. FO administered the project and validated the protocol. CCD contributed to visualization and project administration. DM validated the protocol and did data analysis. DK contributed to editing and review of the final manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by Mbarara University Research Ethics Committee (Approval ID: MUST-2024-1506). Informed consent was sought from the participant's next of kin and assent from children aged 8–17 years in a language they best understood.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. Data are available on request.

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