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Factors Associated with In-Hospital Mortality in Adults with Generalized Secondary Peritonitis in Addis Ababa, Ethiopia: A Retrospective Cohort Study

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Abstract

Background

Generalized secondary peritonitis is a life-threatening surgical emergency that demands prompt resuscitation, antimicrobial therapy, and effective source control. Evidence from resource-limited settings remains limited. This study describes the causes, clinical presentation, operative management, postoperative complications, and factors associated with in-hospital mortality among adults undergoing emergency laparotomy at a tertiary hospital in Addis Ababa, Ethiopia.

Methods

We conducted a single-center retrospective cohort study of consecutive adults aged 18 years or older with intraoperatively confirmed generalized secondary peritonitis who underwent emergency laparotomy at St. Paul's Hospital Millennium Medical College between September 2022 and August 2023. We extracted data from medical records, operative logbooks, surgical-site records, and discharge records. The primary outcome was in-hospital mortality. Because only 20 deaths occurred, the multivariable model was restricted to two prespecified variables: preoperative systolic blood pressure below 90 mmHg and gangrenous small-bowel obstruction. We used Firth's penalized logistic regression to reduce small-sample bias. The study is reported according to the Strengthening the Reporting of Cohort, Cross-sectional and Case-control Studies in Surgery (STROCSS) 2025 guideline.

Results

Of 186 eligible patients, 129 (69.4%) were male, and the median age was 28.5 years (interquartile range 22–38 years). Appendiceal perforation (57/186, 30.6%) and perforated peptic ulcer (43/186, 23.1%) were the leading causes, followed by gangrenous small-bowel obstruction (17/186, 9.1%), gangrenous sigmoid volvulus (15/186, 8.1%), and traumatic small-bowel perforation (14/186, 7.5%). At least one postoperative complication was recorded in 67 patients (36.0%; 95% confidence interval [CI] 29.4–43.1%). Twenty patients died in hospital, giving an in-hospital mortality of 10.8% (95% CI 6.7–15.2%). In exploratory penalized regression, preoperative systolic blood pressure below 90 mmHg (adjusted odds ratio [AOR] 5.42, 95% CI 1.82–16.14; p = 0.002) and gangrenous small-bowel obstruction (AOR 6.89, 95% CI 1.94–24.52; p = 0.003) were associated with higher odds of in-hospital mortality. Septic shock and multiorgan failure accounted for 85% of recorded immediate causes of death.

Conclusions

In this single-center cohort, generalized secondary peritonitis carried a substantial burden of postoperative morbidity and in-hospital mortality. Preoperative hypotension and gangrenous small-bowel

obstruction were associated with higher odds of in-hospital mortality in exploratory analysis, though estimates were imprecise due to limited events. Larger multicenter studies with standardized severity and treatment-timing data are needed; these findings should not be interpreted as validated prediction rules.

Background

Secondary peritonitis is a complicated intra-abdominal infection resulting from the loss of gastrointestinal integrity and contamination of the peritoneal cavity. It can rapidly progress to sepsis, organ dysfunction, and death[1, 2]. Management depends on prompt diagnosis, aggressive resuscitation, appropriate antimicrobial therapy, early source control, and repeated reassessment of the patient's response [1, 2]. Because the infection usually follows gastrointestinal perforation and is commonly polymicrobial, definitive treatment generally requires surgical or percutaneous source control [2, 3]. Stable patients with localized findings may undergo imaging before intervention, but those who are unstable or have diffuse peritonitis need immediate treatment without avoidable delay [4].

Mortality remains high once secondary peritonitis progresses to sepsis or organ dysfunction. Reported mortality is approximately 25–35% among patients with severe sepsis or septic shock and may reach 35–55% in some reviews [5]. These figures, however, relate to patients with severe sepsis or septic shock and cannot be compared directly with all-comers surgical cohorts, in which illness severity is often measured inconsistently. Differences in intensive-care access between low- and high-income settings further complicate comparisons by influencing both case selection and outcomes.

The causes and outcomes of secondary peritonitis vary considerably by setting. In resource-limited environments, patterns of gastrointestinal perforation, delays in presentation, diagnostic constraints, antimicrobial resistance, and access to perioperative and critical care may differ from those reported elsewhere [6–10]. A recent two-hospital Ethiopian cohort of 235 patients identified perforated peptic ulcer and perforated appendicitis as the leading causes, with postoperative complications in 21.7% and in-hospital mortality of 6.8%; longer operative duration and intraoperative vasopressor use were associated with death [11]. That study relied on clinical and operative diagnoses recorded in the chart, did not restrict eligibility to intraoperatively confirmed generalized contamination involving at least two abdominal quadrants, and did not report standardized contamination grading or treatment-timing intervals.

This study addresses three gaps. First, eligibility was limited to patients with intraoperatively confirmed generalized peritonitis involving at least two abdominal quadrants, reducing misclassification compared with broader admission-based definitions. Second, it describes the full spectrum of causes, clinical presentation, operative management, postoperative complications, and in-hospital mortality within a single cohort. Third, it uses Firth's penalized logistic regression in an exploratory analysis, an approach better suited than conventional maximum-likelihood regression when only 20 deaths are available. The study was not designed to develop or validate a clinical prediction model.

Methods

Study design and setting

This single-center retrospective cohort study was conducted in the Department of Surgery at St. Paul's Hospital Millennium Medical College (SPHMMC), a tertiary referral and teaching hospital in Addis Ababa, Ethiopia. The hospital provides 24-hour emergency surgical services, general intensive-care support with vasopressor availability, and access to ultrasonography and plain radiography. Computed tomography was available but was not routinely accessible after hours during the study period. The cohort included all consecutive eligible patients who underwent emergency laparotomy between September 2022 and August 2023. We conducted chart review, data extraction, and analysis from September 2024 to January 2025. We recorded outcomes during the index admission, defined as the hospitalization in which the index laparotomy took place. We report the study according to STROCSS 2025 [12].

Participants

All consecutive adults aged 18 years or older who underwent emergency laparotomy and had intraoperatively confirmed generalized secondary peritonitis were included. Generalized peritonitis was defined as gross intra-abdominal contamination involving two or more abdominal quadrants, as documented by the operating surgeon. The type of contamination—purulent, enteric, feculent, bilious, or mixed—was not systematically recorded and is therefore not reported.

We excluded patients with primary or spontaneous peritonitis, localized peritonitis only, or isolated solid-organ injury with hemoperitoneum but no hollow-viscus perforation. Traumatic hollow-viscus perforation with peritoneal contamination was eligible; however, traumatic and non-traumatic causes were not pooled for comparative inference.

Case identification and participant flow

We identified eligible patients from the Department of Surgery operating-room logbook, which records all emergency laparotomies performed at SPHMMC. We cross-checked each operating-room record against the corresponding inpatient chart, operative note, and discharge summary. Figure 1 shows the participant flow. In total, we screened 312 emergency laparotomies. We excluded 94 because the patient was younger than 18 years or the operative diagnosis was not generalized secondary peritonitis, and we excluded 32 because the chart or operative note was unavailable or insufficient to confirm eligibility. These 32 records represented 10.3% of screened laparotomies and may introduce selection bias; because we could not review them, we cannot rule out the possibility that they included eligible cases. All 186 included patients had complete discharge status.

Sample size

We did not perform a formal sample-size calculation because this retrospective cohort included all consecutive eligible patients during the predefined study period. The available sample size and the number of events (20 deaths) constrained the study's analytical component; therefore, we deliberately restricted the multivariable model.

Operational definitions

Perforated peptic ulcer disease: gastric or duodenal peptic ulcer with full-thickness perforation.

Tumor perforation: gastrointestinal tract perforation attributable to an underlying malignant lesion.

Small-bowel or large-bowel volvulus: Twisting of a segment of bowel around its mesenteric attachment, potentially causing obstruction, ischemia, or gangrene.

Ileosigmoid knotting: a compound volvulus in which the ileum and sigmoid colon form a knot, producing intestinal obstruction and possible bowel ischemia.

Sepsis: infection-associated life-threatening organ dysfunction, as defined by Sepsis-3[13]. In this retrospective study, we based sepsis status on clinical documentation and did not prospectively adjudicate it.

Septic shock: a clinical diagnosis documented in the medical record based on the Sepsis-3 criteria, including the need for vasopressors to maintain mean arterial pressure at 65 mmHg or greater and serum lactate greater than 2 mmol/L despite adequate fluid resuscitation[13]. Recorded septic shock was reported as a documented clinical diagnosis rather than a formally adjudicated Sepsis-3 endpoint.

Enterocutaneous fistula: an abnormal communication between the gastrointestinal tract and skin.

Surgical site infection: infection documented after surgery involving the incision, organ, or space, consistent with standard surveillance definitions[14]. The chart listed surgical site infection as a recorded postoperative diagnosis, but it was not prospectively adjudicated using the Centers for Disease Control and Prevention/National Healthcare Safety Network criteria.

Graham omental patch repair: closure of a perforation with sutures reinforced by an omental patch.

Data collection and outcomes

Five final-year medical students extracted data from patient charts, operative logbooks, surgical site records, and discharge records using a pretested data collection form. All data collectors received two days of training on the abstraction form and operational definitions and piloted the form on 10 charts before data collection. The principal investigator supervised data collection and independently re-abstracted a random 10% sample of charts to assess agreement. Discrepancies were resolved by consensus.

The variables included demographic characteristics, symptom duration, clinical findings, vital signs, laboratory and imaging findings (when available), intraoperative diagnosis, operative procedure, postoperative complications, discharge status, and the recorded immediate cause of death.

The primary outcome was in-hospital mortality, defined as death before discharge from the index hospitalization. The secondary outcome was at least one recorded postoperative complication during the index admission after surgery. We abstracted complications from the chart when the treating team documented them between the end of the index operation and discharge; we excluded complications documented preoperatively. If the same complication recurred, we counted it once per patient. Complications were not graded using the Clavien – Dindo classification because the necessary granularity was not consistently available.

Missing data

Because this was a retrospective chart review, the availability of individual investigations varied among patients. We reported imaging denominators separately for each investigation, based on the number of patients who underwent it. No imputations were performed. Analyses used the available denominators for each variable. The number of missing observations for each variable used in the regression model is reported in Additional File 4. All 186 eligible patients in the analytical dataset had recorded discharge statuses and complete data on the variables used in the regression model.

Statistical analysis

Data were coded and analyzed using IBM SPSS Statistics version 26 and R version 4.2.1 with the logistf package version 1.26.0 for Firth's penalized logistic regression[15, 16]. We summarized categorical variables as frequencies and percentages. We summarized age using the median and interquartile range (IQR). We calculated 95% confidence intervals for proportions using the Wilson method. We calculated etiology-specific mortality as in-hospital deaths divided by the number of patients in the corresponding etiological category.

We summarized postoperative morbidity as the proportion of patients with at least one recorded complication and the frequency of each complication. Because patients could have more than one complication, individual complication categories were not mutually exclusive. We report the number of patients with one, two, or more complications.

The analytical component was exploratory and hypothesis-generating. With only 20 deaths, the multivariable model was restricted to two prespecified variables to reduce overfitting: preoperative systolic blood pressure < 90 mmHg and gangrenous small-bowel obstruction. We selected these variables a priori based on clinical plausibility and prior literature. No data-driven variable-selection procedure was used. We used Firth's penalized logistic regression to reduce small-sample bias and accommodate potential separation [15, 16]. The events-per-variable ratio was 10 (20 deaths and 2

parameters), which remains at the lower end of the conventional threshold; the model should not be regarded as a validated prediction tool. Adjusted odds ratios with 95% confidence intervals are reported.

We assessed apparent model discrimination using the area under the receiver operating characteristic curve and reported it as an unvalidated estimate. We report the Hosmer–Lemeshow goodness-of-fit test with the caveat that, with 20 events, it has low power to detect miscalibration and should not be interpreted as evidence of good calibration. We considered a two-sided p-value < 0.05 statistically significant.

Each patient was assigned a single primary intraoperative diagnosis according to a prespecified hierarchy: first, the principal cause of peritoneal contamination documented in the operative note; if more than one cause was present, the diagnosis judged by the operating surgeon to be the primary source was used; second, if the operative note did not explicitly identify a primary source, the most severe intraoperative finding was used. Therefore, the etiological categories in Table 2 are mutually exclusive at the patient level.

Ethical approval and consent to participate

Ethical approval was obtained from the Institutional Research Ethics Review Committee of St. Paul's Hospital Millennium Medical College (reference number Pm/23/245; approval date, March 15, 2024). The approval covered a retrospective review of routinely collected medical records for the study period from September 2022 to August 2023, including data collected before the formal approval date, under the institution's policy for retrospective chart review of routinely collected data. The study waived the informed consent requirement because it involved no direct patient contact and no prospectively identifiable data. We extracted data from clinical records and stored them in a de-identified form, with access restricted to the study investigators.

Results

Cohort assembly

Of 312 emergency laparotomies screened during the study period, we excluded 94 because patients were younger than 18 years or the operative diagnosis was not generalized secondary peritonitis, and 32 records because the chart or operative note was unavailable or insufficient to confirm eligibility. A total of 186 patients met the eligibility criteria and formed the analytic cohort (Fig. 1). All 186 patients had a recorded discharge status: 20 died, and 166 were discharged.

Figure 1. Participant flow diagram.

[Insert figure here.]

Participant characteristics

The sample included 129 males (69.4%) and 57 females (30.6%), for a male-to-female ratio of 2.3:1. The median age was 28.5 years (interquartile range 22–38 years), and 105 patients (56.5%) were aged 18–30 years. One hundred and nine patients (58.6%) lived in urban areas. Table 1 summarizes the participants' demographic characteristics.

Table 1
Demographic characteristics of the study population (N = 186)

Characteristic	Category	n (%)
Sex	Male	129 (69.4)
	Female	57 (30.6)
Age, years	18–30	105 (56.5)
	31–45	41 (22.0)
	46–60	19 (10.2)
	> 60	21 (11.3)
Residence	Urban	109 (58.6)
	Rural	77 (41.4)

^a Age was also summarized as median (interquartile range) 28.5 (22–38) years in the text.

^b Residence was recorded from the medical record; patients did not self-report it.

Etiology

Appendiceal perforation was the most frequent intraoperative diagnosis (57/186, 30.6%), followed by perforated peptic ulcer (43/186, 23.1%). Etiologic categories were mutually exclusive at the patient level. Table 2 shows the distribution of recorded etiologies by sex. The diagnoses included in the 'Other' category are listed in Additional file 2.

Table 2
Recorded intraoperative etiologies by sex (N = 186)

Etiology	Male	Female	Total, n (%)
Appendiceal perforation	32	25	57 (30.6)
Perforated peptic ulcer	37	6	43 (23.1)
Gangrenous small-bowel obstruction	10	7	17 (9.1)
Gangrenous sigmoid volvulus	13	2	15 (8.1)
Traumatic small-bowel perforation	11	3	14 (7.5)
Traumatic gastric perforation	8	0	8 (4.3)
Ileosigmoid knotting	5	1	6 (3.2)
Tumor perforation	5	1	6 (3.2)
Bladder perforation	1	0	1 (0.5)
Other	7	12	19 (10.2)
Total	129	57	186 (100)

^a Each patient was assigned one mutually exclusive primary etiology.

^b Diagnoses included in the “Other” category are listed in Additional file 2.

Clinical presentation and preoperative findings

All patients reported abdominal pain. Vomiting occurred in 116 patients (62.4%), obstipation in 44 (23.7%), fever in 52 (28.0%), and a history of trauma in 28 (15.1%). Symptom duration was less than 24 hours in 29 patients (15.6%), 24–72 hours in 74 (39.8%), 3–7 days in 63 (33.9%), and more than 7 days in 20 (10.8%). We performed ultrasonography in 100 patients, and peritoneal fluid collection was the most frequent finding (71/100, 71.0%). Plain radiography was performed in 76 patients, and air under the diaphragm was the most frequent finding (30/76, 39.5%), followed by small-bowel obstruction (26/76, 34.2%) and large-bowel obstruction (14/76, 18.4%). Table 3 summarizes the preoperative clinical findings and available investigations.

Table 3
Preoperative clinical findings and investigations

Variable	Category	n/N (%)
Symptom duration	< 24 hours	29/186 (15.6)
	24–72 hours	74/186 (39.8)
	3–7 days	63/186 (33.9)
	> 7 days	20/186 (10.8)
Symptoms and signs	Abdominal pain	186/186 (100)
	Vomiting	116/186 (62.4)
	Obstipation	44/186 (23.7)
	History of trauma	28/186 (15.1)
	Positive shifting dullness	124/186 (66.7)
Systolic blood pressure	< 90 mmHg	25/186 (13.4)
	≥ 90 mmHg	161/186 (86.6)
Heart rate	> 100 beats/min	121/186 (65.1)
	≤ 100 beats/min	65/186 (34.9)
Respiratory rate	> 30/min	16/186 (8.6)
	≤ 30/min	170/186 (91.4)
Leukocyte count	< 4,000 cells/mm³	6/186 (3.2)
	4,000–11,000 cells/mm³	73/186 (39.2)
	> 11,000 cells/mm³	107/186 (57.5)
Hemoglobin	< 10 g/dL	9/186 (4.8)
	≥ 10 g/dL	177/186 (95.2)
Ultrasonography (n = 100)	Peritoneal fluid collection	71/100 (71.0)
	Dilated bowel	8/100 (8.0)
	Localized collection	20/100 (20.0)
	Normal	1/100 (1.0)
Plain radiograph (n = 76)	Small-bowel obstruction	26/76 (34.2)
	Large-bowel obstruction	14/76 (18.4)
	Air under diaphragm	30/76 (39.5)

^a A history of trauma is a mechanism and is presented with symptoms and signs only for descriptive convenience.

^b Ultrasonography findings use n = 100; plain radiographic findings use n = 76.

Operative procedures

The most frequently recorded primary operation was exploratory laparotomy with appendectomy and lavage (57/186, 30.6%), followed by Graham omental patch repair (42/186, 22.6%), and resection with anastomosis (27/186, 14.5%). Table 4 presents the full distribution of recorded primary operative procedures.

Table 4
Recorded primary operative procedures (N = 186)

Procedure	n (%)
Exploratory laparotomy, appendectomy, and lavage	57 (30.6)
Graham omental patch repair	42 (22.6)
Resection and anastomosis	27 (14.5)
Repair	23 (12.4)
Stoma formation	18 (9.7)
Exploratory laparotomy and lavage	10 (5.4)
Resection, anastomosis, and stoma	9 (4.8)
Total	186 (100)

^a Each patient was assigned a single primary procedure category based on the main source-control procedure performed.

Postoperative outcomes

We recorded at least one postoperative complication in 67 of 186 patients (36.0%; 95% CI 29.4–43.1%). Of these 67 patients, 41 had one complication, 18 had two, and 8 had three or more. Intra-abdominal collection was the most frequent recorded complication (16/186, 8.6%), followed by sepsis (10/186, 5.4%). Surgical-site infection, pneumonia, and enterocutaneous fistula were each recorded in nine patients (4.8%). Because individual patients could have more than one complication, the complication frequencies are not mutually exclusive and do not sum to 67. Table 5 shows the distribution of recorded postoperative complications.

Table 5
Recorded postoperative complications (N = 186; 67 patients had at least one recorded complication)

Complication	N	% among patients with ≥ 1 complication	% of cohort
Intra-abdominal collection	16	23.9	8.6
Sepsis	10	14.9	5.4
Surgical-site infection	9	13.4	4.8
Pneumonia	9	13.4	4.8
Enterocutaneous fistula	9	13.4	4.8
Wound dehiscence	6	9.0	3.2
Deep-vein thrombosis	3	4.5	1.6

Note: ^a Complication categories are not mutually exclusive; some patients had more than one complication.

^b Diagnostic criteria and ascertainment methods are provided in Additional file 3

In-hospital mortality

Twenty patients died during hospitalization, giving an overall in-hospital mortality rate of 10.8% (20/186; 95% CI 6.7–15.2%). Mortality varied descriptively across recorded etiologic groups. Mortality was highest among patients with gangrenous small-bowel obstruction (6/17, 35.3%; 95% CI 17.3–58.7%), followed by gangrenous sigmoid volvulus (3/15, 20.0%; 95% CI 7.0–45.2%). Mortality was 14.0% (6/43) among patients with perforated peptic ulcer and 14.3% (2/14) among those with traumatic small-bowel perforation. Mortality after appendiceal perforation was 1.8% (1/57). No deaths were recorded among patients with traumatic gastric perforation, tumor perforation, or bladder perforation; these groups were small. In-hospital outcomes by recorded etiology are presented in Table 6. The recorded immediate causes of death were septic shock in 10 patients (50.0%), multiorgan failure in 7 (35.0%), respiratory failure in 2 (10.0%), and cardiac arrest in 1 (5.0%).

Table 6
In-hospital outcome by recorded etiology

Etiology	Discharged, n	Died, n	Mortality, % (95% CI)
Appendiceal perforation	56	1	1.8 (0.3–9.4)
Perforated peptic ulcer	37	6	14.0 (6.6–27.3)
Gangrenous small-bowel obstruction	11	6	35.3 (17.3–58.7)
Traumatic small-bowel perforation	12	2	14.3 (4.0–39.9)
Gangrenous sigmoid volvulus	12	3	20.0 (7.0–45.2)
Traumatic gastric perforation	8	0	0 (0–32.4)
Ileosigmoid knotting	5	1	16.7 (3.0–56.4)
Tumor perforation	6	0	0 (0–39.0)
Bladder perforation	1	0	0 (0–79.3)
Other	18	1	5.3 (0.9–24.6)
Total	166	20	10.8 (6.7–15.2)

^a Mortality was calculated as deaths divided by the total number of patients within each etiologic category.

^b Estimates for groups with small numbers are unstable and should be interpreted with caution.

Factors associated with in-hospital mortality

In the exploratory two-variable multivariable model, preoperative systolic blood pressure < 90 mmHg and gangrenous small-bowel obstruction were associated with in-hospital mortality. In the univariable analysis, gangrenous sigmoid volvulus and age > 60 years were associated with mortality but were not retained in the multivariable model (Table 7).

Table 7
Univariable and exploratory two-variable multivariable associations with in-hospital mortality

Variable	Univariable OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value	Missing, n
Preoperative SBP < 90 mmHg	5.81 (2.14–15.79)	< 0.001	5.42 (1.82–16.14)	0.002	0
Gangrenous small-bowel obstruction	7.87 (2.38–25.98)	< 0.001	6.89 (1.94–24.52)	0.003	0
Gangrenous sigmoid volvulus (univariable only)	4.14 (1.04–16.47)	0.044	—	—	0
Age > 60 years (univariable only)	2.45 (0.65–9.23)	0.186	—	—	0
Male sex	1.05 (0.38–2.87)	0.928	—	—	0
Heart rate > 100 beats/min	2.30 (0.73–7.20)	0.153	—	—	0
Leukocyte count > 11,000 cells/mm³	0.93 (0.37–2.32)	0.876	—	—	0
Symptom duration > 72 hours	1.26 (0.49–3.25)	0.630	—	—	0
Perforated peptic ulcer	1.83 (0.56–5.98)	0.316	—	—	0

^a SBP, systolic blood pressure; OR, odds ratio; CI, confidence interval.

^b The multivariable model was restricted to two prespecified variables because of the limited number of events (20 deaths).

^c Apparent model performance: area under the receiver operating characteristic curve = 0.78 (95% CI 0.68–0.88); Hosmer–Lemeshow $\chi^2 = 4.82$, df = 6, $p = 0.567$.

^d These are internally derived, unvalidated performance measures and should not be interpreted as evidence of a validated prediction model

Discussion

In this single-center retrospective cohort study of 186 adults who underwent emergency laparotomy for intraoperatively confirmed generalized secondary peritonitis in Addis Ababa, Ethiopia, appendiceal perforation and perforated peptic ulcer were the most frequent etiologies, postoperative complications occurred in 36.0% of patients, and in-hospital mortality was 10.8%. In an exploratory two-variable penalized regression model, preoperative hypotension and gangrenous small-bowel obstruction were associated with mortality. Because only 20 deaths occurred and the study did not include standardized

severity scores or treatment timing data, these associations should be considered hypothesis-generating and require validation in larger multicenter cohorts.

The demographic profile showed a predominance of young men, with more than half of patients aged 18–30 years. Similar patterns have been reported in other Ethiopian and African cohorts[6, 11]. The male predominance is consistent with global patterns of surgical emergencies, in which men are more likely to present with perforated peptic ulcer disease and traumatic perforations. In this analysis, sex was not associated with mortality, suggesting that the male predominance reflects disease incidence rather than differential outcomes.

Appendiceal perforation was the most frequent recorded etiology (30.6%), followed by perforated peptic ulcer (23.1%). Together, these conditions accounted for more than half of the cohort. A recent two-hospital Ethiopian cohort study by Molla et al. reported perforated peptic ulcer disease and perforated appendicitis as the leading etiologies, with a postoperative complication frequency of 21.7% and mortality of 6.8%[11]. The complication frequency (36.0%) and mortality (10.8%) observed in the present study were higher than those previously reported. Differences in eligibility criteria, case mix, hospital settings, study periods, and documentation practices may explain this discrepancy. The earlier and present studies were conducted at different hospitals during different periods and used different inclusion criteria; the published information does not exclude the possibility of patient overlap between the two cohorts.

The highest etiology-specific mortality rate was 35.3% in patients with gangrenous small-bowel obstruction. Mortality was also relatively high among patients with gangrenous sigmoid volvulus (20.0%), perforated peptic ulcer (14.0%), and traumatic small-bowel perforation (14.3%). These estimates should be interpreted cautiously because the corresponding groups were small, and the study was not designed to estimate independent prognostic effects[1, 2].

In the exploratory multivariate model, preoperative hypotension was the strongest factor associated with mortality (AOR 5.42, 95% CI 1.82–16.14, p = 0.002). This finding is clinically plausible because hemodynamic instability reflects severe physiological compromise, systemic inflammation, and inadequate organ perfusion, all of which are associated with death in severe intra-abdominal infection[1, 2]. However, we did not measure treatment timing, resuscitation adequacy, or time to source control. The observed association does not establish that earlier or more aggressive treatment improves outcomes.

Gangrenous small-bowel obstruction remained associated with mortality after adjustment (AOR 6.89, 95% CI 1.94–24.52, p = 0.003). Because this diagnosis is made intraoperatively, it should not be interpreted as a preoperative predictor; it is better characterized as an intraoperative prognostic factor. This association likely reflects bowel ischemia severity, the extent of resection required, and the systemic consequences of transmural necrosis. Patients with gangrenous bowel obstruction may present late, have extensive contamination, and require complex reconstructive procedures; however, these mechanisms were not directly measured.

Gangrenous sigmoid volvulus showed an elevated univariable association (odds ratio 4.14, 95% CI 1.04–16.47, p = 0.044) but was not retained in the multivariable model. Age > 60 years was not statistically significant in the univariable analysis. With only 20 deaths, all these estimates carry substantial uncertainty.

Septic shock and multiorgan failure accounted for 85% of the recorded immediate causes of death. This pattern is clinically plausible in advanced intra-abdominal infections. However, sepsis and septic shock were not prospectively adjudicated using the Sepsis-3 criteria; they reflect clinician-documented diagnoses abstracted from the chart. This observational study did not measure treatment timing or treatment effects, and no causal inference about source-control timing should be drawn from these data[1, 2].

This study has several strengths. It included consecutive eligible adults over a defined 12-month period, used intraoperative confirmation of generalized secondary peritonitis, and described etiologic diagnoses, clinical presentation, operative management, postoperative complications, and in-hospital outcomes within the same cohort. The exploratory multivariate analysis used Firth's penalized regression and was restricted to two prespecified variables to reduce overfitting.

However, the study has important limitations. First, the retrospective, single-center design increases the risk of incomplete or inconsistent documentation and limits generalizability. Second, 32 records (10.3% of screened laparotomies) were unavailable or insufficient to confirm eligibility; if any of these contained eligible cases, the cohort may be incomplete, and selection bias cannot be excluded. Third, severity scores such as the Mannheim Peritonitis Index, Acute Physiology and Chronic Health Evaluation II score, and Sequential Organ Failure Assessment score, comorbidities, contamination grade, time from hospital arrival to operation, antimicrobial regimens, microbiology, intensive-care use, complication severity, management of complications, and post-discharge outcomes were not consistently available. Fourth, sepsis, septic shock, and immediate causes of death were documented by treating clinicians rather than prospectively adjudicated. Fifth, clinicians did not grade complications using the Clavien–Dindo classification. Sixth, the sample size was modest, and the number of events limited the number of variables in the multivariable model; residual confounding cannot be excluded, and the model was not internally or externally validated. Seventh, the analytical component was exploratory, and the two identified associations should not be interpreted as validated predictors. Eighth, interpret the findings in the context of a resource-limited setting; access to computed tomography, intensive-care beds, vasopressors, and broad-spectrum antimicrobials may differ from high-income settings.

This study contributes local tertiary-hospital data from Ethiopia and may inform clinical quality improvement and future prospective research. The association between preoperative hypotension and mortality supports early physiological risk assessment in this population, although treatment timing and effects were not measured. Future multicenter studies should use standardized severity measures and complication grading, capture preoperative physiology and time-to-source-control intervals, document

antimicrobial and critical-care variables, adjudicate sepsis and septic shock prospectively using Sepsis-3 criteria, and follow patients beyond discharge.

Conclusions

In this single-center retrospective cohort of adults undergoing emergency laparotomy for intraoperatively confirmed generalized secondary peritonitis, appendiceal perforation and perforated peptic ulcer were the leading recorded etiologies. Postoperative complications were recorded in 67 of 186 patients (36.0%), and in-hospital mortality was 20 of 186 (10.8%). Preoperative systolic blood pressure < 90 mmHg and gangrenous small-bowel obstruction were associated with higher odds of death in an exploratory two-variable Firth-penalized regression analysis. Because the study included only 20 deaths and lacked standardized severity and treatment-timing variables, these associations require validation in larger multicenter cohorts and should not be interpreted as definitive causal or preoperative prediction effects.

Abbreviations

AOR
Adjusted odds ratio
SBP
Systolic blood pressure
HR
Heart rate
WBC
White blood cell count
SBO
Small-bowel obstruction
CI
Confidence interval
OR
Odds ratio
SPHMMC
St. Paul's Hospital Millennium Medical College
STROCSS
Strengthening the Reporting of Cohort, Cross-sectional, and Case-control Studies in Surgery
CDC/NHSN
Centers for Disease Control and Prevention/National Healthcare Safety Network.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Research Ethics Review Committee of St. Paul's Hospital Millennium Medical College (reference number Pm/23/245; approval date, March 15, 2024). The approval covered a retrospective review of routinely collected medical records from September 2022 to August 2023. The study waived the informed consent requirement because it involved no direct patient contact and no prospectively identifiable data.

Consent for publication

Not applicable. No individual patient data, images, or identifiable details were presented.

Availability of data and materials

The datasets generated and/or analyzed in the current study are not publicly available because they contain potentially identifiable clinical information. De-identified data may be available from the corresponding author upon reasonable request, subject to applicable institutional ethical and administrative approvals.

Competing interests

The authors declare no competing interests.

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Authors' contributions

BAC conceptualized the study, developed the methodology, supervised data extraction, performed formal statistical analysis, interpreted data, and drafted the original manuscript. MB contributed to the literature search and data interpretation and critically reviewed and edited the manuscript for epidemiological rigor. GGM and GT provided clinical oversight, interpreted data, and critically reviewed and edited the manuscript for surgical validity. GGM and GT also provided administrative and structural supervision of the study setting. All authors read and approved the final manuscript and agreed to be accountable for all aspects of the work.

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Figures

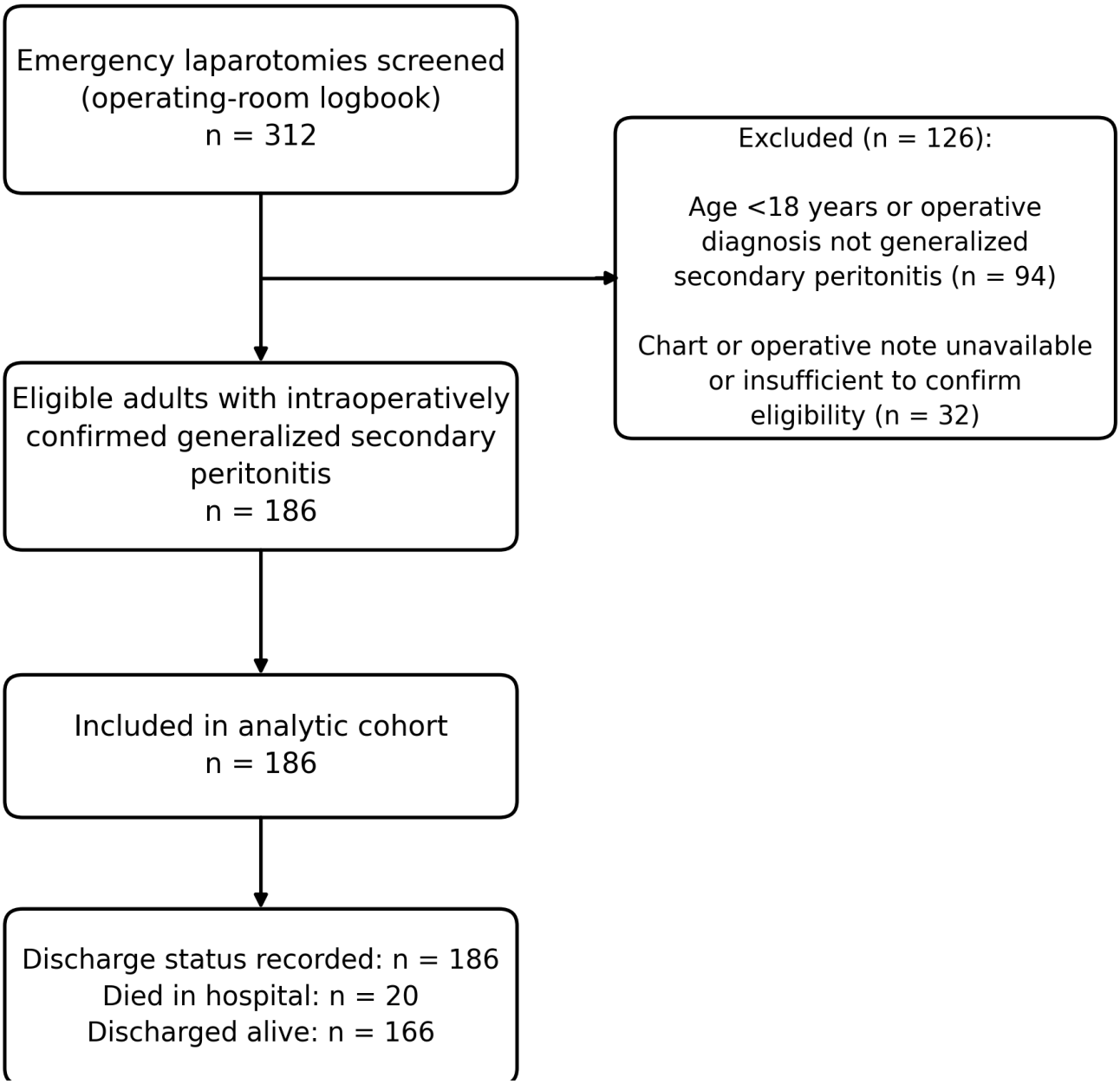

Figure 1

Participant flow diagram.

Supplementary Files

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- PeritonitisSupplementaryMaterial.docx