ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCE
SCHOOL OF MEDICINE
DEPARTMENT OF ANESTHESIA

SURVIVAL STATUS AND PREDICTORS OF MORTALITY AMONG EMERGENCY LAPAROTOMY PATIENTS IN SELECTED GOVERNMENTAL HOSPITAL IN ADDIS ABABA, ETHIOPIA; MULTICENTER RETROSPECTIVE COHORT STUDY

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DEPARETEMENT OF ANESTHESIA
RESEARCH THESIS

Full title of the research project	**Survival status and predictors of mortality among emergency laparotomy patients in selected governmental hospital in Addis Ababa, Ethiopia; multicenter retrospective cohort study**
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Duration of the project	**February 2024 to April 2024**
Study Area	**Tikur Anbessa Specialized Hospital ,Addis Ababa ,Ethiopia** **Zewoditu Memorial Hospital ,Addis Ababa, Ethiopia** **Alert Hospital, Addis Ababa, Ethiopia** **Menelik II Comprehensive Specialized Hospital ,Addis Ababa, Ethiopia**
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Declaration

In partial fulfillment of the requirement for the master in anesthesia, I and undersigned declare that this thesis is our original work.

I understand that plagiarism will not be accepted and all directly quoted materials have been referenced appropriately.

Principal investigator: Sibhat Teka Tessema

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Abstract

Background: *World-widely, emergency laparotomy is a widely performed surgical procedure with high-risk surgery and anesthesia that is challenging and related to high morbidity and mortality. The mortality rate is significant in both developed and developing countries, however, the highest mortality rates are in low and middle income countries. The aim of this study is to determine the impact of factors in time dependent manner among emergency laparotomy patients.*

Objective: *To assess survival status and predictors of mortality among emergency laparotomy patients in Addis Ababa governmental hospitals, Ethiopia, from January 1, 2020 to January1 2023.*

Method: *An institution-based, multicenter retrospective cohort study was conducted at four selected Addis Ababa governmental hospitals among emergency laparotomy patients from January 1, 2020, to January 1, 2023. Each sample patient chart was selected by using a systematic random sampling technique to select 379 patients chart. Data were entered into Epi Data version 4.6.0.2 and analyzed using STATA version 17. A standard Cox-proportional hazards regression analysis model was used to correlate each independent variables with the dependent variables. Both bi-variable regression and multiple cox-regression were fitted to identify predictors of each outcome. Kaplan-Meier graphs are used for estimation. The hazard ratio and its 95% confidence interval were computed, and factors with a p-value of less than 0.05 in the multivariable model were strongly correlated with the mortality of patients who underwent emergency laparotomies.*

Result*: A total of 374 patients were followed retrospectively from a sample of 379 patients, with a median follow-up time of 19 days. The overall mortality of patients who underwent emergency laparotomy was 10.43%. Factors such as preexisting disease (AHR=5.43, 95%CI: 1.56, 18.97), preoperative sepsis (AHR=1.2, 95%CI: 1.03, 3.47), intraoperative vasopressor use (AHR=8.49, 95%CI: 1.69, 42.65), and post-operative complications (AHR=3.73, 95%:1.02, 13.65) were significantly associated with mortality in patients who underwent emergency laparotomy.*

Conclusion*: The overall mortality rate among patients who underwent emergency laparotomy was high compared to previous studies. Preexisting disease, preoperative sepsis, and intraoperative vasopressor use, and postoperative complication were a significant factor. Therefore, optimization is needed before operation for critically ill patients with sepsis.*

Key words: **emergency laparotomy, mortality, predictor's, survival status**

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Acronym and Abbreviation

AAU	Addis Ababa University
AHR	Adjusted Hazard Ratio
ASA	American Society of Anesthesiologist
CHR	Crude Hazard Ratio
COPD	Chronic Obstructive Pulmonary Disease
DM	Diabetes Mellitus
EL	Emergency Laparotomy
Hgb	Hemoglobin
ICU	Intensive Care Unit
LBO	Large Bowel Obstruction
SBO	Small Bowel Obstruction
SBP	Systolic Blood Pressure
STATA	Statics and data
SIRS	Systemic Inflammatory Response Syndrome
WBC	White Blood Cell

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1. INTRODUCTION

1.1. BACKGROUND OF THE STUDY

Laparotomy is the surgical incision in the abdominal cavity to treat serious abdominal condition and save life and performed to treat condition such as abdominal injuries, intestinal obstruction, abdominal infection, tumors, and hernias (1).Emergency laparotomy is the collective term for a variety of urgent intra-abdominal surgical procedures. EL is a high-risk surgery and is associated with a considerable risk of morbidity and mortality (2).. The Operation involves making a middle-line incision through the abdominal wall to gain access to the abdominal cavity and frequently to get bowel resections, the requirement to establish a stoma, or the need for a drainage procedure and open abdominal surgery is a common risk procedure with a high risk of mortality and morbidity (3) . The procedure includes high-risk abdominal surgery for a diverse range of non-traumatic pathologies, such as intestinal obstruction, perforation, and peritonitis, as well as traumatic pathologies (4).Emergency laparotomies patients fall into several categories: those who require a non-elective procedure due to adhesion, bowel obstruction; those who are truly emergent, such as those with hemorrhage that poses a life-threatening risk; urgent cases with peritonitis and intra-abdominal sepsis; and finally, what we might refer to “expedited” cases (5).

Emergency abdominal surgery is performed in most hospitals, and acute laparotomy is considered a high-risk procedure with significant mortality rates ranging from 14% to 20% (6). The incidence of mortality in developed countries is higher; it accounts for 14.9% of those age less than 80 years and 24.4% of those age greater than 80 years. Even though they have sophisticated equipment, numerous HDUs, and manpower. The main predictive factors were age and variation in clinical management (7).

In low-income countries, the of mortality rate is higher; it accounts two to three time higher than high- income counties (8).The main determinant factors were age, type of surgical procedure, infection, poor resource availability, poor service status (9).Risk factors associated with the highest morbidity includes chronic nephropathy, obstructive pulmonary disease, and daily use systemic corticosteroids, while low physical performance, metabolic disease, obstructive

pulmonary disease, and perioperative blood transfusion were risk factors associated with mortality (10).

In Ethiopia, the incidence of mortality is 8.4%, and the postoperative complication was 39.3% .The main predictive factors for mortality were age greater than 65 years, socio-demographic deference, and comorbidity (11). Despite those studies conducted, the effect of length of stay and some paramount predictors with its hazard rate are not well studied.

In general, emergency laparotomies have high mortality rates because of the critical nature of the disease and the surgical interventions, so understanding the factors that contribute to mortality is important for improving outcomes and developing target intervention to reduce mortality. The purpose of this retrospective cohort study is to estimate the survival status and predictors directly associated with the development of the event of death.

1.2. Statement of the Problem

Emergency laparotomy are a high risk intra-abdominal surgical procedures performed for a variety of acute pathologies. It is commonly performed throughout the world, but one six patients die within a month of surgery (12). Emergency laparotomy had the longest critical care and hospital stays, associated with the highest risk of morbidity and mortality (13). Mortality rates currently range from 13% to 18%, which is five times greater than high-risk elective surgery (14).

According to the Lancet Commission on Global Surgery, identified that 313 million surgical procedures are performed worldwide each year, and an estimated 4.2 million people die within 30 days of surgery annually, with low-and middle-income countries accounting for the majority of these deaths. The perioperative mortality rate in low-and middle-income countries was reported to be significantly higher than that in high-income countries. Postoperative deaths account for 7.7% of all deaths globally (15).

According to the National Emergency Laparotomy Audit (NELA) report in 2018, approximately 30,000 emergency laparotomies are performed annually in England, with a 30-day, 1-year, 2-year, 3-year mortality rate of 11.8%, 23%, 29%, and 34%, respectively (16). Emergency laparotomy is commonly undergone all over the world (12). The total number of surgical procedures performed as emergency laparotomy accounted for 175,000 patients' operated annually in America (17). According to UK NHS evidence, more than 1.53 million inpatient surgical patients are admitted each year, with mortality of 1.5% (18). From those 25,000 of patients undergone emergency laparotomy with mortality of 9.6% (19). About 0% to 68 % of emergency laparotomy patients returned to the ward after surgery, and between 9.7% and 87.5% were admitted to the intensive care unit and the mortality rate is varied from 3.6% to 41.7% (7). In sub-Saharan Africa, more than 50% of surgical operations have an emergency with a high POMR (perioperative mortality rate) (20).

Studies in Ethiopian teaching Hospitals showed that emeregency surgery constitute 43.3%-57.4% all operation ,and emergency laparatomy accounts for 23-36% of all surgical procedures performed(21,22)The reported Ethiopian national perioperative mortality rates of 1.1% in 2019 and 0.83% in 2020,when compared to findings' from different academic studies indicating

mortality rates ranging from 3.14% to 18.2%,underreporting potentially challenges in accurately capturing perioperative mortality rates and associated factors (23,24).

Even though improvements in preoperative risk stratification, the establishment of consultant-led emergency surgical services, and the presence of a consultant surgeon and anesthetist have decreased the mortality rate of emergency laparotomy patients in the past decade, the mortality rate still remains elevated by 10% (25). . The disparity in resource availability significantly impacts outcomes, with a mortality rate of 6.9% in developed countries (17) compared to 30.6% to 47% in low-resource countries (26) despite their higher number of healthcare workers, equipment, intensive care units, and overall resources (27) . Emergency laparotomies are frequently performed procedures, and the risks of complications and mortality are recognized to be substantially higher than for laparoscopic and elective laparotomies (28).

Interims of growth in domestic product (GDP) patients undergoing emergency laparotomy utilized €30026.11 (range 1794-40784 per hospital) (29).The socioeconomic status of the area influences how long an emergency laparotomy patient survives. Even though emergency laparotomy are still often performed in general surgery, they can cause significant morbidity and mortality, particularly in low-and middle-income countries with poor health facilities, a labor shortage, and poor access to appropriate surgical and anesthesia care (30).

The main predictive factors were lack of surgical ICU, level of consciousness at the end of anesthesia, anesthetists preoperative opinion on postoperative patient outcome, re-operation after primary operation, late presentation to the hospital and delay of surgical intervention after admission (31) . Poor results are seen with emergency laparotomies (32). Higher ASA physical status categorization, 60 years of age or older, increased urgency of surgery, and a requirement for more intensive immediate postoperative care were all linked to increased mortality (14). Mortality rates were shown to be higher when factors like age, the American society of anesthesiologists, preoperative sepsis, dependent status, current cancer, and comorbidities were present. Acute physiological abnormalities detected by total blood count, albumin, and kidney tests were closely linked to mortality (33). The incidence of mortality in developed countries is higher; it accounts 14.9% of those aged less than 80 years and 24.4% of those age greater than 80 years. Even though they have sophisticated equipment, numerous HDU and manpower. The main predictive factors were age and variation in clinical management (7).In low-income

countries, the of mortality rate is higher; it accounts for two to three time higher than high-income counties (8). Previous research has identify numerous predictors of perioperative mortality among emergency laparotomy patients; however, they are uneven and sometimes contradict each other, emphasizing the need for a study that focuses on the predictors of mortality in our context.

Existing research indicates high mortality rates following emergency laparotomy but provides limited insights into the underlying causes and contributing factors. This gap highlights a detailed investigation into the predictors of mortality. The variability in procedures performed, the variability in surgical diagnosis, the impact of various comorbidities, and the health care services influence patients' outcomes have not been adequately investigated, and there is a lack of consensus on the most effective predictors of mortality, and previous studies did not determine the predictors in a time dependent manner.

Therefore, this study was conducted to determine the impact of factors in a time-dependent manner among emergency laparotomy patients. This study uses semi-parametric survival analysis models to identify the incidence and predictors of emergency laparotomy.

1.3. Justification of the study

The burden of mortality related to emergency laparotomy is high throughout the world, but it is especially more prominent in low and middle income country, including Ethiopia. In our literature search, there are few studies conducted on the mortality of emergency laparotomy in Ethiopia; however the survival status has not been studied.by including the time to death event in the study, a more comprehensive understanding of the factors influencing mortality can be achieved. Analyzing the time to death event allows for the identification of predictors that are specifically associated with early mortality. Previous study done on the mortality of emergency only diagnosis related to non-traumatic emergency laparotomy but in this study including all traumatic and non-traumatic that undergoing emergency laparotomy. There is the scarcity of information on perioperative mortality after emergency laparotomy in Ethiopia, especially in Addis Ababa. While there are limited studies on perioperative mortality in Ethiopia, most include both elective and emergency laparotomy, but this study focuses exclusively on emergency laparotomies.

The hazard ratio of the predictive factors is not known in studies in this field that employ logistic regression analysis to examine predictors of postoperative mortality, so we was used a Cox proportional hazard model to identify key variables that affect how patients die after emergency laparotomy.

1.4. Significance of the study

The finding of this study believed to improve emergence laparotomy care programs provide for health care professionals and policy makers a foundation for interventions to improve the survival status of emergency laparotomy patients. The findings are expected to enhance better clinical judgment, patient care, and resource allocation, leading to improved outcomes for those undergoing this high risk procedure. Additionally, it will also help as a baseline data for future researchers, guiding resource allocation based on unmet needs and ultimately improving survival rates.

To identify the gap and increase the quality of care in emergency laparotomy, this study will determine patient's outcomes, including the timing of death events. The insights gained will improve clinical decision-making, enable early target interventions, and refine medical practices, ultimately reducing mortality rates among emergency laparotomy patients. To reduce surgery and anesthesia related post-operative mortality among emergency laparotomy, it also is very important to know the survival status and predictor's of mortality.

2. LITERATURE REVIEW

Emergency laparotomy is High-risk surgical procedure performed in patients who present with acute abdominal conditions that require immediate intervention. Even though the treatment itself tries to save lives by treating potentially fatal diseases, there is still a significant mortality rate associated with emergency laparotomies (34).

2.1. Mortality from emergency laparotomy

Several studies highlight the significant mortality risk associated with emergency laparotomy. A large-scale, four-year study in the United States found a 14.0% mortality rate within 30 days of surgery(35). The risk appears even greater in specific patient populations. A multicenter study focusing on emergency trauma laparotomies reported an overall mortality rate of 21%, with a staggering 46% mortality rate for patients experiencing hypotension(36). Geographic disparities also seem to exist. A five-year comparison between New York and England revealed a lower mortality rate of 6.9% in New York compared to 13.6% in England(17). . These findings underscore the urgency for further research to improve patient outcomes following emergency laparotomy.

In an 11-year retrospective cohort study conducted in Denmark at a Danish hospital, the 30-day mortality risk was 19.3%. Within the 80-89 age group, the mortality risk was 34.5% for females and 39.4% for males (28). Another study, a one-year retrospective study conducted at Hvidovre Hospital in Denmark, found that there were 17% and 25% mortalities at 30 and 180 days, respectively (37). In a one-year prospective cohort study in an Irish university teaching hospital, the reported mortality rates at thirty and ninety days were 6.66% and 11.6%, respectively. Specifically, among octogenarians (between 80-89 years) ,the 30-days mortality rate was 20% (38).

A six-year retrospective cohort study conducted at a tertiary center in South Africa reported a mortality rate of 12.5% with a median patient age of 34 years, while a 2-year retrospective study at the center Hospitalier Universitaire de Kigali(CHUK) in Rwanda found an overall postoperative mortality rate of 12% (39,40).These similar mortality rates indicate that comparable challenges and outcomes in postoperative care at these tertiary centers.

A study done in Ethiopia reported various postoperative outcomes. A four-year retrospective study done at Gondar University Hospital, the overall 30-days mortality was 8.1%.Similarly, a prospective multicenter cohort study at selected southern Ethiopian governmental hospitals, mortality rate was 8.4% after emergency laparotomy(11,41).

2.2 Factors Affecting Mortality among Emergency Laparotomy

Socio demographic factors

Elderly, According to research conducted in New York and England, age greater than 90 years is the strongest predicted factor of mortality after an emergency laparotomy (17). In a 2-year retrospective cohort study of 170 emergency laparotomy patients at the National University Hospital in Singapore, elderly patients had significantly longer hospital stays and experienced more post-laparotomy complications than non-elderly patients, and their mortality rate was also higher (42). The age of the patient has no impact on the mortality of emergency laparotomy in the study done in India (26) .

Sex, Male patients after emergency laparotomy had a higher mortality rate than female patients in the 80-89 age groups, unless they had the same outcome in an 11-year retrospective cohort study conducted in Denmark. Gender was not associated with mortality in a retrospective study conducted in Sweden (14).

In an Ethiopian prospective study of 191 emergency laparotomy patients, age greater than 65 years had an eight times higher mortality rate than age less than 65 (11). In a 4-year retrospective observational study conducted at Gondar University Hospital, the majority of the patients were from rural areas (41).Another prospective cohort study was conducted in a selected southern Ethiopian hospital, where most of patients were rural residents (11).

Patient related factors

ASA status, According to studies in New York, England, and Denmark American society of anesthesiologist classification system was strongly associated with mortality after an emergency laparotomy (17,35,37).A retrospective cohort study done in the USA with 37,553 patients reported a 14% 30-day death rate overall, more than half with ASA Ⅳ or ASA Ⅴ, septic shock, and dependent functional status (35). A study conducted in India demonstrated that the ASA status of the patient had no impact on the mortality of emergency laparotomies (26).In a systemic

review was done, greater functional dependency, do not resuscitate preoperatively, , white cell count, platelet, hemoglobin, and raised blood urea nitrogen, creatinine, and serum sodium increased mortality, while diabetes mellitus, smoking, in-hospital delay to surgery, and surgeons performing EL did not affect mortality (43). With comorbid illness, the prognosis of patients receiving emergency surgery greatly depends on the existence of co-existing medical illness. The presence of cardiopulmonary disease, presence of cerebrovascular illness, liver cirrhosis, chronic nephropathy, and malignancy influenced the 30-day mortality and the 90-day mortality, as did the presence of cerebrovascular disease, obstructive pulmonary disorder, and malignancy ,according to study done at Copenhagen University Hospital Herley,Denmarkl (44). Another 4-year retrospective cohort study done at Copenhagen university hospital of 323 patients 67% had one or more comorbidities. Hypertension, ischemic heart disease, and chronic obstructive pulmonary disease where the three most prevalent comorbidities (10).Postoperative complication are highly predicted by comorbidity .in comparison to patients who did not have any coexisting disorder, individuals with coexisting conditions were 10 times increased risk of surgical complications. Poor physical function, exhaustion, and compromised immune systems are among the comorbidities that affect patient's prognoses following emergency laparotomies according to a multicenter prospective cohort study at selected southern Ethiopian hospital (11).

Preoperative systolic pressure, extremes of low or high preoperative systolic blood pressure and increased postoperative mortality were not associated with preoperative heart rate, according to a study conducted by the NELA (45). A 10 year retrospective cohort study conducted at University Medical Center Utrecht patients who presented with SBP<90mmhg had high mortality rate compared to patents with a systolic pressure 90 or higher (46). A 4-year retrospective study done in Ethiopia ,patients who had SBP less than 90mmHg is 4 times higher mortality than SBP gather than or equal to 90mmHg (41) .

Disease related factors

The emergency nature of this operation, the variation in surgical pathology and the limited time available to optimize the patients makes it an extremely high risk operation (47).Regarding primary diagnosis of the disease, the majority of the patients were diagnosed with peritonitis, followed by small bowel obstruction, large bowel obstruction, abdominal injury, abdominal abscess, and ileocecal intussusceptions. Preoperative sepsis and the duration of a symptom of the

disease greater than 72hours are significant predictors of postoperative complications (11). 13-year retrospective multicenter cohort study done in the United States trauma center, penetrating trauma, splenic injures hepatic injures, chest and abdominal injuries, hemorrhage during the presentation , initial route of admission was significantly affect the mortality rate of trauma related emergency laparotomy (36). Another prospective observational study conducted in a UK teaching hospital preoperative sepsis one of the predictor of emergency laparotomy (48).according to study conducted by the Royal Collage of anesthetists, London ,UK ,pre-operative anemia is frequent in patients who have an emergency laparotomy and is associated with 30-day and 90-days mortality, unplanned admission to the operating room, and postoperative hospital length of stay (49).In a 4-year retrospective cohort study conducted in Ethiopia, preoperative sepsis was found to be a significant predictors of mortality after emergency laparotomy, with septic patients preoperative mortality being 5 times higher than that of non-septic patients (41).

Care related factors

Poor postoperative outcomes are a significant concern for patients receiving emergency surgery, particularly those undergoing intra-abdominal procedures. The variation in the quality of care provided and the result of emergency admissions and operations is a growing concern (50).Early high risk patients identification ,consultant-led surgery and anesthesia ,early antibiotic administration, and early surgery have been shown to enhance outcomes and demonstrate a 53% reduction in mortality and morbidity following emergency laparotomy (51,52) .operation duration greater than 60 minute associated high mortality rate after emergency laparotomy (53).A retrospective study conducted in USA intraoperative use of vasopressor medication increase mortality following emergency laparotomy in critical ill patient (54). In similar study perioperative complication, re-operation, ICU admission, trauma related, perioperative blood product use, hospitalization time were statistically significant association with 30-day mortality from emergency laparotomy (55).

According to research done at Copenhagen University Hospital, Denmark perioperative blood transfusion was one of the risk factor for post-operative morbidity and mortality after emergency laparotomy (10).

A study conducted by Shahait et al had found that postoperative ICU admission and mechanical ventilation were associated factors of increased mortality after emergency laparotomy (56).A prospective study conducted in Egypt blunt abdominal trauma does not affect the mortality ,while penetrating abdominal trauma increased the mortality rate after post traumatic emergency laparotomy (57).

In general, mortality from emergency laparotomies was higher in low -and middle- Income County than in developed countries. A variety of socio-demographic factors, patient-related factors, diagnosis-related factors, and care-related factors contributed to mortality from emergency laparotomies.

2.3 conceptual framework

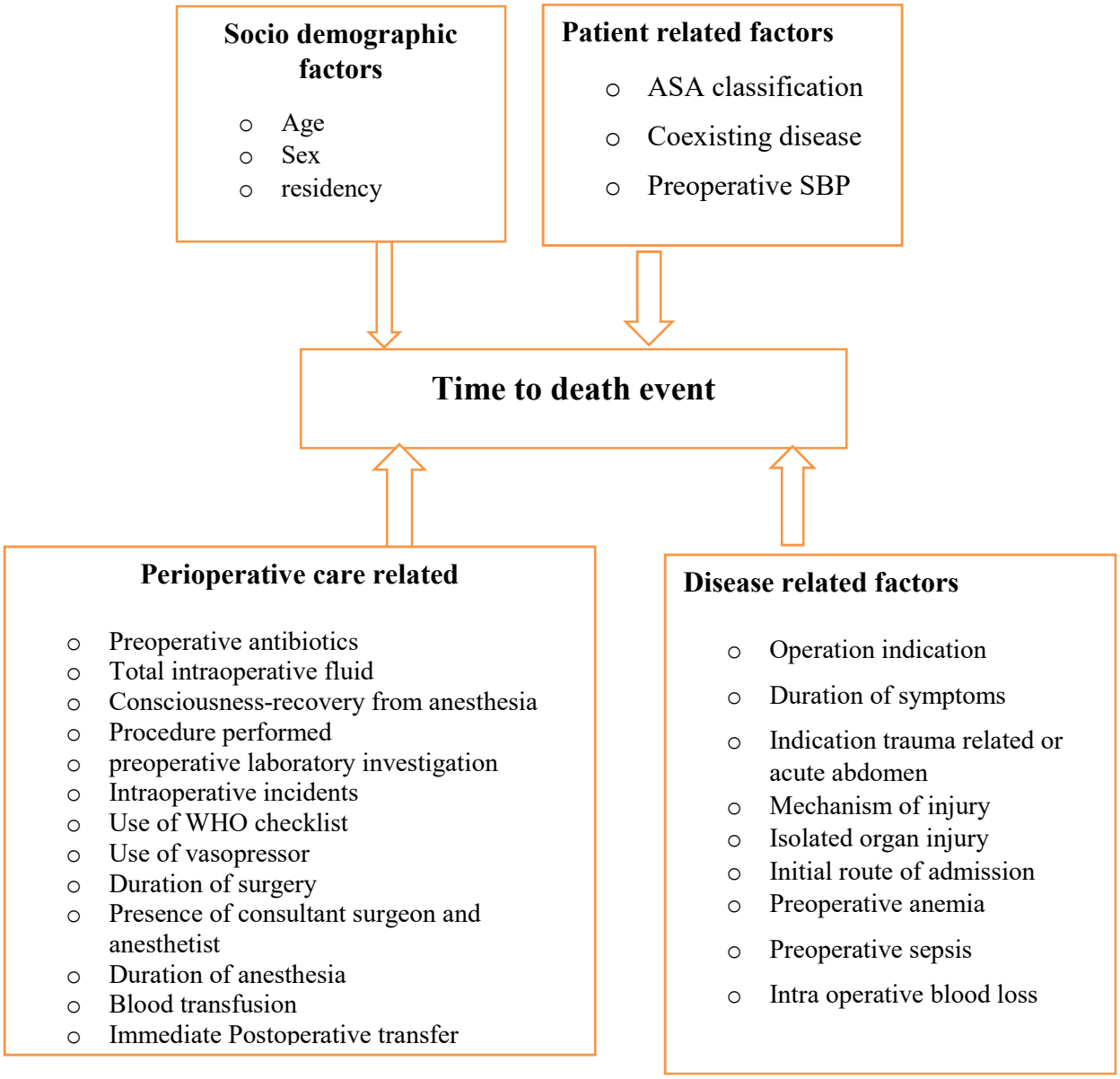

Figure 1: conceptual framework postoperative mortality and predict patients undergoing emergency laparotomy from review of the literature (10,11,14,17,26,44,54,56)

3. Objective

3.1. General objective

- To assess survival status and predictors of mortality among emergency laparotomy patients in Addis Ababa governmental Hospitals, Ethiopia, from Janurary1, 2020-January1, 2023.

3.2. Specific objective

- To determine the incidence of mortality among emergency laparotomy patients in Addis Ababa governmental hospitals, Ethiopia.
- To identify predictors of mortality among emergency laparotomy patients in Addis Ababa governmental hospitals, Ethiopia.

4. Method

4.1. Study design

A multi-center retrospective cohort design was carried out at the Addis Ababa governmental hospitals from January 1, 2020, to January 1, 2023.

4.2. Study area

Addis Ababa is the capital and largest city in Ethiopia, with a population of more than 5.4 million, according to the World Population Review 2023 report. Currently, Addis Ababa has 15 governmental hospitals.

Tikur Anbessa specialized hospital, Menelik II Comprehensive Specialized Hospital, Alert Hospital, and Zewditu Memorial hospital were selected by simple random technique as study areas. Tikur Anbessa specialized Hospital was founded in 1972 and is located in Lideta, sub city of Addis Ababa, Ethiopia. With more than 700 beds and 15 operation rooms, the hospital serves as both an Addis Ababa University teaching hospital and a significant referral facility for the entire country. The hospital provides training for undergraduate and postgraduates medical students, anesthesia, pharmacists, nurses, laboratory technicians, and variety of specialty and sub-specialty program. Menelik II Comprehensive Specialized Hospital, Ethiopian's first hospital, was constructed in 1990 and manned by Russian health personnel. It is one of the five referral hospitals under the supervision of the Addis Ababa city administration. With 800 beds and nine operation rooms. Alert Compressive specialized hospital is the Armauer Hansen Research Institute, founded in 1970, specializing in leprosy research. There is currently a 240-bed teaching hospital, including dermatology, ophthalmology, and surgery departments, an orthopedic workshop, and a rehabilitation program. Zewditu Memorial Hospital was opened in 1976 and located in kirkose, sub city of Addis Ababa.it is university affiliated hospital with over 120 surgical beds.

4.3. Population

4.3.1. Source population

All patients who underwent emergency laparotomy in selected governmental hospitals in Addis Ababa.

4.3.2. Study population

Patients who underwent emergency laparotomy at the four selected hospitals from January 2020 to January 2023

4.4. Sample size and sampling technique

4.4.1. Sample size determination

For the first objective, the sample size was calculated using single population proportion formula. Therefore, based on the findings from a previous study conducted in Southern Ethiopian governmental Hospitals (11),P=8.4% with margin of error 3% with confidence interval 95% and the minimum sample size was determined.

$n= (z\alpha/2)^2 p (1-p)/w^2$

n=329, finally by considering 15% non-response rate

n= 379

The sample size for the second objective (predictors) was determined using the survival analysis sample size calculation formula in STATA version 17. By considering age and ASA classification as the major predictive variable based on a study done in India (6).

Sample size calculation formula for survival analysis has the following 2 steps

Step 1: $M= (Z\alpha/2+Z\beta)^2/ (\log (HR))^2 q0 (1-q0)$

Where: M is the number of events (death)

Log (HR) =logarithm of hazard ratio

Q0=fraction of subject in the unexposed group

Zβ=the reliability coefficients for β

Step 2: N=M/P (event)

Where: N=optimal sample size, P =proportion of event from previous study (11)

Table 1: Sample size determination

Assumption	Predictors	hazard ratio	total sample size after adding 15%
Power=80% α=0.05 β=0.2 SD=0.5 P(event)=0.084	Age	3.004	364
	ASA classification	4.354	204

Therefore, the largest sample size was obtained from the primarily objective then the final sample size is going to be **379**.

4.4.2 Sampling procedure

The chart for study participants was selected using a systematic random sampling procedure. Calculated sample interval, with **k** set approximately to 6. The first chart was picked by lottery method from emergency surgery performed at four hospitals from January 1, 2020, to January 1, 2023.emergency surgery chart was chosen from the health management information system registry every six chart until the requisite sample size is attained. The total sample size and the total number of emergency laparotomy patients in 4 hospitals from January 1, 2020, to January 1, 2023, are 379 and 2,167, respectively. **K**=2,167/379=approximately 6.

The average number of patients undergoing emergence laparotomy in Tikur Anbessa Specialized Hospital, Zewoditu Memorial Hospital, Alert Compressive Specialized Hospital, and Menelik II Compressive Specialized Hospital was from January 1, 2020, to January 1, 2023 was 625, 551, 380, and 581 respectively. Sample from each Hospital was taken =sample size× total NO of EL each hospital / total number of EL in 4 Hospitals.

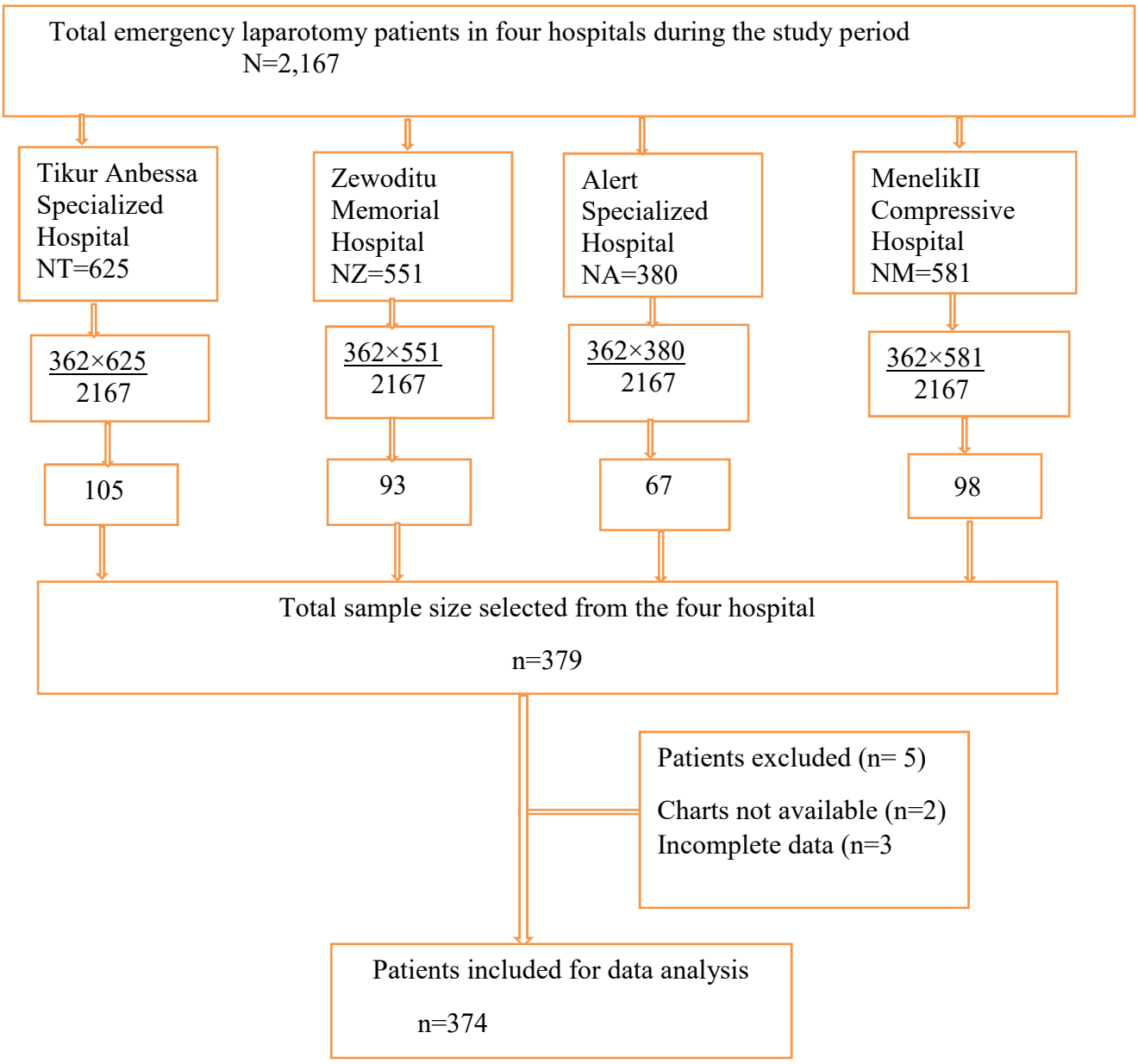

Figure 2: **study unit proportional allocation**

4.5. Inclusion and exclusion criteria

4.5.1. Inclusion criteria

Patients who underwent emergency laparotomies between January 2020 and January 2023 were included

4.5.2. Exclusion criteria

- Age less than 18 year
- C/S, simple appendectomy, and Obstetrics and gynecological laparotomies
- Patients who had missed charts and charts with incomplete details was excluding

4.6. Variable of the study

4.6.1. Dependent variable

- Time to death

4.6.2. Independent variable

Socio demographic factors: Sex, Age, residency, ASA class

Patient related factors: ASA classification, preoperative systolic blood pressure.

Coexisting disease: asthma, COPD, hypertension, DM, cardiac disease, renal disease, neurological disorder, psychiatric disorder, infectious illness.

Disease related factors: duration of symptoms, preoperative anemia, presence of preoperative sepsis, mechanism of injury, and initial rout of admission.

Isolated organ injury: Small bowel, large bowel, spleen, stomach, diaphragmatic injury, abdomino-thoracic injury, Retro peritoneal hemorrhage, liver, multiple injury

Operation indication/diagnosis: SBO, LBO, Abdominal trauma, generalized peritonitis, Ileocecal intussusceptions, malignancy, adhesion, Anastomotic leak/postoperative collection.

Perioperative care related: Preoperative antibiotics, use of WHO checklist, intraoperative use of vasopressor, total intraoperative fluid, conscious-recovery from anesthesia, total intraoperative blood loss, Duration of surgery, Duration of anesthesia, Blood transfusion, and post-operative patient transfer

Types of surgery: Resection and anastomosis, Appendectomy, Gasterojejenostomy, Primary repair Adhesiolysis, Exploratory laparotomy, Diaphragmatic repair, Pedicle omentum pacthe, Colostomy/ileostomy, Hemi colostomy, Splenectomy, Sigmoidoectomy/Hartman colectomy, Lavage/drainage.

Preoperative laboratory investigation: White blood cell, Hemoglobin, platelet, organ function test

Intraoperative incident: Aspiration, difficult intubation and ventilation, hypoxia, hypotension, arrhythmia, hemorrhage, visceral injures, cardiac arrest, delay awaking.

Post-operative complication: Anastomotic leakage, septic shock, wound dehisce, Acute kidney injury, Re-obstruction, Re-laparotomy, Wound infection, Hospital acquired pneumonia, vomiting.

4.7. Data collection analysis and quality control

4.7.1. Data collection procedure

Data was collected by using structure questionnaires. Information from patients was collected from patient chart, logbook, preoperative and intraoperative anesthesia record sheet. Data was collected by a trained four health professionals having a minimum qualification of BSc degree. The training was last for one day and cover the questioner, extensive chart review, and data collection method. Supervision was done during the data collection process to check the completeness of the data and ensure that data collection done properly as trained by one health professional having a minimum qualification of BSc degree.

4.7.2. Data quality control

To assure the quality of the data, a pre-assessment of charts was conducted on 38 charts (10% of the calculated sample size) that were not included in the main study before data collection at Zewoditu Memorial Hospital. During data collection, each questionnaire was checked the completeness and appropriateness by the investigator and another supervisor.

4.7.3. Data processing

Data was checked for completeness and consistence then after cleaned, and entered in to Epi Data version 4.6.0.2software packages. After the data is checked for correct entry, it was exported to STATA version 17 software to analyze the data. Before analysis missing values and outliers was checked. Cross tabulations and summary statistics was used to describe the study population about relevant variables.

4.7.4. Data analysis

The Kaplan- Meier survival curve was calculated to estimate the median survival time, and a Log-rank test was used to compare the survival curve between categorical variables. The assumption in the cox proportional hazards model was checked using the Schoenfeld residuals test and time dependent variable. Cox proportional hazards regression model was used to test the association between each independent variable and the dependent variable. Bivariate Cox regression analysis was used to assess the relationship between each predictor's variable and emergency laparotomy related mortality. Variables with $p<0.25$ and emergency laparotomy related mortality in Bivariate Cox-regression model was entered into multivariate Cox-proportional hazards regression analysis model.

Adjusted Hazard ratio with its 95% confidence interval used for potential risk factors in the multivariable model. P-value ≤ 0.05 is considered a statically significant association between predictors and emergency laparotomy mortality .The goodness of fit test was checked with Cox Snell residuals. . For all regression models, a specifically designed statistic to evaluate the accuracy of a postulated model (goodness-of-fit) is called a residual value. Residual values reflect the difference between the model-estimated values and the observed data that generated the model estimates.

4.7.5 Operational definition

Censored: patient underwent emergency laparotomy and were alive within 30 days, discharge to home, discharged against medical advice or transferred to other hospital without knowing the outcome.

Comorbidity: presence of any systemic disease other than surgical reason

Event: death

Pre-operative anemia: Hemoglobin level<10mg/dl (49)

Sepsis: systemic inflammatory syndrome plus possible source of infection

SIRS: If the patients has two or more of the following signs.(41)

Pulse rate>90 B/min

Respiratory rate>20

Temperature<36◦c or >38◦c

WBC<4000 or >12000/mm^3

Survival status: is the final outcome of emergency laparotomy either death or censored.

Intraoperative complication: any complication, regardless of the cause, occurring from the start to the end of surgery that is related to either surgical, anesthesia, blood loss or vital sign derangement.

Incomplete records: if the data of admission, date of discharge and final outcome are not recorded on the chart.

Survival time: measures the follow-up of time from the day of operation up to 30 days.

Length of stay: the number of days the patients stayed in the hospital from the admission until death or censoring.

Follow- uptime: from the time of admission until either an event or censorship occurs

4.7.6. Ethical consideration

Ethical approval was obtained from the Institutional Review Board (IRB) of the collage of health science, Addis Ababa University. Since this is secondary information, informed consent was not be needed from each client; instead, it was forward to the top administrator of each hospital. Patient's privacy was protected, and neither their identities nor questionnaires content was not made public.

4.7.7. Dissemination of the results

The final report of the research's submitted to the Department of anesthesia, collage of health science, Addis Ababa University. Thereafter, get the study finding distributed to TASH, Alert Hospital, Menelik II Compressive Specialized Hospital, Zewoditu Memorial hospital and Addis Ababa health bureau. Next, the results will try to publish in a scientific publication that has been peer-reviewed.

5. Result

5.1. Socio demographic factors among patients underwent emergency laparotomy

Among the sample of 379 patients who underwent emergency laparotomies who were chosen by systematic random sampling, 374 (98.68%) patients were included in the final analysis. The majority of patients were male; they accounted for 222 (59.36%) of the patients underwent emergency laparotomy. The majority of the patients, 265 (70.86%), arrived from outside Addis Ababa areas. The highest number of patents are between 18 and 65 years old, and they account for 296 (79.14%) of the total patents undergone emergency laparotomy.

Table 2: Socio demographic factors of patients underwent emergency laparotomy from January 2020 to January 2023, Addis Ababa, Ethiopia 2024

Variable		Censored, n (%)	Event (%)	Total, n (%)
		n=335	n= 39	n=374
Residence	Outside Addis Ababa	92(84.40%)	17(15.60%)	109(29.14%)
	Inside Addis Ababa	243 (91.70%)	22(8.30%)	265(70.86%)
Sex	Female	139(91.45%)	13(8.55%)	152(40.64%)
	Male	196(88.29%)	26(11.71%)	222(59.36%)
Age	18-65years	276(93.24%)	20(6.76%)	296(79.14%)
	≥65	59(75.64%)	19(24.36%)	78(20.86%)

5.2. Patient related factors

Out of the total 374 patients underwent emergency laparotomy, the majority of the patients 326 (87.17%) had preoperative systolic blood pressure greater than or equal to 90mmHg. Nearly two-thirds of the patients, 238 (63.64%) had ASA physical status one (ASA1), whereas the American Society of Anesthesiologists 2, 3 and 4 patients accounted for 87 (23.26%), 37 (8.82%), and 16 (4.28%) respectively. Out of the total patients performed emergency laparotomy, 83 (22.19%) had preexisting disease, hypertension, Cancer, DM, RVI, asthma/COPD, cardiac illness, and

renal illness |, which accounts 18 (21.69%), 14 (16.87%), 11 (13.25%), 11 (13.25%), 10 (12.05%), 8 (9.64 %), 5 (6.02%) respectively.

Table 3: Patient related factors among patients underwent emergency laparotomy

Variable		Censored, n (%)	Event (%)	Total, n (%)
		n=335	n= 39	n=374
	ASAI	232(97.48 %)	6(2.52 %)	238(63.64%)
ASA class	ASA II	82(94.25 %)	5(5.75 %)	87(23.26%)
	ASAIII	16(48.48 %)	17(51.52 %	33(8.82%)
	ASAIV	5(31.25 %)	11(68.75 %)	16(4.28%)
Preexisting disease	No	276(94.85%)	15(5.15%)	291(77.81%)
	Yes	59(71.08%)	24(28.92%)	83(22.19%)
SBP	≥90mmhg	315(96.63%)	11(3.37%)	326(87.17%)
	<90mmhg	20(41.67%)	28(58.33%)	48(12.83%)

5.3. Disease related factors

Among 374 patients who underwent emergency laparotomies, more than three-fourths 293 (78.34%) of the patients were non-traumatic emergency laparotomy, from non-traumatic indication generalized Peritonitis is the most common indication, which accounted 130 (44.37%),followed by large bowel obstruction, small bowel obstruction, and ileocecal intussusceptions (19.11%, 18.09%, and 3.41%).Out of 81 (21.66%) traumatic indications more than half were penetrating abdominal injuries 53 (66.25%) ,and most of the patients had multiple injuries (28.75%).

Out of the total patients presented for emergency laparotomy, more than half were presented within less than 72 hours of their initial symptoms 217 (58.02%.The majority of the patients were referred from a health center and another hospital 184 (49.2%).From a total of 374 patients,

65 (17.38%) had preoperative anemia, 41 (10.96%) had preoperative sepsis, and 56 (14.97%) had total intraoperative blood loss greater than 500ml.

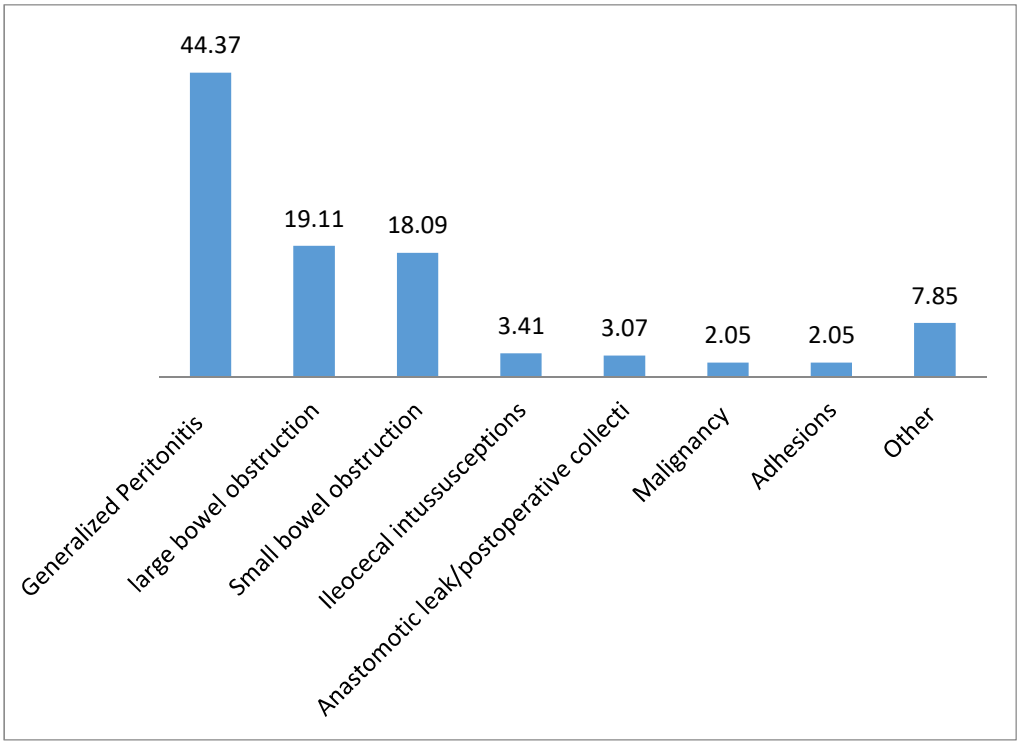

Figure 3: Operation indication of non-traumatic emergency laparotomy among patients underwent emergency laparotomy at Addis Ababa, Ethiopia, from January 2020 to January 2023

Table 4: Disease related factors among patients underwent emergency laparotomy

Variable		Censored, n (%)	Event (%)	Total, n (%)
		n=335	n= 39	n=374
Initial route of admission	Emergency department	156(93.98%)	10(6.02%)	166(44.39%)
	Referred from health center	159(86.41%)	25(13.59%)	184(49.20%)
	Transferred from ward	20(83.3%)	4 (16.67%)	24(4.01%)

Indication of emergency laparotomy	Non-traumatic	263(89.76%)	30(10.24%)	293(78.34%)
	Traumatic	72(88.8%)	9(11.2%)	81(21.66%)
Duration of symptoms	<72 hours	209(96.31%)	8(3.69%)	217(58.02%)
	≥ 72 hours	126(80.25%)	31(19.75%)	157(41.98%)
Preoperative anemia	Yes	38 (58.46%)	27 (41.54%)	65 (17.38%)
	No	297 (96.12%)	12 (3.88%)	309 (82.62%0
Preoperative sepsis	Yes	16 (39.02%)	25(60.98%)	41 (10.96%)
	No	319 (95.80%)	14(4.20%)	333(89.04%)
Intraoperative blood loss	≤500ml	294 (92.45%)	24 (7.55%)	318 (85.03%)
	>500ml	41(73.21%)	15(26.79%)	56(14.97%)

5.4. Perioperative care related factors

Out of 374 patients, almost all had preoperative investigations, 370 (99.3%) had preoperative CBC, and 175 (46.79%) organ function tests. The majority 263 (70.32%) had hemoglobin between 11-18mg/dl, 186 (49.73%) had a white blood cell greater than11 x 103/mm3 and 310 (82.89%) had a platelet count 150-450 x109/L.

The majority (n= 355, 94.92%) of the patients were given prophylaxis antibiotics before operation, and more than 95 % (358) patients used the WHO surgical safety check list. Among 374 patients, 50 (13.37%) had an intraoperative incident, 211 (56.42%) were given more than 2 liters of intraoperative fluid. Out of the total patients, 52 (13.90%) and 83 (22.19%) were given intraoperative vasopressors and perioperative blood transfusions, respectively.

More than half of the procedures 216 (57.75%) had a duration greater than or equal to 2 hours, and 263 (70.32%) had a duration of anesthesia greater than or equal to 2 hours. Among 374 patients, 94 (25.13%) had performed exploratory laparotomy and 51 (13.64%) were admitted to the ICU post-operatively. Among 374 patients underwent emergency laparotomy, 93 (24.87%) had developed post-operative complications, of from which septic shock, accounts for 33.3%.

Table 5: perioperative care related factors among patients underwent emergency laparotomy

Variable		Censored, n (%) n=335	Event (%) n= 39	Total, n (%) n=374
Hemoglobin(Hgb)	<11 mg/dl	61 (64.89%)	33(35.11%)	94(25.13%)
	11- 18 mg/dl	258(98.1%)	5(1.9%	263(70.32%)
	>18 mg/dl	16(94.12%)	1(5.88%	17(4.55%
platelet count(Plt)	< 150 x109/L	21(56.76%)	16(43.24%)	37(9.89%
	150-450 x109/L	290(93.55%)	20(6.45%	310(82.89%)
	>450 x109/L	24(88.89%)	3(11.11%)	27(7.22%)
White blood cell count(WBC)	< 4x 103/mm3	8(80%)	2(20%	10(2.67%)
	4-11x103/mm3	163(91.57%)	15(8.43%	178947.59%
	>11x103/mm3	164(88.17%)	22(11.83%	186(49.73%)
Use WHO surgical check list	Yes	320 (89.39%)	38(10.61%)	358 (95.72%)
	No	15 (93.75%)	1(6.25%	16(4.28%)
Prophylaxis antibiotics	Yes	316(89.01%)	39(10.995	399(94.92%
	No	19(100%)	0.00	19(5.08%)
Total intraoperative fluid used(L)	≤2L	156(95.71%)	7(4.29%)	163(43.58%)
	>2L	179(84.83%)	32(15.17%)	211(56.42%)
Intraoperative vasopressor use	Yes	17(32.69%	35(67.31%	52(13.90%
	No	318(98.76%	4(1.24%)	322(86.10%
Blood transfusion	Yes	51(61.45%)	32(38.55%)	83(22.19%)
	No	284(97.59%)	7(2.41%)	291(77.81%)
Duration of surgery	<2hrs	154(97.47%)	4(2.53%)	158(42.25%)
	≥2hrs	181(83.80%)	35(16.20%)	216(57.75%)
Duration of anesthesia	<2hrs	108(97.30%	3(2.70%)	111(29.68%
	≥2hrs	227(86.31%)	36(13.69%)	263(70.32%)
Intra-operative Incident	Yes	23(46.00%)	27(54.00%)	50(13.37%)
	No	312(96.30%)	12(3.70%)	324(86.63%)
Conscious recover from anesthesia	Full awake	322(96.41%)	12(3.59%)	334(89.30%)
	half-awake	8(53.33%	7(46.67%	15(4.01%)
	Not awake	5(20.00%)	20(80.00%	25(6.68%)
Immediate post-operative transfer	Ward	5(100%)	0	5(1.34%)
	PACU	308(97.16%)	9(2.84%	317(84.67%)
	ICU	22(40.58%)	29(59.42%)	51(13.91%)
post-operative complication	Yes	58(62.37%)	35(37.63%)	81(75.13%)
	No	277(98.58%)	4(1.42%)	5(1.34%)
IF' Yes' Type of Post-operative complication	Wound infection	16(88.8%)	2(11.2%)	18(19.35%)
	Anastomotic leakage	1(100%)		1(1.08%)
	wound dehisce	7(100%)		7(7.53%)

Re-obstruction	1(100%)		1(1.08%
septic shock	7(22.58%)	24(77.42%)	31(33.4%)
AKI	3(60.00%)	2(40.00%)	5(5.38%)
Re laparotomy	7(100.00%)		7(7.53%)
Hospital acquired pneumonia	7(100.00%)		7(7.53%)
others	3(66.6%)	2(33.4%)	6(6.45%)

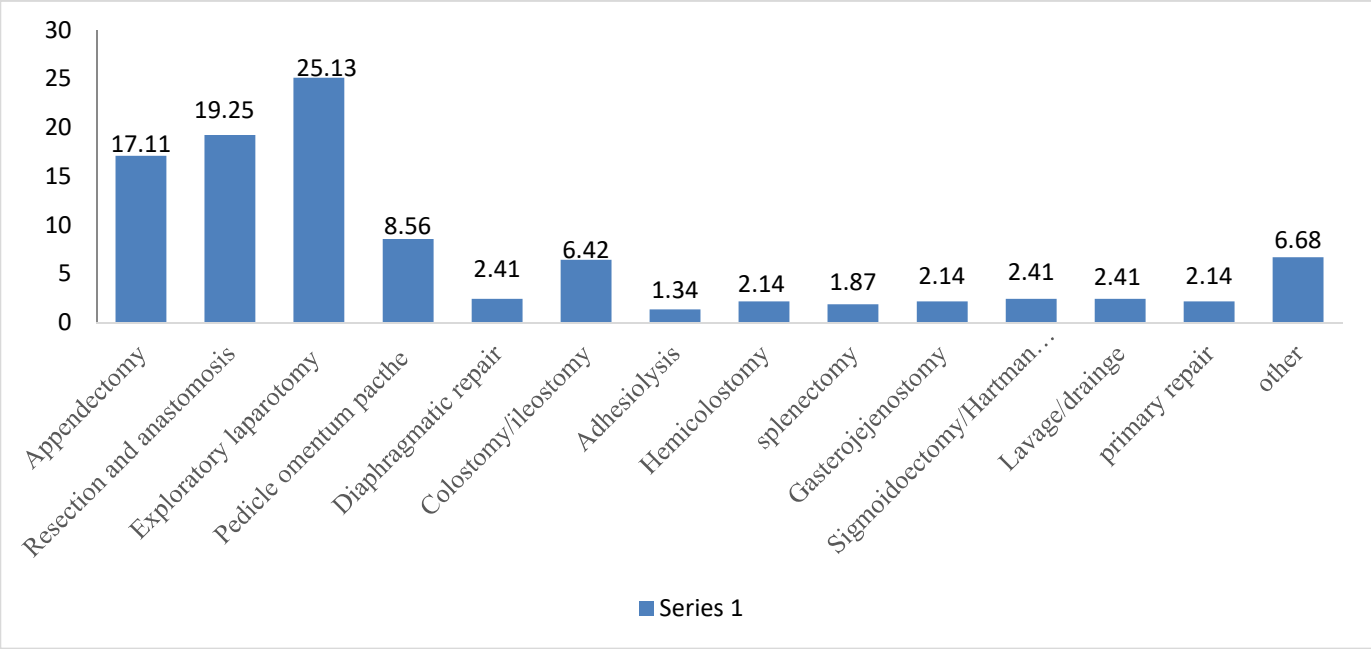

Figure 4: Main operation performed among patients underwent emergency laparotomy at Addis Ababa, Ethiopia, from January 2020 to January 2023

5.5. Survival Analysis

5.5.1. Survival status of patient's underwent emergency laparotomy

In this study, patients were followed for 30 days, with a median follow-up time of 19 days (IQR= 14, 25), and a total follow-up of 2672 persons per day. The incidence rate was found to be 14.6 deaths per 1000 persons per day of observation (95% CI: 10.7, 19.9). In this study, among the total patients undergone emergency laparotomy, 39 (10.43%) were died during the follow-up period and 335 (89.57%) were censored. Among the censored patients that undergone emergency

laparotomy 322 (86.1%) were discharged to home, 3 (0.8%) were discharge against medical care, 4 (1%) referred to another hospital, and 6 (1.3%) were received medical care upon completion of the study.

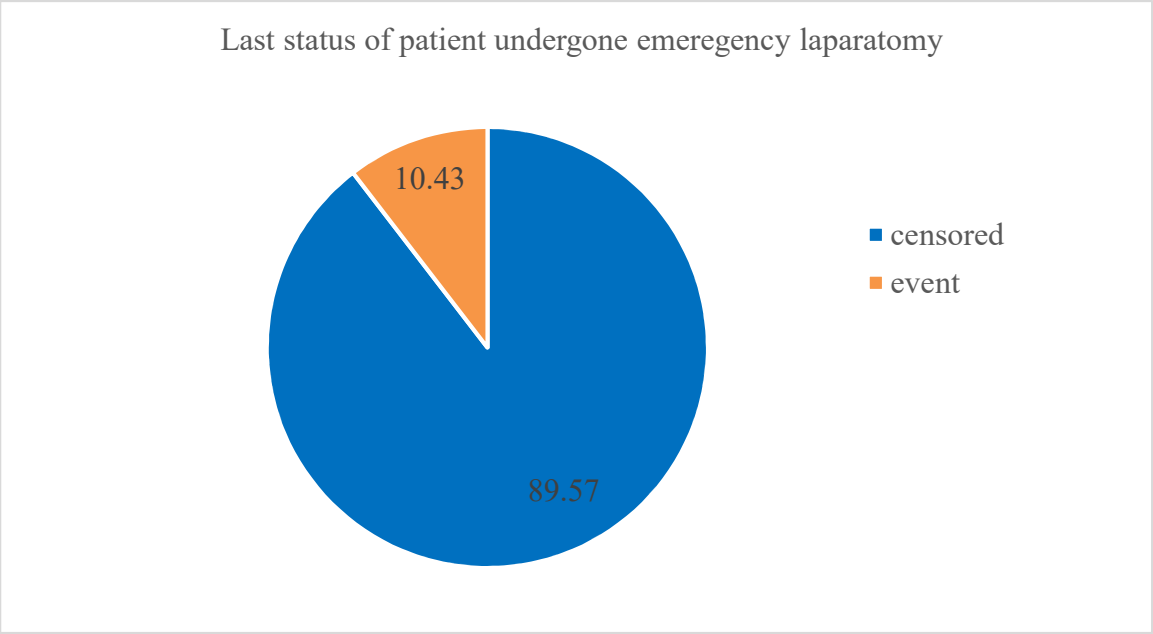

Figure 5: Pie chart of the survival status among patients underwent emergency laparotomy at selected governmental hospitals in Addis Ababa, Ethiopia from Jan 2020 to Jan 2023

Table 6: Life table estimation of mortality among patients underwent emergency laparotomy

Interval	Total	Deaths	Survival	Std. Error	[95% Conf. Int.]
0 3	374	18	0.9519	0.0111	0.9247 0.9694
3 6	356	129	0.6070	0.0253	0.5555 0.6544
6 9	227	126	0.2701	0.0230	0.2261 0.3158
9 12	101	64	0.0989	0.0154	0.0713 0.1318
12 15	37	22	0.0401	0.0101	0.0235 0.0635
15 18	15	4	0.0294	0.0087	0.0156 0.0503
18 21	11	5	0.0160	0.0065	0.0067 0.0330
24 27	6	3	0.0080	0.0046	0.0023 0.0219
27 30	3	2	0.0027	0.0027	0.0003 0.0142
30 33	1	1	0.0000	.	.

The cumulative probability of failure for patient's undergone emergency laparotomy on the first day and at the conclusion of follow-up time was 1.34% and 99.73%, respectively. The median follow-up time was found to be 19 days.

5.5.2. Predictors of mortality among patients undergone emergency laparotomy

The failure estimate graph of patient's underwent emergency laparotomy is used to characterize with the Kaplan-Meier failure function as follows.

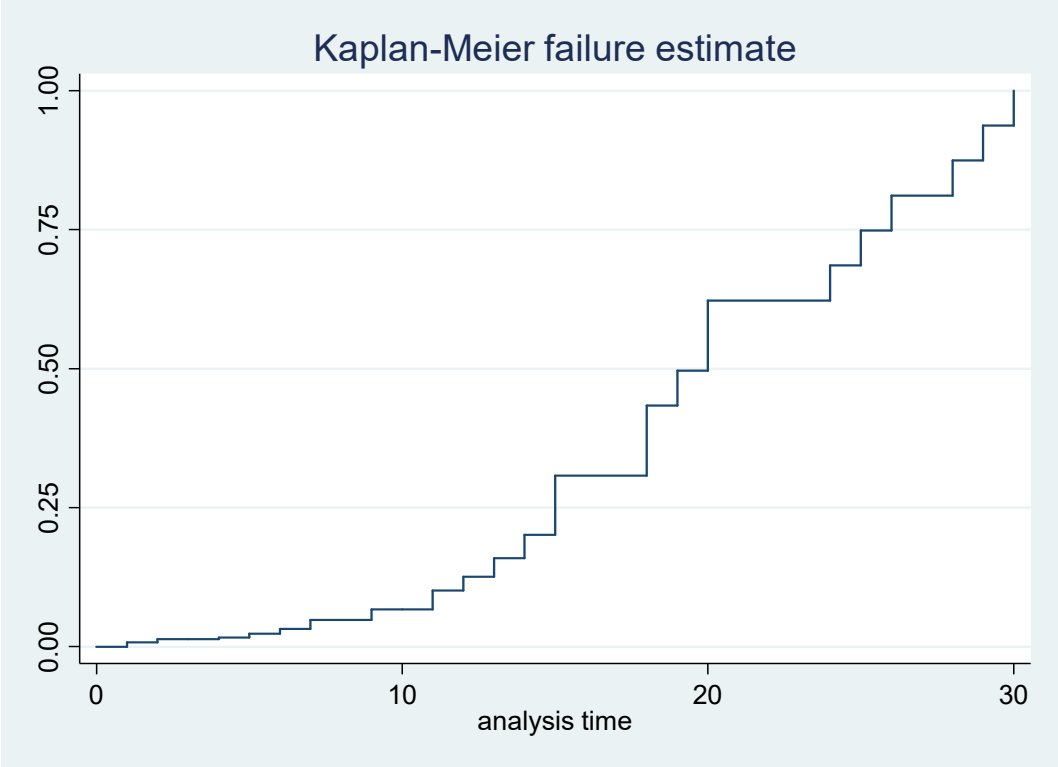

Figure 6: Kaplan-Meier estimate of patients underwent emergency laparotomy from Jan 2020 to Jan 2023, in Addis Ababa, Ethiopia, 2024

For each category variable, a unique graph of the failure estimations in the Kaplan-Meier failure function was generated. This is crucial to identify individual variation in the survival experience within the designated groups. The log-rank test was used to determine if there is a statistically significant difference between the survival functions of the groups in the Kaplan-Meier estimate.

The log-rank test findings showed that there was a significant difference in survival among categories of age, ASA classification, preexisting disease, preoperative hemoglobin, preoperative platelet count, duration of symptoms, preoperative anemia, preoperative sepsis, preoperative

SBP, duration of surgery, duration of anesthesia, intraoperative incident, conscious recovery from anesthesia, total intraoperative blood loss, intraoperative vasopressor used, blood transfusion, post-operative patient transfer, and post-operative complications. However, predictors that had no statistically significant difference after a log-rank test were residency, sex, initial route of admission, indication of emergency laparotomy, WBC, , prophylaxis antibiotics, WHO surgical checklist used, main procedure performed, total intraoperative fluid used , and overall hospital stay.

Table 7: Results of the Log-rank test for predictors among patients underwent emergency laparotomy from Jan, 2020, Addis Ababa, Ethiopia 2024

Predictors	df	log rank test(Chi-square)	P-value
ASA class	1	16.53	0.0009
Age	1	13.5	0.0007
Preexisting disease	1	12.20	0.0005
Hemoglobin(Hgb)	1	18.52	0.0001
platelet count(Plt)	1	6.94	0.0312
Duration of symptoms	1	3.68	0.0050
Preoperative anemia	1	10.87	0.0010
Preoperative sepsis	1	9.64	0.0019
Preoperative SBP	1	24.71	0.0000
Intra-operative incident	1	13.98	0.0002
Intraoperative blood loss	1	17.09	0.0002
Conscious recover from Anesthesia	1	19.72	0.0001
Duration of surgery	1	4.10	0.0429
Duration of Anesthesia	1	5.09	0.0323
Vasopressor used	1	38.05	0.0000
Blood transfusion	1	19.36	0.0000
Post-op transfer	1	58.90	0.0000
post-operative complication	1	14.95	0.0000

5.5.3. Assessing proportional hazard assumption

The model's fitness was checked using the Schoenfeld residuals test for all covariates, and the whole model satisfied the proportional hazards assumption (chi-square= 26.28, P-value = 0.3930).A variable with a p-value less than 0.25 in the bivariate Cox regression analysis was taken into the multivariate cox-regression model. Thus, a variable that showed a significant difference in multivariate analysis was preexisting disease, preoperative sepsis, intraoperative vasopressor use, and post-operative complications, which were significant predictors of mortality among patient who underwent emergency laparotomy at 5% level of significance.

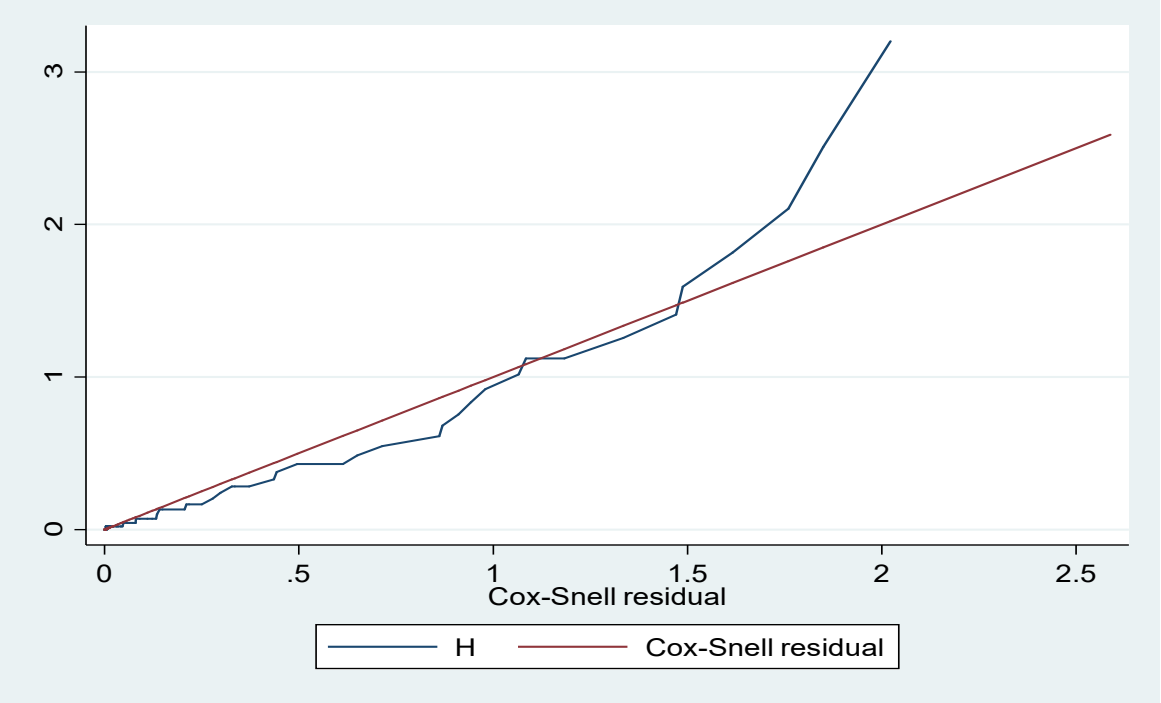

Figure 7: Cox-Snell residuals by fitting cox model for predictors of perioperative mortality among patients underwent emergency laparotomy, from January 1, 2020, to, January 1, 2023

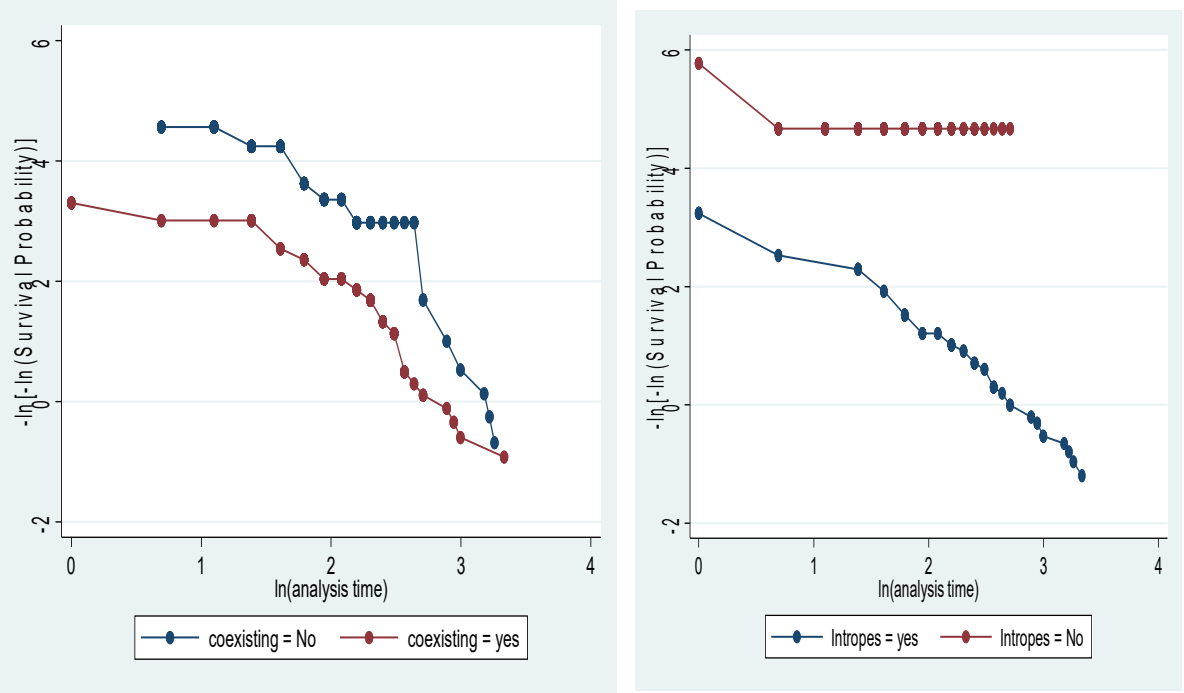

Figure 8: Log(-Log(survival probability))Log(survival time) plot by preexisting disease and intra operative vasopressor use among patients underwent emergency laparotomy in Addis Ababa, Ethiopia, from January 1,2020,to January 1,2023

Table 8: Multivariable analysis using proportional hazards model for predictors among patients underwent emergency laparotomy in Addis Ababa, Jan 2020 to Jan 2023

Variable	Category	**Survival status**		CHR(95%CI)	AHR(95%CI)	P-value
		Censored	Event			
Age	<65years	276	20	1		
	≥65	59	19	1.72(0.87, 3.4)	0.89(0.26, 3.02)	0.848
ASA class	ASAI	232	6	1		
	ASA II	82	5	1.68(0.51, 5.56)	0.37(0.06, 2.27)	0.282
	ASA III	16	17	5.18(1.84, 14.59)	0.38(0.08, 1.76)	0.215
	ASAIV	5	11	9.36(3.17, 27.58)	2.2(0.49, 9.89)	0.300
Preexisting disease	Yes	59	24	3.15(1.59, 6.20)	5.43(1.56,18.97)	0.000***
	No			1		

SBP	≥90mmhg	315	11	1		
	<90mmhg	20	28	5.81(2.63, 12.81)	2.7(0.72, 10.16)	0.143
Duration of symptoms	<72 hours	209	8	1		
	≥ 72hours	126	31	2.49(1.1, 5.61)	0.98(0.31, 3.11)	0.985
Preoperative anemia	No	297	12	1		
	Yes	38	27	3.91(1.85, 8.27)	0.99(0.28, 3.52)	0.995
Preoperative sepsis	No	319	14	1		
	Yes	16	25	4.16(1.93, 8.97)	1.2(1.03, 3.47)	0.035*
Intraoperative blood loss	≤500ml	249	24	1		
	>500ml	41	15	1.79(0.91, 3.53)	1.17(0.37, 3.66)	0.782
Platelet count	< 150 x109/L	21	16	2.06(0.94, 4.52)	0.44(0.165, 1.18)	0.103
	150-450 x109/L	290	20	1		
	>450 x109/L	24	3	2.25(0.65, 7.75)	0.72(0.17, 3.00)	0.655
Intraoperative vasopressor use	No	318	4	1		
	Yes	17	35	20.2(6.82, 59.76)	8.49(1.69, 42.65)	0.009**
Blood transfusion	No	284	7	1		
	Yes	51	32	6.16(2.59, 14.72)	3.24(0.96, 10.88)	0.057
Duration of surgery	<2hrs	154	4	1		.
	≥2hrs	181	35	2.88(1.004, 8.29)	0.43(0.02, 8.33)	0.579
Duration of anesthesia	<2hrs	108	3	1		
	≥2hrs	227	36	2.32(0.70, 7.7)	3.62(0.35, 37.12)	0.278
Intra-operative incident	No	312	12	1		
	Yes	23	27	5.12(2.31, 11.35)	1.45(0.56, 3.74)	0.439
Conscious recover from anesthesia	Full awake	322	12	1		
	Half-awake	8	7	4.59(1.7, 12.37)	0.4(0.10, 1.4963)	0.174
	Not awake	5	20	6.32(2.74, 14.57)	0.65(0.21, 1.98)	0.447
Post-operative complication	No	58	35	1		
	Yes	277	4	8.06(2.65, 24.50)	3.73(1.02, 13.65)	0.046*

NB: Variable which *** P-value<0.001, ** P-value<0.01,* P-value <0.05 shows multivariate modeling result. 1 represented categorical variable which are referenced.

5.5.4. Interpretation of multivariate analysis using adjusted hazard ratio

The mortality hazards of patients who had preexisting disease were 5.43 times higher than the hazards of patients who had no preexisting disease. Keeping all other variables constant. (AHR =5.43, (95% CI: 1.56, 18.97).

The hazard of mortality among patients who had preoperative sepsis was 1.2 times higher than that of patients who had no preoperative sepsis during admission. (AHR =1.2, 95% CI: 1.03, 3.47).

Keeping all other variables constant, patients who had received intraoperative vasopressors had an 8.49 times higher hazard than patients who had not received intraoperative vasopressors. (AHR =8.49, 95% CI: 1.69, 42.65).

The hazard of mortality among patients who developed post-operative complications was 3.73 times higher than that of patients who did not develop postoperative complications.(AHR=3.73,95% CI:1.02,13.65)

6. Discussion

The overall incidence of mortality among patients undergone emergency laparotomy at Addis Ababa governmental hospital was found to be 10.43% (95%CI: 7.7%- 13.97%).Predictors such as preexisting disease, preoperative sepsis, intraoperative vasopressor use, and post-operative complications were identified to be significantly associated with the mortality of patients who performed emergency laparotomy.

This study result was consistent with the findings of studies done in southern Ethiopian governmental hospitals (8.4%), Gondar University Hospital (8.1%), South Africa (12.5%), Rwanda, Egypt (10.3%) and Nigeria (12%) (11, 18 ,34-36,53).

This finding was higher than studies done in New York(6.9%) ,Ireland (6.66%),and Australia (5.2%) (15,33 ,53).The discrepancy occurred due to the high burden of comorbid disease, which is a strong predictor of mortality in this study, and the poor quality of surgical care. This result is also higher than the study conducted in West Oromia (7.42%) and Set. Paul's Hospital Millennium Medical College(3.14%),Ethiopia (24,60).The discrepancy occurred due to inclusion of elective laparotomy cases, which may have reduced the overall mortality rate, in the reporting of total mortality. This study was higher than the Ethiopian national perioperative mortality rate report (0.83%).This difference occurred due to the inclusion of all surgical cases and both emergency and elective operations.

This study finding was lower than the study conducted in Debre Markose Compressive Specialized Hospital, Northwest Ethiopia (61).This difference is due to variations in population and sociodemographic characteristics of the patient. This study result was lower than that of a study done in Denmark at a Danish hospital (19.3%) and Finland (17.8%) (28,53). This discrepancy occurred due to sample size, duration of follow-up time, and indication of surgery. The study conducted in Denmark has large sample size, which is 15,680 (28).

In this study, patients with preexisting disease had a higher mortality rate among patients who underwent emergency laparotomy than patients who had no pre-existing disease. This result is in line with a study conducted in southern Ethiopian governmental hospital, Denmark, and Japan (11,44,62). The possible reasons were that patients with preexisting disease had a high risk of developing intraoperative or postoperative complications, an impaired immune system, poor

physical function, and patients with preexisting disease had poly pharmacy which can interact with medication used during the perioperative period and complicate the outcome of a patient after an emergency laparotomy (63).

In our study, patients with preoperative sepsis had an increased risk of perioperative mortality among those who underwent emergency laparotomy. The same finding was revealed in studies done in a different regions of Ethiopia, such as southern Ethiopian Government Hospitals, Deber Markose, and Gondar, and in studies conducted in the USA (11,41,48,61). This might be explained by the fact that sepsis is associated with an abnormal immune response, which can cause extensive inflammation, septic shock, and organ dysfunction due to tissue hypo perfusion. This makes patients more susceptible to complications in the perioperative period and increases the risk of postoperative infections (64). Sepsis is a complex disorder in which the body's immune system has an extreme response to an infection, resulting in organ dysfunction and an increase 30-day mortality from septic shock, particularly if not treated promptly (62).

In this study, patients who had received vasopressor drugs during the intraoperative period had a higher risk of mortality than patients who had not received vasopressors drugs. This study is supported by research done in Ethiopia and USA (54,61). It can be explained that, patients with intra-abdominal disease may be hypovolemic, either due to fluid loss or as a result of distributive shock in the setting of sepsis or significant inflammation. These patients are likely to require the use of vasopressor in addition to intravenous fluid, however, vasopressor drugs can have a deleterious impact on organ function, notably on the heart and the kidney. The vasoconstrictive effect can lead to increased myocardial oxygen demand and an increased risk of heart failure, as well as decreased renal blood flow and kidney damage (65). Conversely, other research has suggested that vasopressor administration during emergency trauma surgery are not significantly associated with mortality (66). This might be explained by baseline health status and hemodynamics stability of the patient, patient population, type of surgery, the specific vasopressor agent used, and timing of administration. Another study conducted on the effect of vasopressor and surgical mortality concluded that a reduction in mortality in the setting of sepsis and cardiac surgery; however, not associated with difference in mortality in the majority of the sub settings. The possible explanations for this is vasopressor drugs effectively improve cardiac

performance and hemodynamic status despite this improvement vasopressor drugs reduced survival (67).

In our study, patients who developed post-operative complications were strongly associated with the mortality of patients who underwent emergency laparotomies. These studies are in line with studies done in Turkey and the United kingdom(55,65).The possible reasons were that certain conditions can lead to a higher risk of complications such as sepsis, length of hospital stays, and wound infection, which can increase the risk of mortality (68). The other possible explanation was that postoperative complications such as surgical site infection or hospital-acquired pneumonia can introduce pathogens into the body, which can impair the function of vital organs such as the heart, kidney, and lungs. Preventing, detecting, and managing complications is the greatest challenge facing emergency surgery patients. This delay can exacerbate pre-existing conditions and increase the risk of mortality (69).

7. Strength and limitation

7.1. Strength of the study

- 3- Year study period provides varieties of cases, patient demography, and seasonal variation of patient outcome.
- The study were conducted in multicenter Compressive Specialized Hospitals, so diversity of patients was obtained.
- Using systematic random sampling method.

7.2. Limitation of the study

- The short follow-up time of 30 days and the long term outcome may not be sufficiently identified.
- Because the study design was retrospective, important predictor's like availability of consultant surgeons and anesthetist were not included.
- Due to incomplete data on the patient chart variable such as organ function test and albumin level were not analyzed

8. Conclusion and recommendation

8.1. Conclusion

In conclusion, the overall mortality among patients underwent emergency laparotomy at Addis Ababa governmental Hospital was high. Preexisting disease, preoperative sepsis, vasopressor used, and postoperative complication were significant factors associated with mortality of emergency laparotomy.

8.2. Recommendation

For health care providers:

- Identification and intervention for patients with preexisting disease who underwent emergency laparotomies to improve outcomes.
- Preoperative optimization of critically ill patients with sepsis through rapid assessment, fluid resuscitation, vasopressors, and broad-spectrum antibiotics.
- Regular monitoring of patients is necessary for early detection and proper management of post-operative complications.
- Consider the advantages and disadvantages of the use of vasopressors, including doses and indications, and continuously monitor them to manage any potential complications to reduce mortality after an emergency laparotomy.

To the respective Hospitals/institutions:

- Prepare training and education for healthcare personnel on the most recent sepsis management guidelines and best practices.
- In collaboration with healthcare providers, and other stakeholders should improve postoperative management.

For future researchers:

- We recommended researchers who are interested on this are large scale study with prospective follow up study design better evidence.
- We advocate that studies expand the follow-up period beyond 30 days to encompass ninety days, six months, one year, and five years post operatively to better understand not only immediate postoperatively mortality but also long-term survival and complications.
- This study finds valuable predictors of mortality after emergency laparotomy, but it needs additional research on types and doses of vasopressor use.

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Annexes

English version checklist tool

Checklist for data extraction is prepared to gather sociodemographic,clinical treatement,and outcome-related information that is important for examine outcomes and determine determinantes of emergency patients mortality at TASH, Alert Compressive Specialized Hospital, Menelik Ⅱ Compressive Specialized Hospital, Zewoditu Memorial hospital. Without naming the clients,all of this information was taken from individual patients card.This information was collected by2 BSc anesthetist and 1 BSc nurse.Contact Information Sibhat Teka + 251912936077

NO		Possible answer
1	Residence	1. Outside Addis Ababa 2. Inside Addis Ababa
2	Sex	1. Male 2. Female
3	Age	1.age 18-65 years old 2.age >65 years old
4	ASA class	1.I 2.II 3.III 4.IV 5.V 6.VI
5	Preexisting disease	1.yes 2.No
	If ‘’yes” type Preexisting disease	1. Hypertension 4. COPD 7.Renal illness 2. DM 5.Cardiac illness 8.Nurological disorder 3. Asthma 6. Cancer 9. Others
6	Initial route of admission	1.Emergency department 2.Refered from health center 3.Direct admission from clinic 4.Direct refer from ward
7	Indication of emergency laparotomy	1. Non traumatic 2. Traumatic
8	Operation indication for non-traumatic emergency laparotomy	1.Gneralized Peritonitis 3.SBO 4.Ileocecal intussusceptions 2. LBO 5. 8Anastomotic leak/postoperative collection 6.Maligenancy 7.Adhesion 8.othrs
9	Mechanisms of injury	1.Blunt 2.Pentertating
10	Isolated organ injury	1. Small bowel 2. Large bowel 3.Spleen 4.Stomach 5.Diaphragmatic injury 6.Abdomino-thoracic injury 7.Retro peritoneal hemorrhage 8.Liver 9.Multiple injury
11	Preoperative investigation	Yes No
12	CBC	WBC
		HGB
		Platelet
13	Organ function test	Yes No

14	Duration of symptoms	1. <72 hours 2. ≥ 72 hours
15	Preoperative anemia	1.Yes 2.No
16	Preoperative sepsis	1.Yes 2.NO
17	Preoperative systolic blood pressure	1.≥90mmhg 2.<90mmhg
18	Prophylaxis antibiotics	1. Yes 2. No
19	Conscious recover from anesthesia	1.Full awake 2.Half-awake 3, Not awake
20	Intra-operative incident	1.Yes 2.No
21	Use of WHO checklist	Yes No
22	Main procedure	1. Appendectomy 2. Resection and anastomosis 3. Exploratory laparotomy 4.Primary repair 5. Diaphragmatic repair 6. Adhesiolysis 7. Gasterojejenostomy 8. Pedicle omentum pacthe 9. Colostomy/ileostomy resection 10. Hemi colostomy 11. Splenectomy 12. Sigmoidoectomy/Hartman colectomy 13. Lavage/drainage 14. other
23	Duration of surgery	1.geater than or equal to 2hours 2. less than 2 hours
24	Total intraoperative fluid used	1. Less than or equal to 2L 2. greater than 2L
25	Total intraoperative blood loss	1 less than or equal to 500 2.greater than 500
26	Duration of anesthesia	1.geater than or equal to 2hours 2. less than 2 hours
27	Intraoperative use of vasopressor	1.Yes 2.No
28	Perioperative blood transfusion	1.Yes 2.Yes
29	Postoperative admission	1. Ward 2.PACU 3. ICU
30	If ICU	On mechanical ventilated or Not
31	Post-operative complication	1.Anastomotic leakage 6.septic shock 2. wound dehisce 7.AKI 3. Re-obstruction 8. Re laparotomy 4. Wound infection 9. Hospital acquired pneumonia 5.vomating 10.others
32	The overall length of hospital stay	1. <14 days 2. ≥ 14 days
33	Date of operation performed	…….
34	Date of event occurred	……
35	Last status of the patient	A. Referred to other hospital B. Discharge against medical care C. Alive D. Died

A request for waiver of informed consent

Principal investigator: Sibhat Teka Tessema

Research topic: survival status and predictor of mortality among emergency laparotomy patients in selected governmental hospital in Addis Ababa; Ethiopia

Study Area: 4 selected governmental hospital in Addis Ababa

Purpose of research: the purpose of research plan will be to improve the survival status and decrease the mortality rate among emergency laparotomy

Data was collected:

- ✓ Socio-demographic data
- ✓ Patient co-coexisting condition

- **Disease related factor**
  - ✓ Operation indication
  - ✓ Duration of symptoms
  - ✓ Indication trauma related or acute abdomen
  - ✓ Mechanism of injury
  - ✓ Isolated organ injury is included from your recommendation.
  - ✓ Initial route of admission
  - ✓ Seniority of decision maker
  - ✓ Preoperative anemia
  - ✓ Preoperative sepsis
  - ✓ Preoperative blood loss
- **Perioperative care given**
  - ✓ Preoperative antibiotics
  - ✓ Anesthetic drugs
  - ✓ Total intraoperative fluid
  - ✓ Consciousness-recovery from anesthesia
  - ✓ Total intraoperative blood loss
  - ✓ Type of anesthesia
  - ✓ Procedure performed

- ✓ preoperative laboratory investigation
- ✓ Intraoperative incidents
- ✓ Use of WHO checklist
- ✓ Intraoperative use of vasopressor
- ✓ Types of surgery
- ✓ Duration of surgery
- ✓ Duration of anesthesia
- ✓ Blood transfusion
- ✓ Vasopressin used
- ✓ Postoperative transfer

There are 2,167 patients was underwent emergency laparotomy in four selected governmental hospital during the study period. The researcher was select the patient card by systematic probability method. Patient medical history only knows by the researcher or data collector. The results of the research will not affect the clinical care of the individual.

Is there sufficient justification for IRB to approve a waiver of informed consent?

The IRB may determine that the criteria have been met based on the following rationale provided by the researcher:

1. The research presents no more than "minimal risk" of harm to subjects.
   ……..
2. The waiver or alteration will not adversely affect the rights and welfare of the subjects.
   …….....
3. The research could not practicably be carried out without the waiver or alteration.
   ……
4. It would not be appropriate to provide these subjects with information about the result research……

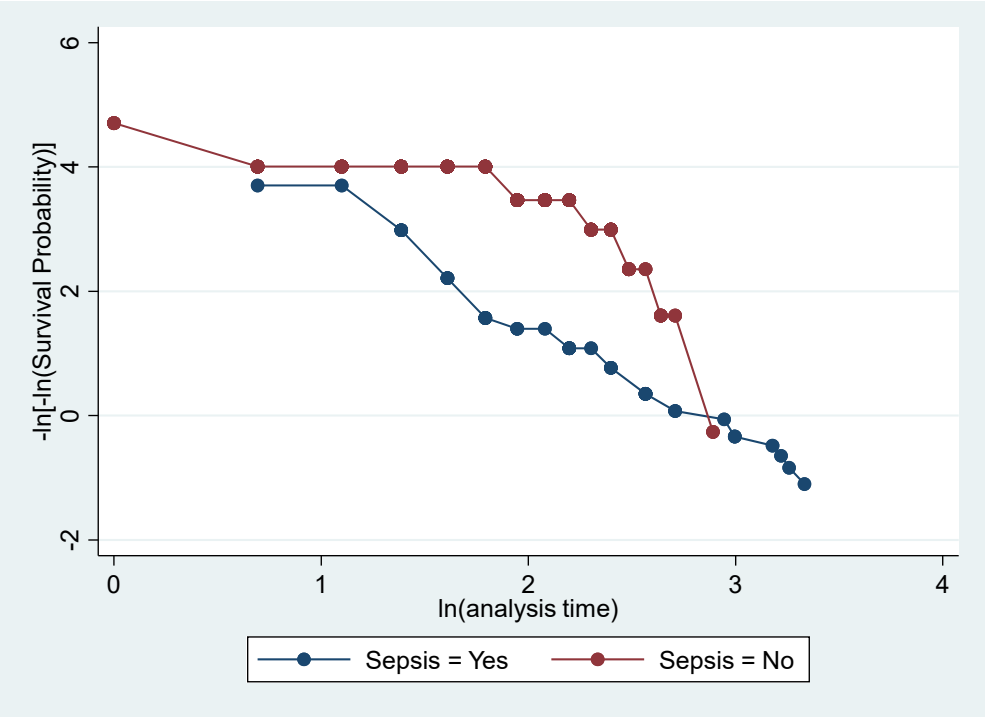
Table 9: Multicollinarity using VIF for independent variable

Variable	VIF	1/VIF
Pre op SBP	5.05	0.198201
Pre op Sepsis	4.25	0.235552
ASA	3.27	0.305673
Conscious recovery from anesthesia	3.23	0.309986
Intraoperative incident	3.10	0.322758
Vasopressor	3.01	0.331970
Immediate postop transfer	2.90	0.344985
Duration of surgery	2.54	0.394048
complication	2.34	0.426751
Duration of anesthesia	2.34	0.427650
Blood transfusion	2.19	0.455725
Pre op Anemia	2.18	0.458455
coexisting	1.99	0.503378
Hgb	1.95	0.511963
Total intra op	1.49	0.670688
OFT	1.46	0.683731
Intraoperative bleeding	1.39	0.719402
Initial rout of admission	1.36	0.735283
diagnosis	1.31	0.762903
Duration of S/S	1.31	0.763394
performed	1.27	0.787050
overall length of hospital stay	1.18	0.6956
Sex	1.26	0.796197
Plt	1.24	0.806465
Antibiotic's	1.17	0.851843
WBC	1.17	0.856426
Who checklist	1.07	0.932520
Mean VIF	**2.09**	

Table 10: Schonelfeld residual

Variable	rho	chi2	df	prob>chi2
Residency	0.14161	1.30	1	0.2544
Age	-0.20304	1.94	1	0.1639
ASA	-0.12030	1.21	1	0.2707
coexisting	0.33963	6.72	1	0.0956
Initial rout of admission	-0.01091	0.00	1	0.9445
diagnosis	0.05127	0.10	1	0.7535
Plt	0.07019	0.35	1	0.5567
WBC	-0.03925	0.10	1	0.7473
OFT	0.08129	0.27	1	0.6022
Duration of S/S	-0.23462	2.81	1	0.0934
Pre op Anemia	0.08428	0.4	1	0.5204
Preoperative Sepsis	-0.05829	0.1	1	0.7117
Pre op SBP	0.08892	0.55	1	0.4578
WHO checklist	-0.10355	0.41	1	0.5211
main operation performed	0.10847	0.71	1	0.3991
intra op incident	-0.26029	3.21	1	0.0734
Conscious recover from anesthesia	-0.31483	4.27	1	0.0887
Duration of anesthesia	-0.28393	5.28	1	0.0615
intra op bleeding	-0.07485	0.22	1	0.6370
total intra op fluid	-0.03831	0.08	1	0.7734
vasopressor	-0.22890	2.84	1	0.0921
Blood transfusion	-0.10304	0.79	1	0.3752
Transfer	-0.16863	2.60	1	0.1068
Post op complicated	-0.05768	0.17	1	0.6769
overall length of stay	-0.00353	0.00	1	0.9768
global test		**26.28**	**25**	**0.3930**

Figure 9: Log-Log plot by preoperative sepsis and postoperative complication



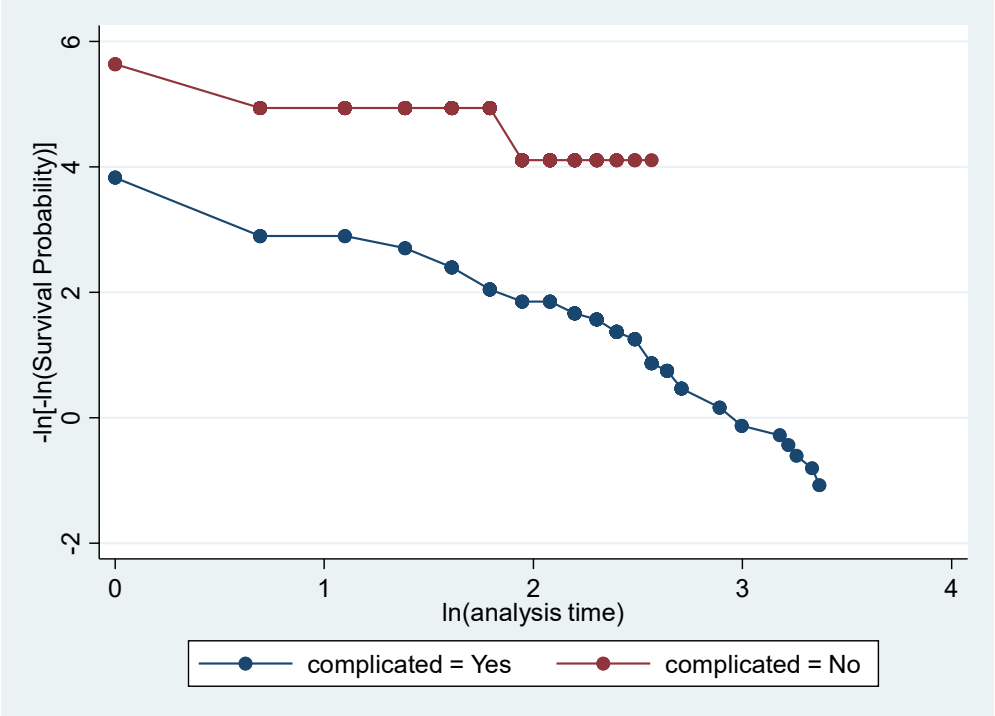
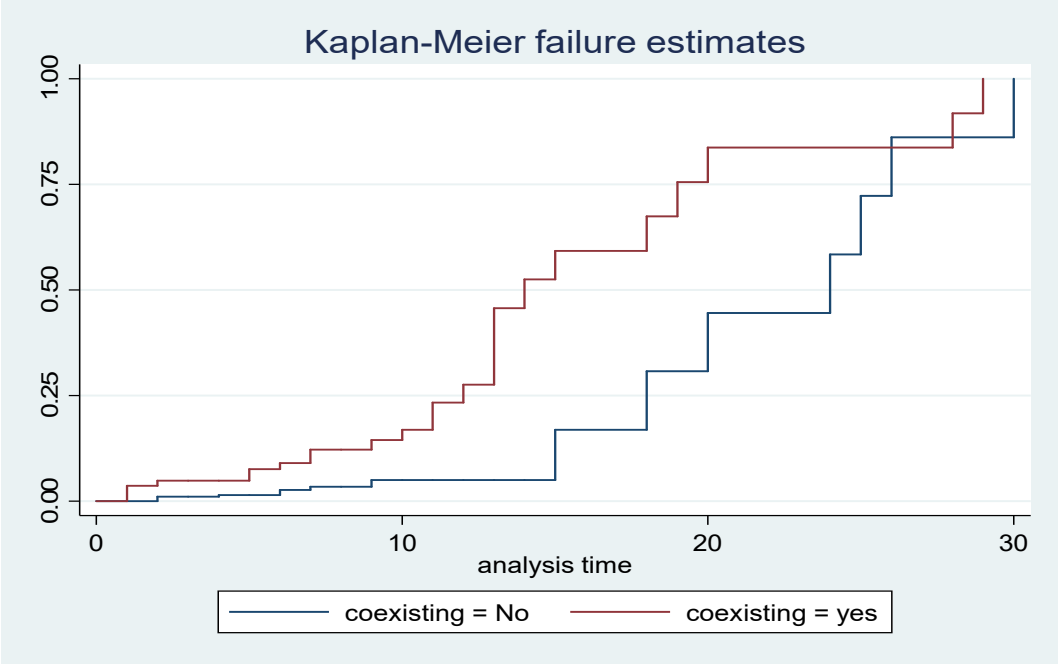
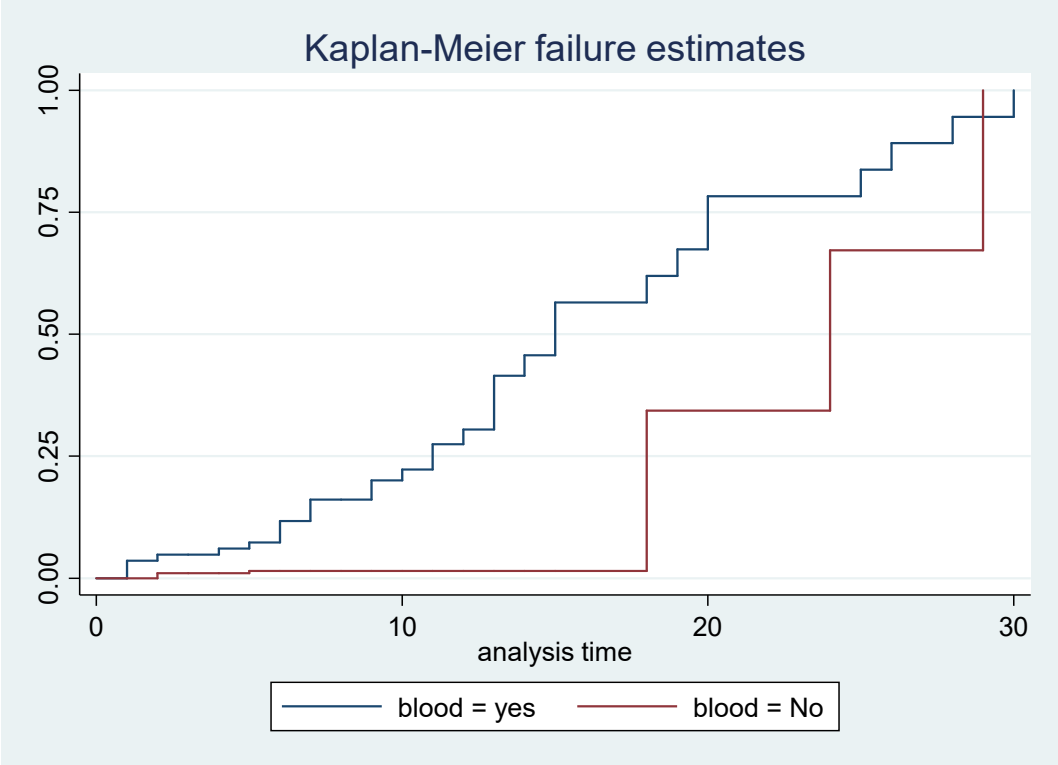
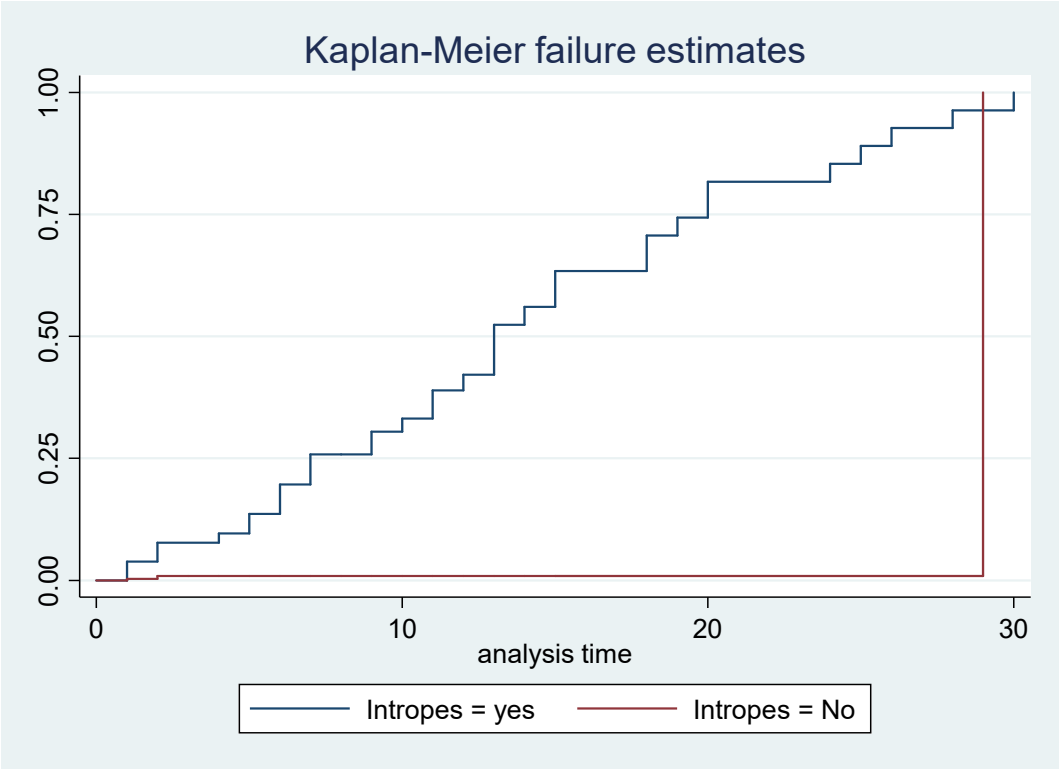
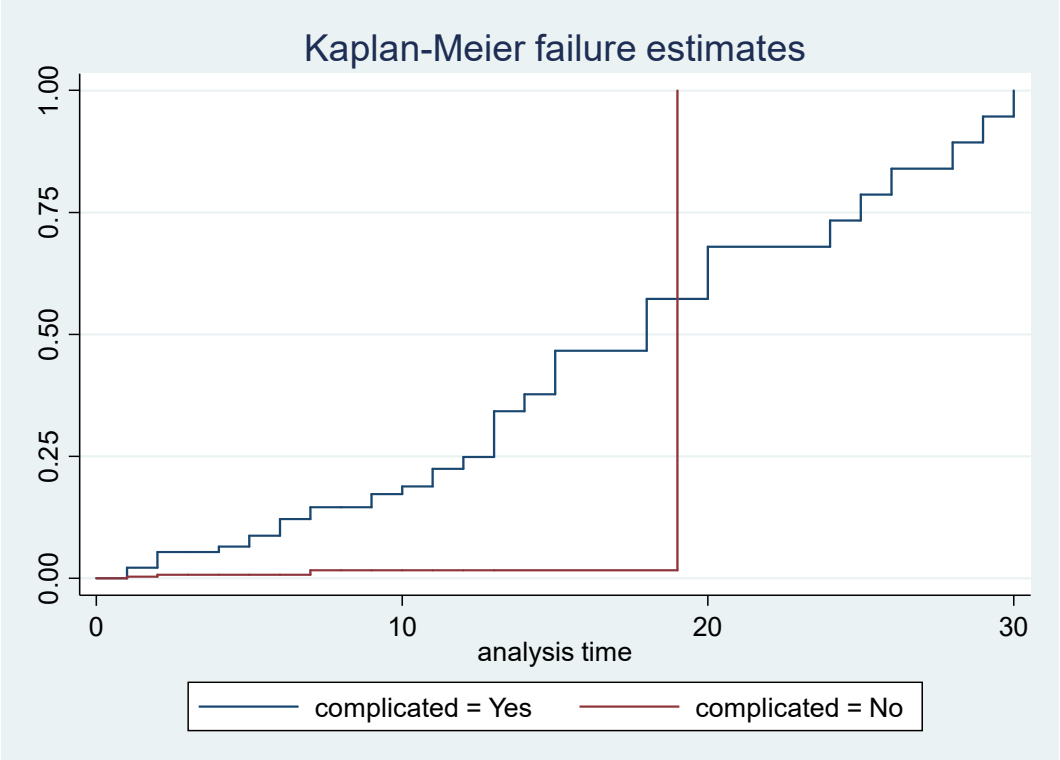


Figure 10: Kaplan-Meier function graph by preexisting disease, preoperative sepsis, and vasopressor used, and post-operative complication






Kaplan-Meier failure estimates
0.00
0.25
0.50
0.75
1.00
0
10
20
30
analysis time
Intropes = yes
Intropes = No


Kaplan-Meier failure estimates
0.00
0.25
0.50
0.75
1.00
0
10
20
30
analysis time
complicated = Yes
complicated = No