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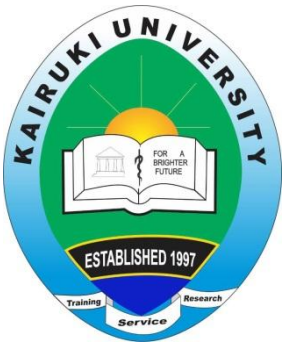

DEPARTMENT OF SURGERY

UTILITY OF SURGICAL APGAR SCORE AS A PREDICTOR OF EARLY POSTOPERATIVE MAJOR COMPLICATIONS AND MORTALITY AMONG ADULT PATIENTS FOLLOWING EMERGENCY LAPAROTOMY IN DAR ES SALAAM REGIONAL REFERRAL HOSPITALS, TANZANIA. A PROSPECTIVE COHORT STUDY.

BY

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A DISSERTATION SUBMITTED AS PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER OF MEDICINE (SURGERY) DEGREE AT KAIRUKI UNIVERSITY.

2025

CERTIFICATION

We, the undersigned, acknowledge that we have reviewed this dissertation entitled: **"The Surgical Apgar Score as a Predictor of Early postoperative Major Complications and Mortality Among Adult Patients Undergoing Emergency Laparotomy in Dar es Salaam Regional Referral Hospitals"** and recommend its acceptance by Kairuki University.

This dissertation is submitted in partial fulfillment of the requirements for the award of the degree of Master of Medicine in Surgery.

Supervisor: DR. Samuel Swai.

Date: 26.11.2025

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DECLARATION AND COPYRIGHT

I, Dr. Mabula Emmanuel Ng'homango, affirm that this dissertation is the result of my independent work. It has neither been submitted nor published, in whole or in part, to any other university or academic institution for the purpose of obtaining a degree or any other academic qualification.

As a postgraduate student enrolled at Kairuki University, I confirm that the content presented herein is entirely my original contribution.

Signature: _____

Date: 26/11/2025

ACKNOWLEDGEMENT AND DEDICATION

I would like to sincerely thank God for the gift of life and the strength towards development of this research dissertation.

I also thank all my teachers for helping me by ensuring the efficiency development of this dissertation, special thanks goes to my supervisors Dr. Samuel Swai and Dr. Albert Kategire for their unconditional help to facilitate this dissertation. Special thanks to my family for their all time support. This dissertation is dedicated to all patients with a abdominal conditions requiring emergency laparotomies, as it is going to change the mode of practices in our Dar es Salaam regional referral hospitals.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ARRH	Amana Regional Referral Hospital
APACHE	Acute Physiological and Chronic Health Evaluation
ASA	American Society of Anaesthesiologist
DRRHs	Dar es salaam Regional Referral Hospitals
EMD	Emergency Medicine Department
KU	Kairuki University
IVF	Intravenous Fluid
MRRH	Mwananyamala Regional Referral Hospital
NSQUIP	National Surgical Quality Improvement Programme
POSSUM	Physiological and Operative Severity Score for Enumeration of Mortality and Morbidity
SAS	Surgical Apgar score
SOPD	Surgical Outpatient Department
SRS	Surgical Risk Scale
SSA	Sub Saharan Africa
SSI	Surgical Site Infection
TRRH	Temeke Regional Referral Hospital
WHO	World Health Organisation
LMIC	Low and Medium Income Countries.

DEFINITIONS OF TERMS

1. **Early post-operative major complications** Any post operative event that leads to significant morbidity,prolonged hospitalization,reoperation,or death within 30 days post operation [1].
2. **Mortality** is defined by NSQIP as death occurring within 30 days post-operative.[1]
3. **Surgical Apgar Score (SAS),** is a surgical scoring system comprises of 10-points which consists of intraoperative variables (mean arterial pressure, heart rate, and estimated blood loss), in which a low score identifies those with high risk of developing adverse surgical complications.[2]

ABSTRACT

Background: Globally, laparatomy poses adverse postoperative outcomes and mortality. Early postoperative risk stratification to identify patients at risk is importatant so as to provide better postoperative outcomes and clinical care. The surgical Apgar score (SAS) is a simple and objective scoring system that can be utilized by a surgeon for a better postoperative decision making. However, the score has not been widely validated in resource-limited settings where it would be most valuable. This study aimed to evaluate the capability of SAS to project early postoperative major complications and 30-day mortality following emergency laparotomy in DRRHs.

Methodology: This was a prospective observational follow up study among eligible patients aged 18 years and above undergoing emergency laparotomy at Dar es Salaam Regional Referral Hospitals between April 2025 and July 2025. Intraoperative variables were collected, and post-operative outcomes including major postoperative complications and mortality were followed up till 30 days. SAS was calculated from intraoperative lowest heart rate, lowest MAP and blood loss and patients were categorised into 3 categories namely: low risk (8–10), medium risk (5–7), and high risk (0–4) for the development of major complications.

Results: A total of 101 patients were included in the study. Males outnumbered females by a ratio of 1.9: 1. The median age was 48 [IQR, 42-56] years. Overall, major postoperative complication and mortality rates were 60.4% and 15.8%, respectively. The mean SAS score was 5.43. The complication rate was found to be significantly high (71.4%) in the high-risk category (SAS, 0-4) compared to 56.8% in the medium (SAS, 5-7) and 40.0% in the low risk category (8-10) (X^2 =25.070,

p<0.001). Patients categorized as high-risk group had a 23.8% mortality rate compared to 13.6% and 0.0% in the medium and low risk groups, respectively (X2=40.930, p-value <0.001). SAS had a fair and good discriminatory ability for major postoperative complications and mortality with the area under the curve of 0.725(95% CI, 0.624–0.825) and 0.866 (95% CI 0.735 - 0.996), respectively. According to multivariate logistic regression analysis, co-morbidities (OR, 3.11[1.11-8.23]; *p*-value =0.004), ASA score (OR 2.34[1.17-9.11]; p-value = 0.011) and duration of surgery (OR, 7.21[2.73-22.11]; *p*-value = 0.002) were found to be statistically significantly associated with major post-operative, whereas co-morbidities (OR, 6.12[2.21-23.11]; p-value =0.003), ASA score > 2 (OR 7.22[2.11-34.21]; p-value = 0.012) and duration of surgery (OR, 2.19[1.17-3.73]; p-value =0.017) were independent factors associated with 30-day mortality.

Conclusion: This study demonstrated that low SAS (0-4) is associated with increased risk of developing major complications and/or mortality afte emergency laparotomy in our setting. SAS had shown a fair and good discriminatory ability for predicting the risk of developing major postoperative complications and mortality following emergency laparotomy, respectively.

CHAPTER ONE

1.1 INTRODUCTION

1.2 BACKGROUND

Annually, postoperative problems accounts for approximately more than seven million people globally[3], Also it accounts for about 7.7% of all mortality worldwide which occur within 30 days post surgery[45]. Postoperative mortality is also the third largest cause of death worldwide. Majority/half of those deaths and complications occurs in Low- and middle-income countries (LMICs) worldwide.

In Africa, 20% of patients undergoing surgery encounter complications following their operation, and 10% of these individuals die as a consequence of these issues. Compared to wealthier countries, the mortality rate for laparotomies is two to three times higher in Sub-Saharan Africa (SSA)[6 7 8].

The 10-point Surgical Apgar Score can be a valuable tool for identifying patients at high or low risk of serious complications after surgery and may assist in implementing strategies to reduce poor outcomes. The score is derived from information that is often accessible even in resource-limited environments. It is calculated using the patient's lowest mean arterial pressure, estimated blood loss, and lowest heart rate during the surgical procedure. The score ranges from 0 to 10, with lower scores suggesting greater surgical risk [9].

Fluctuations in blood pressure and heart rate often reflect the patient's overall health condition as well as the effectiveness of anesthesia administration[10 11]. The components that make up the Surgical Apgar Score reflect the patient's general health, the severity of the surgical trauma, and the surgical team's capacity to manage and stabilize hemodynamic changes during the procedure. Estimated blood loss serves as an indicator of the surgery's complexity and the surgeon's technical

performance[12].These elements combine to generate a score that offers healthcare professionals an evaluation of the procedure's success and the relative likelihood of postoperative complications or mortality.

At present, various surgical risk-assessment systems are available. However, most of them are rarely utilized in surgical patients since they are difficult to calculate at the bedside and demand multiple data points which are often based on inconsistent lab results, and have mainly been validated in Western populations [13].

Several studies have demonstrated a significant correlation between SAS and postoperative morbidity and mortality [14] and found that patients with scores <5 had a markedly increased risk of major complications. Subsequent research has confirmed its predictive value, making it a potentially valuable tool for perioperative risk stratification and postoperative management. Despite its widespread application, there remains debate regarding its predictive accuracy across different patient populations, surgical procedures, and healthcare settings. Additionally, while SAS is easy to implement, it does not account for perioperative risk factors such as patient co-morbidities or intraoperative fluid management. Given these considerations, further research is needed to assess the utility of SAS in different surgical contexts. Despite the fact that SAS has been validated for many procedures and in several countries in western countries, few studies have been conducted in Africa where patient demographics and the clinical environment are different [15]. This existing knowledge gap prompted the author to conduct this study in our centre to evaluate the capability of the SAS to predict post-operative major complications and mortality during the 30 days after emergency laparotomy and to assess whether it can be employed in Dar es Salaam regional referral hospitals.

1.3 PROBLEM STATEMENT

Emergency laparotomy is one of the routine procedures done in Dar es salaam Tanzania and carries a significant post-operative complications causing increased morbidity and mortatlity[16].

However, there is a lack of a straight forward, accurate, reproduciable, and objective risk stratification system to predict postoperative morbidity and mortality while directing postoperative patient care at TRRH,MRRH and ARRH and the SAS has primarily been validated in resource-rich western settings[17 18 19].

A study done at Muhimbili National hospital which included about 111 patients with emergency laparotomy, this study found that 64% of patients develop major postoperative complications, with a mortality rate of 16.2% [16].

Several contributing factors have shown to increase post-operative complications and mortality in emergency laparotomy, these includes intraoperative factors like significant blood loss, duration of operations, knowledge of operative doctor, patient co-morbidities like advanced age and chronic diseases. Post-operative factors like poor post-operative cares, limited resources.

There is knowledge gap since SAS has not been validated in low resource settings like Dar es Salaam regional referral hospitals to predict and stratify surgical risk,nevertheless,its utility and predictive accuracy have not been well established in these settings,where patient populations,perioperative resources,and postoperative care differ markedly from those in high income countries where SAS was developed.

AT present,most surgical risk assessments in Dar es Salaam hospitals rely on subjective clinical judgements rather than standardized scoring systems.Consequently,high risk patients may not be identified early,leading to delayed postoperative monitoring,inadequate resource allocation and preventable complications.

Therefore, there is a critical need for testing the utility and applicability of the score at Dar salaam regional hospitals.

This study is therefore essential to determine the utility of SAS in postoperative complications among patients undergoing emergency laparotomy at Dar es salaam regional hospitals.

This can assist in recognizing patients who are at elevated risk for post-surgical complications, enabling prompt initiation of targeted treatments or specific interventions during the early postoperative phase to reduce the likelihood of complications and decrease the risk of mortality. This approach is expected to enhance patient outcomes and reduce the burden of post-operative complications in Dar es salaam regional hospitals.

1.4 RATIONALE

SAS has primarily been validated in high resource settings. However it is not used in Dar es Salaam regional hospitals, where there is a low resource settings of which it may affect intraoperative and post-operative outcomes. SAS is simple and objective tool. However the use of subjective measures to predict complications and mortality has been suggested to be one of the causes of inefficient postoperative management [20,21].

The results derived from the application of the Surgical Apgar Score (SAS) in this study will contribute to the following:

i. Evaluating the utility on the predictive value of SAS for complications and mortality among high-risk patients, thereby facilitating the selection of the most appropriate risk assessment tools for use in Dar es Salaam regional hospitals.
ii. Addressing the current knowledge gap concerning the utility of SAS in forecasting early negative outcomes after laparotomy in Dar es Salaam Regional Referral Hospitals.
iii. Enabling surgeons to recognize patients at elevated risk of poor outcomes following laparotomy and implement strategies(optimal anesthesia management, hemodynamic stability, blood loss control, temperature and pain management, infection control) to enhance patient recovery [22].
iv. Helping to determine which patients require intensive management, including identifying candidates for damage control procedures versus definitive surgery, and those likely to benefit from postoperative intensive treatment and organ assistance[23].
v. Supporting informed decision-making and optimal allocation of medical resources.
vi. Providing foundational local data

1.5 RESEARCH QUESTION

Is the Surgical Apgar Score a reliable tool for forecasting postoperative major complications and mortality among patients having emergency laparotomy in Dar es Salaam's regional referral hospitals?

1.6 RESEARCH OBJECTIVES

1.6.1 MAIN OBJECTIVE

To determine the utility of the SAS to predict post-operative major complications and mortality during the 30 days post-laparotomy in Dar es salaam regional referral hospitals.

1.6.2 SPECIFIC OBJECTIVES

1. To determine Patients profile Characteristics.
2. To determine Common indications for performing laparotomy.
3. To determine Post operative major complications during the 30days post-operative period
4. To determine Mortality rate during the 30days post-operative period
5. To determine the association between SAS and the occurrence of major complications during the 30-day postoperative period
6. To determine the association between SAS and mortality during the 30-day postoperative period.

1.7 CONCEPTUAL FRAMEWORK

The utility of SAS for post-operative major complications and mortality can be determined by the intraoperative variables which are intraoperative blood loss, lowest mean arterial pressure and lowest heart rate during the whole period of operation.

Patients were followed for 30 consecutive days for any development of post-operative complications or death, and if SAS can predict post-operative major complications and death and its applications to bring changes at Dar es salaam regional hospitals.

Low SAS will help to identify patients with high risk of post-operative complications for immediate intraoperative and post-operative decisions making and hospital resource allocations for minimizing and preventing development of post-operative complications.

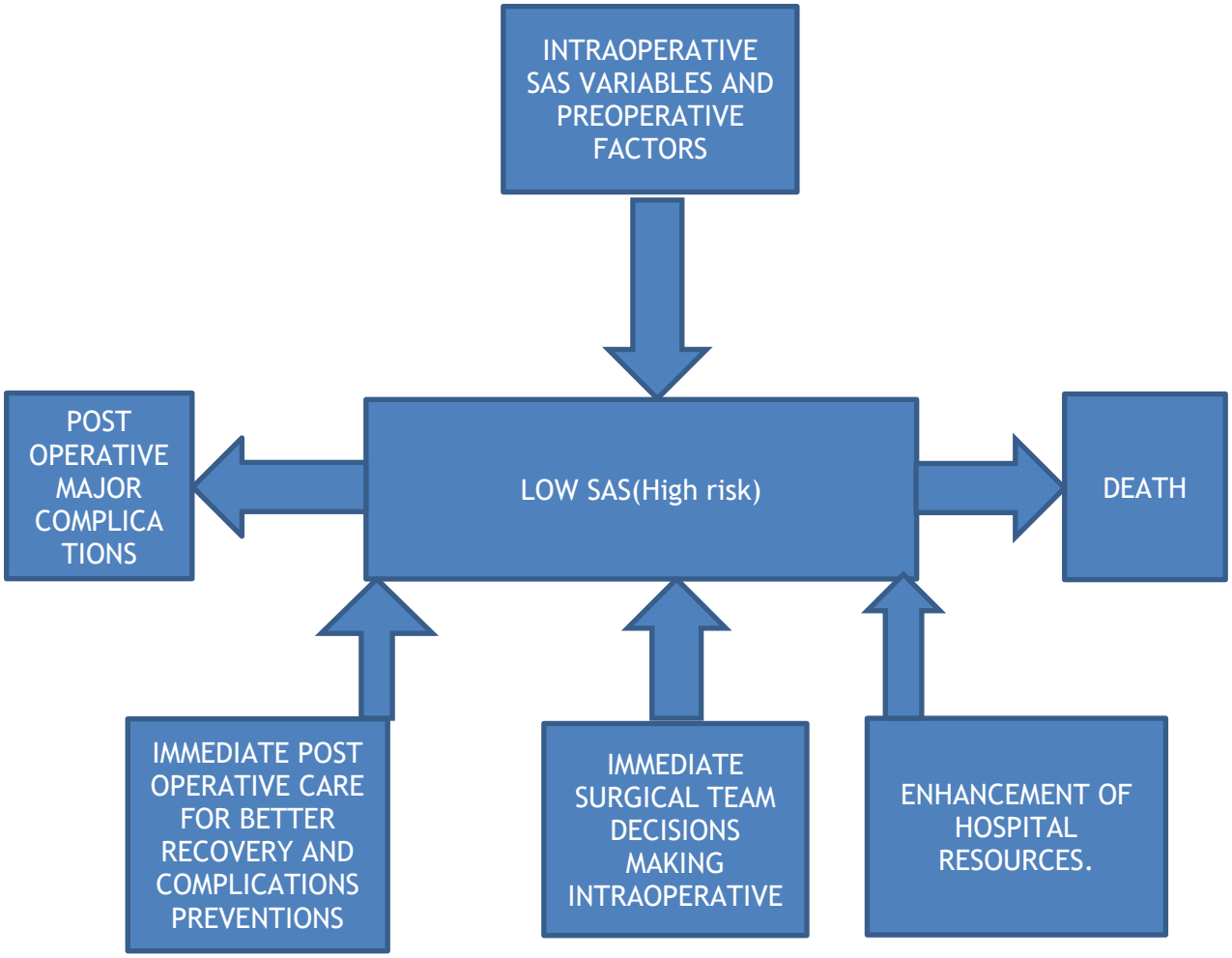

Figure 1: Conceptual Framework for SAS predictive ability for major complications and mortality

CHAPTER TWO

2.1 LITERATURE REVIEW

2.2 PREDICTIVE ACCURACY OF SAS.

In general surgical procedures, SAS has demonstrated significant predictive capabilities for postoperative Adverse Outcomes and Mortality. Research performed at Mulago National Referral Hospital evaluated the performance on the predictive value of the Surgical Apgar Score (SAS) for postoperative outcomes. The findings showed that an SAS below 7 had a sensitivity of 60.5% and a specificity of 81.14% for identifying major complications, while for mortality prediction, the sensitivity and specificity were 54.8% and 81.3%, respectively.While the ROC AUC for post-operative complications were found to be 0.75 and 0.77 respectively. The leading reasons for performing laparotomy were peritonitis (28%), intestinal obstruction (27%), and intra-abdominal cancers (11%), with the overall mortality rate reported at 10.6% [25] . In a study conducted at Muhimbili National Hospital, the Surgical Apgar Score (SAS) demonstrated a sensitivity of 61.76% and a specificity of 77.78% in predicting major postoperative complications. Additionally, the study identified peritonitis (44.1%) and intestinal obstruction (36.9%) as the most common indications for emergency laparotomy, with a recorded mortality rate of 16.22% [16].

A study done by Dullo et al in Kenya has shown ROC AUC for SAS predicting morbidity was 0.796 which was good predictive accuracy [8].

Other study done by Hynes AB et al in multicenter study across US,in that study AUC for predicting major complications or death within 30days was found to be 0.70 and 0.77 respectively [22].

Another study done by Choudhari R et al,2022 India,the AUC for post-operative complications was 0.88 while for 30 day mortality was found to be 0.88.The common

indications for performing laparotomy was found to be trauma, peritonitis, intestinal obstructions, peritonitis, hollow viscus perforation, abscess drainage and tumor resection [28].

In low- and middle-income nations, frequent reasons for conducting laparotomy include acute appendicitis, gallstones, acute abdominal conditions, blunt or penetrating injuries, sigmoid volvulus, biliary peritonitis, liver abscesses, and gastric outlet obstruction [16 25].

These conditions often present at an advanced stage, and preoperative stabilization may be insufficient, leading to considerable postoperative complications and death.

While SAS has been studied in various settings, its predictive accuracy in Tanzania regional referral hospitals remains under explored, also previous studied have mainly focused on high resource settings. There is a gap in assessing SAS in resource limited hospitals with different patient demographics, perioperative care, and complication profiles. Therefore filling these gaps can improve the relevance of SAS in guiding perioperative decision making and resource allocation in Dar es Salaam regional hospitals.

2.3 PREOPERATIVE RISK STRATIFICATION

Ideally, risk assessment tools should be unbiased and offer mortality predictions, helping to facilitate communication and understanding of disease severity. When identifying patients who are at high risk of postoperative problems for effective a nd aggressive treatment or the start of particular measures in the immediate postopera tive period, risk stratification is crucial to mitigate the development of complications and prevent death[14].

Implementing perioperative risk stratification for morbidity and mortality is essential for effective resource allocation and enabling patients to make well-informed decisions. Accurate risk assessment in patients undergoing laparotomy plays a crucial role in minimizing postoperative complications and death, which can be achieved through the use of standardized and objective risk-scoring system[26] [27].

2.4 POST OPERATIVE OUTCOMES AFTER LAPAROTOMY.

Conditions Affecting the Abdomen that necessitate laparotomy are common in low- and middle-income countries and are often linked to high rates of postoperative complications and mortality.

Mortality

Mortality is among the major post-operative outcomes recorded during laparotomy in resource limited settings. According to a study by Bruno Chan et al [25] the postoperative mortality rate at Mulago National Referral Hospital was 10.6%, with deep organ space infections being the most prevalent complication among laparotomy patients. In contrast, a 2023 study conducted at Muhimbili National Hospital reported a higher mortality rate of 16.22% and identified respiratory complications as the most common postoperative issue following emergency laparotomy [16].

A study done by Dullo et al in Kenya has shown a mortality of 7.9% post laparatomy [8].

Another study done by Choudhari R et al,2022 India,the mortality rate was found to be 3.2 % post-operative complications

The common indications for performing laparotomy was found to be trauma, peritonitis, intestinal obstructions, peritonitis, hollow viscus perforation, abscess drainage and tumor resection [28].

A study done by Ngarambe et al in Rwanda has shown a mortality of 18.3% post laparatomy [43].

In another study done by Shameem Unnisa and Md Jawed on SAS study,the mortality rate was found to be 4.5%.

Gawande et al. aimed to develop a comparable surgical risk model in Boston by applying multivariable logistic regression to a retrospective dataset to identify both preoperative and intraoperative factors linked to surgical morbidity and mortality [14].

Ultimately, they chose to construct their model using intraoperative variables, as these were found to independently predict patient outcomes. The model incorporated three key indicators: estimated blood loss, lowest heart rate (to account for arrhythmias), and lowest mean arterial pressure. This ten-point scoring system was later validated through prospective analysis.

A study demonstrated that the Surgical Apgar Score (SAS), when applied during general or vascular surgeries, correlated with major complications and a mortality rate of 3%.

Post-operative complications.

Laparotomy found to have significant post-operative morbidity especially in low resource settings. A 2022 study by Bruno Chan et al. found that deep organ space infections were the most frequent complication among patients who underwent laparotomy at Mulago National Referral Hospital. The study reported that 24% of patients experienced major postoperative complications, with surgical site infections being the most prevalent, followed by wound dehiscence and anastomotic leaks. The majority of these procedures were performed by surgical residents [25].

A 2023 study conducted at Muhimbili National Hospital reported a mortality rate of 16.22% following emergency laparotomy. The most commonly observed postoperative complications included respiratory complications (21.62%), surgical site infections (18.02%), and renal dysfunction (13.51%) [16].

A prospective observational study involving 220 patients undergoing both elective and emergency surgeries found that lower SAS correlated with higher complication rates and increased mortality. Specifically patients with scores between 0-4 experienced a 50% complication rate, whereas those with scores 9-10 had 4.2% complication rate and no mortalities. The study concluded that SAS is simple and valid predictor of postoperative outcomes in general surgery.[28] However there is a research gap since there is a limited validation of SAS in low resource settings since most of the studies have been conducted in high income countries and developed settings, for example Muhimbili and Mulago hospitals have high standard practice in terms of availability of standard diagnostic equipments, level and number of operating staffs, and bed state than Dar es salaam regional hospitals.

Most of the emergence surgeries in Dar es Salaam regional hospitals are done by registrar and residents which might contribute to poor post-operative outcome. Also since its applicability is not well known in assessing how resource limitations impact its effectiveness in Dar es Salaam Regional hospitals.

In a study done by Ngarambe et al, the complication rate developed was 28. 6% while a study done in India by Choundhari et al found a complication rate of 20. 5% [43] [28].

2.5 ORIGIN OF THE SURGICAL APGAR SCORE.

In 1952, Dr. Virginia Apgar, an anesthesiologist at Columbia University, created the original Apgar Score, a quick assessment tool used to evaluate the condition of newborns shortly after birth and to monitor their response to resuscitation efforts. The evaluation is performed at both one and five minutes after delivery, and it assesses five criteria: skin color, heart rate, reflex irritability, muscle tone, and breathing effort [29].

The Apgar score helps assess signs of hemodynamic instability such as bradycardia, poor perfusion, low muscle tone, cyanosis, respiratory depression, or apnea. Its widespread adoption in obstetric care is largely due to its simplicity and practicality.

Moreover, the score has been validated in numerous studies involving patients undergoing different surgical interventions, indicating its potential for broader use. It may also serve as a useful tool for identifying individuals at increased risk of postoperative complications or death, including those discharged soon after surgery [14] [31].

2.6 COMPARISON BETWEEN THE SURGICAL APGAR SCORE AND OTHER RISK ASSESSMENT SYSTEMS

Risk assessment tools often incorporate both objective and subjective components to estimate the likelihood of postoperative complications and mortality. Some scoring systems, such as the American Society of Anesthesiologists (ASA) classification and the Acute Physiology and Chronic Health Evaluation (APACHE), include subjective criteria that may vary based on clinical judgment [31] [32] [33],the Surgical Risk Scale (SRS)), The Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) has faced criticism because it relies heavily on clinical judgment, which may not be universally applicable to all patients [33] [34].

A significant limitation of many risk assessment models lies in the difficulty of accurately collecting and standardizing the required clinical data for computing applicability and predicted postoperative outcomes and mortality.

Because of their intricacy, the Physiological and Operative Severity

The Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) and its related models are generally unsuitable for use in settings

with limited resources. [34] This constraint is also seen in the National Surgical Quality Improvement Program (NSQIP) database, which is primarily applied in Western countries. In contrast to these more complex scoring systems, the Surgical Apgar Score (SAS) is based on only three intraoperative variables—lowest heart rate, lowest mean arterial pressure (MAP), and estimated blood loss (EBL)—to estimate the likelihood of postoperative complications and mortality.

SAS offers a simple, objective, and user-friendly approach with strong discriminatory ability to identify patients at either high or low risk of serious complications or death within 30 days after surgery.

The parameters needed for its calculation are easily obtainable in most clinical environments.[31 35]

Research gap:

i. Investigating the impact of eliminating subjective parameters on the predictive power of surgical risk scores could provide valuable insights into whether more objective measures, as seen in the SAS, provide a more consistent and reliable prediction at Dar es salaam regional referral hospitals.
ii. Most of the scoring system is compatible to western/developed settings because of its complexity and cost, however understanding how well the SAS performs in varied settings, particularly in low-resource is crucial since its simple and objective. This includes assessing its validity in predicting outcomes for diverse patient populations, including different age groups, comorbidities, and types of surgeries.

2.7 UTILITY AND OUTCOMES OF SAS IN OTHER STUDIES.

Prospective observational study was carried out at Muhimbili National Hospital, focusing on patients who underwent emergency laparotomies. The aim of the study was to determine the Surgical Apgar Score's predictive accuracy for the severity of post-operative complications.

Along with describing the severity pattern of postoperative complications among patients who had emergency laparotomies, the study also sought to determine whether SAS and the severity of post-operative complications after emergency laparotomies were correlated.

The study showed that the SAS is a reliable predictor of the severity of postoperative complications following emergency laparotomies at Muhimbili National Hospit with the sensitivity 61.76% and specificity of 77.78% of SAS for the development of major complications were recorded [16].

A study done by Dullo et al in Kenya has shown ROC AUC for SAS predicting morbidity was 0.796 which was good predictive accuracy [8].

Other study done by Hynes AB et al in multicenter study across US,in that study AUC for predicting major complications or death within 30days was found to be 0.70 and 0.77 respectively [22].

Another study done by Choudhari R et al,2022 India,the AUC for post-operative complications was 0.88 while for 30 day mortality was found to be 0.88.The common indications for performing laparotomy was found to be trauma,peritonitis,intestinal obstructions,peritonitis,hollow viscus perforation, abscess drainage and tumor resection [28]

At Mulago Hospital, a resource-limited tertiary care facility in Uganda, a prospective observational study carried out involving adult patients undergoing laparotomy.

Participants were followed for a period of four months. Data on preoperative and intraoperative characteristics were collected, and the Surgical Apgar Score (SAS) was calculated based on these variables. Patients were then grouped into three risk categories: low (8–10), moderate (5–7), and high (0–4).The primary outcomes measured were in-hospital mortality and major postoperative complications. Depending on the nature of the data, results were presented as medians with interquartile ranges, means with standard deviations, or as proportions,SAS had shown predictive capability for mortality and postoperative complications [25].

To determine whether the Surgical Apgar Score (SAS) is a dependable predictor of postoperative complications in patients undergoing hysterectomy for cancer, a retrospective cohort study was carried out between 2008 and 2010 at a single academic institution. The study included a series of consecutive cancer-related hysterectomies. Perioperative complications were defined according to criteria established by the American Board of Obstetrics and Gynecology and were categorized into intraoperative and postoperative events. The univariate analysis showed that SAS was effective in predicting both types of complications.[36]

The Surgical Apgar Score (SAS) has been shown to be a useful tool in predicting postoperative complications across various cancer types. However, limited data exists regarding its relevance in esophageal cancer. This study focused on patients who underwent transthoracic esophagectomy, aiming to evaluate the ability of SAS to predict major postoperative complications—particularly anastomotic leakage—and to assess its association with patient outcomes. Univariate analysis revealed that SAS was significantly associated with all major complications, including anastomotic leakage.

Furthermore, multivariate logistic regression identified a low SAS as an independent risk factor for both anastomotic leakage and other major postoperative complications.[37]

A cohort study conducted at a tertiary hospital in the Caribbean evaluated the predictive accuracy of the Surgical Apgar Score (SAS) in patients undergoing emergency abdominal surgery. The SAS was retrospectively calculated from anesthesia records for all patients who had emergency abdominal procedures over a 12-month period. Postoperative surgical records were reviewed to identify major complications and mortality. The relationship between SAS and patient outcomes was analyzed using binary logistic regression, and the score's discriminative power was assessed through receiver operating characteristic (ROC) curve analysis. Out of 220 patients included in the study, 72 (33%) experienced either a major in-hospital complication or death. The highest rate of complications was observed among patients with low SAS values, with 68% of those scoring in the lowest category experiencing adverse outcomes ($p < 0.0001$).[38]

Research gap; Though SAS has found to have predictive ability on post-operative outcomes in other studies, there is a limited data on how SAS performs in resource limited setting like Dar es salaam regional hospitals where there is a limited hospital resources like few number of Surgeons and other health personnel, few diagnostic equipments, few number of hospital beds and overcrowding of patients. Therefore the impact of SAS on clinical decision making and post-operative outcome and care is paramount in this setting.

CHAPTER THREE

3.0 METHODOLOGY

3.1. STUDY DESIGN

A prospective Cohort study was conducted in Dar es Salaam regional referral hospitals to evaluate the Surgical Apgar Score as a predictor of early surgical major complications.

TABLE 2: SURGICAL APGAR SCORE

	0points	1point	2points	3points	4points
Estimated blood loss(mls)	>1000	601-1000	101-600	<100	—
Lowest mean arterial pressure(mmhg)	<40	40-54	55-69	>70	—
Lowest heart rate(beats/min)	>85	76-85	66-75	56-65	<55

The Surgical Apgar Score (SAS) is calculated by summing the points assigned in each category during a surgical procedure.[14]

A. Pathologic bradyarrhythmia—including asystole, sinus arrest, and atrioventricular block rhythms—are assigned zero points. Estimated blood loss is determined using the gross formula.

B. Blood pressure and heart rate values are taken from anesthesia records, specifically from measurements recorded at the time of incision.

C. The blood pressure component of the score is based on the mean arterial pressure (MAP). If MAP is not directly recorded, it is calculated using the lowest recorded systolic and diastolic pressures with the formula:

MAP = diastolic pressure + (systolic pressure − diastolic pressure) ÷ 3.

D. If asystole or complete heart block occurs, the heart rate score is recorded as zero.

The gross formula for estimation of blood loss is described below[40]:

EBL=EBV × [HBI-HBF/HBI+HBF]/2+(500 × Tu) Where,

EBV=Estimated blood volume (body weight in kgs × 70 ml/kg) HBi = Pre-operative hemoglobin (g/dl),

HBf=Post-operative hemoglobin (g/dl) around 24 h after surgery

Tu=Sum of units of blood transfused (i.e. whole blood, packed red blood cell transfused).

3.2. STUDY SETTING

This study was carried out in selected regional hospitals in Dar es Salaam which are MRRH, ARRH and TRRH since these hospitals provide a range of surgical services making them suitable for this study. The Dar es Salaam Regional Referral Hospitals, comprising three key referral facilities in Tanzania's largest city, serve a catchment population of over 8 million people and collectively offer an estimated total bed capacity of around 1,000.

For a period of 5 months there were about 120 patients who underwent laparotomies. The selection of Dar es Salaam regional hospitals was based on the following factors:-

i. Availability of many surgical cases compared to other health facilities, i.e for a period of 4 months there were 120 laparotomy cases. This helps to ensure sufficient sample size.

ii. Availability of skilled personnel, this includes surgeons, surgical nurses, anesthetists, this helps to ensure Standard Operating Procedures, checklists and reliable data collections.

iii. Different surgical cases from different areas within Dar es Salaam, this provides adequate sample size and more representative results.

iv. Good environment for conducting research, since these hospitals have been used for conducting various research and academic background.

v. Availability of specialized surgical services making it a good choice for conducting SAS.

The study was carried out in the Emergency Medicine Department (EMD), Adult Intensive Care Unit (AICU), general surgical wards, and Surgical Outpatient Department (SOPD) at MRRF, TRRF, and ARRH, involving all admitted patients scheduled for emergency laparotomy.

Patients undergoing laparotomy at Dar es Salaam regional referral hospitals are managed by different cadres of doctors from anesthetic technicians, Medical Officers, interns, residents, Senior medical Officers in general surgery and anesthesiologists and their consultants. The hospitals are capable of undertaking major surgical procedures on daily basis. Each hospital is well equipped with 3 operating theatre rooms where both 3 rooms are for emergency/elective operations**.** Also each hospital has an Adult Intensive Care Unit with 10bed capacity in which mixtures of cases with serious life threatening conditions are admitted for intensive care and stabilization.

3.3 STUDY DURATION

Study was conducted between June 2025 and August 2025.

3.4 STUDY/TARGET POPULATION.

The target population were all patients aged >18years and older undergoing emergency laparotomy at Dar es salaam regional referral hospitals admitted to the general surgical wards, Emergency medicine department, Surgical outpatient

department, intensive and high dependency units whom the eligibility criteria between March and July 2025.

The minimum total number of patients was 101 patients, whereby patients were selected as follows in each hospital, 37(37%) from ARRF, 34(31%) from TRRH and 32(32%) patients from MRRH

3.5 SAMPLE SIZE

The sample size for the study was determined using the Yamane Taro formula (1967).[37]

$n=N/1 +N(e)^2$

Where; n = the sample size

N = the population size (Number of patients who underwent emergency laparotomies 4 months period from May 2024 to October 2024) = 120(Obtained from hospital operation record book, whereby 44(37%) from ARRF,37(31%) from TRRH and 39(32%) patients from MRRHThe sample size was calculated using the Yamane Taro (1967) formula with a precision level (e) of 0.05:

$$\mathbf{n = N / (1 + N(e^2))}$$

$$\mathbf{n = 120 / [1 + 120(0.05)^2] = 92}$$

To account for a potential 10% loss to follow-up, an additional 9 participants were included, bringing the minimum required sample size to **101 patients**.

Participants were proportionally selected from the three regional referral hospitals as follows:

- **37 patients (37%)** from Amana Regional Referral Hospital (ARRH)
- **31 patients (31%)** from Temeke Regional Referral Hospital (TRRH)
- **33 patients (33%)** from Mwananyamala Regional Referral Hospital (MRRH)

3.6 SAMPLING PROCEDURE

Using consecutive sampling due to emergency setting and limited patient pool, all patients 18 years and above admitted at Dar es Salaam regional referral hospitals (MRRH, ARRH, TRRH) and for whom emergency laparotomy was scheduled and who met all inclusion and none of the exclusion criteria were recruited until the desired sample size was obtained within a specified time frame.

3.7 INCLUSION CRITERIA.

All patients aged 18 years and above planned for emergency laparotomy in Dar es salaam regional referral hospitals (MRRH, ARRH, TRRH) who consented to participate in the study and 30 day follow up period.

3.8 EXCLUSION CRITERIA

1. Patients who had major concurrent surgery involving other part of the body within 30 days following the laparotomy being studied.
2. Patients diagnosed with metastatic or nonresectable tumors.
3. Patients who had mini-laparotomy or laparoscopic surgeries.
4. Patients undergoing repeat (re-laparotomy) procedures.
5. Patients presenting with polytrauma.

To track the occurrence of major complications or death within 30 days after surgery, the principal investigator or a research assistant recorded the telephone contact details of each participant or their next of kin on a separate form. Follow-up was conducted via phone calls on postoperative days 1, 3, and 5, and then every other day until discharge, death, or the 30th postoperative day.

In addition to telephone follow-up, patients were assessed during their routine postoperative clinic visits. During these visits, clinical notes were reviewed, and any symptoms reported by the patient were documented to aid in identifying postoperative complications or mortality.

Major complications were classified according to the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) criteria. These included pneumonia, acute kidney injury, cardiac arrest, wound dehiscence, deep or organ-space surgical site infections, anastomotic leaks, and septic shock.

For risk stratification, patients were categorized according to their Surgical Apgar Score (SAS) as follows:

High risk: SAS 0–4

Moderate risk: SAS 5–6

Low risk: SAS 7–10

3.9 DATA COLLECTION PROCEDURES.

Patient recruitment for the study was enrolled before surgery and the recruitment carried out in the emergency medicine units and general surgical wards of MRRH, ARRH, and TRRH by the principal investigator. Individuals meeting the inclusion criteria were enrolled after securing informed written consent, obtained either from the patient or their next of kin.

Each participant underwent a thorough evaluation, which included a comprehensive medical history, physical examination, and relevant diagnostic investigations. Demographic data were collected from the patient, their relatives, referring facilities, or accompanying healthcare personnel. This information included age, sex, place of residence, occupation, marital status, and any known comorbid conditions.

Details of the assessments and interventions carried out at MRRH, ARRH, and TRRH from the day of admission were documented. This included the admission diagnosis, general clinical examination findings (such as blood pressure, pulse rate, respiratory rate, oxygen saturation, urine output, temperature, random blood glucose, and hemoglobin levels), relevant investigations, and the treatment provided.

Information regarding the surgical procedure was collected from postoperative notes, including intraoperative diagnosis, type of surgery performed, operation duration, immediate postoperative care, and the rank of the operating surgeon or surgical team.

For Surgical Apgar Score (SAS) classification, patients were grouped into three categories: **high-risk** (SAS 0–4), **Moderate risk**: SAS 5–6 and **low-risk** (SAS 7–10) for developing postoperative complications.

All patients who underwent emergency laparotomy were followed for 30 days to assess outcomes. Follow-up was conducted both in the general surgical wards and in the Surgical Outpatient Department (SOPD). For those who missed clinic appointments, follow-up was continued via phone calls to track their postoperative progress until the 30-day period was completed.

3.10 STUDY VARIABLES

3.10.1 INDEPENDENT VARIABLES

Socio-demographic characteristics collected in the study included the patient's age, sex, and area of residence.

Clinical characteristics encompassed the type of surgery performed (emergency), the intraoperative diagnosis, duration of the procedure (in minutes), and the surgeon's level of training (resident/registrar versus specialist).

The Surgical Apgar Score (SAS) components were calculated based on estimated blood loss, the lowest recorded mean arterial pressure, and the lowest recorded pulse rate.[14]

3.10.2 DEPENDENT VARIABLES

Major postoperative complications were identified based on the criteria established by the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) and COPELAND et al [1 2] .

These complications were classified as binary outcomes: either present (Yes) or absent (No). included the following:

A. Pneumonia was diagnosed based on radiological findings and/or clinical signs and symptoms. A patient was considered to have pneumonia if they met the following criteria:

>**.**The patient must exhibit at least two of the following symptoms:

I) Development of a new or worsening cough, shortness of breath (dyspnea), or rapid breathing (tachypnea).

II) Appearance of new purulent sputum or a noticeable change in sputum characteristics.

III) Deterioration in gas exchange, such as an SpO_2 below 90% on room air.

>**.**A patient should have one or more of the following signs

I) Fever greater than 38°C without an identifiable cause.

II) Abnormal white blood cell count, either leukopenia (WBC < 4000/mm^3) or leukocytosis (WBC > 12,000/mm^3).

> For radiological exam (X-ray) with at least one of the following:

I) New, progressive, or persistent infiltrates.

II) Areas of consolidation or opacity

III) Presence of cavitation

B. Acute kidney injury (AKI) was assessed based on any of the following criteria: a 2- to 3-fold increase in serum creatinine, a serum creatinine level ≥ 4 mg/dL (≥ 354 µmol/L) with an acute rise of >0.5 mg/dL (>44 µmol/L), initiation of renal replacement therapy, urine output less than 0.5 mL/kg/h for 12 hours, or complete absence of urine (anuria) for 12 hours.

C. Cardiac arrest was defined as the absence of signs of circulation, no palpable central pulse, or bradycardia with a heart rate below 60 beats per minute accompanied by poor perfusion, requiring external chest compressions and assisted ventilation, along with unresponsiveness and lack of spontaneous breathing.

D. Wound dehiscence was defined as the disruption of skin or fascial closure and was classified as either superficial or deep wound breakdown.

E. A surgical site infection (SSI) was defined as an infection occurring within 30 days after surgery. SSIs were classified into three categories: superficial, deep, and organ-space infections.

>Superficial SSI is an infection that involves only skin or subcutaneous tissues of the incision and with one or more of the following,

I) Erythema, tenderness and localized swelling at the incision site.

II) Purulent drainage from superficial incision

III) Diagnosis done by Surgeon.

> **Deep Surgical Site Infection (SSI)** involves infection of the deep soft tissues (such as fascia and muscle layers) of the surgical incision and is identified by at least one of the following criteria:

I) Purulent drainage from the deep incision, excluding the organ space.

II) Incision dehiscence observed by the surgeon in a patient presenting with at least one sign or symptom, such as fever (≥38°C), localized pain, or tenderness.

III) Diagnosis confirmed by the surgeon.

> **Organ-Space Surgical Site Infection (SSI)** is defined as an infection related to the surgical procedure that involves any anatomical organ or space and is identified by at least one of the following criteria:

I) Purulent drainage from a drain inserted through a stab wound into the organ or space.

II) Abscess within the organ or space detected by direct examination, during reoperation, or through histopathology or radiologic evaluation.

III) Diagnosis made by the surgeon.

F. **Anastomotic Leak** was defined as the discharge of intestinal contents through a surgical drain, wound, or abnormal opening.

G. **Septic Shock** was defined as persistent hypotension (low systolic blood pressure) accompanied by signs of impaired perfusion, which may include, but are not limited to, lactic acidosis, reduced urine output (oliguria), or acute changes in mental status.

H. **Mortality** was defined as death occurring within 30 days following laparotomy.

3.11. DATA ANALYSIS

Data was entered into and analyzed using SPSS version 23 soft-ware. Descriptive statistics was used to summarize the baseline information of the participants. A Chi-square test was used to analyze the associations between SAS categories and development of early post-operative major complications.

Fischer's exact test was used to analyze the association between SAS categories and mortality during a study. Logistic regression was used to study the association between dependent variables (complications) and independent variables (categorical or continuous).

A P Value of, < 0.05 was considered statistical significant.

Predictive Power (AUC-ROC Analysis) of SAS: In this study the receiver Operating Characteristic (ROC) curve was used to assess predictive accuracy of SAS. The Area under the Curve (AUC) for SAS in major complications post-laparotomy generally ranges from 0.65 to 0.80.An AUC closer to 1.0 indicates better predictive ability, while 0.5 suggests no predictive power.

3.12. ETHICAL CONSIDERATIONS

3.13. Ethical clearance

Shall be sought from KU IREC for conducting this study. Approval to carry out the study will be obtained from the Dar es Salaam Regional Medical Officer, as well as the Medical Officers in charge of the selected hospitals.

3.14. Informed consent

A participant was fully informed about the nature of this study, its purpose and potential risks. They were voluntary participations without any force. Written consent was obtained from all study participants, clear and comprehensive information about the study was provided, including an explanation that details regarding their treatment, such as the history of illness and operative findings were used solely for research purpose.

3.15 Voluntary participations and right to withdraw

Participants were assured that their involvement is voluntary and does not impact the care they receive. Participants have the right to withdraw from the study, they were also reassured that withdrawing from the study did not affect the quality or availability of their treatment in any way.

3.16. Risks to the participant

Psychological and emotional risks to the patient during the study, this was minimized by giving thorough education and reassurance about the study. We maintained strict confidentiality, patient's names and registration numbers were not revealed. Ethical approval was sought from our institutional ethics review committee.

3.17 Confidentiality and anonymity

To ensure confidentiality, all information collected from the respondent was ensured securely stored, and data were anonymized by assigning serial numbers instead of using names. Confidentiality was strictly maintained throughout the study in accordance with ethical standards.

3.18 Benefits of the Research and Advantages for Participants.

The study generated valuable data identifying patients at risk of developing complications post-laparotomy. This information guided the implementation of targeted interventions to minimize complications in Dar es Salaam Regional referral Hospitals, ultimately improving the quality of surgical care. Additionally, they informed quality improvement initiatives to enhance patients outcomes and service delivery in Tanzania that was taken to provide better service to patients in Tanzania.

This information will also be provided to the Ministry of Health, adding to its expanding database and aiding in evidence-based policy and decision-making.

3.19 LIMITATIONS OF THE STUDY.

Some patient might present with anemia and other hemodynamic instability before surgery. This will affect the objective total blood loss estimated. However, because it is well within observers limits of precisions, the broad categorization and the use of a formula for estimated blood loss allow for a rather accurate estimation.

Anaesthesia will have an impact on perioperative hemodynamics, including blood pressu re, pulse rate, and mean arterial pressure. Drugs, which can alter the physiological status of participants.

Additionally, preoperative fluid resuscitation state of the patient can affect the intraoperative hemodynamic state. This could have an impact on how the SAS is calculated, misclassifying patients and possibly influencing the high or low rate of complications and/or deaths in the various SAS groups. However the use of standardized anesthetic check list and minimization of IVF was ensured the minimization of this limitation.

The study will includes only primary outcomes, and therefore does not evaluate long term complications such as mortality beyond 30days or quality of life measures, which would be considered secondary outcomes.

3.20. DATA QUALITY CONTROL

To maintain internal validity in this study, several measures were implemented:

1. A standardized, pre-tested questionnaire was utilized for data collection.
2. Research assistants received thorough training on administering the questionnaire and collecting data accurately.

3. The principal investigator oversaw the process by ensuring data completeness and consistency, providing training to research assistants, actively participating in the perioperative care of study participants, and managing data collection and analysis.

3.21 DISSEMINATION OF DATA

The results of this study were documented in a dissertation submitted as part of the requirements for the Master of Medicine (Surgery) degree at Kairuki University. Copies will be accessible in the Kairuki University Library and at Kairuki Hospital. Furthermore, a manuscript based on the dissertation will be prepared for submission to a peer-reviewed journal for possible publication.

CHAPTER FOUR

4.0 RESULTS

4.1. SOCIO DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

During the study period, one hundred and one (101) patients who met the inclusion criteria were included in the final analysis] (Figure 1). The participants' ages ranged from 18 to 93 years, with a median age of 48 years [Interquartile Range (IQR): 42–56] (Figure 2). The largest proportion of patients (37.6%) fell within the 41–50 years age group (Figure 2). There were 66(65.3%) males and 35(34.7%) females, giving a male to female ratio of 1.9: 1. The average age for males was 46.2years compared to 42.7 years for females (p=0.129). Co-morbid conditions were identified in 26 patients (25.7%). Among these, hypertension was the most prevalent, reported in 9 patients (34.6%), followed by diabetes mellitus, which was present in 6 patients (23.1%).Peptic ulcer disease, HIV infection, sickle cell disease were recorded in 5 (19.2), 3(11.5%) and 3(11.5%) patients respectively. Table 1 below shows Sociodemographic and clinical characteristics among patients who underwent emergency laparotomy (N= 101).

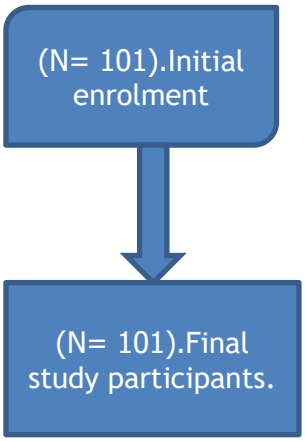

Figure 1: Flow diagram of adult patients following emergency laparotomy (N= 101)

Table 1: Sociodemographic and clinical characteristics among patients who underwent emergency laparotomy (N= 101).

Patient's characteristics	**Number of patients (N)**	**Percentage (%)**
Age (in years)	Median [IQR] years	48[42-56]
18-20	4	3.9
21-30	9	8.9
31-40	32	31.7
41-50	38	37.6
51-60	11	10.9
>60	7	6.9
Sex		
Male	66	65.3
Female	35	34.7
Area of residence		
Rural	23	22.8
Urban	78	77.2
Presence of co-morbidities		
Yes	26	25.7
-Hypertension	9	34.6
-Diabetes	6	23.1
-PUD	5	19.2
-HIV	3	11.5
-SCD	3	11.5
No	75	74.3

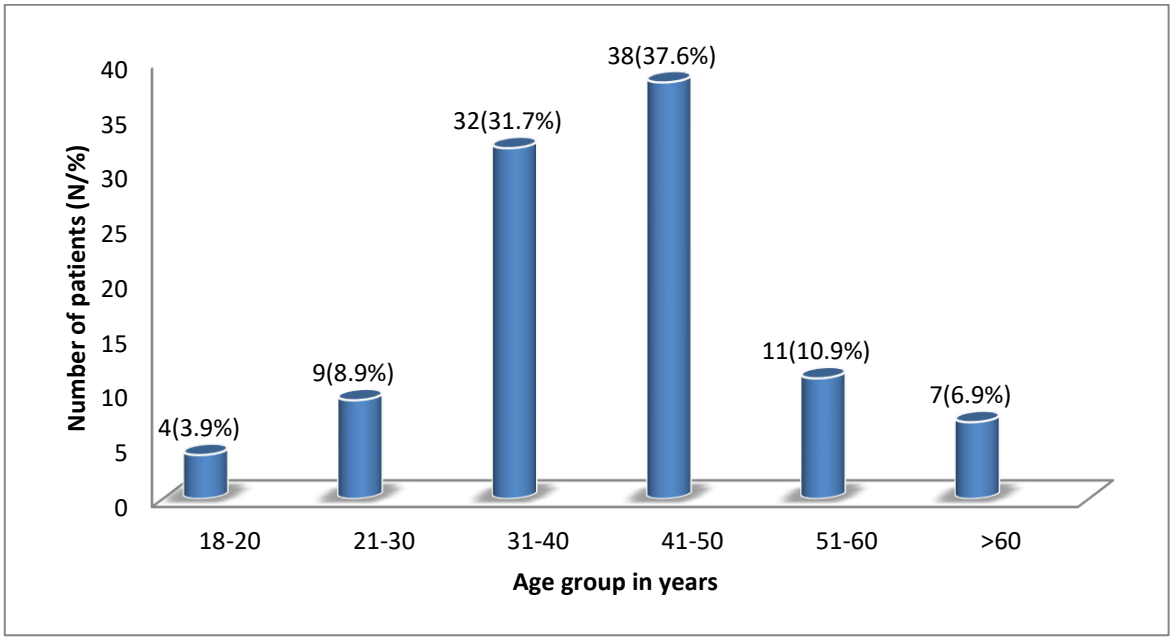

Figure 2: Age group distribution among patients who underwent emergency laparotomy (N= 101)

4.2. PATIENT'S OPERATIVE CHARACTERISTICS

Preoperatively, all patients scheduled for emergency laparotomy in this study were assessed for fitness for anesthesia using ASA score, of which the majority, 82(81.2%) were found to have ASA score ≤ 2. The leading indication for emergency laparotomy was peritonitis at 48.5% followed by intestinal obstruction at 43.6%. More than half (53.5%) of laparotomies were conducted by surgical residents/registrar. Other patient's operative characteristics are summarized in Table 2. Bowel resection and primary anastomosis was the most prevalent type of surgical procedure accounting for 19(18.4%) patients (Figure 3). The duration of operation ranged from 80 to 310 minutes with a mean duration of 174 minutes. The majority of the patients, 58 (57.4%) had the duration of surgery of >120 minutes.

Table 2: Operative characteristics among patients who underwent emergency laparotomy (N= 101)

Operative characteristics	Number of patients	Percentages
ASA score		
1	41	40.0
2	42	42.0
3	4	4.0
4	2	2.0
5	12	12.0
Cadre of primary surgeon		
Surgeon	36	35.6
Resident/ Registrar in surgery	65	64.4
Indication for surgery		
Peritonitis	**44**	43.6
Perforated PUD	*19*	
Perforated bowel	*12*	
Perforated appendicitis/Appendicular	*13*	
abscess	**42**	41.6
Intestinal obstruction	*1*5	
Sigmoid volvulus	*12*	
Obstructed inguinal hernia	*8*	
Postoperative adhesions	*7*	
Bowel malignancies	**8**	7.9
Acute appendicitis	**7**	6.9
Abdominal trauma		
Duration of surgery		
≤120 minutes	43	42.6
>120 minutes	58	57.4

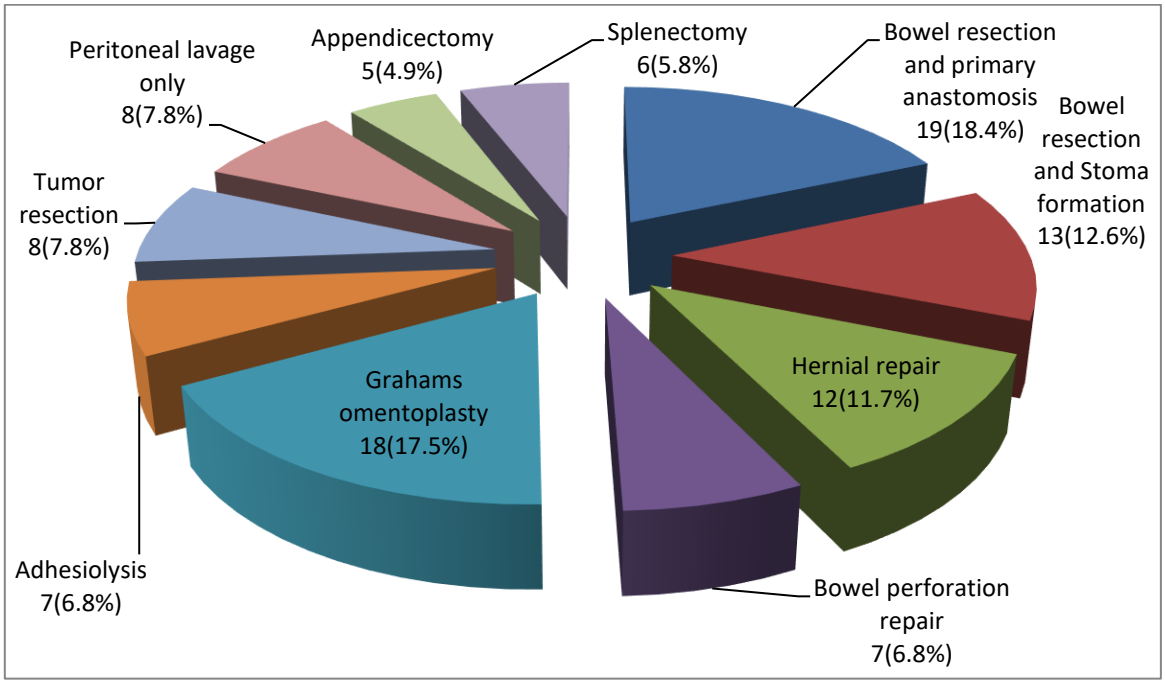

Figure 3: Distribution of patients according to the type of surgical procedure performed (N= 101)

4.3. SURGICAL APGAR SCORE (SAS): SCORE CATEGORY DISTRIBUTION AND INTRAOPERATIVE PARAMETERS

In this study, most of the patients had a mean SAS score of 5.43. The mean estimated blood loss was 652 mills, while the mean of the lowest MAP was 68 mmHg and mean of the lowest heart rate was 74 beats per minute.

Based on the Surgical Apgar Score (SAS), patients were grouped into three risk categories: high (scores 0–4), medium (scores 5–6), and low (scores 7–10). The majority, 44 individuals (43.6%), were classified under the medium-risk group. A smaller portion, 15 patients (14.9%), fell into the low-risk category, while 42 patients (41.6%) were identified as high risk (refer to Table 3).

Table 3: Surgical Apgar score (SAS): score category distribution and intraoperative parameters (N= 101)

Variables	Mean ± SD	Frequency (N/%)
Mean SAS score	**5.43 ±1.432**	
SAS score category		
• Low risk(8-10) • Medium risk(5-7) • High risk (0-4)		**15(14.9)** **44(43.6)** **42(41.6)**
Mean estimated blood loss (mls)	**652±1.221**	
Mean lowest heart rate (bpm)	**74**	
Mean lowest MAP (mmHg)	**68**	

4.4. PATIENT TREATMENT OUTCOMES

4.4.1. Postoperative major complications

Out of 101 patients who underwent emergency laparotomy, 61(60.4%) developed major postoperative complications postoperatively. The most common postoperative complication was surgical site infections accounting for 54.1% of cases (Figure 4). Patients were monitored postoperatively on days 1, 3, 5, and again on day 30 to identify any complications. Hemorrhage and hypotension, were observed on the first day after laparotomy. Surgical site infection was most frequently developed on day 5, and pneumonia and pyrexia of unknown origin were commonly diagnosed on day 3 while anastomotic leak was reported at day 3 after operation. The distribution of complications within the different risk categories is illustrated in Table 4 below.

The complication rate was found to be significantly high (71.4%) in the high-risk group compared to 56.8% in the medium and 40.0% in the low risk group (X^2 =25.070,

p<0.001) (Table 4). Regarding the ROC curve analysis, SAS had fair discriminatory ability with the AUC for major postoperative complications (Figure 5) at 0.725 (95% CI, 0.624–0.825) (Table 5).

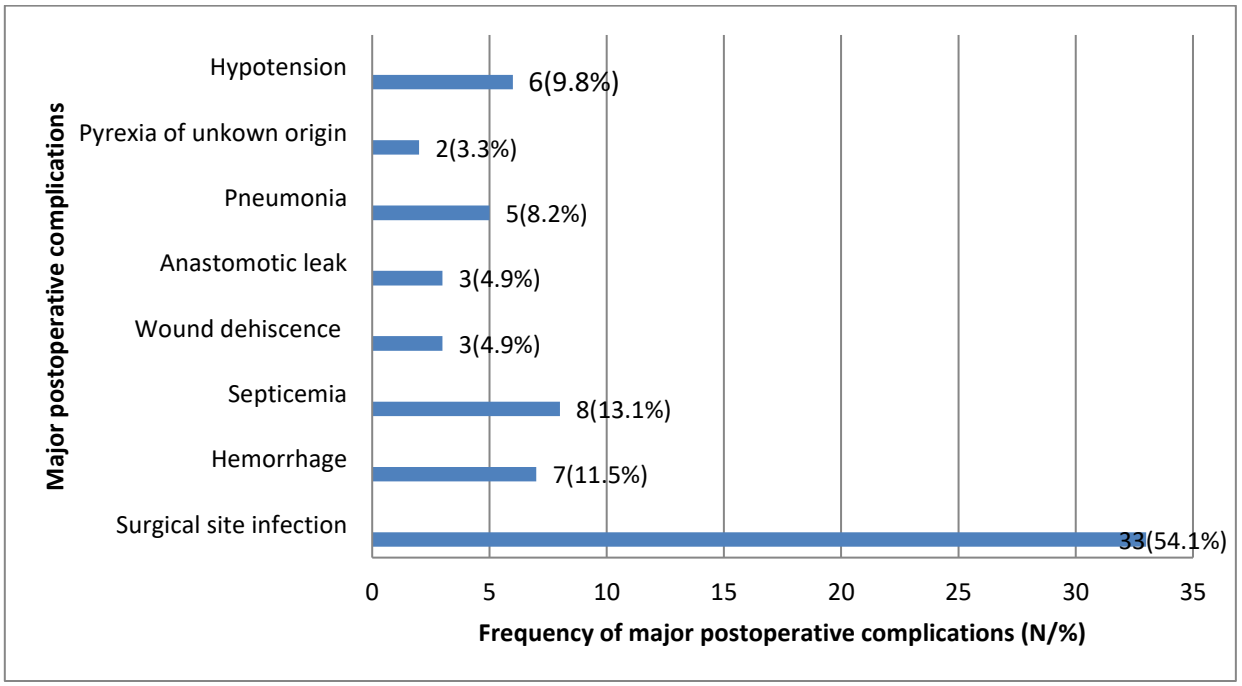

Figure 4: Distribution of patients according to major postoperative complications following emergency laparotomy

Table 4: Association between SAS categories and major postoperative complications (N= 101)

SAS category	Complications		Total	Chi-square	p-value
	Absent (N= 40)	Present (N=61)			
Low risk (8-10)	9 (60.0)	6 (40.0)	15	25.070	<0.001
Medium risk(5-7)	19 (43.2)	25 (56.8)	44		
High risk (0-4)	12 (28.6)	30 (71.4)	42		

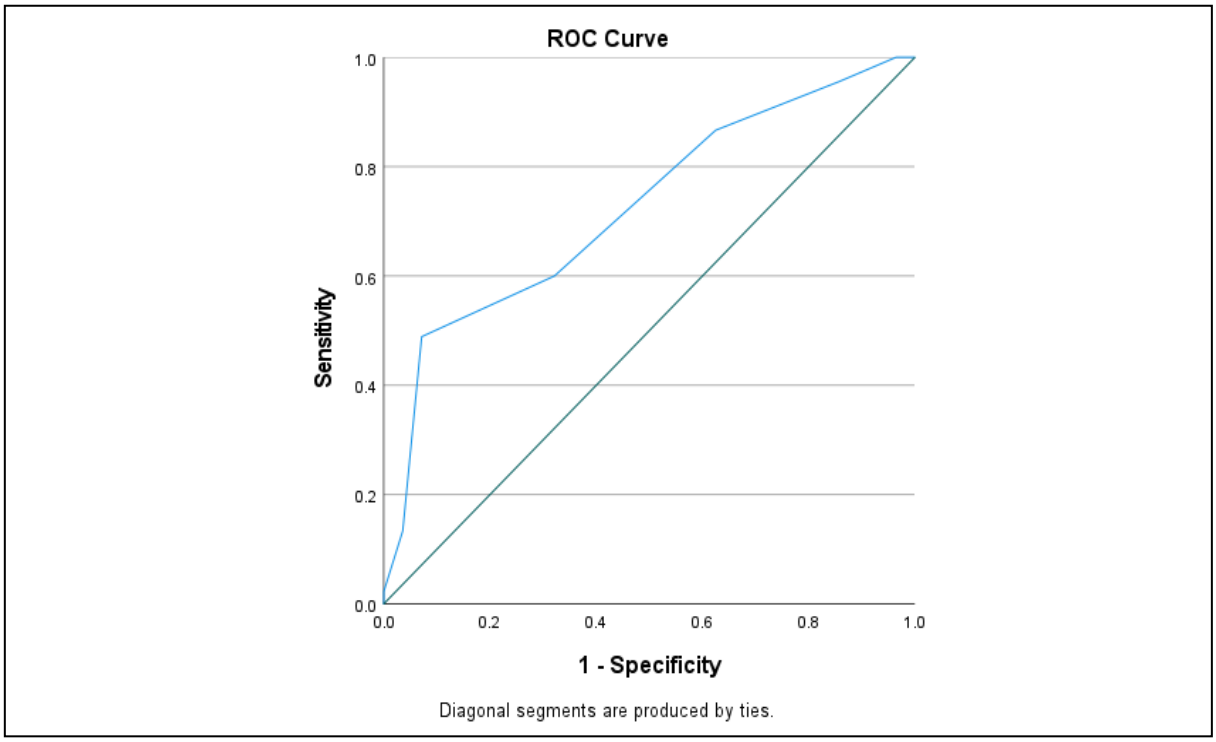

Figure 5: ROC for SAS predicting major postoperative complications

Table 5: ROC for SAS predicting major postoperative complications

AUC	SD Error	Asymptomatic significance	Asymptomatic 95% CI (lower bound)	Asymptomatic 95% CI (Upper bound)
0.725	0.51	0.000	0.624	0.825

4.4.2. Thirty-day mortality

Among all patients, mortality was recorded in sixteen cases, giving a mortality rate of 15.8%.

In this study, the high-risk group based on the Surgical Apgar Score (SAS) experienced the greatest mortality, with 10 deaths (23.8%), followed by the medium-risk group with 6 deaths (13.6%). No deaths occurred in the low-risk category. This demonstrates a significant association between SAS risk categories and patient survival status (χ^2 =

40.930, p < 0.001). Additionally, the low-risk group had the highest number of survivors after emergency laparotomy (Table 6). The ROC curve for SAS predicting 30-day mortality (Figure 6 and Table 7) showed an area under the curve of 0.866 (95% CI 0.735 - 0.996) indicating a good predictive capability of 30-day mortality.

Table 6: Association between SAS categories and thirty-day mortality (N= 101)

SAS category	Survival		Total	Chi-square	p-value
	Alive (N= 85)	Dead (N=16)			
Low risk (8-10)	15(100%)	0(0.0%)	15	40.930	<0.001
Medium (5-7)	38(86.4%)	6 (13.6%)	44		
High risk (0-4)	32(76.2%)	10 (23.8%)	42		

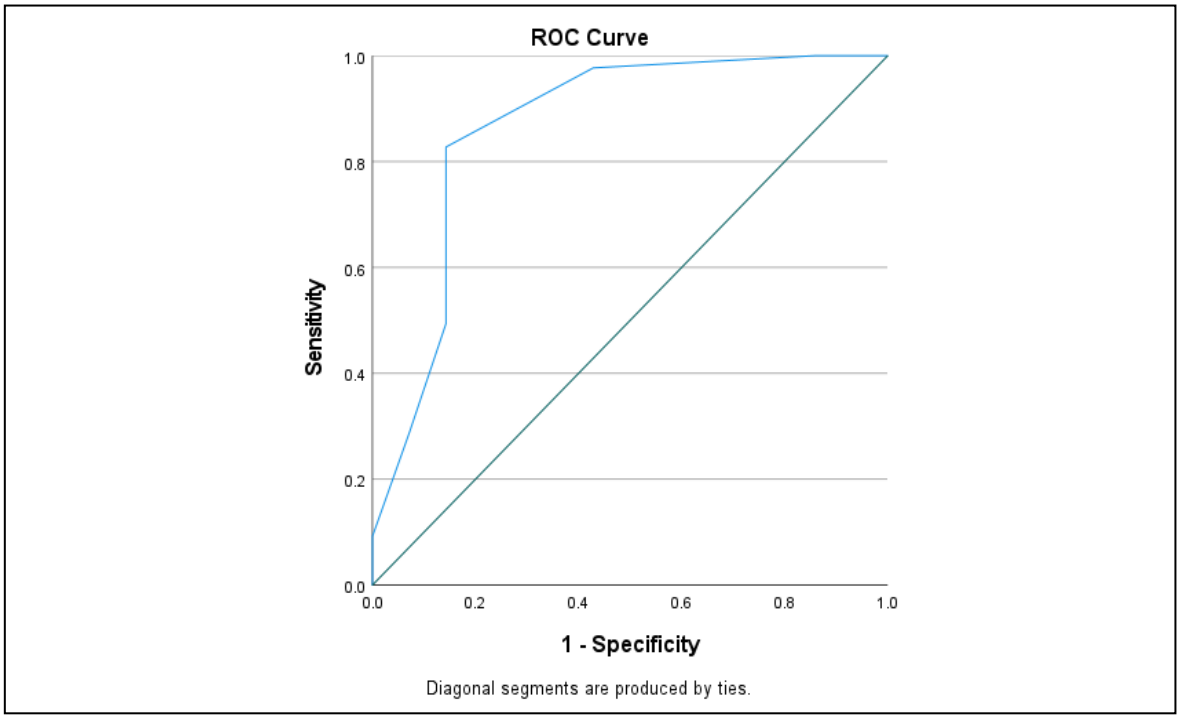

Figure 6: ROC for SAS for predicting 30-day mortality

Table 7: ROC for SAS for predicting 30-day Mortality

AUC	SD error	Asymptomatic sig	Asymptomatic 95% CI Lower bound	Asymptomatic 95% CI Upper bound
0.866	0.67	0.000	0.735	0.996

4.5. FACTORS ASSOCIATED WITH MAJOR POSTOPERATIVE COMPLICATIONS AND MORTALITY

5.5.1. Factors associated with major post-operative complications

Table 8a below show factors associated with major post-operative complications according to univariate and multivariate logistic regression analyses. According to multivariate logistic regression analysis, co-morbidities (OR, 3.11[1.11-8.23]; *p*-value =0.004), ASA score (OR 2.34[1.17-9.11]; p-value = 0.011) and duration of surgery (OR, 7.21[2.73-22.11]; *p*-value = 0.002) were found to be statistically significantly associated with major post-operative complications.

Table 8: Factors associated with major post-operative complications according to univariate and multivariate logistic regression analyses

Predictor (independent) Variables	Major complications		Univariate analysis		Multivariate analysis	
	Present (N=61)	Absent (N=40)	OR[95%CI]	P-value	OR[95%CI]	P-value
Age						
≤40 >40	27 (60.0) 34 (60.7)	18(40.0) 22(39.3)	1 1.44[0.35-2.39]	 0.837		
Sex						
Male 66 Female 35	40 (60.6) 21 (60.0)	26(39.4) 14(40.0)	1 2.71[0.44-4.33]	 0.445		
Co-morbidities						
Present Absent	22(84.6) 39(52.0)	4(15.4) 36(48.0)	1 2.81[1.22-6.71]	 **0.011**	3.11[1.11-8.23]	**0.004**
ASA score						
≤2 82 >2 19	44 53.7) 17 (89.5)	38(46.3) 2(10.5)	1 4.11[1.12-11.77]	 **0.033**	2.34[1.17-9.11]	**0.011**
Cadre of primary surgeon						
Surgeon Resident/Registrar	21 (58.3) 40(61. 5)	**1**5(41.7) 25 (38. 5)	1 1.52[0.33-2.66]	 0.326		
Duration of surgery						
≤120 minutes >120 minutes	20 (46.5) 41 (70.7)	23(53.5) 17(29.3)	1 5.11[2.11-11.12]	 **0.021**	7.21[2.73-22.11]	**0.002**

4.5.2. Factors associated with 30-day mortality

According to the multivariate analysis (Table 7b), factors independently linked to 30-day mortality included the presence of co-morbidities (OR 6.12 [2.21–23.11]; p = 0.003), an ASA score greater than 2 (OR 7.22 [2.11–34.21]; p = 0.012), and longer surgical duration (OR 2.19 [1.17–3.73]; p = 0.017).

Table 8b: Factors associated with 30-day mortality according to univariate and multivariate logistic regression analyses

Predictor (independent) Variables	Survival		Univariate analysis		Multivariate analysis	
	Alive (N=85)	**Dead (N=16)**	**OR[95%CI]**	**P-value**	**OR[95%CI]**	**P-value**
Age						
≤40	38(84.4)	7(15.6)	1			
>40	47(83.9)	9(16.1)	1.45[0.11-2.22]	0.711		
Sex						
Male	54(81.8)	12(18.2)	1			
Female	31(88.6)	4 (11.4)	0.84[0.23-3.15]	0.753		
Co-morbidities						
Present	14(53.8)	12 (46.2)	1			
Absent	71(9.7)	4 (5.3)	2.55[1.88-9.11]	**0.011**	6.12[2.21-23.11]	**0.003**
ASA score						
≤2	76(92.7)	6 (7.3)	1		1	
>2	9(47. 4)	10 (52.6)	22.92[3.63-44.81]	**0.001**	7.22[2.11-34.21]	**0.012**
Cadre of primary surgeon						
Surgeon 36	31(86.1)	5 (13.9)	1			
Resident/Registrar 6	54 (83.1)	11(16.9)	1.26[0.57-2.29]	0.925		
Duration of surgery						
≤120 minutes	39(90.7)	4 (9.3)	1			
>120 minutes	16(79.3)	12(20.7)	1.88[1.29-2.74]	**0. 006**	2.19[1.17-3.73]	**0.017**

CHAPTER FIVE

5.0 DISCUSSION

In this study, the majority of patients were in their 40s and there was a higher prevalence among males compared to females, with a male-to-female ratio of 1.9:1. This finding aligns with similar research conducted in low- and middle-income countries (LMICs) that utilized the Surgical Apgar Score (SAS) to evaluate early postoperative outcomes following laparotomies laparotomies [7, 8, 16, 25]. However, this demographic pattern differs markedly from that seen in high-income countries, where patients undergoing emergency laparotomy tend to be older, typically in their 60s or 70s [2-3] . The exact reason for this age and gender difference in these countries is not known although it may reflect differences in risk factor for exposure to conditions that may lead to surgical acute abdomen which requires emergency laparotomy.

In this study, peritonitis was identified as the leading cause for emergency laparotomy, followed closely by intestinal obstruction, consistent with findings from research in Nigeria and Zambia that evaluated early surgical outcomes after laparotomy [21, 41]. Likewise, studies conducted at Mulago National Referral Hospital in Uganda and Muhimbili National Hospital in Tanzania also reported peritonitis and intestinal obstruction as the primary reasons for emergency laparotomies [25] [16] . However, this pattern contrasts sharply with reports from Kenya, where trauma-related cases are more commonly cited as the leading reason for emergency laparotomies [8]. In low- and middle-income countries (LMICs), other frequent indications for emergency laparotomy include acute appendicitis, generalized acute abdomen, abdominal trauma (both blunt and penetrating), sigmoid volvulus, biliary peritonitis, and liver abscesses [42]. These conditions often present at advanced stages, and due to limited resources, preoperative resuscitation is frequently suboptimal—contributing to increased rates of postoperative complications and mortality [41, 42].

Emergency laparotomy is one of the most commonly performed surgical procedures globally and carries a significant post-operative complications causing increased morbidity and mortatlity [8] [16]. In the present study, the overall in-hospital complication rate following emergency laparotomy was 60.4%, a figure which is significantly high than 24.2%, 40.8% and 29% that was reported in Uganda [25] Kenya [8] and Rwanda [43], respectively, but low compared to 78.4% and 94% that was reported by Kyaruzi *et al* at Muhimbili and Shaikh *et al* respectively [16] [44] among patients who underwent emergency laparotomies. The variation in complication rates observed across studies may be attributed to differences in several factors, including the extent of antibiotic coverage, quality of preoperative preparation and resuscitation, anesthesia standards, surgical timing, and overall hospital conditions. The relatively high complication rate in the current study could be due to the fact that many patients presented at a late stage, often with irreversible physiological decline, making recovery unlikely even with appropriate surgical intervention. Additionally, the majority of operations in this study were carried out by junior surgical trainees who were the first responders, which may have contributed to the increased complication rates observed. Furthermore, since all patients in this study underwent emergency surgical procedures, they were inherently at greater risk for major postoperative complications and mortality compared to those undergoing elective surgeries.[45] Evidence from existing literature indicates that emergency operations are typically linked with higher rates of adverse outcomes, largely due to inadequate preoperative resuscitation and the critical condition of patients at the time of intervention [41-44].

Consistent with findings from other studies, [8] [41] [42] surgical site infections (SSIs) were the most frequently observed complication following emergency laparotomy in our study. This is likely due to the high proportion of patients presenting with gross

peritoneal contamination from visceral perforations, leading to direct contamination of the surgical wound. In contrast, a study conducted at Muhimbili National Hospital identified respiratory complications as the most common postoperative issue following emergency laparotomy [16]. The elevated incidence of SSIs in our setting may also be linked to intraoperative contamination of the laparotomy site during the procedure.

The Surgical Apgar score (SAS) presents a simple, immediate and an objective means in identifying patients at risk of developing major post-operative complications, utilizing data available in most settings [2, 3, 23, 31]. In the present study, the complication rate was found to be significantly high (71.4%) in patients with SAS score of 0-4 (high-risk group) compared to 40.0% in patients with SAS scores of 8-10 (low risk group). These complication rates compare favorably with those reported by Regenbogen *et al* [9]. This observation demonstrates the reproducibility of the SAS in identifying patients at risk of developing major post-operative complications. In a LMIC like Tanzania, a simple tool like the SAS would find use in routine post-operative risk stratification. This would facilitate easier identification of high-risk patients and prompt initiation of appropriate interventions.

Regarding the ROC curve analysis, the Surgical Apgar Score (SAS) in our study demonstrated a fair predictive performance, with an area under the curve (AUC) of 0.725 for major postoperative complications. This result aligns with findings from a study conducted in Rwanda, which reported a similar AUC value of 0.7 for predicting major postoperative complications [43]. In contrast, a separate study involving patients who underwent emergency abdominal surgery reported a lower AUC of 0.63 [3] for the SAS, indicating weaker discriminatory ability compared to our findings. This reduced performance may be attributed to better perioperative optimization, which could have influenced the SAS values. In the present study, the AUC for SAS aligns with existing

literature suggesting that the score has a reasonable ability to distinguish patients at risk of developing postoperative complications and mortality following laparotomy [38].

Literature reports 30-day mortality rates after emergency laparotomy in resource-limited settings to range between 15% and 27.7%.[46] The mortality rate observed in this study was 15.8%, which is comparable to the 16.22% and 18.3% reported at Muhimbili National Hospital and Tertiary Referral hospital in Rwanda among similar patients, respectively [16] [8]. However, it is notably higher than the 7.9% and 10% mortality rate documented in Kenya and Uganda respectively [8] [25]. The elevated mortality in our study may be explained by the exclusive inclusion of emergency cases, many of which were not adequately optimized preoperatively, and by significant delays in diagnosis and surgical intervention.

In this study, the greatest number of deaths occurred among patients classified in the high-risk SAS category (23.8%) and the low SAS group had no death which shows a significant correlation between SAS category and mortality. The finding of our study agrees with Gawande *et al* [14] which showed that the lower this score was (high-risk group), the more it was significantly associated with significant mortality postoperatively.

The ROC curve for SAS predicting 30-day mortality in our study showed an AUC of 0.866 indicating a good predictive capability of 30-day mortality. This is keeping with Ngarambe *et al* [43] in Rwanda which demonstrated an AUC of 0.79 for 30-day hospital mortality indicating a good discriminatory ability after laparotomy at a tertiary referral hospital.

Numerous factors have been identified in the literature as being linked to the occurrence of major postoperative complications and 30-day mortality following laparotomy [34, 47]. In this study, co-morbidities, ASA score > 2 and prolonged duration

of surgery were factors significantly associated with occurrence of major postoperative complications and mortality. As reported in several studies [34, 47, 48], associated co-morbidities have been reported in literature to influence the outcome of patients following laparotomy. In the present study, the presence of co-morbidities was found to predict the occurrence of major post-operative complications and 30-day mortality following emergency laparotomy. Previous studies have shown that postoperative patients with associated co-morbidities, such as diabetes mellitus are at high risk of developing surgical site infections and possibly death due to their low immunity [49]; this was confirmed in this study.

Many studies have shown a strong association between ASA status and outcomes following surgical intervention [33, 50-52]. The ASA classification is a standardized and reproducible numerical system commonly used to assess the severity of illness in surgical patients. It is widely recognized as a reliable indicator of a patient's vulnerability to infection [51]. Increased ASA scores have been reported to be associated with an increased risk of poor postoperative outcome [33, 52]. In this study, a significant association was observed between higher ASA class and increase risk of major postoperative complications and deaths. Similar finding was also reported in other studies [52, 53].

The association may be attributed to the overall poor general health of the study participants, as indicated by their higher ASA classification.

In agreement with other studies [33, 54], this study found that the duration of surgery >120 minutes is associated with increased risk of developing major postoperative complications and deaths.

Longer surgical procedures are associated with a greater risk of major postoperative complications, such as surgical site infections (SSI), due to factors like tissue drying,

increased exposure to bacteria, and reduced levels of prophylactic antibiotics in the tissues. This supports the idea that giving an additional dose of antibiotics during extended surgeries (e.g., lasting more than 2 hours) could help lower the overall rate of SSIs [55].

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1. CONCLUSION.

This study showed that the Surgical Apgar Score (SAS) effectively predicts major complications and mortality after emergency laparotomy in our setting. The lower the SAS, the higher the chance of postoperative complications and mortality,SAS demonstrated fair to good accuracy in identifying patients at either elevated or reduced risk of developing serious in-hospital complications and/or mortality after undergoing laparotomy in the Regional Referral Hospitals of Dar es Salaam, Tanzania, respectively.

6.2. LIMITATIONS.

- Short study duration that was not sufficient to enroll sufficient number of patients underwent laparotomy surgery.
- Only primary outcomes were studied without looking on the secondary outcomes.
- The 3 RRHs had some capacity and capability differences which might affect the surgical outcomes in our current study.

6.3. RECOMMENDATIONS.

- It is suggested that surgeons in the Departments of Surgery at Regional Referral Hospitals in Dar es Salaam incorporate the Surgical Apgar Score (SAS) as a tool to identify and categorize patients at higher or lower risk of serious postoperative complications and/or in-hospital mortality.

- The SAS can also support clinical decision-making, including determining the need for intensive interventions, choosing between damage control and definitive surgery, and recognizing patients who may benefit most from postoperative critical care and organ support.
- Further local research is recommended to assess the effectiveness of SAS in predicting secondary surgical outcomes within our healthcare setting.

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APPENDICES

APPENDIX 1: RESEARCH TIME FRAME

ACTIVITIES	Nov. 24	Dec. 24-March 25	April-July	July	July	July -Aug
Dissertation writing						
Departmental Review and Ethical Approval						
Collection of data						
Data entry process						
Analysis and interpretation of data.						
Report writing, presentation and Report submission						

APPENDIX 2: QUESTIONNAIRE IN ENGLISH

THE SURGICAL APGAR SCORE: APPLICABILITY IN PATIENTS UNDERGOING LAPAROTOMY AT DAR ES SALAAM REGIONAL REFERRAL HOSPITAL

Patient Information

- **Patient File Number:** _____
- **Mobile Phone Number:** _____
- **Age (in years):** _____
- **Sex:** ☐ Male ☐ Female
- **Type of Procedure:** ☐ Emergency ☐ Elective
- **Intraoperative Diagnosis:** _____
- **Operation Duration (minutes):** _____

Surgical Apgar Score

PARAMETER	**RECORDED**	**SCORE**
ESTIMATED BLOOD LOSSmls		
LOWEST MEAN ARTERIALPRESSURE (mmhg)		
LOWEST PULSE RATE (beats/min)		

Major Postoperative Complications

- **Presence of Complications:**☐ Absent ☐ Present
- **Specific Type of Complications (indicate Yes/No for each day):**

Complication	**Day 1**	**Day 3**	**Day 5**	**Day 30**
Hemorrhage	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Deep Wound Infection	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Superficial Wound Infection	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

Complication	Day 1	Day 3	Day 5	Day 30
Urinary Complications	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Respiratory Complications	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Septicemia	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Pyrexia of Unknown Origin	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Wound Dehiscence	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Anastomotic Leakage	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Thrombosis: Deep Venous	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Thrombosis: Pulmonary Embolism	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Organ Dysfunction: Renal	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Organ Dysfunction: Cardiac	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Organ Dysfunction: Respiratory	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Hypotension	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Death	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Other (specify): _____	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

APPENDIX 3: ORODHA YA KUKAGUA LUGHA YA KISWAHILI

ALAMA YA APGAR YA UPASUAJI: ORODHA YA KUKAGUA LUGHA YA KISWAHILI

Taarifa za mgonjwa;

- **Namba ya faili la mgonjwa: :_____**
- **Namba ya simu: :_____**
- **Umri: :_____**
- **Jinsia:**☐ Me ☐Ke
- **Aina ya upasuaji:**☐ Emergency
- **Ugonjwa wakati wa upasuaji:_____**
- **Muda wa upasuaji (dakika):_____**
- **Kiwango cha elimu ya daktari anaepasua :**☐ Resident/Registrar ☐ Specialist

Alamaya Apgar yaupasuaji.

Kigezo	**kilichopimwa**	**Alama**
Kiwango cha damukilichopoteamls		
Kiwango cha chini cha Shinikizo la damu la kati (mmhg)		
Kiwango kidogo cha mapigo ya moyo (beats/min)		

Matatizo makubwa baada ya upasuaji

- Uwepo wa matatizo baada ya upasuaji:☐Yapo☐Ayapo
- Elezea uwepo wa matatizo baada ya upasuaji (Weka Ndio/Hapana kwa siku tajwa):

Matatizo/magonjwa	**Siku 1**	**Siku 3**	**Siku 5**	**Siku 30**
Kuvuja damu	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana

Matatizo/magonjwa	Siku 1	Siku 3	Siku 5	Siku 30
Maambukizi ya ndani ya tumbo	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Maambukizi ya juu kwenye ngozi	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Maambukizi ya mkojo	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Maambukizi ya kifua	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Maambukizi ya bakteria kwenye damu	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Homa isiyoeleweka	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Kufunguka kwa jeraha	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Kutoboka utumbo	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Kuganda damu kwenye mishipa	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Kuganda damu: mapafu	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Hitilafu ya viungo: Figo	☐ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Hitilafu ya viungo: Moyo	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Hitilafu ya viungo: Mapafu	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana
Shinikizo la damu la chini	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana

Matatizo/magonjwa	Siku 1	Siku 3	Siku 5	Siku 30
Kifo	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	
Mengineyo (Elezea): _____	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	☐Ndiyo ☐Hapana	

APPENDIX 4: STUDY CONSENT FORM IN ENGLISH

THE SURGICAL APGARSCORE: APPLICABILITY IN PATIENTS UNDER GOING LAPAROTOMY AT DAR ES SALAAM REGIONAL REFERRAL HOSPITALS.

Study No:

Hospital No:

Purpose of the Study

This study seeks to evaluate how well the Surgical Apgar Score can predict outcomes for patients undergoing abdominal surgery at Mwananyamala, Amana, and Temeke Regional Referral Hospitals. The score is derived from essential vital signs recorded during surgery. Results from this research are expected to help improve postoperative monitoring and the overall management of surgical patients.

Risks and benefits

There are no risks or harm associated with participating in this study. All tests performed will be part of the standard treatment process, and no extra procedures or costs will be imposed on you as a result of taking part in the research.

Voluntary participation

Participation in this study is of your own free will. You will not bedenied medical care in case you refuse to participate in the study. You may stop participating at any time with no consequences whatsoever.

Confidentiality

All information will be treated with confidentiality. Your identity will not be exposed to the public.

I, the undersigned, confirm that the above information has been explained to me, that I have understood it, and that I willingly agree to participate.

Signature/Thumbprint:

(Patient/Parent/Guardian)

Telephone No

(Patient/Parent/Guardian)

Enquiries:

For any enquiries or further clarification, please contact the following people;

1

2

APPENDIX 5: STUDY CONSENT FORM IN SWAHILI.

SURGICAL APGAR SCORE: MANUFAA KWA WAGONJWA WA UPASUAJI WA TUMBO KATIKA HOSPITALITY ZA RUFAA MKOA DAR ES SALAAM.

Fomu ya

idhini:

Nambar ya

utafiti:

Nambari ya Hospitali:

Lengo la Utafiti

Utafiti huu unalenga kutathmini umuhimu wa *Surgical Apgar Score* kwa wagonjwa wanaofanyiwa upasuaji wa tumbo katika hospitali za rufaa za mkoa wa Dar es Salaam. Kipimo hiki huhesabiwa kwa kuzingatia shinikizo la damu, mapigo ya moyo, na kiasi cha damu kinachopotea wakati wa upasuaji. Matokeo yatakayopatikana yanatarajiwa kusaidia kuboresha ufuatiliaji na uangalizi wa wagonjwa baada ya upasuaji.

Hatari na faida

Hakutakuwa na madhara au hatari zinazotarajiwa kutokana na ushiriki katika utafiti huu. Wagonjwa hawatafanyiwa vipimo vya ziada zaidi ya vile vinavyohitajika kwa matibabu ya kawaida, na pia hakuna gharama za ziada zitakazojitokeza kutokana na kushiriki katika utafiti.

Ushiriki wa hiari

Ushiriki wako katika utafiti huu ni wa hiari kabisa, na hautalazimishwa kwa namna yoyote. Utendelea kupokea huduma zote za matibabu zinazohitajika ata kama utakataa kushiriki katika utafiti huu. Unaweza kuondoa ushiriki wako wakati wowote na hakuna madhara utakayopata.

Usiri

Habari zozote utakazotoa zitawekwa kwa sir na jina lako halitachapishwa popote.

Mimi, niliyetia sahihi, nilielezewa, nimeelewa, na kwa hiari nakubali kushiriki katika utafiti.

Sahihi / Alama ya Kidole:

(Mgonjwa / Mzazi / Mlezi)

Nambari ya Simu:

(Mgonjwa / Mzazi / Mlezi)

Taarifa za Ziada

Kwa ufafanuzi au taarifa zaidi, tafadhali wasiliana na:

1.

2.

APPENDIX 6: DEFINITION OF POST OPERATIVE MAJOR COMPLICATIONS (COPEL AND ET AL)

- **Wound hemorrhage:** Formation of a localized hematoma that requires surgical evacuation.
- **Deep hemorrhage:** Postoperative bleeding that necessitates a return to the operating room for re-exploration.
- **Chest infection:** Production of purulent sputum, with or without corresponding changes visible on a chest X-ray or through other clinical signs.
- **Wound infection:** Inflammation of the wound characterized by cellulitis or the presence of purulent discharge.
- **Deep infection:** Detection of an intra-abdominal abscess or collection confirmed either clinically or via imaging studies.
- **Urinary infection:** Identification of infection through positive urine culture results.
- **Septicaemia:** Presence of positive blood cultures with clinical signs and symptoms.
- **Pyrexia of unknown origin:** A body temperature exceeding 37.5 °C for over 24 hours after the initial postoperative fever has resolved, with no identifiable cause.
- **Wound dehiscence:** Partial or complete separation of a surgical wound, either superficially or deeply.
- **Deep venous thrombosis and pulmonary embolus:** Diagnosed through Doppler ultrasound studies.
- **Cardiac failure:** Clinical signs or symptoms indicating left ventricular or congestive heart failure.

- **Impaired renal function:** Defined as an increase in blood urea levels by more than 5 mmol/L compared to preoperative measurements.
- **Hypotension:** A sustained drop in systolic blood pressure below 90 mmHg lasting more than 2 hours.
- **Respiratory failure:** Difficulty in breathing necessitating emergency mechanical ventilation, supported by blood gas analysis results.
- **Anastomotic leakage:** Escape of bowel contents through a surgical drain, wound, or abnormal opening.

THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF HEALTH

Telephone Address:

Telephone: 022-2760500

Mwananyamala Regional
Referral Hospital,
P.O.Box 61665
Dar es Salaam.

RE: NO: MA. 239/240/01/1207

DATE: 19th June,2025

Director,
Muhimbili University of Health and,
Allied Sciences,
Clinical Medicine,
P.O.BOX 65001,
DAR ES SALAAM.

REF: MABULA EMMANUEL NG'HOMANGO - TO CONDUCT DATA COLLECTION IN MWANANYAMALA REGIONAL REFERRAL HOSPITAL.

The captioned subject refers

2. May you be informed that your request to research Titled "***Surgical Apgar Score as a Predictor of Early Surgical Major Complications and Mortality among Adult Patients Undergoing Laparotomy at Mwananyamala Regional Referral Hospital from 2022 to 2023 in Kinondoni Dar es salaam" 20th*** **June,2025, to 20th Julai,2025** is asserted.

3. The Institution charges **100,000/=**, as Research fee as per student spent. The payments are to be made upon reporting.

4. May she report to the Administration and HR department head for further instruction.

Thanks.

Mashala R.R.
RESEARCH COORDINATOR
FOR: MEDICAL OFFICER INCHARGE
MWANANYAMALA REGIONAL REFERRAL HOSPITAL

COPY:

Head of Surgery Department - **MWANANYAMALA REGIONAL REFERRAL HOSPITA**

Student **- Report to Surgery Department**

KAIRUKI UNIVERSITY (KU)

70 Chwaku Street,
Mikocheni,
P.O BOX 65300,
Dar es Salaam,
Tanzania.

Tel: +255-22-2700021/4
Fax: +255-22-2775591
Email: irec@ku.ac.tz
Website: www.ku.ac.tz

Ref. No. KU/IREC/27.10/574 **12 June, 2025**

Dr. Mabula Emmanuel Ng'homango,
Kairuki University,
70 Chwaku Street,
Mikocheni,
P. O. Box 65300.
Dar es Salaam, Tanzania.

RE: ETHICAL CLEARANCE CERTIFICATE FOR CONDUCTING HEALTH RESEARCH

I am pleased to inform you that the research titled: **Surgical Apgar Score as a Predictor of Early Surgical Major Complications and Mortality among Adult Patients Undergoing Emergency Laparotomy in Dar es Salaam Regional Referral Hospitals, March - June 2025 (Ng'homango, M. E., 2025)** has been granted ethical approval.

This approval is in effect for one year from the above date.

- Any changes in the procedures should be reported to the Institutional Research Ethics Committee.
- Significant changes will require the submission of a revised request for ethical approval.
- You will be required to submit **a study progress report** every six months.

Permission to publish your findings should be sought from the National Institute for Medical Research (NIMR) before submission to a publisher and not concurrently.

CHAIR PERSON

Name: Prof. Frederick Kaijage

Signature:

SECRETARY

Name: Prof. Columba Mbekenga

Signature:

DIRECTOR POSTGRADUATE STUDIES AND RESEARCH INSTITUTE
KAIRUKI UNIVERSITY
P. O. Box 65300, DSM

THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF HEALTH

AMANA REGIONAL REFERRAL HOSPITAL

Telegram "HEALTH", DODOMA
Phone No.: +255 026 – 2323267
Email: ps@afya.go.tz

P.O. Box 25411
DAR ES SALAAM
Phone: 022—2861903

REF. NO. MoHCDGEC/ARRH/R.1/VOL V/49

Date: 19/06/2025

Director, Postgraduate Studies and
Research Institute,
Kairuki University,
P.O. Box 65300,
DAR ES SALAAM.

Re: PERMISSION FOR DATA COLLECTION

Refer to your letter which requested us to allow Mabula Emmanuel Ng'homango to conduct research and collect data in our institution.

We are here to acknowledge your request with the following conditions, that he must submit the results of his research after completion of analysis in order the hospital to make use of data's to solve hospital problems.

Regards.

FOR: MEDICAL OFFICER I/C
AMANA REGIONAL REFERRAL HOSPITAL
P.O. Box 25411
DAR ES SALAAM

Dr. Rose Ntambulo
FOR: MEDICAL OFFICER INCHARGE
AMANA REGIONAL REFERRAL HOSPITAL

JAMHURI YA MUUNGANO WA TANZANIA
WIZARA YA AFYA.
HOSPITAL YA RUFAA YA MKOA YA TEMEKE
Barua pepe:barua@temekerrh.go.tz,S.L.P 45232 Dar es Salaam,Simu: 0222856007

Kumb. Na. MA. 472/554/02/63 **Tarehe: 23/06/2025**

Dr. Mabula Emmanuel Ng'homango
Kairuki University (KU)
S.L.P 65300,
DAR ES SALAAM.

YAH: OMBI LA KUFANYA UTAFITI (RESEARCH) "SURGICAL APGAR SCORE AS A PREDICTOR OF EARLY SURGICAL MAJOR COMPLICATIONS AND MORTALITY AMONG ADULT PATIENTS UNDERGOING EMERGENCY LAPAROTOMY IN DAR ES SALAAM REGIONAL REFERRAL HOSPITALS, MARCH- JUNE 2025"

-

Tafadhali husika na somo tajwa hapo juu.

2. Tumepokea barua yako ya tarehe **12/05/2025** kuhusu ombi lako la kufanya Utafiti (Research) **"Surgical Apgar Score As A Predictor Of Early Surgical Major Complications And Mortality Among Adult Patients Undergoing Emergency Laparotomy In Dar Es Salaam Regional Referral Hospitals, March- June 2025"** katika Taasisi yetu.

3. Ombi lako limekubaliwa, utatakiwa kulipa ada kiasi cha **Tshs 100,000/=** Hivyo wasiliana na mhasibu wa mapato wa Hospitali **Ndg. Lusajo Nsajigwa** kwa namba **0717 959495** ili akupatie control Number kwa ajili ya malipo ya ada hii ili uweze kuruhusiwa kufanya utafiti.

4. Asante kwa ushirikiano.

Kny: MKURUGENZI MSAIDIZI
HOSPITALI YA RUFAA YA MKOA WA TEMEKE
24 JUN 2025
Dkt. Husna Msangi
Kny: MKURUGENZI
HOSPITALI YA RUFAA YA MKOA YA TEMEKE

Nakala: CSCO

- ***Tafadhali hakikisha taarifa ya utafiti inabaki hospitalini***

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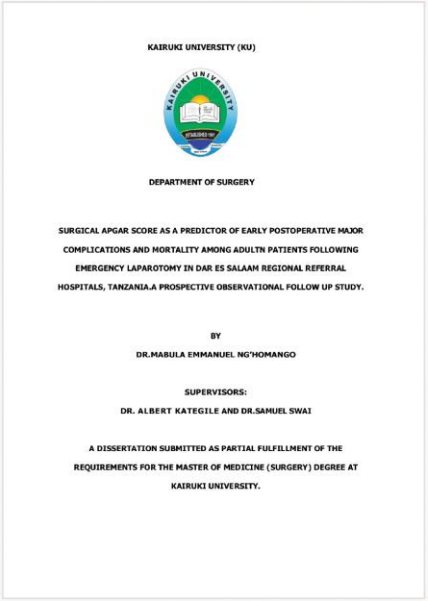

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DEPARTMENT OF SURGERY

SURGICAL APGAR SCORE AS A PREDICTOR OF EARLY POSTOPERATIVE MAJOR COMPLICATIONS AND MORTALITY AMONG ADULTN PATIENTS FOLLOWING EMERGENCY LAPAROTOMY IN DAR ES SALAAM REGIONAL REFERRAL HOSPITALS, TANZANIA.A PROSPECTIVE OBSERVATIONAL FOLLOW UP STUDY.

BY

DR.MABULA EMMANUEL NG'HOMANGO

SUPERVISORS:

DR. ALBERT KATEGILE AND DR.SAMUEL SWAI

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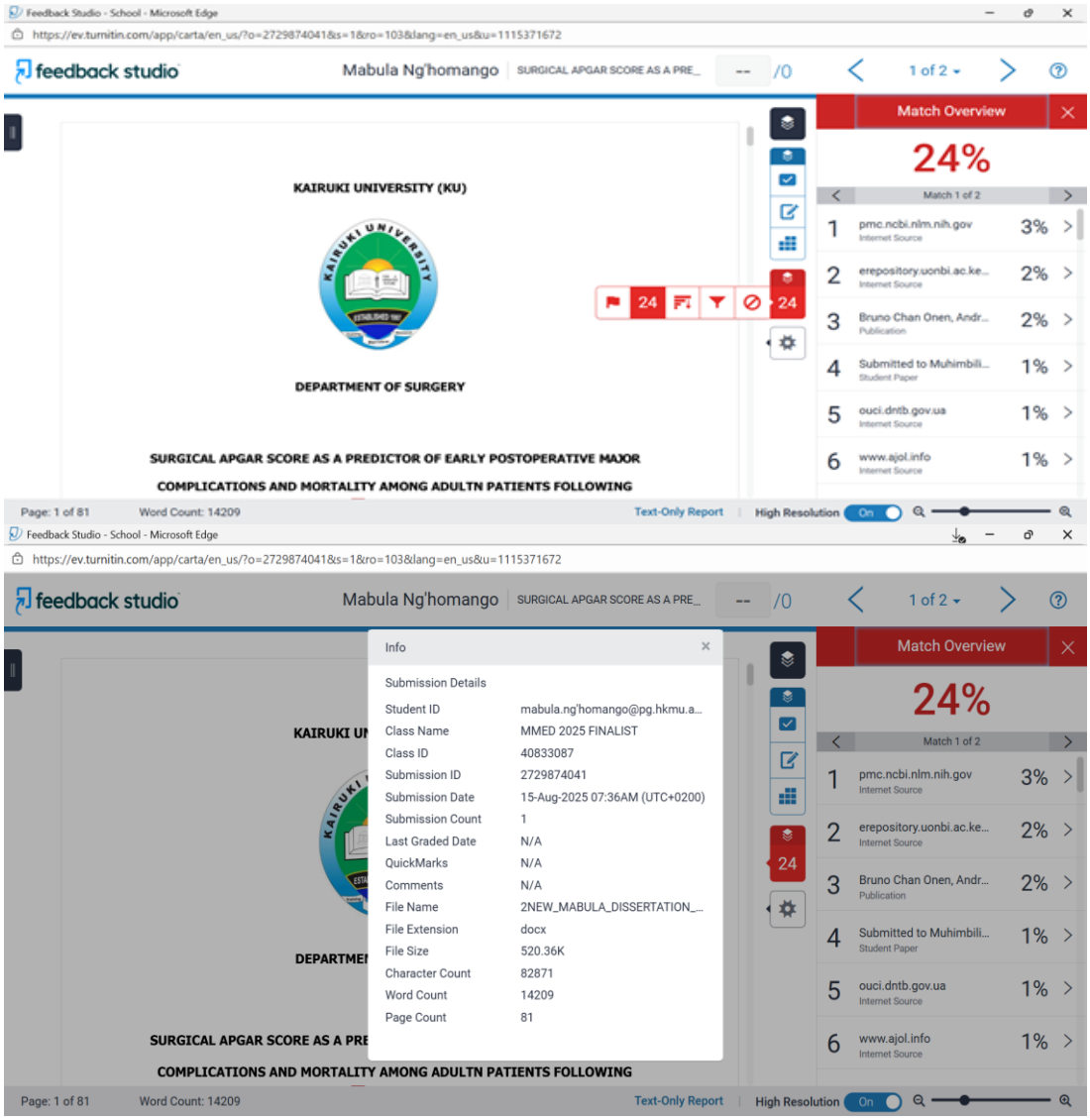
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