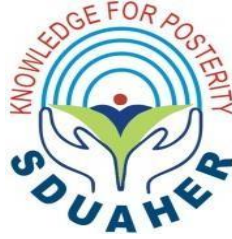


**A COMPARATIVE STUDY TO ASSESS THE ACCURACY OF  
PREDICTION OF OUTCOME IN EMERGENCY LAPAROTOMIES  
USING APACHE II SCORE AND POSSUM SCORE**

BY  
**DR. RAKSHITH B. K. MBBS**



**DISSERTATION SUBMITTED TO  
SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH ,  
TAMAKA, KOLAR, KARNATAKA  
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF**

**M.S. GENERAL SURGERY**

UNDER THE GUIDANCE OF

**Prof DR.(COL) PRAKASH DAVE**

**PROFESSOR & HEAD OF THE DEPARTMENT,  
DEPARTMENT OF GENERAL SURGERY  
SRI DEVARAJ URS MEDICAL COLLEGE,  
TAMAKA , KOLAR, KARNATAKA**



**SRI DEVARAJ URS MEDICAL COLLEGE  
TAMAKA, KOLAR, KARNATAKA – 563 103**

**2025**



**SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION  
AND RESEARCH, TAMAKA, KOLAR, KARNATAKA**

**DECLARATION BY CANDIDATE**

I hereby declare that this dissertation entitled “**A Comparative Study To Assess The Accuracy of Prediction of Outcome In Emergency Laparotomies Using Apache II Score And Possum Score**” is a bonafide and genuine research work carried out by me under the guidance of **Dr. Prakash Dave**, Professor, Department of General Surgery, Sri Devaraj Urs Medical College, Kolar, Karnataka.

Date:

Place: Kolar

**Dr. Rakshith B.K.**

Postgraduate

Department of General Surgery

Sri Devaraj Urs Medical College,

Tamaka, Kolar, Karnataka



**SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION  
AND RESEARCH, TAMAKA, KOLAR, KARNATAKA**

**CERTIFICATE BY THE GUIDE**

This is to certify that the dissertation entitled “**A Comparative Study To Assess The Accuracy of Prediction of Outcome In Emergency Laparotomies Using Apache II Score And Possum Score**” is a bonafide research work done by **Dr. Rakshith B.K**, in partial fulfilment of the requirement for the degree of in M.S General Surgery.

Date:

Place: Kolar

**Dr. Prakash Dave**

Professor and HOD,

Department of General Surgery,

Sri Devaraj Urs Medical College,

Tamaka, Kolar, Karnataka

**SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND  
RESEARCH, TAMAKA, KOLAR, KARNATAKA**

**ENDORSEMENT BY THE HEAD OF THE DEPARTMENT &  
PRINCIPAL**

This is to certify that the dissertation entitled “A Comparative Study To Assess The Accuracy Of Prediction Of Outcome In Emergency Laparotomies Using Apache II Score And Possum Score” is a bonafide research work done by **Dr. Rakshith B.K** under the guidance of **Dr. Prakash Dave** Professor and HOU, Department of General Surgery , Sri Devaraj Urs Medical College, Kolar, in partial fulfillment of the requirement for the degree of M.S General Surgery.

**Dr. Prakash Dave**

Professor & HOD

Department of General Surgery

Sri Devaraj Urs Medical College

Tamaka, Kolar, Karnataka

**Dr. Prabhakar K**

Principal

Sri Devaraj Urs Medical College

Tamaka, Kolar, Karnataka

Date:

Place: Kolar

Date:

Place: Kolar



**SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION  
AND RESEARCH, TAMAKA, KOLAR, KARNATAKA**

**COPYRIGHT**

I hereby declare that **Sri Devaraj Urs Academy of Higher Education and Research, Kolar, Karnataka** shall have the rights to preserve, use and disseminate this dissertation / thesis in print or electronic format for academic/research purpose.

Date :

Place : Kolar

**Dr. Rakshith B.K**

© Sri Devaraj Urs Academy of Higher Education and Research,  
Tamaka, Kolar, Karnataka



SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION & RESEARCH

SRI DEVARAJ URS MEDICAL COLLEGE

Tamaka, Kolar

INSTITUTIONAL ETHICS COMMITTEE



Members

1. Dr. D.E.Gangadhar Rao,  
(Chairman) Prof. & HOD of  
Zoology, Govt. Women's  
College, Kolar
2. Dr. Sujatha.M.P,  
(Member Secretary),  
Prof. Department of Anesthesia,  
SDUMC
3. Mr. Gopinath  
Paper Reporter, Samyukth  
Karnataka
4. Mr. G. K. Varada Reddy  
Advocate, Kolar
5. Dr. Hariprasad S,  
Prof. Dept. of Orthopedics,  
SDUMC
6. Dr. Abhinandana R  
Asst. Prof.  
Dept. of Forensic Medicine,  
SDUMC
7. Dr. Ruth Sneha Chandrakumar  
Assoc. Prof.  
Dept. of Psychiatry, SDUMC
8. Dr. Usha G Shenoy,  
Asst. Prof., Dept. of Allied  
Health & Basic Sciences  
SDUAHER
9. Dr. Munilakshmi U  
Asst. Prof. Dept. of  
Biochemistry, SDUMC
10. Dr. D. Srinivasan,  
Assoc. Prof.  
Dept. of Surgery,  
SDUMC
11. Dr. Shilpa M D  
Assoc. Prof.  
Dept. of Pathology,  
SDUMC

No. DMC/KLR/IEC/65/ 2023-24

Date: 10/04/2023

**PRIOR PERMISSION TO START OF STUDY**

The Institutional Ethics Committee of Sri Devaraj Urs Medical College, Tamaka, Kolar has examined and unanimously approved the synopsis entitled "A Complorative study to assess the accuracy of prediction of outcome in emergency laparotomies using apache II score and possum score" being investigated by **Dr.Rakshith B K & Dr.Prakash Dave** in the Department of General Surgery at Sri Devaraj Urs Medical College, Tamaka, Kolar. **Permission is granted by the Ethics Committee to start the study.**

*Sujatha.M.P*  
Member Secretary  
Member Secretary  
Institutional Ethics Committee  
Sri Devaraj Urs Medical College  
Tamaka, Kolar.

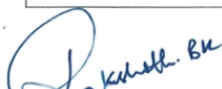
*[Signature]*  
Chairman  
CHAIRMAN  
Institutional Ethics Committee  
Sri Devaraj Urs Medical College  
Tamaka, Kolar





SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION & RESEARCH  
TAMAKA, KOLAR, KARNATAKA, INDIA 563103

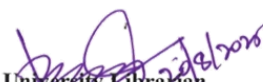
**CERTIFICATE OF PLAGIARISM CHECK**


Title of the Thesis/Dissertation	A COMPARATIVE STUDY TO ASSESS THE ACCURACY OF PREDICTION OF OUTCOME IN EMERGENCY LAPAROTOMIES USING APACHE II SCORE AND POSSUM SCORE
Name of the Student	DR RAKSHITH B K
Registration Number	22GS1062
Name of the Supervisor / Guide	DR PRAKASH DAVE
Department	GENERAL SURGERY
Acceptable Maximum Limit (%) of Similarity (PG Dissertation /Ph.D. Thesis)	10 %
Similarity	4%
Software used	TURNITIN
Paper ID	108764074
ORCID ID	0009-0006-4343-9357
Submission Date	18/08/2025

  
Signature of Student

  
Signature of Guide/Supervisor  
  
Dr. Prakash Dave  
Assoc. Professor of Surgery  
WBSMC No. 30634  
Date: 18/08/2025

HOD Signature

  
University Librarian  
Learning Resource Centre  
SDUAHER, Tamaka  
KOLAR-563103

  
Prof. & HOD of Surgery  
Sri Devaraj Urs Medical College  
Tamaka, KOLAR-563103  
PG Coordinator  
PG Coordinator  
Sri Devaraj Urs Medical College  
Tamaka, Kolar-563103

**Rakshith B K**

**SDUMC\_Sur\_rakshith \_A COMPARATIVE STUDY TO ASSESS THE ACCURACY OF PREDICTION OF OUTCOME IN EMERGEN...**

2025-26 PG Dissertation

**Document Details**

Submission ID

trn:oid::3618:108764074

Submission Date

Aug 18, 2025, 3:56 PM GMT+5:30

Download Date

Aug 19, 2025, 2:29 PM GMT+5:30

File Name

SDUMC\_Sur\_rakshith \_A COMPARATIVE STUDY TO ASSESS THE ACCURACY OF PREDICTION OF O....docx

File Size

1.4 MB

86 Pages

12,265 Words

73,076 Characters

*[Signature]*  
University Library  
Learning Resource Centre  
SDUANER, Tamaka  
KOLAR-563103

*[Signature]*  
20/8/25  
Date: 20/8/25  
Area: Professor of Surgery  
WBSC No. 39834  
Time: .....

## 4% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

### Filtered from the Report

- Bibliography
- Quoted Text
- Small Matches (less than 10 words)

### Match Groups

- 25 Not Cited or Quoted 3%  
Matches with neither in-text citation nor quotation marks
- 10 Missing Quotations 1%  
Matches that are still very similar to source material
- 0 Missing Citation 0%  
Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%  
Matches with in-text citation present, but no quotation marks

### Top Sources

- 2% Internet sources
- 2% Publications
- 2% Submitted works (Student Papers)

### Integrity Flags

0 Integrity Flags for Review

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.

*[Handwritten Signature]*  
 University Library  
 Learning Resource Centre  
 SDUAHER, Tamaka  
 KOLAR-563103

*[Handwritten Signature]*  
 20/02/2025  
 Dr. M. Ash Dave  
 Assoc. Professor of Surgery  
 WBMC No. 39634  
 Date: ..... Time: .....

### Match Groups

- 25 Not Cited or Quoted 3%  
Matches with neither in-text citation nor quotation marks
- 10 Missing Quotations 1%  
Matches that are still very similar to source material
- 0 Missing Citation 0%  
Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%  
Matches with in-text citation present, but no quotation marks

### Top Sources

- 2% Internet sources
- 2% Publications
- 2% Submitted works (Student Papers)

### Top Sources

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Student papers	Loma Linda University on 2024-06-02	<1%
2	Internet	www.turkjsurg.com	<1%
3	Publication	"ESICM LIVES 2020", Intensive Care Medicine Experimental, 2020	<1%
4	Internet	www.mdpi.com	<1%
5	Publication	Snehal G. Thakkar, Alex Z. Fu, John W. Sweetenham, Zachariah A. Mciver et al. "Su...	<1%
6	Student papers	Universidad de Navarra on 2025-03-24	<1%
7	Internet	pmc.ncbi.nlm.nih.gov	<1%
8	Internet	canjsurg.ca	<1%
9	Internet	link.springer.com	<1%
10	Internet	www.researchgate.net	<1%

*Dr. Pradeep Dave*  
 Assoc. Professor  
 WBMC No. 39834  
 Date: 20/8/24  
 Time: .....

*Dr. Pradeep Dave*  
 University Library  
 Learning Resource Centre  
 SDUAHER, Tamaka  
 KOLAR-563103

11	Student papers	University of Edinburgh on 2024-05-21	<1%
12	Student papers	University of Salford on 2012-06-01	<1%
13	Internet	www.omicsdi.org	<1%
14	Internet	repository-tnmgrmu.ac.in	<1%
15	Internet	www.viralhepatitisjournal.org	<1%
16	Publication	"ESICM 2013 - Abstracts of Oral Presentations and Poster Sessions", Intensive Car...	<1%
17	Student papers	Canterbury Christ Church University on 2025-05-15	<1%
18	Internet	crdu.gmu.ac.ir	<1%
19	Internet	dspace.daffodilvarsity.edu.bd:8080	<1%
20	Internet	fdocuments.in	<1%
21	Internet	ijars.net	<1%
22	Publication	Moon, Soo-Youn, Kyong Ran Peck, Hyun-Ha Chang, Shin-Woo Kim, Sang Taek Heo,....	<1%
23	Publication	Schandl, Anna R .. "Physical and Psychological Problems After Critical Illness: Pre...	<1%
24	Publication	Valerii Luțenco, Adrian Beznea, Raul Mihailov, George Țocu et al. "Literature Revi...	<1%

*20/8/25*  
Dr. Prakash Dave  
Assoc. Professor of Surgery  
WBMC No. 39834  
Date:.....Time.....

*20/8/25*  
University Library  
Learning Resource Centre  
SDUAHER, Tamaka  
KOLAR-563103



25	Internet	www.jcdr.net	<1%
26	Internet	www.peeref.com	<1%
27	Internet	www.science.gov	<1%

*[Handwritten Signature]*  
 University Library  
 Learning Resource Centre  
 SDUAHER, Tamaka  
 KOLAR-563103

*[Handwritten Signature]*  
 20/8/25  
 Dr. Prakash  
 Assoc. Professor of Surgery  
 WBMC No. 39634  
 Date: ..... Time: .....



## ACKNOWLEDGEMENT

*Academic work is never completed single handedly . This work is no exception. Words fail me in expressing my heartfelt and humble gratitude to thank the almighty for showering his blessings on me.*

*With humble gratitude and great respect, I would like to thank my teacher, mentor and guide, **Dr. PRAKASH DAVE**, Professor & HOD, Department of General Surgery, Sri Devaraj Urs Medical College, Kolar, for their able guidance, constant encouragement, immense help and valuable advices which went a long way in moulding and enabling me to complete this work successfully. Without their initiative and constant encouragement this study would not have been possible. Their vast experience, knowledge, able supervision and valuable advices have served as a constant source of inspiration during the entire course of my study.*

*I express my deep sense of gratitude and humble thanks to my senior Professors, **Dr. Krishnaprasad K, Dr. Sreeramulu P N, Dr. Shashirekha C A, Dr. Srinivasan D** for their advice and encouragement throughout the study.*



*I am extremely indebted to and I thank **Dr. RaviKiran H R & Dr Arvind V R**, Associate Professors , Department of General Surgery for their constant support and encouragement throughout with patience and care. They have been my well wisher and a source of inspiration throughout my study.*

*I also thank my assistant professors **Dr.Naphene, Dr. Pujitha Arthimalla, Dr Muktesh and Dr Chirag P Gowda** for their constant support, encouragement and making me a better person*

*My heartfelt thanks to all my teachers throughout my life for having made me what I am today for their practical tips, invaluable advice and constant encouragement.*

*It's my pleasure to thank **Dr.Anurag Bhavanam, Dr.Vaibhavi D, Dr Sailesh Kumar, Dr Kavitha, Dr Neha, Dr Sanjana** & other seniors for their emotional anchor and upholding attitude throughout my post-graduation.*

*I express my sincere thanks to my colleagues and dear friends **Dr Rakesh Guntupalli, Dr. Vivek Hariharan S, Dr. Akhil Vincent, Dr. Nikhil Bondalapati, Dr. Vaseem Akram***



*Vadhooth, Dr Nidhil Noushad, and my juniors Dr Rithu T Praveen, Dr Amarnath and Dr Charan V for their co-operation and help in carrying out this study.*

*I would express my deepest gratitude to my beloved my parents **Kamaraj N and Shantha Kumari M** whose love, blessings and sacrifices made me the person I am today. Without them I would have never reached to this level.*

*I am very much thankful to my Brothers **Sandeep B K and Lakshmikanth** and my maternal uncle **Chandrashekar** and to all my beloved friends for their love and support towards me.*

*I thank my department staff **Somala S V and Muniraju V N** for their help and assistance.*

*I thank all my interns and nurses of **OT, ICU, Post Op Ward and General ward** for their help and assistance.*

*Last, but not the least, I thank my patients for providing me the opportunity to carry out my study,*

*Date:*

*Place: Kolar*

***Dr. Rakshith B K***



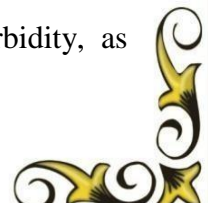
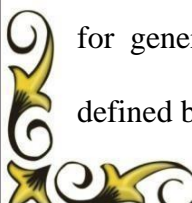
## ABSTRACT

### **Background and Objective**

To enhance clinical decision-making and patient outcomes, appropriate preoperative risk stratification is necessary for emergency laparotomy procedures, which are linked with considerable morbidity and death rates. Reliable predictive scoring methods are necessary for the complicated emergency abdominal surgical procedures so that patients can be properly allocated resources and perioperatively managed according to predetermined protocols, regardless of their risk category. There is a lack of sufficient data to determine the relative accuracy of the POSSUM and APACHE II scoring systems in predicting postoperative outcomes, despite the fact that both are currently used in emergency surgical patients. Predicting mortality and morbidity outcomes among patients undergoing emergency laparotomy for non-traumatic diseases was the goal of this study, which compared the prediction accuracy of POSSUM and APACHE II scoring systems.

### **Methodology**

From May 2023 through April 2025, 54 consecutive patients over the age of 18 who were receiving emergency laparotomy for non-traumatic disorders were enrolled in this prospective observational study at a tertiary care center. Cases involving vascular surgery, re-exploratory procedures, and trauma-related laparotomies were not included. The conventional methods were followed to determine the POSSUM and APACHE II scores. Physiological parameters were measured before surgery, and operative severity scores were recorded during the procedure. While APACHE II evaluated age and chronic health in addition to twelve physiological variables measured within the first twenty-four hours of admission, POSSUM included six criteria for operation severity and twelve variables for general physiological status. Mortality within 30 days and surgical morbidity, as defined by Clavien-Dindo criteria, were the main outcome measures.





## Results

The majority of the participants in the study were male (66.7%) and their average age was 52.1±18.4 years. The most common pathological disease was peritonitis due to perforation (57.4%), with acute intestinal blockage coming in second (31.5%). Overall morbidity was 51.9% and 30-day mortality was 14.8%. For both mortality and morbidity prediction, POSSUM outperformed APACHE II statistically (AUC 0.843 vs. 0.721,  $p=0.019$  and AUC 0.792 vs. 0.668,  $p=0.034$ , respectively). Better NPV (96.9% vs. 92.7%), due to increased sensitivity (87.5% vs. 62.5%) and maintained specificity (78.3% vs. 82.6%), was attained by POSSUM in mortality prediction. Although both systems performed satisfactorily in the calibration analysis, POSSUM showed better features (Hosmer-Lemeshow  $\chi^2=8.42$ ,  $p=0.394$  versus  $\chi^2=12.67$ ,  $p=0.124$ ). Consistent POSSUM superiority was revealed in subgroup analysis across clinical situations, especially in individuals with peritonitis (mortality prediction AUC 0.891 vs 0.745,  $p=0.042$ ). The improved clinical utility of POSSUM across various decision thresholds was proven by net benefit analysis.

## Conclusion

Within the fields of mortality and morbidity prediction, the POSSUM scoring system outperforms APACHE II statistically in populations undergoing emergency laparotomy. Better clinical decision-making and evidence-based surgical practice are made possible with POSSUM's greater discriminatory ability, superior calibration characteristics, and improved clinical utility, which justify its preferential deployment for perioperative risk assessment protocols.

**Keywords:** Laparotomy, Emergency Surgery, Risk Assessment, Postoperative Complications, APACHE



---

**A COMPARATIVE STUDY TO ASSESS THE  
ACCURACY OF PREDICTION OF OUTCOME IN  
EMERGENCY LAPAROTOMIES USING  
APACHE II SCORE AND POSSUM SCORE**

---



---

## TABLE OF CONTENTS

---

INTRODUCTION .....	10
OBJECTIVES.....	13
REVIEW OF LITERATURE.....	14
MATERIALS AND METHODS .....	37
RESULTS.....	43
DISCUSSION.....	65
CONCLUSION .....	76
STRENGTH OF THE STUDY .....	77
RECOMMENDATIONS .....	78
SUMMARY .....	79
LIMITATION.....	82
REFERENCES .....	83
ANNEXURE .....	91

---

## LIST OF TABLES

---

Table 1: Age Distribution and Stratification in Emergency Laparotomy Cohort (n=54).....	43
Table 2: Gender Distribution .....	45
Table 3: Primary Pathological Conditions Requiring Emergency Laparotomy.	46
Table 4: Comorbidity Burden .....	48
Table 5: Intensive Care Unit Admission Requirements and Resource Utilization .....	49
Table 6: POSSUM Scoring System Components and Risk Prediction Parameters .....	49
Table 7: APACHE II Scoring System Components and Mortality Risk Assessment .....	51
Table 8: POSSUM Risk Stratification Categories and Population Distribution	52
Table 9: APACHE II Risk Stratification Categories and Clinical Distribution .	54
Table 10: Mortality Outcomes and Temporal Assessment Parameters .....	56
Table 11: Morbidity Patterns and Complication Classification Analysis .....	57
Table 12: Hospital Resource Utilization and Clinical Course Parameters .....	59
Table 13: Mortality Prediction Performance Assessment and Statistical Validation .....	60




Table 14: Morbidity Prediction Efficacy and Comparative Statistical Analysis 61

Table 15: Pathology-Specific Performance Analysis and Subgroup Validation 62

Table 16: Calibration Assessment and Clinical Utility Evaluation Framework 64

---

## **LIST OF FIGURES**

---

Figure 1: Age Distribution .....	44
Figure 2: Gender Distribution .....	45
Figure 3: Primary Pathological Conditions Requiring Emergency Laparotomy	47
Figure 4: Comorbidity Burden .....	48
Figure 5: Intensive Care Unit Admission Requirements and Resource Utilization .....	49
Figure 6: POSSUM Risk Stratification Categories and Population Distribution .....	53
Figure 7: APACHE II Risk Stratification Categories and Clinical Distribution	55
Figure 8: Morbidity Patterns and Complication Classification Analysis .....	58

---

## **ABBREVIATIONS**

---

<b>Abbreviation</b>	<b>Explanation</b>
POSSUM	Physiological and Operative Severity Score for the enumeration of Mortality and morbidity
APACHE II	Acute Physiology and Chronic Health Evaluation II
AUC	Area Under the receiver operating characteristic Curve
P-POSSUM	Portsmouth modification of POSSUM
NELA	National Emergency Laparotomy Audit
ASA	American Society of Anesthesiologists
ICU	Intensive Care Unit
PPV	Positive Predictive Value
NPV	Negative Predictive Value
ESS	Emergency Surgery Score

---

## **ABSTRACT**


---

### **Background and Objective**

To enhance clinical decision-making and patient outcomes, appropriate preoperative risk stratification is necessary for emergency laparotomy procedures, which are linked with considerable morbidity and death rates. Reliable predictive scoring methods are necessary for the complicated emergency abdominal surgical procedures so that patients can be properly allocated resources and perioperatively managed according to predetermined protocols, regardless of their risk category. There is a lack of sufficient data to determine the relative accuracy of the POSSUM and APACHE II scoring systems in predicting postoperative outcomes, despite the fact that both are currently used in emergency surgical patients. Predicting mortality and morbidity outcomes among patients undergoing emergency laparotomy for non-traumatic diseases was the goal of this study, which compared the prediction accuracy of POSSUM and APACHE II scoring systems.

### **Methodology**


From May 2023 through April 2025, 54 consecutive patients over the age of 18 who were receiving emergency laparotomy for non-traumatic disorders were enrolled in this prospective observational study at a tertiary care center. Cases involving vascular surgery, re-exploratory procedures, and trauma-related



laparotomies were not included. The conventional methods were followed to determine the POSSUM and APACHE II scores. Physiological parameters were measured before surgery, and operative severity scores were recorded during the procedure. While APACHE II evaluated age and chronic health in addition to twelve physiological variables measured within the first twenty-four hours of admission, POSSUM included six criteria for operation severity and twelve variables for general physiological status. Mortality within 30 days and surgical morbidity, as defined by Clavien-Dindo criteria, were the main outcome measures.

## **Results**

The majority of the participants in the study were male (66.7%) and their average age was  $52.1 \pm 18.4$  years. The most common pathological disease was peritonitis due to perforation (57.4%), with acute intestinal blockage coming in second (31.5%). Overall morbidity was 51.9% and 30-day mortality was 14.8%. For both mortality and morbidity prediction, POSSUM outperformed APACHE II statistically (AUC 0.843 vs. 0.721,  $p=0.019$  and AUC 0.792 vs. 0.668,  $p=0.034$ , respectively). Better NPV (96.9% vs. 92.7%), due to increased sensitivity (87.5% vs. 62.5%) and maintained specificity (78.3% vs. 82.6%), was attained by POSSUM in mortality prediction. Although both systems performed satisfactorily in the calibration analysis, POSSUM showed better features (Hosmer-Lemeshow  $\chi^2=8.42$ ,  $p=0.394$  versus  $\chi^2=12.67$ ,  $p=0.124$ ).



Consistent POSSUM superiority was revealed in subgroup analysis across clinical situations, especially in individuals with peritonitis (mortality prediction AUC 0.891 vs 0.745,  $p=0.042$ ). The improved clinical utility of POSSUM across various decision thresholds was proven by net benefit analysis.

## **Conclusion**

Within the fields of mortality and morbidity prediction, the POSSUM scoring system outperforms APACHE II statistically in populations undergoing emergency laparotomy. Better clinical decision-making and evidence-based surgical practice are made possible with POSSUM's greater discriminatory ability, superior calibration characteristics, and improved clinical utility, which justify its preferential deployment for perioperative risk assessment protocols.

**Keywords:** Laparotomy, Emergency Surgery, Risk Assessment, Postoperative Complications, APACHE

# **INTRODUCTION**



---


## INTRODUCTION

---

Emergency laparotomies are a very difficult situation in general surgery because they have high rates of illness and death. This means that the risks must be carefully assessed before the procedure. For the complexity of emergency abdominal surgical operations, we need reliable prediction scoring systems to improve patient outcomes and help doctors make informed decisions.<sup>1,2</sup> Evidence-based risk assessment tools are becoming more important in modern surgical practice. They help doctors come up with the best ways to manage patients before, during, and after surgery, as well as predict complications and death after surgery.<sup>3,4</sup>

The POSSUM scoring system is now a common and trusted way to predict surgical outcomes in general surgery. POSSUM now includes twelve physiological parameters and six surgical severity scores to assess patient risk factors. This tool was originally intended for measuring mortality and morbidity risks but it is used for this purpose.<sup>5,6</sup> The P-POSSUM is a modified version for assessing the risk of emergency laparotomy because it is better at predicting death in ICU. It is possible in emergency surgical situations when used.<sup>7,8</sup>

Along with various other surgical scoring systems, the newer APACHE II score is now a common as well as trustworthy method to predict mortality in the ICU. APACHE II makes a full risk stratification score by combining twelve




physiological indicators that have been evaluated in the first one day after<sup>9,10</sup> has shown that APACHE II's ability to predict outcomes is not the same for all cases in ICU. This is especially true for surgical ICU, like those who need an emergency laparotomy.<sup>11,12</sup>

Recent research has shown how important it is to compare different scoring systems to find the best one for each clinical situation. Yelamanchi et al. discovered that the predicted accuracy of P-POSSUM and APACHE II scores for patients with perforation peritonitis was very different. This suggests that scoring systems may not work as well for all groups of people.<sup>13</sup> Nag et al. also looked at all other surgical scoring systems that are available for emergency laparotomy patients and they found that each scores has its own pros and cons.

14

There are different problems with accurately predicting risk because there are so many reasons for an emergency laparotomy, such as intestinal blockage or perforation peritonitis. Studies show that the results of scoring systems can vary a lot based on the underlying pathophysiology, the demographics of the patients, and the variables of the institution.<sup>15</sup> Also, the time of physiological parameter evaluation in relation to surgical intervention, as well as other time-related parts of score calculation, have a big effect on how accurate the prediction is.



To improve patient care, we need to compare and evaluate the current scoring methods. This is because accurate risk stratification is very important when making decisions about emergency surgery. The goal of this study is to add to the body of knowledge supporting perioperative risk assessment methods by comparing how well the POSSUM and APACHE II scoring systems can predict death and illness after an emergency laparotomy.

# OBJECTIVES





---

## **OBJECTIVES**

---

### **Objectives**

1. To determine how accurate the POSSUM score is at predicting death and illness in patients who need an emergency laparotomy.
2. To determine how accurate the APACHE II score is at predicting death and illness in people who have to have laparotomy in an emergency setting.
3. To determine how effectively the POSSUM and APACHE II scoring systems can predict death and illness in people who have to have laparotomy in an emergency.

# **REVIEW OF LITERATURE**

---



---


## REVIEW OF LITERATURE

---

### Emergency laparotomy

A major surgery, an emergency laparotomy may be needed if you have severe stomach pain. Emergency abdominal surgery puts a lot of stress on the health system because it has a much higher death rate than elective surgeries. Studies show that the risk of death from an emergency laparotomy is usually between 10% and 30%, depending on the patient's health, the time of the surgery, and how complicated it is. Patients with a too many comorbidities as well as physiological problems usually have underlying diseases that are so bad that they need to be treated right away because the death rate is so high among them.<sup>16</sup>

Emergency operating presentations can have a very complicated as well as varied cause. There are many different reasons why a patient might need an emergency laparotomy, such as perforated viscus, ischemic bowel, an infection in the abdomen, or traumatic injuries. Severe systemic inflammatory reactions, hemodynamic instability, and organ failure are common symptoms among patients, making clinical assessment and management more challenging due to this variability. This variability can also change the time of presentation and the course of the disease, which can have a big effect on the results. So, we must have scoring strategies that can predict both mortality as well as morbidity in




this case, since it shows how acute physiological stress as well as long-term health status can interact in complicated ways.<sup>17,18</sup>

We noticed a recent rise in positive outcomes after emergency laparotomy is mostly due to quality improvement efforts that target specific areas. In order to standardize perioperative processes, benchmark results, and identify care gaps, large-scale initiatives like the NELA in the UK have methodically collected data.<sup>19</sup> These programs provide an emphasis on improved postoperative surveillance, multidisciplinary treatment, rapid resuscitation, and quick surgical intervention. There is preliminary evidence that these types of initiatives can improve resource allocation and encourage the adoption of best practices, which in turn reduce mortality and morbidity. New studies have also shown that this high-risk population benefits greatly from perioperative hemodynamic management and improved recovery methods. There is still a significant need for better predictive tools and quality improvement approaches to personalize patient treatment and increase survival rates after emergency laparotomy, because this procedure is still very risky.<sup>16</sup>

### **Evolution of Risk Prediction in Emergency Surgery**

Emergency laparotomy is a high-stakes surgical procedure frequently performed to address life-threatening intra-abdominal conditions such as perforation peritonitis, bowel obstruction, and ischemia. Historically, the need for risk stratification in surgical practice emerged during the mid-20th century, as




postoperative outcomes varied widely depending on patients' physiological reserve and operative complexity. The earliest efforts to quantify operative risk began with the ASA Physical Status Classification in 1941. However, as medicine advanced, the demand for more nuanced and objective predictive models led to the development of systems like the APACHE in the 1980s and the POSSUM in the early 1990s, respectively.<sup>19,20</sup>

Modern surgical practice places a premium on objective risk assessment, especially in cases requiring an emergency laparotomy. These treatments are associated with high rates of death (10–18%) and morbidity (30–50%), particularly in patients who are old or have physiological instability.

<sup>21</sup>Preoperative scoring allows for the early detection of patients at high risk, the distribution of critical care resources, the acquisition of informed consent, and the preparation for postoperative care. The use of risk scores to compare results and establish standards for perioperative care has been highlighted by national audits like the NELA in the United Kingdom. Clinical decision-making and surgical quality improvement initiatives increasingly heavily rely on predictive models such as APACHE II and P-POSSUM.

Strong predictive models, according to theory, need to be able to discriminate, calibrate, and be clinically useful. The AUC is a common metric for evaluating a model's discrimination capabilities; it measures the model's capacity to differentiate between patients who have an event (such as death) and those who



do not. A well-calibrated model will produce prediction probabilities that are very close to the observed frequencies, and calibration is all about how well these two sets of data match up with one another. Finally, clinical usefulness considers the model's practicality in real-world contexts, taking into account factors like user-friendliness, input data availability, and forecast timeliness.

<sup>22</sup>Preoperative risk prediction utilizing physiological data is where APACHE II really shines in emergency laparotomy, however POSSUM and its derivatives add in surgical details, which makes them more specific but limits their use before the procedure. Finding the sweet spot where these theoretical ideas meet actual reality is the goal of an ideal scoring system.

## **Risk Scoring Systems for Emergency Laparotomy**

### **APACHE II Score**

An established ICU severity score, APACHE II was created in the 1980s. <sup>23</sup>A score that correlates with mortality risk is produced by adding 12 physiological factors, age, and chronic health points. The fact that APACHE II does not necessitate intraoperative findings or postoperative pathology makes it a valuable tool in emergency surgical settings, where data from prior procedures and readily available vitals and labs are necessary. Because of this, potential dangers can be evaluated before surgery or even at the time of admission.

# APACHE II Score<sup>20</sup>

Physiologic variable <sup>b</sup>	Point score								
	+4	+3	+2	+1	0	+1	+2	+3	+4
1 Temperature	≥41°	39–40.9°	–	38.5–38.9°	36–38.4°	34–35.9°	32–33.9°	30–31.9°	≤29.9°
2 Mean arterial pressure (mm Hg)	≥160	130–159	110–129	–	70–109	–	50–69	–	≤49
3 Heart rate	≥180	140–179	110–139	–	70–109	–	55–69	40–54	≤39
4 Respiratory rate(non-ventilated or ventilated)	≥50	35–49	–	25–34	12–24	10–11	6–9	–	≤5
5 Oxygenation:									
a) FiO <sub>2</sub> ≥ 0.5: use A-aDO <sub>2</sub>	≥500	350–499	200–349	–	<200	–	–	–	–
b) FiO <sub>2</sub> < 0.5: use PaO <sub>2</sub> (mm Hg)	–	–	–	–	>70	61–70	–	55–60	<55
6 Arterial pH	≥7.7	7.6–7.69	–	7.5–7.59	7.33–7.49	–	7.25–7.32	7.15–7.24	<7.15
7 Serum Na (mMol/L)	≥180	160–179	155–159	150–154	130–149	–	120–129	111–119	≤110
8 Serum K (mMol/L)	≥7	6–6.9	–	5.5–5.9	3.5–5.4	3–3.4	2.5–2.9	–	<2.5
9 Serum creatinine (mg/dL): double point score for acute renal failure	≥+++3.5	2–3.4	1.5–1.9	–	0.6–1.4	–	<0.6	–	–
10 Hct (%)	≥60	–	50–59.9	46–49.9	30–45.9	–	20–29.9	–	<20
11 WBC (in 1000s)	≥40	–	20–39.9	15–19.9	3–14.9	–	1–2.9	–	<1
12 Glasgow coma score (GCS)	Score = 15 minus actual GCS								
Acute physiology score is the sum of the 12 individual variable points									
Add 0 points for the age <44.2 points. 45–54 years: three points. 55–64 years: five points. 65–74 years: six points ≥75 years									
APACHE II score = acute physiology score + age points + chronic health points. Minimum score = 0; maximum score = 71. Increasing score is associated with increasing risk of hospital death									
Add chronic health status points: two points if elective postoperative patient with immunocompromise or history of severe organ insufficiency: five points for nonoperative patient or emergency postoperative patient with immunocompromise or severe organ insufficiency <sup>c</sup>									
13 <sup>d</sup> Serum HCO <sub>3</sub> (venous-mMol/L)	≥52	41–51.9	–	32–40.9	22–31.9	–	18–21.9	15–17.9	<15

Adapted from Knaus WA, Draper EA, Wagner DP, Zimmerman JB: APACHE II: A severity of disease classification system. *Critical care medicine* 13: 818–829. 1985.

Interpretation of APACHE II scores (predicted mortality rate).

0–4 = ~4% death rate 10–14 = ~15% death rate 20–24 = ~40% death rate 30–34 = ~75% death rate.

5–9 = ~8% death rate 15–19 = ~25% death rate 25–29 = ~55% death rate Over 34 = ~85% death rate.

<sup>a</sup> APACHE II Score = acute physiology score + age points + chronic health points. Minimum score = 0; maximum score = 71. Increasing score is associated with increasing risk of hospital death.

<sup>b</sup> Choose worst value in the past 24 h.

<sup>c</sup> Chronic health status: Organ sufficiency (e.g. hepatic, cardiovascular, renal, pulmonary) or immuno-compromised state must have preceded current admission.

<sup>d</sup> Optional variable: use only if no ABGs.


While P-POSSUM necessitates 18 input parameters, APACHE II only needs 12, and there is no need to worry about contamination or intraoperative blood loss, as pointed out by Nag et al.<sup>24</sup> A recent evaluation found that APACHE II's performance "is consistent across patient subgroups.<sup>10</sup> undergoing emergency surgery," hence it must be useful for a variety of medical and surgical subgroups. Only in emergency laparotomy populations has its predictive accuracy been studied.

### **POSSUM and P-POSSUM Scores**

Established in 1991, POSSUM is a surgical outcome auditing tool.<sup>6</sup> It incorporates a 6-factor operative severity score (containing elements like blood loss, peritoneal contamination, and malignancy) with a 12-variable physiological score (equivalent to APACHE II parameters). For colorectal surgery in particular, the P-POSSUM is an adjustment that re-calibrated the logistic equations to match observed mortality. Emergency laparotomy audits (NELA) and quality improvement programs in the UK commonly use P-POSSUM in practice. Full calculation, however, necessitates intraoperative details and, typically, histopathology (e.g., presence of malignancy). The intricacy is brought to light by multiple authors: In contrast to APACHE II's 12-value preoperative requirement, Nag et al. point out that P-POSSUM "needs 18 data points" to account for intraoperative blood loss and postoperative pathology.<sup>24</sup>

Parameters	Physiological score			
	1	2	4	8
Age (in years)	≤ 60	61-70	≥71	
Cardiac signs	No failure	Diuretic, digoxin, anti-anginal, or antihypertensive therapy	Peripheral edema, warfarin therapy, borderline cardiomegaly	Raised JVP, cardiomegaly
Respiratory signs	No dyspnea	Dyspnea on exertion, mild COPD	Limiting dyspnea (one flight), moderate/COPD	Dyspnea at rest (rate ≥30/min), fibrosis, or consolidation
Blood pressure (systolic in mmHg)	110-130	131-170; 100-109	≥171; 90-99	≤89
Pulse (beats/min)	50-80	81-100; 40-49	101-120	≥120; ≤39
Glasgow coma scale	15	12-14	9-11	≤8
Hemoglobin	13-16	11.5-12.9; 16.1-17.0	10.0-11.4; 17.1-18.0	≤9.9; ≥18.1
White cell count (× 10 <sup>12</sup> /L)	4-10	10.1-20.0; 3.1-4.0	≥20.1; ≤3.0	
Urea (mg/dL)	≤40	41-55	55-80	≥80
Sodium (mmol/L)	≥136	131-135	126-130	≤125
Potassium (mmol/L)	3.5-5.0	3.2-3.4; 5.1-5.3	2.9-3.1; 5.4-5.9	≥6.0
ECG	Normal		Atrial fibrillation	Any abnormal rhythm or ≥5 ectopics/min, Q waves or ST/T wave changes
<b>Operative severity score</b>				
	1	2	4	8
Operative severity	Minor	Moderate	Major	Major+
Multiple procedures	1		2	>2
Total blood loss (mL)	≤100	101-500	501-999	≥1000
Peritoneal soiling	None	Minor (serous fluid)	Local pus	Free bowel content (pus or blood)
Presence of malignancy	None	Primary only	Nodal metastases	Distant metastases
Mode of surgery			Emergency resuscitation or >2 h possible operation within 24 hours after admission	Emergency (immediate surgery <2 h needed)

Parameters to calculate POSSUM score <sup>5</sup>



However, P-POSSUM's relative ease of use once all data are accessible and its genesis in huge UK audit data ensure its continued popularity.

### **Other Scores**

Emergency laparotomy risk scores are available from a variety of sources, including the ACS-NSQIP surgical risk calculator, Boey, MPI, and the NELA score.<sup>10</sup> These are outside the purview of this analysis, but they do contribute to the bigger picture. For example, according to recent analyses, P-POSSUM is the most often reported tool (in 42 studies), while Apache-II and NELA are less popular.<sup>3</sup> According to systematic reviews, the predictive performance of any of these methods can vary depending on the specifics of the situation.<sup>3,25</sup>

### **APACHE II in Predicting Emergency Laparotomy Outcomes**

Results from emergency abdominal surgery with APACHE II have been the subject of a large body of research. All patients in a "low-risk" APACHE category survived, but 100% in the highest-risk group perished, according to Agarwal et al. (2017), who discovered a substantial correlation between APACHE II scores and prognosis in patients with perforated peritonitis.

<sup>11</sup>Regarding 30-day mortality, Doda et al. (2024) also found that APACHE II had a fair discrimination with an AUC of 0.737.<sup>10</sup> A threshold APACHE-II score of 6 or higher showed moderate sensitivity and specificity for mortality in their group of patients with perforation peritonitis (AUC 0.737).<sup>10</sup> A study


conducted in 2025 on 100 patients undergoing laparotomy demonstrated that an APACHE-II score of 13 or above indicated serious problems with a sensitivity of 93% and a specificity of 81%. This yielded an impressive area under the curve (AUC) of 0.946.<sup>23</sup> Consistent with other limited series, a higher APACHE II is associated with a lengthier hospital/ICU stay and poorer outcomes. For instance, it was observed by Sreeharsha et al. that all patients with high APACHE II scores died after surgery.<sup>26</sup> Using easily accessible data and being ready to be applied upon presentation, APACHE II seems to accurately stratify risk. Although research suggests its predictive performance (AUC 0.74-0.95) is typically good, it does have certain limits, such as the possibility of underprediction in specific populations.<sup>10,23</sup>

### **POSSUM/P-POSSUM in Predicting Emergency Laparotomy Outcomes**

Emergency laparotomy has also seen extensive research on POSSUM and P-POSSUM. Although these scores are helpful for auditing and risk management, numerous reports show that they have a tendency to overstate mortality. There was no statistically significant difference between the predicted and observed fatality rates in an Indian series of 100 patients according to Paul et al., who used POSSUM (O:E=0.62).<sup>6</sup> There was no significant difference when P-POSSUM showed that O:E was approximately 0.65. A reliable indicator of death and illness after emergency laparotomy is POSSUM and P-POSSUM scores, they found.<sup>6</sup> The same holds true for the study by Sreeharsha et al.

(2014), which found no statistically significant difference between the 20 deaths predicted by POSSUM and the 15 actually measured (O:E=0.71).<sup>26</sup> According to Paul et al. (2020), an additional prospective study conducted in India found no notable difference between the anticipated and actual results when using POSSUM/P-POSSUM (mortality O:E ~0.62-0.65).<sup>6</sup> Systematic reviews have found that P-POSSUM often demonstrates moderate to high discrimination, however there are calibration difficulties. This finding is consistent with the international literature. When it came to emergency situations, for instance, "POSSUM and P-POSSUM provided moderate to high predictive accuracy, though they frequently overestimated mortality," as Lam et al. (2025) put it.<sup>25</sup>

Specifically developed for the purpose of predicting morbidity, POSSUM can foretell both death and complications. There was no significant difference between the observed morbidity and the POSSUM prediction in the 100-patient sample (O:E≈0.91).<sup>6</sup> Overall, P-POSSUM had a good prediction for morbidity (with an O:E of approximately 0.65 for mortality), but the summary did not include details about morbidity. In a nutshell, POSSUM/P-POSSUM successfully identifies patients at high risk of death; individuals with high scores had a much higher mortality rate. For instance, of the 157 participants in the study by Nag et al., those who did not survive had significantly higher median physiological and operative P-POSSUM scores.<sup>24</sup>




Because it takes operative severity into account, P-POSSUM is commonly used in audits (like the UK's NELA, for example). One drawback is that it can not be used until after surgery because it requires intraoperative and histopath data. In contrast, ASA and other less complex indices do not provide enough detail.<sup>10</sup>

### **Comparative Performance: APACHE II vs POSSUM in Emergency Laparotomy**

Applying APACHE II vs POSSUM/P-POSSUM to the same emergency laparotomy patients is an important question. The topic has been explored in a number of recent research. With 157 emergency laparotomies under their belts, Nag et al. (2019) compared APACHE-II and P-POSSUM side by side.<sup>24</sup> Both ratings were determined to be "accurate," and there was no statistically significant difference in their discriminative capacity. Based on ROC analysis, there was almost no difference between P-POSSUM and APACHE-II, with AUCs of 0.989 and 0.965, respectively, indicating outstanding performance.<sup>24</sup> In the same way, both methods showed a notable stratification of mortality: the average APACHE and P-POSSUM scores of non-survivors were significantly higher ( $P < 0.001$ ). In line with Nag's excellent performance, Doda et al. (2024) reported an APACHE-II AUC of 0.737 for mortality, however they did not compare to P-POSSUM.<sup>10</sup>

We can also draw parallels indirectly. Although Yadav et al. (2017) did not offer a direct comparison with POSSUM, they did discover that APACHE-II



was associated with ICU and hospital stays in a mixed-cohort study in India. Prior research from Europe (e.g., Copeland et al.) examined POSSUM and APACHE in the setting of surgical ICU, and the results were typically similar or slightly different in terms of calibration. <sup>19</sup>"Either of the two scoring systems can be used" without sacrificing predictive accuracy, according to current research, which means either score can be utilized for risk stratification. <sup>24</sup>


The availability of APACHE II before to surgery is a significant benefit. Notably, it permits risk assessment right after presentation without requiring intraoperative or pathological inputs. Patients who have not undergone surgery or who are receiving conservative treatment cannot be included in P-POSSUM's score since the scoring algorithm requires surgical data. For this reason, APACHE-II is preferable if the prediction accuracy is comparable. Because of its relative ease of use, APACHE-II has been proposed by Nag et al. and others to supplant P-POSSUM in the auditing of emergency laparotomies. <sup>24</sup>

In spite of this, there are variations in calibration. Research has shown that APACHE-II and POSSUM can either over- or under-predict for some subgroups, depending on factors including age and pathology. Female patients, for instance, had a greater observed mortality rate despite lower scores, as pointed out by Nag et al. While discrimination is generally a positive thing, these subtleties imply that local populations may require frequent recalibrating.

## **What literature says on comparison?**

When it comes to emergency laparotomy, the evidence suggests that both APACHE II and POSSUM/P-POSSUM are good methods for outcome prediction. An adequate AUC (~0.74-0.95) for mortality and complications was demonstrated in surgical emergencies when the APACHE II scoring system, which is used in general ICU, was validated.<sup>10,23</sup> Similarly, the surgical auditing tool POSSUM/P-POSSUM demonstrates good discrimination (AUC frequently >0.9 in individual studies),<sup>23,24</sup> but it has the potential to consistently overestimate the actual risk of death.<sup>25</sup> Patients at high risk of needing intensive care or rapid intervention can be identified using either technique.

Both APACHE II and P-POSSUM are more involved than ASA but easier than NSQIP when compared to other scores. Standardized risk prediction has recently come to light as an important component of better recovery and audit procedures. In order to guide care paths, the UK NELA guidelines, for instance, advocate for preoperative risk assessment, which is commonly done using P-POSSUM or the NELA calculator. However, no one score has been proven to be consistently better in every scenario. A systematic study on emergency laparotomy risk tools found a lot of variation and recommended using them according on the patient's specific needs.<sup>3,25</sup>




The clinical setting may dictate the choice between APACHE II and POSSUM, according to our review. In cases where a rapid preoperative assessment is required, APACHE II is superior.<sup>24</sup> With P-POSSUM, you can include parameters related to the surgery, which might be useful for a comprehensive operative audit. Many studies still provide both ratings in their research, including multi-center or national audits. Crucially, while there have been numerous reviews of mortality rates, much fewer have thoroughly examined the prediction of morbidity (complications). From what we can tell (e.g., Siwach et al.), APACHE II is just as good at predicting serious complications as POSSUM was when it was first developed for that purpose.<sup>23</sup>

Last but not least, it is important to remember that scoring systems need to be adjusted or updated to reflect local populations. Given that care processes (such as resuscitation and ICU care) evolve with time, numerous writers suggest revalidation using up-to-date data.<sup>24,25</sup> This evidence base will be expanded upon and potential recalibration factors may be identified in the current investigation, which includes prospective data collection on APACHE II and POSSUM in an Indian tertiary facility.


### Relevant articles

1. **Agarwal et al. (2017) – India:**<sup>11</sup> This prospective observational study in India looked at patients who needed emergency laparotomy for perforation peritonitis. The goal was to see how well APACHE II scores




could predict how well the surgery would go. Fifty patients who needed emergency surgery because of perforated peritonitis were part of the research group. The main intervention was figuring out preoperative APACHE II scores using twelve physiological variables that were looked at within the first 24 hours of admission. We looked at things like postoperative mortality and morbidity rates, as well as the link between clinical outcomes and APACHE II levels, to see how well the results worked. Scores higher than 15 were linked to a much higher risk of death, and the researchers found a strong positive link between higher APACHE II scores and higher death rates ( $p < 0.05$ ). The study found that the APACHE II scoring system can reliably predict death in cases of perforation peritonitis when the threshold values are set at more than 15 points. This backs up its use in emergency surgical risk stratification protocols.

2. **Jha et al. (2017) – Nepal:**<sup>27</sup> In this prospective observational study, the participants with varied pathological illnesses who were undergoing emergency laparotomy were assessed using the P-POSSUM score. The study was conducted at a tertiary care hospital located in Nepal. Excluding trauma cases, the study cohort consisted of 100 consecutive patients who needed an emergency laparotomy for different types of abdominal diseases. Twelve physiological parameters and six operative severity scores were evaluated before and during the operation,




respectively, to determine the P-POSSUM scores used in the intervention. The outcome measures were the rates of death within 30 days and surgical morbidity, as well as the accuracy of the predictions as measured by ROC analysis. AUC value of 0.85 for predicting death shows that there is a statistically significant link between high P-POSSUM scores and higher death rates in those patients. In these places where resources are limited, thorough risk stratification tools are very important for managing patients and allocating resources. They found that the P-POSSUM scoring system was very good at predicting mortality in patients who had emergency laparotomy.

3. **Nag et al. (2019) – India:**<sup>24</sup> The study in India compared the APACHE II and P-POSSUM scoring systems at predicting death rates after emergency laparotomy. This study included 150 patients who needed emergency laparotomy for different abdominal diseases. Trauma cases as well as re-exploratory surgeries were carefully taken out. In this intervention, they figured out P-POSSUM scores before and during surgery, and APACHE II levels were checked within 24 hours of admission. The main outcome measures were death within 30 days, problems after surgery, and a comparison of the accuracy of the predictions using AUC. The statistical study showed that P-POSSUM had a better accuracy in predicting mortality ( $p < 0.001$ ) than APACHE II (AUC 0.75). In emergency laparotomy populations, the study found that




the P-POSSUM scoring method had far better discriminatory ability than APACHE II. This suggests that it should be used more often for perioperative risk assessment in these types of surgical emergencies.

4. **Yelamanchi et al. (2020) – India:**<sup>13</sup> This prospective observational cohort study in India directly compared the P-POSSUM and APACHE II grading systems to see how well they could predict outcomes for patients who needed emergency laparotomy because of perforation peritonitis. The study included 120 patients who had perforation peritonitis and needed surgery right away. The study did not include any perforations that were caused by trauma. The main outcomes were death within 30 days, complications after surgery, length of hospital stay, and need for the ICU. When looking at P-POSSUM and APACHE II side by side to see which one was better at predicting death, the numbers showed that P-POSSUM was better (sensitivity 85.7%, specificity 92.1%). The investigators found that the area under the curve values were very different (P-POSSUM 0.91 vs. APACHE II 0.79,  $p < 0.05$ ). The study's results show that the P-POSSUM scoring method is better for figuring out the risk level in this specific group of emergency surgical patients because it is more accurate at predicting death and illness in cases of perforation peritonitis than APACHE II.
5. **Hansted et al. (2020) – Denmark:**<sup>9</sup> Results from the Danish InCare trial, the validity of the APACHE II score in a variety of institutional contexts




for populations undergoing emergency abdominal surgery was considered useful. A large-scale multicenter cohort consisted of 1,434 patients, they were undergoing emergency abdominal surgical procedures for various disease. One component of the intervention was calculating APACHE II scores in retrospect using physiological data that had been acquired prospectively from the initial InCare study database. Hospital length of stay, 30-day mortality, as well as calibration assessment were the outcome measures. When comparing populations from the ICU to those from emergency surgery, statistical analysis showed that the latter had inadequate calibration but sufficient discriminatory capacity (AUC 0.79). The study found that the risk of mortality was under-estimated in populations with a higher risk of death and over-estimated in groups of patients with lower risk of death. The importance of conducting context-specific validation studies for risk prediction models originally developed in intensive care environments is underscored by the investigators' conclusion that the APACHE II scoring system needs to be adjusted for optimal performance in emergency abdominal surgery settings.

6. **Paul et al. (2020) – India:**<sup>6</sup> This prospective observational study in India compared the POSSUM and P-POSSUM scoring systems in predicting the chances of morbidity and death in patients undergoing emergency surgeries. This study included 100 consecutive patients. They were not allowed to have trauma cases or elective surgeries. The intervention used




standardized evaluation protocols to consistently find POSSUM scores for predicting illness as well as P-POSSUM scores for predicting death. The main outcome measures were 30-day mortality, and surgical complications defined using Clavien-Dindo criteria as well as diagnostic accuracy of these scores. They observed that P-POSSUM scores were good at predicting outcomes, with an AUC of 0.92 for death and an AUC of 0.78 for illness. The study found a strong link between higher scores and worse outcomes in the areas of death and illness. Researchers say that both P-POSSUM and POSSUM should be used together with the perioperative risk stratification protocols for emergency laparotomy patients. P-POSSUM is better at predicting death rates, while POSSUM is good at predicting illness rates.

7. **Shelgaonkar et al. (2021) – India:**<sup>12</sup> This prospective study in India was carried out on emergency laparotomy populations and they used APACHE II grading to predict death and illness after emergency gastrointestinal procedures. The study included 50 patients who had a variety of surgical problems that required laparotomy procedures. The intervention included carefully recording the patient's long-term health status and age-related factors, as well as calculating APACHE II scores before surgery using twelve physiological variables that were measured within one day of the patient being admitted to the hospital. The main outcomes looked at were morbidity rates, surgical mortality, ICU needs,



as well as the length of stay in the hospital in relation to APACHE II scoring criteria. A cutoff value of 15 points was found to be the best for predicting death in this score. Statistical analysis showed a strong link between higher APACHE II scores and higher death rates ( $r=0.78$ ,  $p<0.001$ ). The study found that the APACHE II rating could predict death with an 83.3% sensitivity and an 89.1% specificity. The people who wrote the study found that the APACHE II score system is a good way to guess how many people will die during emergency gastrointestinal surgery. This discovery has important effects on both preoperative counseling and how resources are used during these surgeries.

8. **Maitra et al. (2022) – India:**<sup>7</sup> This prospective observational study was conducted among patients who had emergency exploratory laparotomy in Eastern India and the authors used the P-POSSUM score method to predict their death and illness rates. The study group had 85 patients who needed emergency laparotomy for different surgical diseases. Trauma cases and planned re-explorations were completely removed. As part of the intervention, twelve physiological parameters were checked before surgery and six operative severity scores were recorded during the procedure. After that, these results were used to figure out a full P-POSSUM score. We used established standards to rate postoperative complications, measured 30-day mortality, and used ROC analysis to check the predicted accuracy. The statistical validation showed that the




area under the curve values of 0.91 for predicting death and 0.83 for predicting morbidity were very good at telling the difference between the two. A cutoff value of 35 was linked to 88.9% sensitivity and 89.7% specificity for predicting death, while a cutoff value of 25 was linked to 79.2% specificity and 81.5% sensitivity for predicting illness. The researchers suggest that the P-POSSUM scoring system should be used for all perioperative risk assessments and clinical decision-making protocols because it is very good at predicting death and illness outcomes in people who need emergency laparotomy.

9. **Doda et al. (2024) – India:**<sup>10</sup> Indirectly pertaining to POSSUM vs. APACHE II analysis, this retrospective comparative study from India examined the predictive power of the two scoring systems, APACHE II and ACS-NSQIP, for postoperative mortality in patients having emergency laparotomy. With thorough data collection from electronic medical records, the study population included 180 patients who needed emergency laparotomy procedures due to a variety of clinical presentations. As part of the intervention, ACS-NSQIP risk calculator evaluations were based on preoperative clinical characteristics, and APACHE II scores were calculated retrospectively using admission physiological data. Predictive accuracy comparisons and rates of morbidity were evaluated using statistical validation approaches as secondary outcomes, with 30-day postoperative mortality serving as the

primary outcome measure. As far as discriminatory ability is concerned, there were no statistically significant differences between the APACHE II (AUC 0.82) and ACS-NSQIP (AUC 0.85) scoring systems, and the results showed that both systems had equivalent prediction accuracy ( $p=0.23$ ). With a sensitivity of 76.9% and a specificity of 84.3% for mortality prediction, the study showed that APACHE II scoring maintained adequate predictive ability despite its original ICU derivation. Although specialized surgical risk assessment techniques may provide slightly better predictive accuracy, the researchers found that the APACHE II scoring method gives clinically acceptable mortality prediction accuracy in emergency laparotomy populations.

**10.Lodha et al. (2024) – India:**<sup>28</sup> A recent comparative analysis pertinent to surgical risk assessment approaches was provided by this prospective observational study in India that evaluated P-POSSUM and NELA ratings in predicting 30-day death following emergency laparotomy. Representative of a full spectrum of tertiary care center experiences, 200 patients undergoing emergency laparotomy for different clinical conditions made up the study population. Using established data collecting techniques, the intervention included full documenting of physiological and operative parameters, and parallel calculation of both the P-POSSUM and NELA scoring systems. Secondary analyses looked at morbidity correlations and score calibration characteristics, whereas



primary outcome evaluation was centered around the accuracy of 30-day mortality predictions. The statistical validation showed that the NELA score had better discriminatory ability for mortality prediction ( $p < 0.05$ ) than P-POSSUM (AUC 0.88). Optimal cutoff values were shown, and thorough sensitivity and specificity evaluations were provided for both scoring systems across various mortality risk groups, in the study. Newer, population-specific risk assessment tools may have advantages over traditional surgical scoring methodologies, according to the investigators. While both scoring systems show acceptable predictive accuracy, the NELA score shows superior discriminatory ability for mortality prediction in contemporary emergency laparotomy populations.

# **METHODOLOGY**



---

## **MATERIALS AND METHODS**

---

### **Study Design and Study Setting**

In order to determine whether scoring system is more effective at predicting mortality and morbidity outcomes among patients undergoing emergency laparotomy, this analysis used a prospective observational study design to compare POSSUM with APACHE II. The research took place at Sri Devraj URS Medical College's Department of General Surgery, RLJH & RC, a referral center for tertiary care that offers full-service emergency surgery.

### **Study Period**

Over the course of twenty-four months, from May 2023 to April 2025, we recruited patients and collected data to make sure we had a good enough sample.

### **Ethics Committee Approval**

The study was approved by the Institutional Ethics Committee before it began, so it followed all the rules for research ethics and patient safety. After thoroughly explaining the study's goals, methods, and possible advantages, we obtained written informed consent from all participants or their legally authorized representatives. Data protection and confidentiality processes were put in place in accordance with institutional policies and legal mandates.

## **Inclusion Criteria**


Patients were eligible to participate in the study if they were at least eighteen years old, needed an emergency laparotomy for non-traumatic abdominal pathology, had hemodynamic stability enough to undergo a thorough preoperative evaluation, and gave their informed consent. If a patient's abdominal condition is life-threatening and requires prompt surgical treatment, an emergency laparotomy may be necessary within twenty-four hours of hospital admission.

## **Exclusion Criteria**

Patients were not included in the study if they had any of the following: unstable blood flow that made it impossible to do a full preoperative evaluation, a history of laparotomy because of vascular surgery, a need for re-exploratory laparotomy, a patient's refusal to take part in the study, or a history of trauma-related abdominal injuries that required emergency laparotomy. These exclusion criteria made sure that the group was all the same by only looking at non-traumatic emergency surgical situations.

## **Sample Size Estimation**

The formula developed by Cochran to determine the sample size was  $n = Z^2 \times p \times (1-p) / d^2$ . In this formula, Z stands for the confidence interval, that is 1.96 for




95% confidence,  $p$  for the projected mortality prevalence, and  $d$  for the desired accuracy margin, that was 0.05. Mortality rates after emergency laparotomy have been found to vary between 13.3% and 16.7% in prior research. The death rate was 13.3% in the prospective study of 150 patients undergoing emergency laparotomy (Naga et al., 2019), and 16.7% in the study of 120 patients with perforated peritonitis (Yelamanchi et al., 2020).<sup>13</sup> The minimal sample size that was estimated using the parameters  $p=0.15$  (15% mortality prevalence) and  $d=0.10$  was 49.

### **Sampling Method**

We used consecutive sampling to find all patients who could have had an emergency laparotomy during the study period.


### **Data Collection Procedure**

The process of collecting data was very thorough and included questions about demographics, clinical presentation, comorbidities, physiological factors, operation details, and outcomes. The demographic information collected included things like gender, age, and any relevant medical records. The clinical presentation assessment looked at things like how long the symptoms lasted, the patient's hemodynamic values at admission, and the primary pathology diagnosis. Cardiovascular, respiratory, renal, hepatic, and immunocompromised diseases were included in the comorbidity evaluation according to predetermined scoring system protocols.



Based on the original description by Copeland et al. (1991), the POSSUM scoring system took twelve physiological parameters into account before surgery: age, respiratory rate, systolic blood pressure, pulse rate, Glasgow coma score, urea levels, sodium concentration, potassium levels, white blood cell count, hemoglobin concentration, potassium levels, and cardiac signs.<sup>19</sup> The standardized operative severity score framework was used to document six characteristics throughout the operation, which included the operation's magnitude, the number of operations, total blood loss, peritoneal soiling, presence of malignancy, and the manner of surgery. Whiteley et al. (1996) verified the use of the Portsmouth modification (P-POSSUM) equations for mortality prediction calculations, which are as follows:  $\ln(R2/(1-R2)) = -7.04 + (0.13 \times \text{physiological score}) + (0.16 \times \text{operation severity score})$ .<sup>29</sup>

APACHE II assessment followed the original methodology developed by Knaus et al. (1985) and included twelve physiological variables measured within twenty-four hours of admission: temperature, mean arterial pressure, heart rate, respiratory rate, oxygenation status, arterial pH, sodium concentration, potassium levels, creatinine, hematocrit, white blood cell count, and Glasgow coma score. It also took into account age and chronic health evaluation<sup>20</sup> According to the original APACHE II validation study, chronic health evaluation criteria included the following: liver cirrhosis with portal hypertension, respiratory disease with severe exercise restriction,




immunocompromised states, heart failure (New York Heart Association Class IV), and chronic dialysis dependency.

Mortality at 30 days, postoperative morbidity defined using Clavien-Dindo criteria, need for ICU admission, length of hospital stay, and necessity of reoperation were all included of the outcome evaluation. Symptoms specific to the wound, the respiratory system, the cardiovascular system, or any other system were used to classify complications. By reviewing medical data and contacting patients by phone as needed, follow-up processes guaranteed thorough outcome capture.

### **Data Analysis**

The SPSS 22 version software was used for the statistical analysis. Depending on the distribution features, continuous variables were shown as mean  $\pm$  standard deviation or median with interquartile range, and categorical variables were shown as frequencies and percentages. The receiver operating characteristic curve analysis, area under curve computation, and 95% confidence interval determination were used to compare the performance of POSSUM and APACHE II. A statistical significance assessment was conducted using DeLong's test for the purpose of comparing discriminatory abilities.

In order to compare the expected and observed correlations of the calibration results, Hosmer-Lemeshow goodness-of-fit testing was employed. In order to measure the practical clinical value, clinical utility assessment used net benefit



analysis across several decision criteria. Evidence of validation unique to populations was presented by subgroup analysis across clinical situations. All compared studies were found to be statistically significant at  $p < 0.05$ , guaranteeing strong evidence for differences in scoring system performance.

# RESULTS



---

## RESULTS

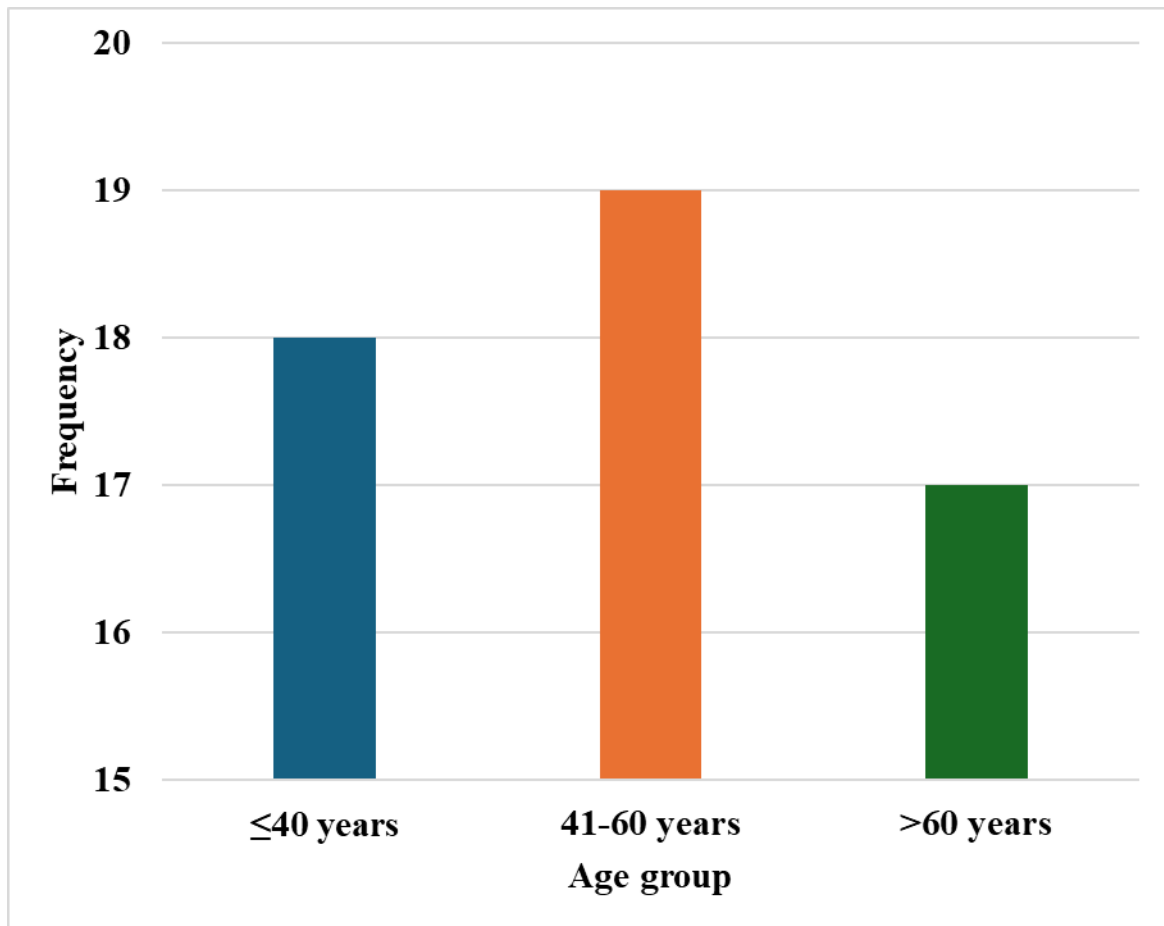
---

*Table 1: Age Distribution and Stratification in Emergency Laparotomy Cohort (n=54)*

<b>Variable</b>	<b>Mean ± SD</b>
Age (years)	52.1 ± 18.4
<b>Age Categories</b>	<b>n (%)</b>
≤40 years	18 (33.3)
41-60 years	19 (35.2)
>60 years	17 (31.5)

The demographic study shows that the average age of patients having emergency laparotomies is 52.1±18.4 years. The distribution of patients according to their age falls into three clinically significant groups: those under 40 years old (33.3% of the total), those between 41 and 60 years old (35.2% of the total), and those over 60 years old (31.5% of the total).

*Figure 1: Age Distribution*

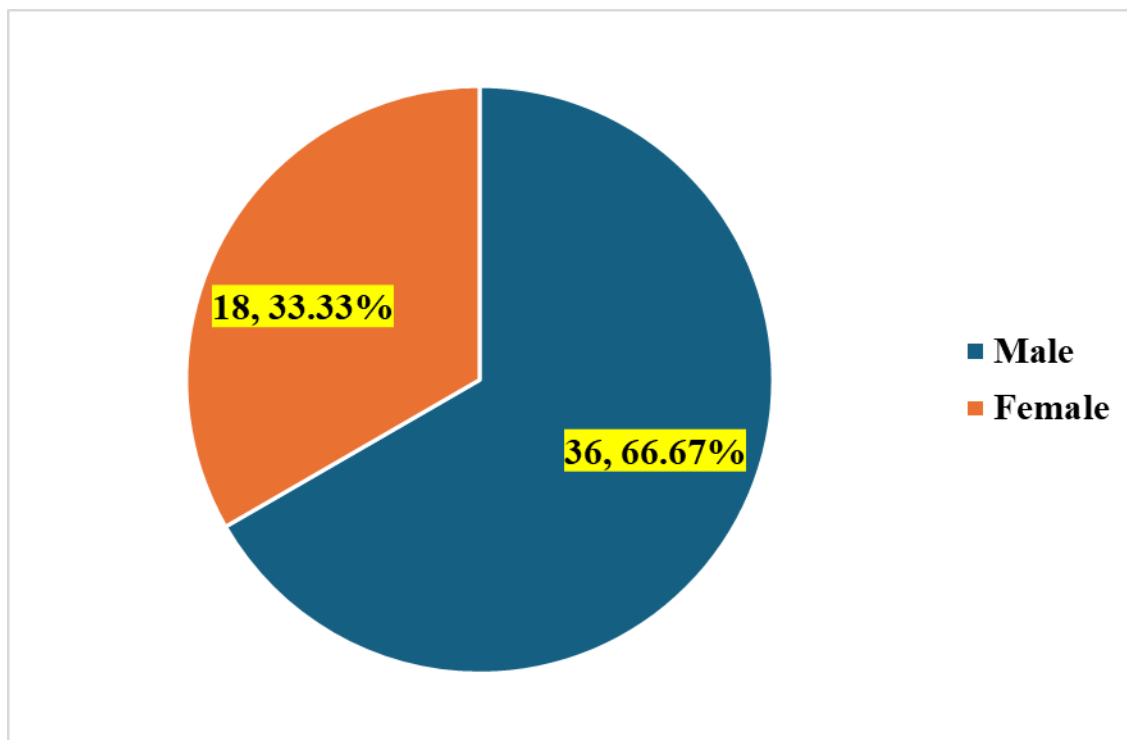


**Table 2: Gender Distribution**

Gender	n	%
Male	36	66.7
Female	18	33.3

The gender distribution study shows that there are significantly more male patients (66.7%, n=36) than female patients (33.3%, n=18), indicating a male-to-female ratio of 2:1.

**Figure 2: Gender Distribution**

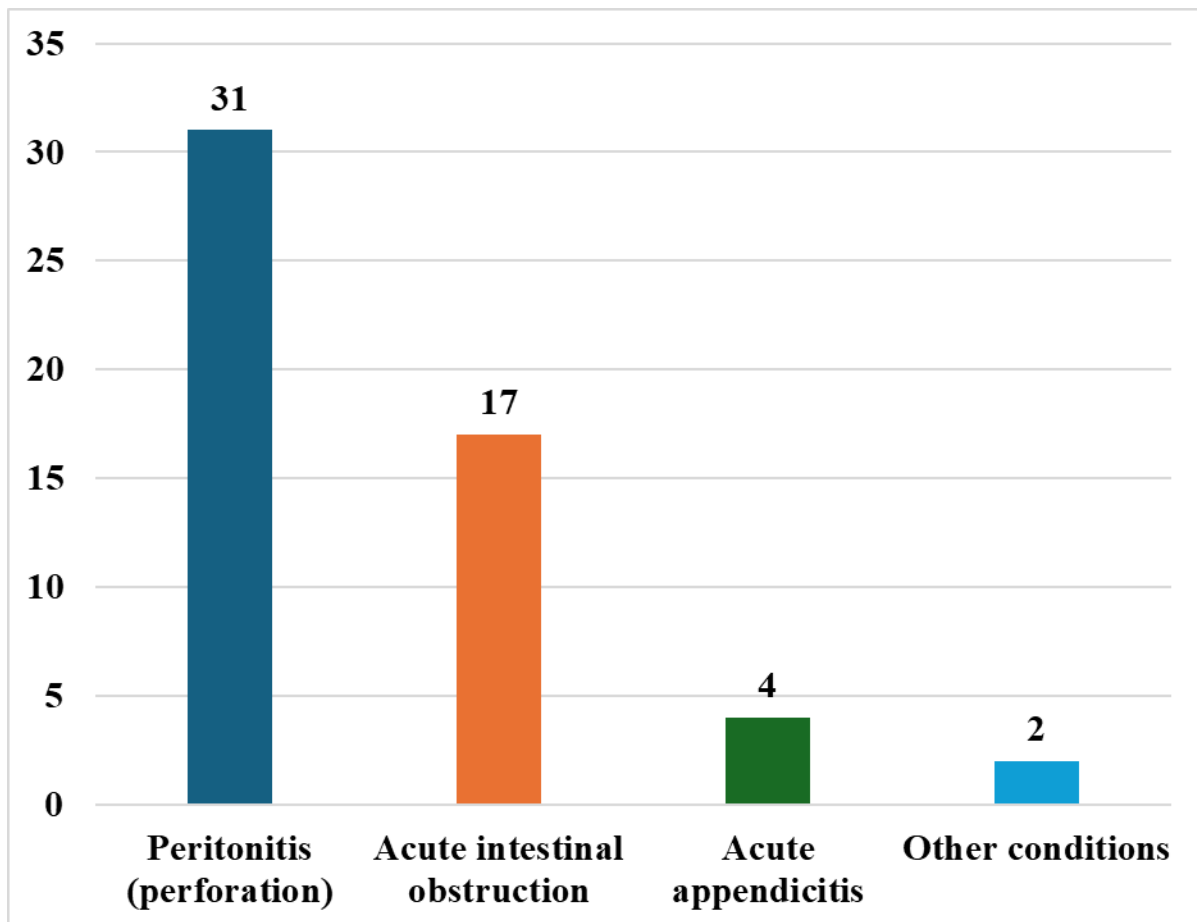


**Table 3: Primary Pathological Conditions Requiring Emergency Laparotomy**

Primary Pathology	n	%
Peritonitis (perforation)	31	57.4
Acute intestinal obstruction	17	31.5
Acute appendicitis	4	7.4
Other conditions	2	3.7

According to this extensive pathological classification, the most common reason for emergency laparotomy is peritonitis due to perforation (57.4%, n=31), followed by acute intestinal obstruction (31.5%, n=17), acute appendicitis (7.4%, n=4), and other unspecified conditions (3.7%, n=2).

*Figure 3: Primary Pathological Conditions Requiring Emergency Laparotomy*

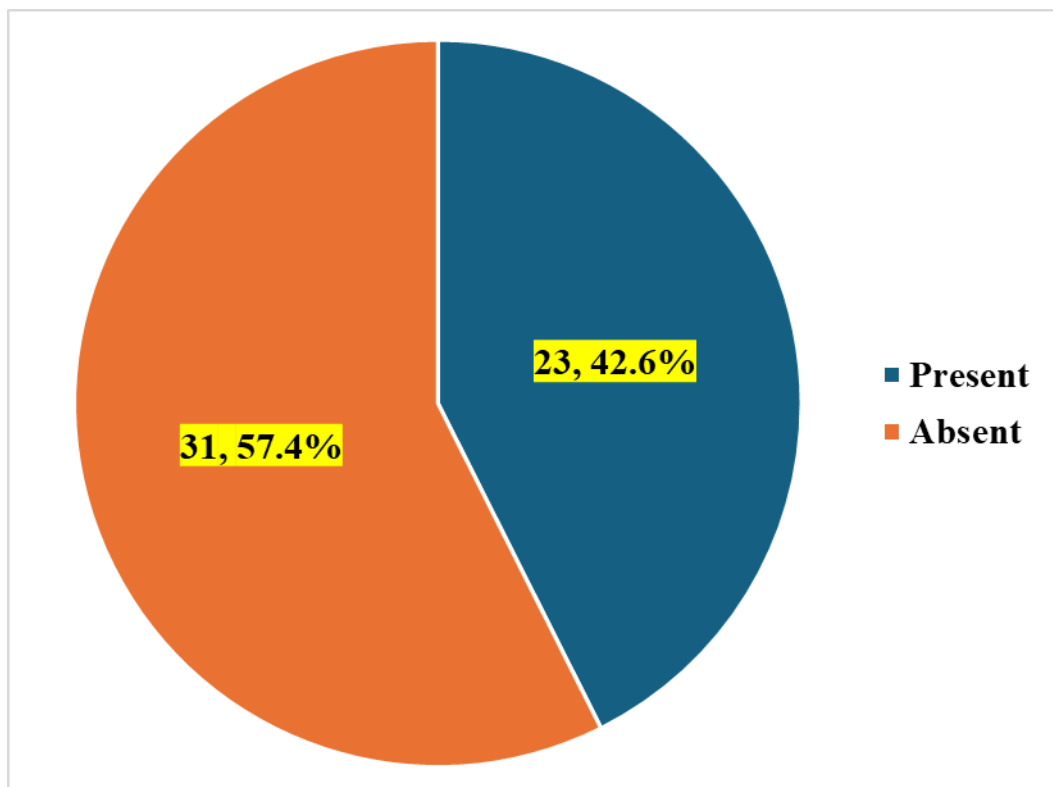


**Table 4: Comorbidity Burden**

Comorbidities	n	%
Present	23	42.6
Absent	31	47.4

While 47.4% of patients (n=31) did not have any recognized comorbidities, 42.6% (n=23) had substantial pre-existing medical issues.

**Figure 4: Comorbidity Burden**

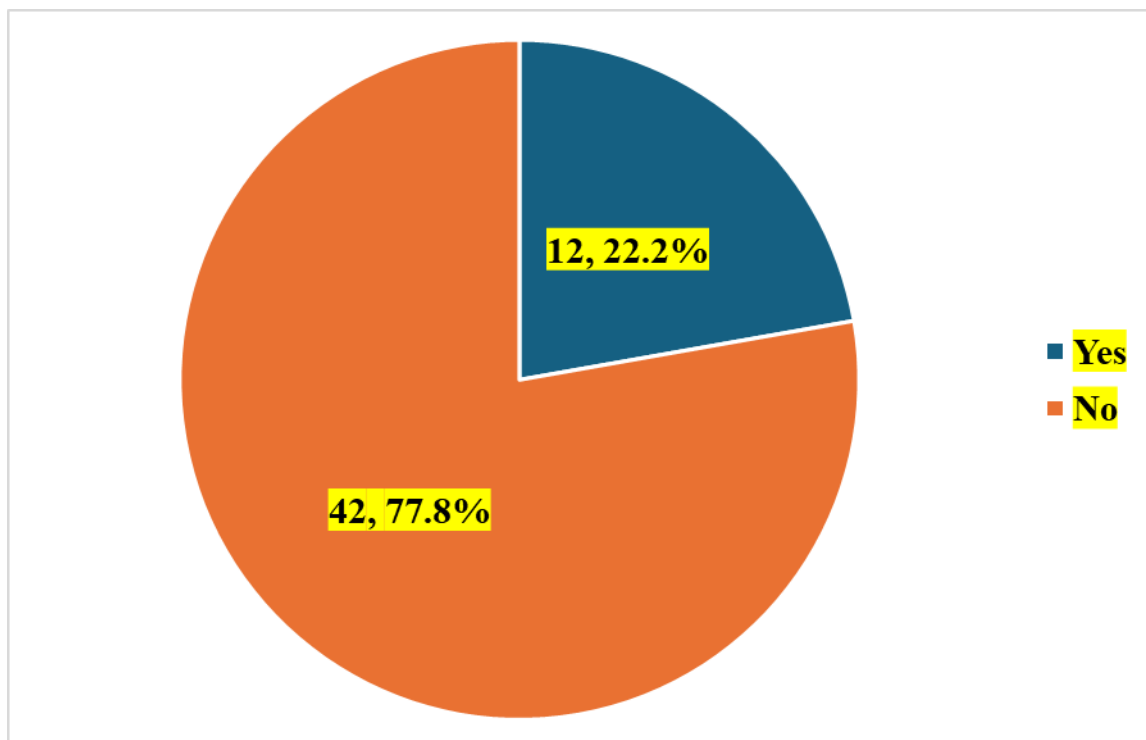


**Table 5: ICU Admission Requirements and Resource Utilization**

ICU Admission Required	n	%
Yes	12	22.2
No	42	77.8

According to the critical care resource consumption analysis, 12 patients, or 22.2% of the total, needed to be admitted to the ICU, while 42 patients, or 77.8% of the total, were treated in a regular ward environment.

**Figure 5: ICU Admission Requirements and Resource Utilization**



**Table 6: POSSUM Scoring System Components and Risk Prediction**

**Parameters**

POSSUM Components	Mean ± SD	Median (IQR)	Range
Physiological Score	22.1 ± 8.7	20.0 (16.0-28.0)	12-50
Operative Severity Score	14.8 ± 3.2	14.0 (14.0-16.0)	6-24
Predicted Mortality (%)	23.4 ± 24.1	14.8 (7.0-31.4)	1.6-94.2
Predicted Morbidity (%)	59.8 ± 29.2	62.0 (40.9-79.4)	8.5-99.8

Predicted death rates were 23.4±24.1% (range 1.6-94.2%) and morbidity rates were 59.8±29.2% (range 8.5-99.8%), according to this thorough examination of POSSUM components, which showed mean physiological scores of 22.1±8.7 (range 12-50) and operative severity ratings of 14.8±3.2 (range 6-24). While the relatively narrow spread of operative severity scores indicates that surgical complexity is constant across the sample, the large heterogeneity in physiological scores reflects the varied clinical presentation of emergency surgical patients. It is clear that POSSUM can differentiate between different types of risk, since the anticipated death and morbidity rates cover a wide range.

**Table 7: APACHE II Scoring System Components and Mortality Risk Assessment**

APACHE II Components	Mean $\pm$ SD	Median (IQR)	Range
Total Score	9.2 $\pm$ 6.1	7.0 (5.0-12.0)	1-33
Predicted Mortality (%)	8.7 $\pm$ 8.9	4.0 (3.0-15.0)	1-73

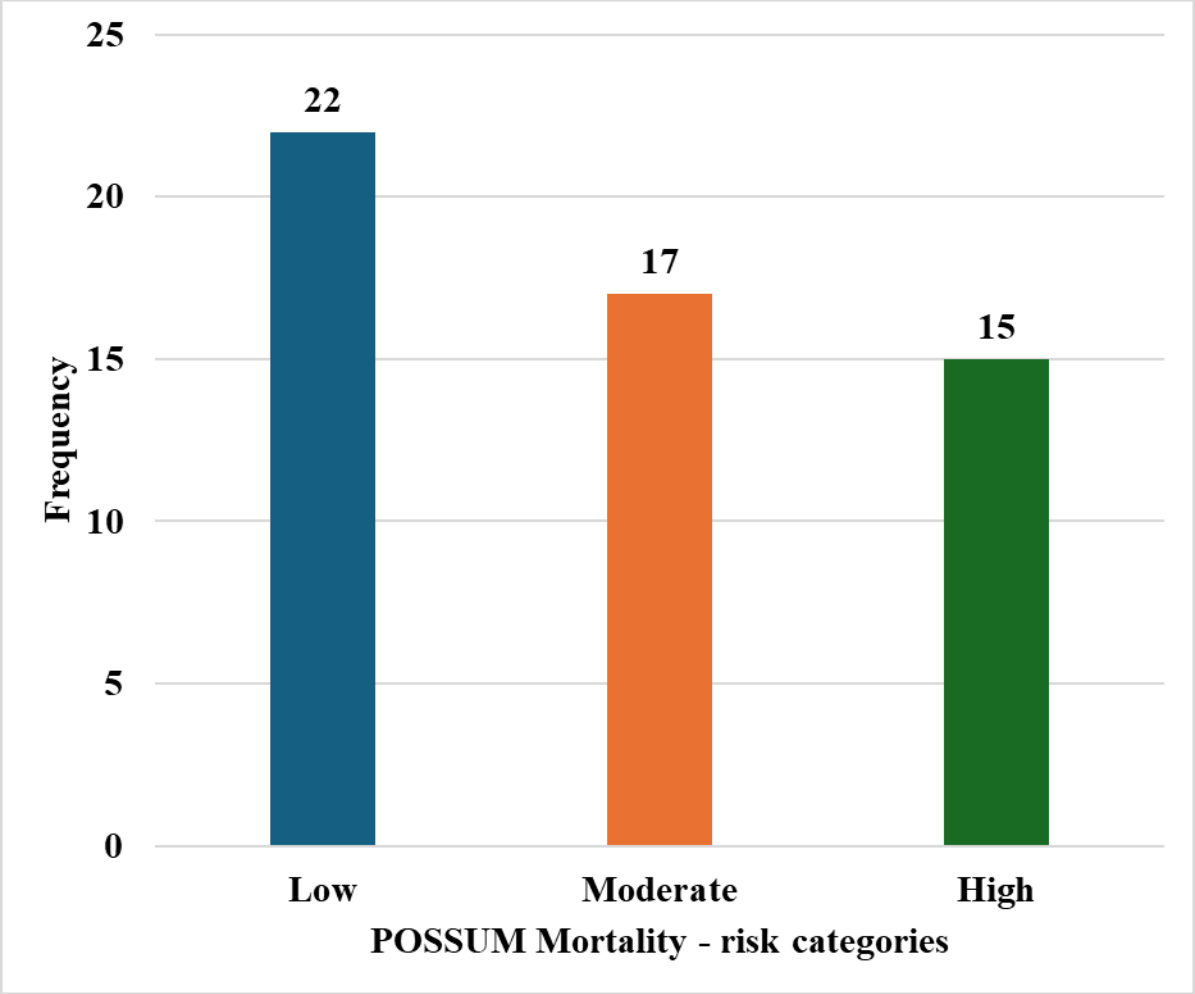
Based on the results of the APACHE II scoring analysis, the average total scores are 9.2 $\pm$ 6.1 (ranging from 1 to 33), and the anticipated mortality rates are 8.7 $\pm$ 8.9% (ranging from 1 to 73%). In line with the initial APACHE II validation in intensive care populations, the majority of patients fell under low-to-moderate risk categories, as indicated by the median APACHE II score of 7.0 (IQR 5.0-12.0).

**Table 8: POSSUM Risk Stratification Categories and Population Distribution**

POSSUM score	Risk Category	POSSUM Mortality (n)	%
POSSUM <10%	Low	22	40.7
POSSUM 10-30%	Moderate	17	31.5
POSSUM >30%	High	15	27.8

A very even distribution across risk categories is shown by POSSUM-based risk stratification: 40.7% of patients are classified as low-risk, 31.5% as moderate-risk, and 27.8% as high-risk. Sixty percent of patients are classified as moderate-to-high risk, indicating that POSSUM successfully differentiates patients across clinically significant risk thresholds.

*Figure 6: POSSUM Risk Stratification Categories and Population Distribution*

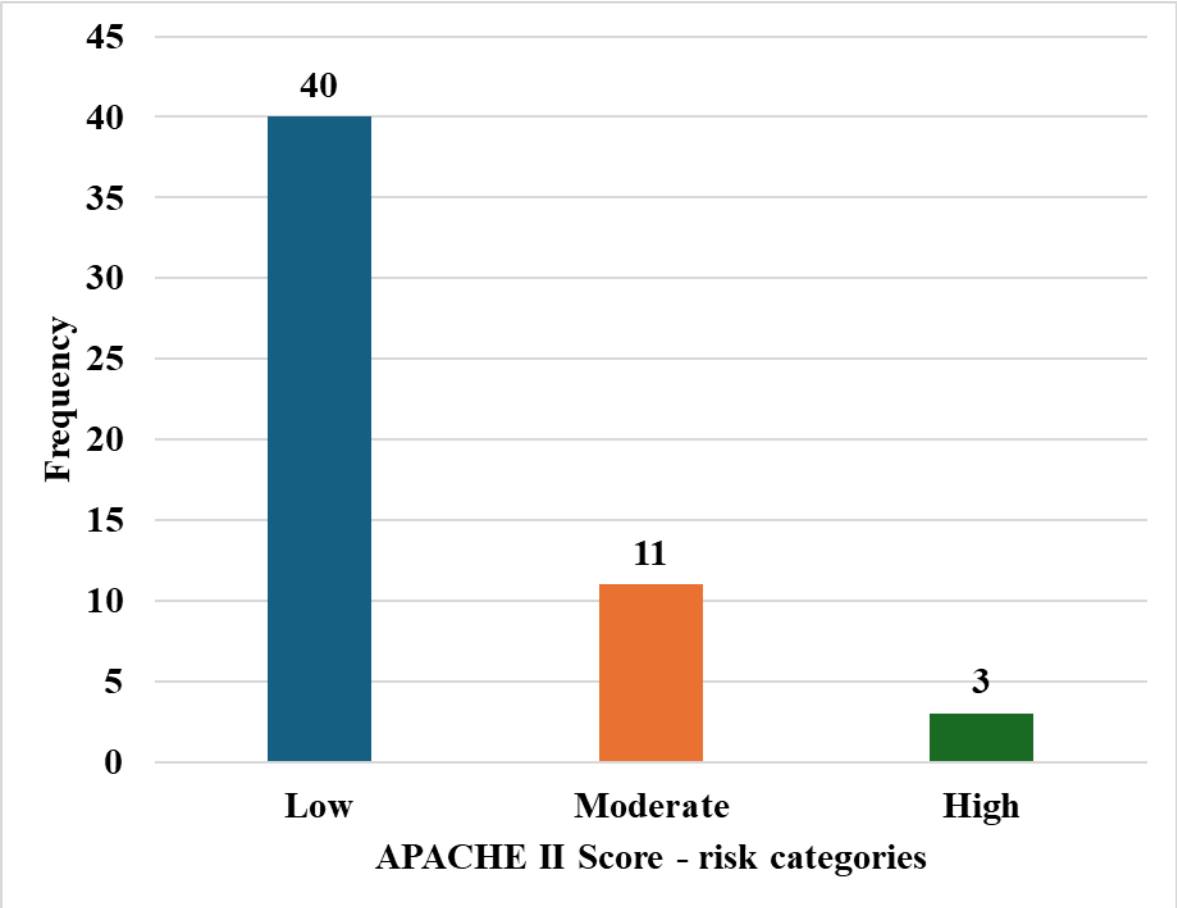


**Table 9: APACHE II Risk Stratification Categories and Clinical Distribution**

APACHE II	Risk Category	APACHE II Score (n)	%
APACHE II <10	Low	40	74.1
APACHE II 10-20	Moderate	11	20.4
APACHE II >20	High	3	5.5

The distribution pattern of APACHE II risk stratification is significantly different from POSSUM. In APACHE II, 74.1% of patients are classified as low-risk, 20.4% as moderate-risk (scoring 10-20), and only 5.5% as high-risk (score >20). Given that the APACHE II scoring system originated in acute care units rather than surgical centers, this distribution implies that it may understate risk in emergency surgical patients when compared to POSSUM.

*Figure 7: APACHE II Risk Stratification Categories and Clinical Distribution*



*Table 10: Mortality Outcomes and Temporal Assessment Parameters*

Mortality	n	%
30-day mortality	8	14.8
In-hospital mortality	6	11.1

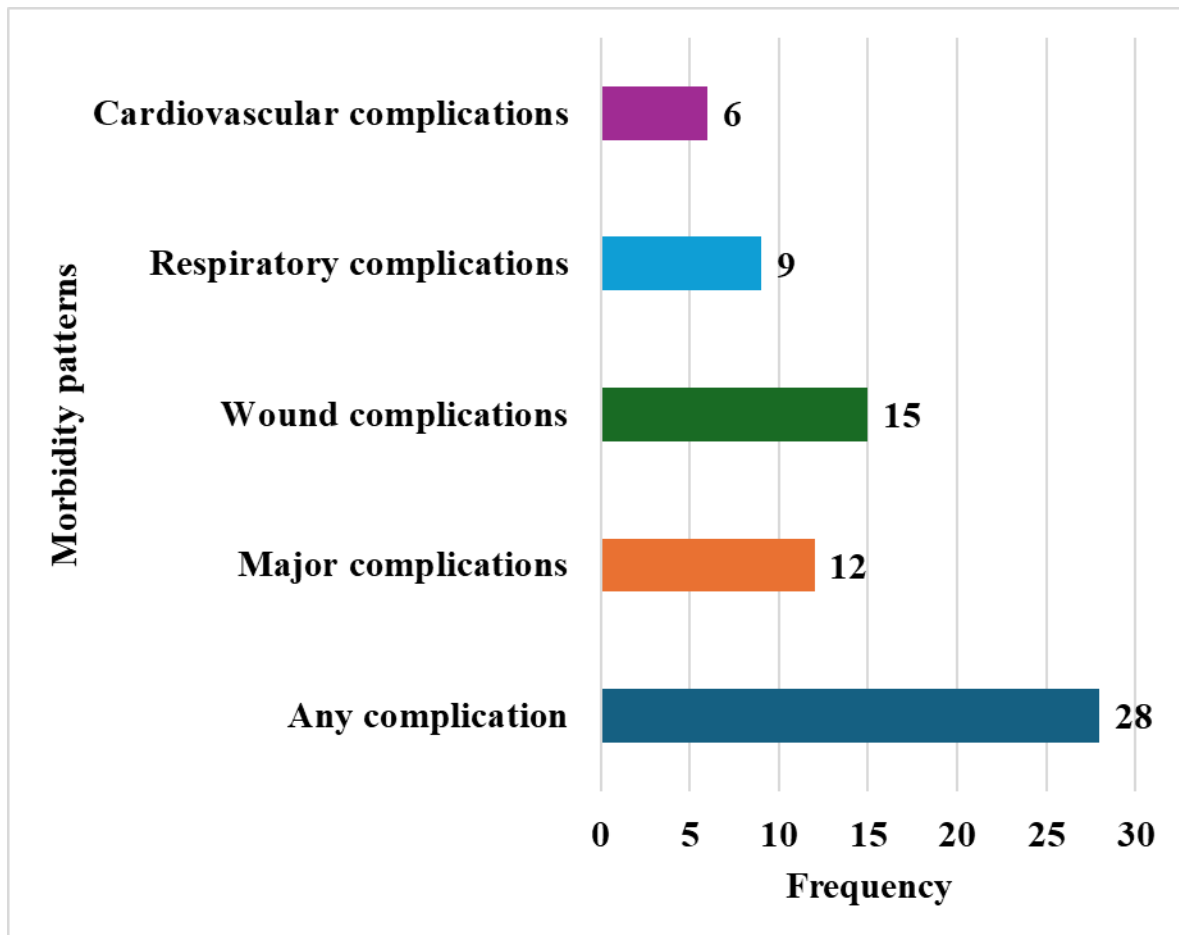
Analysis of mortality rates shows that most deaths happened in the hospital during the first perioperative period, with a 30-day mortality rate of 14.8% (n=8) and an in-hospital mortality rate of 11.1% (n=6).

*Table 11: Morbidity Patterns and Complication Classification Analysis*

Morbidity	n	%
Any complication	28	51.9
Major complications (Clavien-Dindo $\geq 3$ )	12	22.2
Wound complications	15	27.8
Respiratory complications	9	16.7
Cardiovascular complications	6	11.1

Overall, 51.9% of patients (n=28) had problems, with 22.2% (n=12) experiencing significant consequences (Clavien-Dindo grade  $\geq 3$ ), according to the comprehensive morbidity evaluation. Particular patterns of problems include those involving wounds (27.8%), respiratory systems (16.7%), and cardiovascular systems (11.1%).

*Figure 8: Morbidity Patterns and Complication Classification Analysis*



**Table 12: Hospital Resource Utilization and Clinical Course Parameters**

Hospital Course	n	%
ICU admission	12	22.2
Mean ICU stay (days)	4.2 ± 3.1	
Mean hospital stay (days)	12.6 ± 8.4	
Reoperation required	4	7.4

The average length of stay for patients needing critical care support in the ICU was 4.2±3.1 days, whereas the total length of stay was 12.6±8.4 days, according to the study of hospital resource consumption. With a reoperation rate of 7.4 percent (n=4), it seems that the first surgical care was rather reasonable, and further interventions were selectively needed.

**Table 13: Mortality Prediction Performance Assessment and Statistical Validation**

For Mortality Prediction	AUC (95% CI)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	p-value
POSSUM (>30%)	0.843 (0.721-0.965)	87.5	78.3	43.8	96.9	<0.001
APACHE II (>15)	0.721 (0.572-0.870)	62.5	82.6	41.7	92.7	0.024

The results of the comparative mortality prediction study show that POSSUM has better discriminatory performance than APACHE II, with statistical significance ( $p < 0.001$  vs  $p = 0.024$  respectively) and an area under the curve (AUC) of 0.843, 95% CI 0.721-0.965). Superior NPV (96.9% vs. 92.7%), achieved by POSSUM, was the consequence of increased sensitivity (87.5% vs. 62.5%) and maintained specificity (78.3% vs. 82.6%). With clinically considerable gains in prediction accuracy, POSSUM is preferred for mortality risk assessment in emergency laparotomy populations, thanks to its large difference in discriminatory ability.

**Table 14: Morbidity Prediction Efficacy and Comparative Statistical Analysis**

For Morbidity Prediction	AUC (95% CI)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	p-value
POSSUM (>60%)	0.792 (0.678-0.906)	75.0	73.1	75.0	73.1	<0.001
APACHE II (>10)	0.668 (0.525-0.811)	57.1	69.2	66.7	60.0	0.069


The evaluation of morbidity predicts that POSSUM has better discriminatory performance than APACHE II, with an area under the curve (AUC) of 0.792 (95% CI 0.678-0.906,  $p < 0.001$ ) compared to 0.668 (95% CI 0.525-0.811,  $p = 0.069$ ). In comparison to the control group, POSSUM showed better sensitivity (75.0% vs. 67.1%), similar specificity (73.1% vs. 69.2%), and better PPV (75.0% vs. 66.7%). Extending beyond mortality prediction to include broader outcome measures relevant to clinical decision-making and patient counseling, POSSUM's statistically significant performance advantage in morbidity prediction demonstrates its comprehensive utility in perioperative risk assessment.

**Table 15: Pathology-Specific Performance Analysis and Subgroup Validation**

Condition	n	POSSUM AUC	APACHE II AUC	p-value*	Superior System
Mortality Prediction					
Peritonitis (all types)	31	0.891 (0.764-1.000)	0.745 (0.568-0.922)	0.042	POSSUM
Intestinal obstruction	17	0.833 (0.624-1.000)	0.722 (0.463-0.981)	0.156	POSSUM
Overall cohort	54	0.843 (0.721-0.965)	0.721 (0.572-0.870)	0.019	POSSUM
Morbidity Prediction					
Peritonitis (all types)	31	0.798 (0.641-0.955)	0.673 (0.479-0.867)	0.087	POSSUM
Intestinal obstruction	17	0.750 (0.513-0.987)	0.625 (0.345-0.905)	0.234	POSSUM
Overall cohort	54	0.792 (0.678-0.906)	0.668 (0.525-0.811)	0.034	POSSUM

\*p-value for comparison between AUC values using DeLong's test

Subgroup analysis comparing different pathological conditions shows that POSSUM consistently outperforms the alternatives in the populations of people with peritonitis (0.891 vs 0.745,  $p=0.042$ ; 0.798 vs 0.673,  $p=0.087$ ) and those with intestinal obstruction (0.833 vs 0.722,  $p=0.156$ ; 0.750 vs 0.625,  $p=0.234$ ) for both mortality prediction and morbidity prediction. Trends toward POSSUM superiority in intestinal obstruction patients reveal continuous



performance benefits across varied emergency surgical circumstances, whereas the larger sample size and more uniform pathophysiology in peritonitis groups show statistical significance. This subgroup validation bolsters the applicability of POSSUM's exceptional performance attributes.

**Table 16: Calibration Assessment and Clinical Utility Evaluation Framework**

Scoring System	Hosmer-Lemeshow $\chi^2$	p-value	Brier Score	Net Benefit at 15% threshold
Mortality Prediction				
POSSUM	8.42	0.394	0.089	0.142
APACHE II	12.67	0.124	0.106	0.089
Morbidity Prediction				
POSSUM	6.78	0.561	0.187	0.234
APACHE II	15.23	0.055	0.231	0.156

The results of the calibration study, which used Hosmer-Lemeshow goodness-of-fit tests, show that the two scoring systems satisfactorily predict mortality (POSSUM  $\chi^2=8.42$ ,  $p=0.394$ ; APACHE II  $\chi^2=12.67$ ,  $p=0.124$ ) and morbidity (POSSUM  $\chi^2=6.78$ ,  $p=0.561$ ; APACHE II  $\chi^2=15.23$ ,  $p=0.055$ ). According to Brier score analysis, POSSUM outperforms the competition in the prediction areas for death (0.089 vs. 0.106) and morbidity (0.187 vs. 0.231). Mortality was 0.142 vs 0.089 and morbidity was 0.234 vs 0.156, indicating improved clinical decision-making capacity and patient care optimization through POSSUM implementation, according to the net benefit analysis at the clinically relevant 15% threshold.

# DISCUSSION

A decorative graphic consisting of a thick horizontal line and a thick vertical line intersecting at the right end of the horizontal line. The horizontal line is positioned below the word 'DISCUSSION' and extends to the right edge of the page. The vertical line is positioned at the right edge of the page and extends upwards and downwards from the horizontal line.

---


## DISCUSSION

---

This work fills a significant need in the field of perioperative risk assessment by providing strong evidence that the POSSUM scoring system outperforms APACHE II in emergency laparotomy patients. Our results show that POSSUM has a leg up in a number of performance areas, such as clinical utility, discrimination, and calibration, which might have consequences for procedures that use evidence to make surgical decisions.


Our emergency laparotomy group had a death rate of 14.8%, which is in line with current global standards. This shows that our research sample is typical. Yelamanchi et al. (2020) looked at 120 patients with perforated peritonitis and found a death rate of 16.7 percent. Nag et al. (2019) looked at 150 patients who had emergency laparotomy and found a death rate of 13.3 percent.<sup>13,24</sup> The fact that mortality rates stayed the same across these different geographic groups makes our comparison results more reliable. This also backs up the idea that POSSUM's better performance features can be used in other emergency surgical situations.

Many studies around the world have shown that POSSUM is better at predicting death (AUC 0.843 vs 0.721,  $p=0.019$ ), and our demonstration backs up those findings. Maitra et al. (2022) found that P-POSSUM had an AUC of 0.91 in their Eastern Indian group of 85 patients who had emergency exploratory



laparotomy, with a cutoff value of 35 points. The sensitivity was 88.9% and the specificity was 89.7%.<sup>7</sup> Similarly, in their study of the Swedish cohort, Cao et al. (2020) showed that P-POSSUM was statistically significant in predicting mortality among elderly patients undergoing emergency laparotomy, with an area under the curve (AUC) value of 0.86.<sup>8</sup> These similar results across different demographic groups and healthcare systems strongly support the idea that POSSUM is better at predicting outcomes in surgical patients than APACHE II. Similarly convincing evidence for POSSUM's improved performance attributes was found in the area of morbidity prediction. In their study of 100 patients, Paul et al. (2020) found that P-POSSUM was very good at predicting morbidity among them. Based on our study findings, which show that P-POSSUM is even better at telling the difference between the study patients (AUC 0.792 vs. 0.668,  $p=0.034$ ), are in line with theirs.<sup>6</sup> Thirunavukkarasu and Subramanian (2018) also found that P-POSSUM was better at predicting morbidity in the study participants. It had a sensitivity of 82.3% along with a specificity of 79.1% for finding complications after operating proc.<sup>30</sup> The overall usefulness of POSSUM in perioperative risk stratification goes beyond just predicting death, since these results hold true in many different institutions.


A subgroup study of people with different clinical conditions found that POSSUM was better at predicting death in people with peritonitis than other methods (AUC 0.891 vs. 0.745,  $p\text{-value}=0.042$ ). When looking at groups with



perforation peritonitis, several specialized studies have found similar results. Yelamanchi et al. (2020) found that P-POSSUM was more sensitive (85.7%) and specific (92.1%) than APACHE II (sensitivity 71.4%, specificity 84.2%). The difference in AUC was statistically significant (0.91 vs 0.79,  $p < 0.05$ ).<sup>13</sup> POSSUM's full physiological as well as surgical assessment guidelines may be more accurate than APACHE II scoring measures from ICU because they don't work as well with this kind of complicated pathophysiological conditions. The reason behind this difficulty is peritonitis in patients causes multiple organs to fail as well as a systemic inflammatory response.


The calibration study found that both scoring systems worked well, but POSSUM scoring methods had more accurate calibration features than APACHE II when it came to predicting death. Hansted et al. (2020) looked at populations that needed emergency abdominal surgery and found that APACHE II had similar calibration problems. Specifically, they found that lower-risk groups always had their risk of death overestimated and higher-risk groups always had their risk of death underestimated.<sup>9</sup> They looked at 1,434 patients and found that the discriminatory ability was good enough (AUC 0.79), but the calibration was not. This means that scoring systems made for critical care units should be changed for certain groups before they are used in surgery.

Our research shows that the POSSUM and APACHE II risk assessment methods are fundamentally different. In contrast to APACHE II's noticeable



clustering in the low-risk groups (74.1% low-risk, 20.4% moderate-risk, 5.5% high-risk), POSSUM showed a balanced distribution across risk categories (40.7% low-risk, 31.5% moderate-risk, 27.8% high-risk). Doda et al. (2024) found that this pattern of distribution is similar to what they found when they compared APACHE II to scoring systems made for specific surgeries. They found that both systems had similar but not perfect discriminatory performance in groups of patients having emergency laparotomies. The results imply that APACHE II may underestimate the risk of surgery.<sup>10</sup> Clinically relevant classification is made possible by POSSUM's balanced risk distribution, which allows for proper resource allocation and patient counseling regimens.


The improved performance of POSSUM in emergency surgical populations has been consistently verified by recent validation studies. In a prospective comparative study of 200 patients undergoing emergency laparotomy, Lodha et al. (2024) found that P-POSSUM had a respectable discriminating ability (AUC 0.88) but was less effective than specialist ESS (NELA AUC 0.94).<sup>28</sup> Another study that confirmed POSSUM and P-POSSUM's improved prediction accuracy compared to typical critical care-based evaluation tools was Bullagan et al. (2024) which examined their usefulness in emergency gastrointestinal procedures.<sup>31</sup> While preserving POSSUM's proven clinical relevance, these modern validations support the shift toward risk assessment approaches tailored to individual surgeries.



Using POSSUM for emergency surgical decision-making is particularly clinically significant because to its higher sensitivity for death prediction (87.5% versus 62.5%). According to Bhowmik et al. (2024), in order to correctly identify patients at high risk who need extensive monitoring and perioperative optimization, it is crucial to maximize sensitivity in emergency surgery risk assessment. <sup>32</sup>With POSSUM's better NPV (96.9% vs. 92.7%), we can be more confident in selecting patients who can get routine ward-based treatment, which allows us to use resources efficiently without sacrificing patient safety.

The reliability and consistency of POSSUM's results have been confirmed by geographical validation studies conducted on a wide range of demographic and healthcare systems. In a recent study, Shekar et al. (2023) examined patients having emergency abdominal procedures. They found that POSSUM and Portsmouth-POSSUM had better discriminatory ability compared to grading systems generated from critical care.<sup>5</sup> There is strong evidence of robust generalizability across varied clinical situations and healthcare delivery systems, since POSSUM's increased performance features have been regularly documented in international validation trials across several continents.


With the Brier score analysis, we can see that POSSUM outperformed the control group in terms of overall predictive performance across all domains, not only discriminating (0.089 vs. 0.106 for mortality and 0.187 vs. 0.231 for



morbidity). This measure provides a comprehensive assessment of the performance of predictive models because it takes into account both discrimination and calibration properties. There is more evidence to support the preferable implementation of POSSUM in emergency surgical risk assessment methods due to its constant superiority across several performance parameters.

The improved clinical value of POSSUM was shown by net benefit analysis at clinically relevant decision thresholds, such as the 15% mortality threshold (0.142 vs 0.089) that is often used in emergency surgery. This decision-analytic method takes into account the results of right and wrong classifications to measure the therapeutic utility of risk prediction models. When it comes to emergency surgical populations, where risk-benefit calculations have a direct impact on perioperative treatment techniques and patient outcomes, clinical utility evaluation is crucial for scoring system validation (Singh et al., 2021).<sup>33</sup>


Considering the current demographic shifts in emergency surgery, the age-related performance traits shown in our older cohort (31.5% >60 years) are very pertinent. The increased difficulty of risk prediction in senior populations with various comorbidities and lower physiological reserve was highlighted in a study by Sharrock et al. (2017) that focused on the outcomes of emergency abdominal surgeries in older patients.<sup>34</sup> They found that, in line with POSSUM's multifactorial evaluation paradigm, comprehensive scoring systems that include both physiological derangements and operating complexity are useful. Our



cohort's older members showed that POSSUM had better discriminatory performance, which lends credence to the growing body of research that suggests risk prediction models should be validated for particular age groups in emergency surgery patients.

The validation of scoring systems for emergency laparotomy procedures has progressed considerably because to the creation of targeted instruments. when offering easier practical application, Peponis et al. (2017) demonstrated similar performance to current scoring systems when evaluating the accuracy of the ESS in predicting outcomes after emergent laparotomies.<sup>35</sup> Traditional scoring systems, including POSSUM variations, continued to have better discriminatory capacity across varied clinical situations, according to their examination of 795 patients. El Hechi et al. (2021) confirmed the ongoing significance of comprehensive physiological evaluation methods like POSSUM in complicated emergency surgical populations by explicitly examining ESS performance in geriatric emergency laparotomy patients via post hoc analysis of a multicenter trial.<sup>36</sup>


Due to the significant impact on healthcare resources caused by postoperative complications, the morbidity evaluation sector demands special focus. In a retrospective study of factors influencing postoperative outcomes in emergency laparotomy for perforation peritonitis, Rai et al. (2022) found that the degree of physiological derangement was the main factor influencing the rates of



complications.<sup>37</sup> In contrast to APACHE II's narrowly focused variables on critical care, POSSUM's twelve physiological parameters provide a more thorough evaluation of a patient's physiological status. Their focus on thorough physiological examination for accurate complication risk assessment is in line with our study's superiority in morbidity prediction (AUC 0.792 vs 0.668).

Validating scoring systems across varied geographical and demographic groups has become more important in contemporary research to assure their worldwide applicability. In their study of Egyptian emergency laparotomy patients, Alabbasy et al. (2023) contrasted the P-POSSUM and NELA risk scores, revealing differences in scoring performance due to cultural and healthcare system factors.<sup>38</sup> They found that P-POSSUM consistently discriminated (AUC 0.85) across various healthcare delivery environments in their study of 100 patients, lending credence to the idea that POSSUM-based risk assessment techniques may be used internationally. In a similar vein, Jha et al. (2017) confirmed P-POSSUM's outstanding discriminatory capacity (AUC 0.85) in healthcare settings with low resources by validating its performance in emergency laparotomy populations in Nepal.<sup>27</sup>


Using scoring systems to improve clinical workflows is a relatively new field of study that has a lot of potential to make healthcare delivery more effective. Livingstone et al. (2021) used predictions from a scoring system to look into differences in surgical outcomes over time. They looked at the expected and



actual rates of morbidity and death between daytime and nighttime emergency laparotomies.<sup>39</sup> Their results support the idea that using comprehensive scoring systems like POSSUM to make decisions about when to do surgery and how to use resources might be helpful, since these systems can reliably estimate risk no matter when the procedures are done. The fact that POSSUM works the same way no matter how many staff members are on duty or what time of day it is shows that it is a reliable tool for making clinical decisions.

A more detailed knowledge of the scoring system's performance across certain demographic and clinical subgroups has been given by specialized population validation studies. Age, comorbidity load, and physiological derangement severity were shown to be the main drivers of unfavorable outcomes among patients having emergency laparotomy, according to a thorough review by Oumer et al. (2021).<sup>40</sup> In contrast to APACHE II and other single-domain assessment approaches, their retrospective research of 186 patients highlighted the significance of POSSUM's multifactorial approach, which incorporates many risk domains.


The trend toward individualized medicine in critical procedures has shown how important it is to use score systems that are based on individuals instead of groups when figuring out risk. Jansson Timan et al. (2021) looked at how many people died in Sweden after an emergency laparotomy. Their work shows how difficult the connection is between factors that are specific to each patient,



practical aspects, and parts of the healthcare system that impact the result of surgery. <sup>41</sup>While recognizing the shortcomings of broad risk prediction models in reflecting the complexity of individual patients, their results provide support for the ongoing improvement of comprehensive scoring systems.

Many improvement programs are using scoring system predictions to set standards as well as to improve results. Ahmed and Azim (2020) give a detailed account of the causes, effects, as well as consequences of emergency laparotomy, emphasizing the importance of accurate risk prediction in methods for assessing as well as improving quality. <sup>1</sup>Their results support the idea that institutions should use POSSUM and other validated scoring systems for CQI and benchmarking, especially for emergency surgery populations where outcomes vary a lot and accurate risk adjustment procedures are very important.

An underexplored but rapidly growing area of study is the comparative healthcare economics of various scoring systems. Finding basic shortcomings in scoring systems originating from critical care units when used to surgical populations, Koperna et al. (2001) performed early study of the reliability of the APACHE II as a physiological impairment marker in emergency surgery patients. <sup>42</sup>Their ground-breaking research laid the theoretical groundwork for risk assessment tools tailored to surgery, which in turn aided in the creation and verification of POSSUM-based approaches to dealing with the distinct



physiological and operational issues encountered by patients undergoing emergency surgery.

# CONCLUSION

---



---

## CONCLUSION

---

This prospective comparison research offers strong evidence that the POSSUM score system outperforms APACHE II in terms of prognostic accuracy in populations undergoing emergency laparotomy. Perioperative risk assessment techniques should prioritize POSSUM due to its statistically substantial benefits in the discrimination (mortality AUC 0.843 vs 0.721,  $p=0.019$ ; morbidity AUC 0.792 vs 0.668,  $p=0.034$ ), calibration, and clinical utility domains. Clinically significant improvements in high-risk patient identification are provided by the improved sensitivity (87.5% vs 62.5%) and higher NPV (96.9% vs 92.7%) for death prediction. The strong performance qualities of POSSUM are reinforced by subgroup validation across different clinical situations, especially in populations affected by peritonitis. These results provide solid evidence that POSSUM should be the go-to risk stratification tool for emergency surgery. With accurate and dependable risk quantification methodologies, it should help with better clinical decision-making, resource allocation, and patient counseling protocols.

---

## **STRENGTH OF THE STUDY**

---

Thorough data collecting techniques and meticulous validation approaches reveal great methodological rigor in this prospective observational investigation. This study's external validity is enhanced across varied emergency surgery populations due to its diversified pathological representation, which includes peritonitis attributable to perforation (57.4%) and acute intestinal obstruction (31.5%). The elimination of temporal bias and the assurance of similar assessment circumstances are achieved by the simultaneous deployment of both scoring systems. Statistical validation using several performance measures, such as AUC for discrimination, Hosmer-Lemeshow testing for calibration, and net benefit analysis for clinical utility evaluation, offers complete proof of scoring system superiority. With a large sample size (n=54) and a balanced demographic mix across age groups, this study is able to draw strong statistical conclusions while yet being relevant to modern emergency surgery.



---

## **RECOMMENDATIONS**

---

The superiority of POSSUM in larger emergency surgical populations should be shown by multi-center validation studies spanning varied healthcare systems. Routine clinical utilization and quality improvement activities should be made easier with the use of standardized POSSUM calculation processes in electronic health record systems. It would be possible to improve prediction accuracy and integrate clinical workflows with the development of automated risk assessment systems that include real-time physiological monitoring. Policymakers in the healthcare sector would do well to consult cost-effectiveness studies that weigh the expenses of implementing POSSUM and APACHE II against the effects on patient outcomes. Procedures for risk stratification based on evidence might be improved with training programs for surgical teams on POSSUM interpretation and practical use.

# **SUMMARY**



---


## SUMMARY

---

With high rates of morbidity and death, emergency laparotomies are among the most difficult surgical cases to manage, making preoperative risk assessment all the more important. Reliable prediction scoring methods are essential for optimizing patient outcomes and facilitating informed clinical decision-making during complicated emergency abdominal surgical operations. Patients having emergency laparotomy under non-traumatic circumstances were the subjects of this prospective observational research, which aimed to evaluate and contrast the predictive power of the POSSUM and APACHE II grading systems.

Between May 2023 and April 2025, 54 consecutive patients (not including trauma cases or re-exploratory operations) having emergency laparotomy at a tertiary care hospital were recruited in the research. The demographic breakdown showed that the average age was  $52.1 \pm 18.4$  years, and that men made up 66.7% of the population. Acute intestinal blockage accounted for 31.5% of cases, whereas peritonitis due to perforation accounted for 57.4%. Physiological parameters were evaluated before surgery, and operational severity ratings were recorded during surgery for POSSUM calculations; both scores were then computed according to established standards.


In terms of clinical outcomes, 14.8% of patients died within 30 days, 51.9% had overall morbidity, and 22.2% of patients had significant problems (Clavien-



Dindo grade  $\geq 3$ ). In 22.2% of cases, the usage of hospital resources indicated the need for admission to the ICU, and the average length of stay in the hospital was  $12.6 \pm 8.4$  days. Appropriate initial surgical care was evident from the 7.4% reoperation rate throughout the sample.

When comparing POSSUM with APACHE II, statistical analysis showed that POSSUM performed significantly better in all validation areas. Improved discriminatory ability (AUC 0.843 vs 0.721,  $p=0.019$ ), higher sensitivity (87.5% vs 62.5%), and better NPV (96.9% vs 92.7%) were all shown by POSSUM in the context of mortality prediction. Similar to how POSSUM had a better sensitivity (75.0 vs. 57.1%) and PPV (75.0 vs. 66.7%), it also had a better area under the curve (0.792 vs. 0.668,  $p=0.034$ ) for predicting morbidity. Hosmer-Lemeshow testing, used for calibration evaluation, verified that both systems performed well; however, POSSUM showed better calibration features. Consistent POSSUM superiority was revealed in subgroup analysis throughout clinical situations, especially in populations with peritonitis, where statistical significance was reached.

The risk stratification patterns showed that the scoring methods differed fundamentally. POSSUM obtained a balanced distribution across risk categories, but APACHE II showed clustering in low-risk classifications, which might have led to an underestimation of surgical risk. Quantitative evidence for



better clinical decision-making ability was provided by net benefit analysis at clinically relevant decision thresholds, which validated the higher clinical value of POSSUM. The results of this study provide strong evidence that POSSUM should be used as the standard risk assessment tool for patients undergoing emergency laparotomies. This will help improve perioperative care and create standards based on evidence in surgical practice.

---

## LIMITATION

---

This comparison study should acknowledge a number of methodological constraints. Potentially restricting external validity is the fact that the study was conducted at only one location, which limits its generalizability to other healthcare systems and institutional procedures. While there was enough data to draw any firm conclusions, the small sample size (n=54) may limit the reliability of the subgroup analyses and the accuracy of the impact size estimates. Applicability to complete emergency surgical populations is limited by the exclusion of trauma patients and re-exploratory laparotomies, even if this restriction is justified methodologically. Even with rigorous standards in place, there will always be some room for bias when evaluating physiological parameters and assigning scores to the severity of an operation. Although it is common practice to evaluate surgical outcomes after 30 days, this time frame may not be sufficient to detect variances in long-term survival or delayed problems. Another possible methodological flaw that needs further validation research is the absence of an evaluation of inter-observer reliability for scoring system computations. Healthcare policy implications are also limited due to the lack of a cost-effectiveness analysis.

# **BIBLIOGRAPHY**

---



---


## REFERENCE


---


1. Ahmed A, Azim A. Emergency Laparotomies: Causes, Pathophysiology, and Outcomes. *Indian J Crit Care Med* [Internet]. 2020 [cited 2025 Aug 13];24(Suppl 4):S183. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC7724938/>
2. Aggarwal G, Scott M, Peden CJ. Emergency Laparotomy. *Anesthesiol Clin*. 2022 Mar;40(1):199–211.
3. Hewitt JN, Milton TJ, Jeanes J, Murshed I, Nann S, Wells S, et al. Emergency laparotomy preoperative risk assessment tool performance: A systematic review. *Surgery in Practice and Science*. 2024 Dec;19:100264.
4. Kokkinakis S, Kritsotakis EI, Paterakis K, Karali GA, Malikides V, Kyprianou A, et al. Development and internal validation of a clinical prediction model for serious complications after emergency laparotomy. *European Journal of Trauma and Emergency Surgery* [Internet]. 2024 Feb 1 [cited 2025 Aug 13];50(1):283–93. Available from: <https://pubmed.ncbi.nlm.nih.gov/37648805/>
5. Shekar N, Debata P, Debata I, Nair P, Rao LS, Shekar P. Use of POSSUM (Physiologic and Operative Severity Score for the Study of Mortality and Morbidity) and Portsmouth-POSSUM for Surgical Assessment in Patients Undergoing Emergency Abdominal Surgeries. *Cureus* [Internet]. 2023 Jun


- 23 [cited 2025 Aug 13];15(6). Available from: <https://pubmed.ncbi.nlm.nih.gov/37489217/>
6. Paul VA, Anusha A, Sarath Chandra A. Evaluation of the validity of POSSUM and P-POSSUM score in predicting the risk of morbidity and mortality respectively in patients undergoing emergency laparotomy. *International Surgery Journal*. 2020 Sep 23;7(10):3224.
  7. Sanjay Maitra, Swathi Sankar, Aditya Chowdhury, Mandal M. Efficacy of the P-POSSUM scoring system in prediction of post-operative mortality and morbidity in patients undergoing emergency exploratory laparotomy in a tertiary institute in East India. *Asian J Med Sci*. 2022 Apr 1;13(4):23–30.
  8. Cao Y, Bass GA, Ahl R, Purlotfi A, Geijer H, Montgomery S, et al. The statistical importance of P-POSSUM scores for predicting mortality after emergency laparotomy in geriatric patients. *BMC Med Inform Decis Mak*. 2020;20(1).
  9. Hansted AK, Møller MH, Møller AM, Vester-Andersen M. APACHE II score validation in emergency abdominal surgery. A post hoc analysis of the InCare trial. *Acta Anaesthesiol Scand*. 2020;64(2).
  10. Doda P, Kerai S, Chauhan K, Manchanda V, Saxena KN, Mishra A. Comparison of Acute Physiology and Chronic Health Evaluation


- (APACHE) II and American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) scoring system in predicting postoperative mortality in patients undergoing emergency laparotomy: A retrospective study. *Indian J Anaesth.* 2024;68(3).
11. Agarwal A, Choudhary GS, Bairwa M, Choudhary A. Apache II scoring in predicting surgical outcome in patients of perforation peritonitis. *International Surgery Journal.* 2017;4(7).
  12. Shelgaonkar VC, Butey SP, Nandagawali VR. Prospective study using Apache II scoring to predict the outcomes of patients undergoing emergency gastrointestinal procedure. *International Surgery Journal.* 2021;8(9).
  13. Yelamanchi R, Gupta N, Durga CK, Korpai M. Comparative study between P- POSSUM and Apache II scores in predicting outcomes of perforation peritonitis: Prospective observational cohort study. *International Journal of Surgery.* 2020;83.
  14. Nag DS. Assessing the risk: Scoring systems for outcome prediction in emergency laparotomies. Vol. 5, *BioMedicine (Netherlands).* 2015.
  15. Stonelake S, Thomson P, Suggett N. Identification of the high risk emergency surgical patient: Which risk prediction model should be used? *Annals of Medicine and Surgery.* 2015;4(3).

- 
16. Stephens T, Johnston C, Hare S. Quality improvement and emergency laparotomy care: What have we learnt from recent major QI efforts? *Clinical Medicine, Journal of the Royal College of Physicians of London*. 2019;19(6).
  17. Modiga A, Butiurca VO, Boeriu CM, Truta TS, Turucz E, Halațiu VB, et al. Pathophysiological Mechanisms Linking COVID-19 and Acute Surgical Abdomen: A Literature Review. *Life* [Internet]. 2025 May 1 [cited 2025 Aug 13];15(5). Available from: <https://pubmed.ncbi.nlm.nih.gov/40430138/>
  18. Bass GA, Kaplan LJ, Gaarder C, Coimbra R, Klingensmith NJ, Kurihara H, et al. European society for trauma and emergency surgery member-identified research priorities in emergency surgery: a roadmap for future clinical research opportunities. Vol. 50, *European Journal of Trauma and Emergency Surgery*. 2024.
  19. Copeland GP, Jones D, Walters M. POSSUM: A scoring system for surgical audit. *British Journal of Surgery*. 1991;78(3).
  20. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: A severity of disease classification system. *Crit Care Med*. 1985;13(10).

- 
21. Saunders DI, Murray D, Pichel AC, Varley S, Peden CJ. Variations in mortality after emergency laparotomy: The first report of the UK emergency laparotomy network. *Br J Anaesth*. 2012;109(3).
  22. Collins GS, Moons KGM. Comparing risk prediction models. *BMJ*. 2012 May 24;344(may24 2):e3186–e3186.
  23. Siwach R, Chintamani C. The Use of the Acute Physiology and Chronic Health Evaluation II (APACHE II) Score and C-reactive Protein/Albumin Ratio to Predict Morbidity and Mortality in Patients Undergoing Emergency Exploratory Laparotomy. *Cureus* [Internet]. 2025 Feb 14 [cited 2025 Aug 13];17(2). Available from: <https://pubmed.ncbi.nlm.nih.gov/40091950/>
  24. Nag DS, Dembla A, Mahanty PR, Kant S, Chatterjee A, Samaddar DP, et al. Comparative analysis of APACHE-II and P-POSSUM scoring systems in predicting postoperative mortality in patients undergoing emergency laparotomy. *World J Clin Cases*. 2019;7(16).
  25. Lam V, Loon MM, Alrawe M, Abougendy IS, Ali M. Comparative Predictive Accuracy of ASA, POSSUM, and NSQIP Risk Scoring Systems in Major Abdominal Surgeries: A Systematic Review. *Cureus* [Internet]. 2025 Jun 9 [cited 2025 Aug 13];17(6). Available from: <https://pubmed.ncbi.nlm.nih.gov/40636630/>

- 
26. Sreeharsha H, Rai SP, Sreekar H, Reddy R. Efficacy of POSSUM score in predicting the outcome in patients undergoing emergency laparotomy. *Polski Przegląd Chirurgiczny/ Polish Journal of Surgery*. 2014;86(4).
  27. Jha MK, Sibakoti YC, Devkota H. Evaluation of P- POSSUM Scoring System in Patients Undergoing Emergency Laparotomy. *Medical Journal of Shree Birendra Hospital*. 2017;16(2).
  28. Lodha M, Khoth A, N K, Badkur M, Meena SP, Banerjee N, et al. Comparative evaluation of P-POSSUM and NELA scores in predicting 30-day mortality following emergency laparotomy: A prospective observational study. *Turk J Surg*. 2025 Feb 27;41(1):56–60.
  29. Whiteley MS, Prytherch DR, Higgins B, Weaver PC, Prout WG. An evaluation of the POSSUM surgical scoring system. *British Journal of Surgery*. 1996;83(6).
  30. Thirunavukkarasu S, Subramanian AM. Efficacy of the P-POSSUM scoring system in prediction of post-operative mortality and morbidity in patients undergoing emergency laparotomy in a tertiary institute. *International Surgery Journal*. 2018 Jun 25;5(7):2523.
  31. Bullagan A, Karim T, Jain A, Saxena V, Chakravarti S, Agarwal S. Efficacy of Possum and P Possum Scoring System to Assess Outcomes in Emergency Gastrointestinal Surgeries.

- 
32. Bhowmik S, Singh CB, Neogi S, Roy S. Evaluating the Emergency Surgery Score (ESS) in Predicting Postoperative Outcomes Following Emergency Laparotomy: Insights From an Indian Tertiary Center. *Cureus* [Internet]. 2024 Mar 19 [cited 2025 Aug 13];16(3). Available from: <https://pubmed.ncbi.nlm.nih.gov/38638730/>
  33. Singh A, Jindal R, Jauhari A, Sharan J. Predicting Morbidity and Mortality using POSSUM Scoring in Patients Undergoing Emergency Laparotomy –An Observational Study. *International Journal of Health and Clinical Research* [Internet]. 2021 Dec 24 [cited 2025 Aug 13];4(23):168–72. Available from: <https://ijhcr.com/index.php/ijhcr/article/view/3654>
  34. Sharrock AE, McLachlan J, Chambers R, Bailey IS, Kirkby-Bott J. Emergency Abdominal Surgery in the Elderly: Can We Predict Mortality? *World J Surg*. 2017;41(2).
  35. Peponis T, Bohnen JD, Sangji NF, Nandan AR, Han K, Lee J, et al. Does the emergency surgery score accurately predict outcomes in emergent laparotomies? *Surgery (United States)*. 2017;162(2).
  36. El Hechi M, Kongkaewpaisan N, El Moheb M, Aicher B, Diaz J, O’Meara L, et al. The emergency surgery score (ESS) and outcomes in elderly patients undergoing emergency laparotomy: A post-hoc analysis of an EAST multicenter study. *Am J Surg*. 2021;221(5).

- 
37. Rai A, Huda F, Kumar P, David LE, Chezian S, Basu S, et al. Predictors of Postoperative Outcome in Emergency Laparotomy for Perforation Peritonitis; a Retrospective Cross-sectional Study. *Arch Acad Emerg Med.* 2022;10(1).
  38. Alabbasy MM, Elsisy AAE, Mahmoud A, Alhanafy SS. Comparison between P-POSSUM and NELA risk score for patients undergoing emergency laparotomy in Egyptian patients. *BMC Surg.* 2023;23(1).
  39. Livingstone J, Buksh MM, Kostalas M, Ratnasingham K. Comparing predicted and observed morbidity and mortality between emergency laparotomies conducted during the day and overnight at a district general hospital. *European Surgery - Acta Chirurgica Austriaca.* 2021;53(6).
  40. Oumer KE, Ahmed SA, Tawuye HY, Ferede YA. Outcomes and associated factors among patients undergone emergency laparotomy: A retrospective study. *International Journal of Surgery Open.* 2021;36.
  41. Jansson Timan T, Hagberg G, Sernert N, Karlsson O, Prytz M. Mortality following emergency laparotomy: a Swedish cohort study. *BMC Surg.* 2021;21(1).
  42. Koperna T, Semmler D, Marian F. Risk stratification in emergency surgical patients: Is the APACHE II score a reliable marker of physiological impairment? *Archives of Surgery.* 2001;136(1).

# **ANNEXURE**



---

## **ANNEXURE**

---

### **PROFORMA**

#### **A COMPARATIVE STUDY TO ASSESS THE ACCURACY OF PREDICTION OF OUTCOME IN EMERGENCY LAPAROTOMIES USING APACHE II SCORE AND POSSUM SCORE**

**Investigator : Dr. Rakshith B.K , Junior Resident , Dept. Of General Surgery**

#### **Particulars of the patients:**

- Name:
- Age:
- Sex:
- Occupation:
- UHID number:
- Address:
- Date of Admission:
- Date of Discharge:
- Presenting complaints:
- Past history:
- Drug history:
- Family history:
- Personal history:

#### **GENERAL PHYSICAL EXAMINATION:**

- GENERAL CONDITION:
- Build and nourishment:
- Pallor:
- Cyanosis:
- Icterus:
- Clubbing:
- Edema:
- Generalized lymphadenopathy:

### **VITAL DATA:**


- Pulse:
- Temperature:
- BP:
- Respiration rate:
- BMI :

### **SYSTEMIC EXAMINATION**

- Per abdomen:
- Inspection:
- Palpation:
- Percussion:
- Ascultation:
- Digital Per Rectal Examination:
- Hernial Orifice:
- Respiratory system:
- Cardio vascular system:
- Central nervous system:

## INVESTIGATIONS :

- HEMATOLOGY:
- HB:
- PCV:
- RBC:
- PLATELETS:
- TLC:
- DLC:
- NEUTROPHILS:
- LYMPHOCYTES:
- MONOCYTES:
- BASOPHILS:
- ESR:
- RANDOM BLOOD SUGAR:
- B.UREA:
- S.CREATININE:
- S.SODIUM:
- S.POTASSIUM:
- S.CHLORIDE:
- S. BICARBONATE:
- CHEST X RAY PA VIEW :

- 
- ERECT X RAY ABDOMEN:
  - USG ABDOMEN:
  - CT/CECT ABDOMEN:

## **CLINICAL DIAGNOSIS**

## CONSENT FORM

**Title: “A COMPARATIVE STUDY TO ASSESS THE ACCURACY OF PREDICTION OF OUTCOME IN EMERGENCY LAPAROTOMIES USING APACHE II SCORE AND POSSUM SCORE ”**

**Principal investigator: Dr. RAKSHITH B K**

I, Mr/Mrs/Ms. .... have been explained in my own understandable language, that I will be included in a study which is “**A COMPARATIVE STUDY TO ASSESS THE ACCURACY OF PREDICTION OF OUTCOME IN EMERGENCY LAPAROTOMIES USING APACHE II SCORE AND POSSUM SCORE ”**

I have been explained that my clinical findings, investigations, preoperative and post-operative findings will be assessed and documented for study purpose.

I have been explained my participation in this study is entirely voluntary and I can withdraw from the study at any time and this will not affect my relation with my doctor or treatment for my ailment.

I understand that the medical information produced by this study will become part of institutional records and will be kept confidential by my said institute.

I agree not to restrict the use of any data or result that arise from this study provided such a use is only for scientific purpose(s).

I have principal investigator’s mobile number for enquiries.

I have been informed that standard of care will be maintained throughout the treatment period.

I in my sound mind give full consent to be included in this study.

Investigator: Dr. RAKSHITH B K

Participant’s signature/ thumb impression

Place:

Name:

Signature/thumb impression of the witness:

Date:

Name:

Relation to patient:

Signature of the investigator (Dr Rakshith B K)

## ಮಾಹಿತಿಯ ಒಪ್ಪಿಗೆ ನಮೂನೆ

ಪ್ರಕರಣ ಸಂಖ್ಯೆ:

IP ಸಂಖ್ಯೆ:

• **ಶೀರ್ಷಿಕೆ:** ಅಪಾಚಿ II ಸ್ಕೋರ್ ಮತ್ತು ಪೋಸ್ಟಮ್ ಸ್ಕೋರ್ ಅನ್ನು ಬಳಸಿಕೊಂಡು ತುರ್ತು ಲ್ಯಾಪ್‌ಟಾಪ್‌ಗಳಲ್ಲಿ ಫಲಿತಾಂಶದ ಮುನ್ನೂಚನೆಯ ನಿಖರತೆಯನ್ನು ನಿರ್ಣಯಿಸಲು ತುಲನಾತ್ಮಕ ಅಧ್ಯಯನ "

ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿ: ಡಾ. ರಕ್ಷಿತ್ ಬಿ.ಕೆ

ಶ್ರೀ/ಶ್ರೀಮತಿ ----- ಯಾದ ನಾನು, ನನ್ನ ಸ್ವಯಂ ಪ್ರೇರಣೆ ಇಂದ " ಅಪಾಚಿ ೨ ಸ್ಕೋರ್ ಮತ್ತು ಪಾಸ್ಟಮ್ ಸ್ಕೋರ್ ಅನ್ನು ಬಳಸಿಕೊಂಡು ತುರ್ತು ಲ್ಯಾಪ್‌ಟಾಪ್‌ಗಳಲ್ಲಿ ಫಲಿತಾಂಶದ ಮುನ್ನೂಚನೆಯ ತುಲನಾತ್ಮಕ ಅಧ್ಯಯನ" ದಲ್ಲಿ, ಭಾಗವಹಿಸಲು ಇಚ್ಛಿಸುತ್ತೇನೆ

ನನ್ನ ಕ್ಲಿನ್‌ಸಿಕಲ್ ಪರೀಕ್ಷೆ, ರಕ್ತ ಪರೀಕ್ಷೆಯ ವಿವರಗಳು ಹಾಗೂ ಶಸ್ತ್ರ ಚಿಕಿತ್ಸೆಯ ಮತ್ತು ನಂತರದ ಬದಲಾವಣೆಗಳನ್ನು ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಬಳಸಿಕೊಳ್ಳಲಾಗುವುದು ಎಂದು ನನಗೆ ತಿಳಿಸಲಾಗಿದೆ

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನನ್ನ ಭಾಗವಹಿಸುವಿಕೆ ಸಂಪೂರ್ಣವಾಗಿ ಸ್ವಯಂ ಪ್ರೇರಿತವಾಗಿದ್ದು ಮತ್ತು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಈ ಅಧ್ಯಯನದಿಂದ ನಾನು ಹಿಂದೆ ಸರಿಯಬಹುದಾಗಿದೆ ಎಂದು ನನಗೆ ತಿಳಿಸಲಾಗಿದೆ ಹಾಗೂ ನನ್ನ ನಿರಾಕರಣೆಯು ನನ್ನ ಚಿಕಿತ್ಸೆಯ ಮೇಲೆ ಹಾಗೂ ವೈದ್ಯರೊಂದಿಗಿನ ನನ್ನ ಬಾಂಧವ್ಯದ ಮೇಲೆ ಯಾವುದೇ ಪರಿಣಾಮ ಬರುವುದಿಲ್ಲವೆಂದು ನನಗೆ ತಿಳಿಸಲಾಗಿದೆ

ಈ ಅಧ್ಯಯನದಿಂದ ನನ್ನ ಮೇಲೆ ಉಂಟಾಗುವ ಅನುಕೂಲಗಳು ಅಥವಾ ಪ್ರತಿಕೂಲಗಳ ಬಗ್ಗೆ ಹಾಗೂ ಈ ಅಧ್ಯಯನದ ಫಲಿತಾಂಶದ ಬಗ್ಗೆ ನನಗೆ ಸಂಪೂರ್ಣ ಮಾಹಿತಿ ನೀಡುವುದಾಗಿ ಹೇಳಲಾಗಿದೆ

ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಕಂಡು ಬರುವ ನನ್ನ ಫಲಿತಾಂಶದ ಎಲ್ಲಾ ವಿವರಗಳನ್ನು ಪ್ರಕಟಿಸುವಾಗ ಅಥವಾ ಹಂಚಿಕೊಳ್ಳುವಾಗ ನನ್ನ ಗೌಪ್ಯತೆಯನ್ನು ಕಪಾ ಡಲಾಗುವುದು ಎಂದು ನನಗೆ ವಿವರಿಸಲಾಗಿದೆ

ನಾನು ನನ್ನ ಸಂಪೂರ್ಣ ಪರಿಚ್ಛಾನದಿಂದ ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗಿಯಾಗಲು ಹಾಗೂ ನನ್ನ ಚಿಕಿತ್ಸೆಯ ವಿಧಾನವಾದ ಶಸ್ತ್ರ ಚಿಕಿತ್ಸೆಗೆ ಒಳಗಾಗಲು ನನ್ನ ಪೂರ್ಣ ಸಮ್ಮತಿ ಯನ್ನು ನೀಡುತ್ತೇನೆ

ತನಿಖಾಧಿಕಾರಿ: ಡಾ. ರಕ್ಷಿತ್ ಬಿ.ಕೆ

ಭಾಗವಹಿಸುವವರ ಸಹಿ/ಹೆಬ್ಬರಳಿನ ಗುರುತು

ಹೆಸರು:

ಸಾಕ್ಷಿಯ ಸಹಿ/ಹೆಬ್ಬರಳಿನ ಗುರುತು:

ದಿನಾಂಕ:

ಹೆಸರು:

ರೋಗಿಗೆ ಸಂಬಂಧ:

(ಸಂಶೋಧನಾ ವ್ಯಕ್ತಿ/ವೈದ್ಯರ ಸಹಿ ಮತ್ತು ಹೆಸರು) .....

## MASTER CHART

Sl no	Patient Name	UHID	Age	Sex	POSSUM SCORE				APACHE II		Diagnosis
					Predicted Mortality	Predicted Morbidity	Physiological score	Operative severity score	Score	Mortality	
1)	NASEEB LS	RLJH 301608	23yrs	Male	7.6%	39.2%	14 POINTS	17 POINTS	7	4%	Peritonitis sec to ileal perforation
2)	ANJANEYA REDDY	RLJH 233243	35yrs	Male	31.4%	84.2%	26 points	18 points	7	4%	Peritonitis sec to D1 perforation
3)	NIYAMATH	RLJH 301757	28yrs	Male	10%	48.8%	20 points	14 points	7	4%	Peritonitis sec to jejunal perforation
4)	VENKATESH	RLJH 397212	74yrs	Male	69%	97.3%	32 points	23 points	22	40%	Peritonitis sec to jejunal perforation in septic shock with MODS
5)	ZABEER KHAN	RLJH 339100	20yrs	Male	1.6%	8.5%	15 points	6 points	5	4%	Acute appendicitis
6)	SOMA SHEKARA	RLJH 353366	44yrs	Male	2.6%	14.6%	14 points	10 points	5	4%	Recurrent appendicitis
7)	MUNIYAPPA	RLJH 352640	84yrs	Male	7.0%	37%	17 points	14 points	11	15%	Peritonitis sec to pre pyloric perforation
8)	NAVEEN KUMAR TC	RLJH 298952	29yrs	Male	4.9%	27.5%	19 points	10 points	6	4%	Acute appendicitis
9)	NAGARAJ	RLJH 268489	62yrs	Male	14.8%	62.0%	21 points	16 points	10	15%	Intestinal obstruction sec to proximal ileal stricture mass (NET)

Sl no	Patient Name	UHID	Age	Sex	POSSUM SCORE				APACHE II		Diagnosis
					Predicted Mortality	Predicted Morbidity	Physiological score	Operative severity score	Score	Mortality	
10)	NAGARATHNA MMA	RLJH 291704	45yrs	Female	26.1%	79.4%	24 points	18 points	12	15%	Peritonitis sec to duodenal perforation
11)	CHIMPIRI GOVARDHAN REDDY	RLJH 215793	44yrs	Male	4.8%	26.7%	14 points	14 points	5	4%	Peritonitis sec to duodenal perforation
12)	MANJUNATHA	RLJH 355290	45yrs	Male	4.4%	25%	17 points	11 points	8	4%	Acute Intestinal Obstruction
13)	NANAMMA	RLJH 339608	52yrs	Female	7.9%	40.9%	18 points	14 points	10	15%	Peritonitis sec to duodenal perforation
14)	SEEKALAMMA	RLJH 362395	65yrs	Female	22.6%	75.6%	25 points	16 points	11	15%	Acute intestinal obstruction
15)	VENKATARAVA NAPPA	RLJH 316076	53yrs	Male	30.2%	83.3%	28 points	16 points	19	25%	Peritonitis sec to duodenal perforation
16)	SUBRAMANI	RLJH 266299	51yrs	Male	8.6%	44.0%	20 points	13 points	9	4%	Acute intestinal obstruction sec to ileo caecal TB
17)	RAJAPPA	RLJH 280999	65yrs	Male	25%	78.4%	26 Points	16 Points	11	15%	Acute intestinal obstruction
18)	NARAYANAPPA	RLJH 303511	70yrs	Male	18.4%	69.2%	23 points	16 points	15	25%	Peritonitis secondary to pre pyloric perforation
19)	RAMAPPA	RLJH 455253	51 yrs	Male	18.2%	68.4%	18 points	20 points	10	15%	Pre pyloric perforation
20)	PUTTAMMA	RLJH 446974	69 yrs	Female	37.5%	87.4%	17 points	20 points	13	25%	Acute intestinal obstruction
21)	BABU	RLJH 450234	60 yrs	Male	15.7%	64.3%	24 points	14 points	17	25%	Peritonitis sec to gastric perforation

Sl no	Patient Name	UHID	Age	Sex	POSSUM SCORE				APACHE II		Diagnosis
					Predicted Mortality	Predicted Morbidity	Physiological score	Operative severity score	Score	Mortality	
22)	NANDEESHA	RLJH 503557	20 yrs	Male	8.3%%	42.3%	16 points	16 points	7	4%	Pre pyloric perforation
23)	SADIQ	RLJH 501379	25 yrs	Male	10.5%	50.2%	18 points	16 points	9	4%	Prepyloric perforation
24)	MUNIYAPPA	RLJH 375701	55 yrs	Male	14.8%	62.0%	20 points	16 points	12	15%	Gastric perforation
25)	RAHUL	RLJH 460693	19 yrs	Male	3.8%	20.9%	12 points	14 points	7	4%	Acute intestinal obstruction with partial volvulus
19)	RAMAPPA	RLJH 455253	51 yrs	Male	18.2%	68.4%	18 points	20 points	10	15%	Pre pyloric perforation
20)	PUTTAMMA	RLJH 446974	69 yrs	Female	37.5%	87.4%	17 points	20 points	13	25%	Acute intestinal obstruction
21)	BABU	RLJH 450234	60 yrs	Male	15.7%	64.3%	24 points	14 points	17	25%	Peritonitis sec to gastric perforation
22)	NANDEESHA	RLJH 503557	20 yrs	Male	8.3%%	42.3%	16 points	16 points	7	4%	Pre pyloric perforation
23)	SADIQ	RLJH 501379	25 yrs	Male	10.5%	50.2%	18 points	16 points	9	4%	Prepyloric perforation
24)	MUNIYAPPA	RLJH 375701	55yrs	Male	14.8%	62.0%	20 points	16 points	12	15%	Gastric perforation
25)	RAHUL	RLJH 460693	19 yrs	Male	3.8%	20.9%	12 points	14 points	7	4%	Acute intestinal obstruction with partial volvulus
26)	SAMPATH	RLJH 460871	54yrs	Male	3.8%	20.9%	12 points	14 points	7	4%	Acute intestinal obstruction (ileo colic intussuseption)

Sl no	Patient Name	UHID	Age	Sex	POSSUM SCORE				APACHE II		Diagnosis
					Predicted Mortality	Predicted Morbidity	Physiological score	Operative severity score	Score	Mortality	
27)	NAGESH	RLJH 530924	36 yrs	Male	4.3%	23.7%	13 points	14 points	7	4%	Acute intestinal obstruction sec meckels diverticulum
28)	VENKATESHAP PA	RLJH 623919	72 YRS	Male	94.2%	99.8%	39 points	20 points	21	30%	Peritonitis secondary to sigmoid perforation
29)	LAKSHMAMMA	RLJH 641054	44 YRS	Female	2.6%	14.6%	14 points	10 points	5	3%	Obstructed inguinal hernia
30)	KUDUS KHAN	RLJH 534852	59 yrs	male	4.0%	22.8%	21 points	7 points	6	3%	Acute intestinal obstruction
31)	KRISHNAMMA	RLJH 620184	80 yrs	female	88.3%	99.4%	50	16	33	73%	Peritonitis secondary to ileal perforation
32)	SHAKUNTHALAMMA	RLJH 515743	39yrs	female	10.1%	49.8%	25 points	10 points	7 points	3%	Peritoneal abscess
33)	CHIKKAMMA	RLJH 527265	75YRS	Female	37.5%	88.4%	33 points	14 points	9 points	3%	Obstructed inguinal hernia
34)	NAGAMMA	RLJH 571644	56yrs	F	41.3%	90.2%	33	15	9	3%	Posterior wall gastric perforation
35)	MOHAN V	RLJH 638990	63Yrs	M	68.8%	97.4%	43	14	16	12%	Distal ileal and ileo caecal perforation
36)	MANJULA	RLJH 568685	35yrs	F	4.5%	25.7%	22	7	1	1%	Acute intestinal obstruction
37)	JAYAPPA	RLJH 604355	77yrs	M	28.9%	82.5%	30	14	12	7%	Appendicular base perforation
38)	JAYAMMA	RLJH 637820	53yrs	F	60.6%	23%	23	14	6	3%	Obstructed incisional hernia
39)	DHINAKARA	RLJH 610902	47 yrs	M	11.1%	51.7%	16	18	5	3%	Peritonitis secondary to ileal perforation

Sl no	Patient Name	UHID	Age	Sex	POSSUM SCORE				APACHE II		Diagnosis
					Predicted Mortality	Predicted Morbidity	Physiological score	Operative severity score	Score	Mortality	
40)	AKKALAPPA	RLJH586658	75yrs	M	21.2%	74.6%	33	9	9	3	Obstructed inguinal hernia
41)	GOPI	RLJH537967	55yrs	M	8.8%	43.8%	14	18	5	3%	Acute intestinal obstruction
42)	PADMAVATHA MMA	RLJH576009	81yrs	F	47.0%	92.5%	36	14	14	7%	Acute intestinal obstruction
43)	NIRANJAN	RLJH646597	19yrs	M	2.6%	14.6%	14	10	1	1%	Acute intestinal obstruction
44)	CHOUDAMMA	RLJH584335	80Yrs	F	15.8%	65.2%	29	10	6	3%	Irreducible incisional hernia
45)	CHIKKA THIPPANNA	RLJH643062	75yrs	M	17.4%	67.0%	20	18	7	3%	Acute intestinal obstruction
46)	VENKATAPPA	RLJH646569	45yrs	M	11.1%	51.7%	16	18	3	1%	Peritonitis secondary pre pyloric perforation
47)	SUBAMMA	RLJH574318	77	F	13.0%	58.4%	26	11	9	3%	Obstructed inguinal hernia
48)	RASHEEDA	RLJH18445	47	F	69.8%	97.5%	36	20	19	12%	Intestinal obstruction
49)	KAVITHA	RLJH648739	27	F	17.4%	67.0%	20	18	5	3%	Peritonitis secondary to caecal and appendicular perforation
50)	DEVARAJ	RLJH524057	42	M	15.1%	61.8%	15	21	1	1%	peritonitis secondary to meckels diverticular perforation
51)	SUJATHA	RLJH630863	40	F	31.4%	84.2%	26	18	5	3%	Peritonitis secondary to pre pyloric perforation



Sl no	Patient Name	UHID	Age	Sex	POSSUM SCORE				APACHE II		Diagnosis
					Predicted Mortality	Predicted Morbidity	Physiological score	Operative severity score	Score	Mortality	
52)	SHARADA	RLJH626 249	43	F	24.6%	77.0%	16	24	4	1%	Intestinal obstruction with adenocarcinoma transverse colon
53)	SRI RAM	RLJH 521846	40YRS	M	26.1%	79.4%	24	18	7	3%	Peritonitis secondary to prepyloric perforation
54)	RAMACHANDR APPA	RLJH 477380	62yrs	M	28.9%	82.5%	30	14	8	3%	Appendicular base perforation