Evaluation of Portsmouth-Possum Score System in Accessing Surgical Outcome in General Surgery Patient

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Abstract: ***Accurate prediction of postoperative outcomes is essential for perioperative risk stratification and surgical audit. This prospective observational study evaluated the performance of the Portsmouth Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (P-POSSUM) in predicting postoperative outcomes among 100 patients undergoing major general surgical procedures at a tertiary care centre. Predicted morbidity and mortality were calculated using the P-POSSUM scoring system and compared with observed 30-day outcomes. The observed postoperative morbidity and mortality rates were 37% and 12%, respectively. P-POSSUM underpredicted morbidity (26.27% vs. 37.0%) and overpredicted mortality (15.72% vs. 12.0%). The model demonstrated modest but significant discriminatory ability for morbidity (AUC = 0.644, p = 0.017), whereas its performance for mortality was not statistically significant (AUC = 0.638, p = 0.121). Multivariable analysis identified the physiological score and estimated blood loss as independent predictors of postoperative morbidity, while age independently predicted 30-day mortality. Overall, P-POSSUM showed moderate utility for perioperative risk assessment, performing better in predicting morbidity than mortality. These findings support its use as an adjunctive tool for preoperative risk stratification and surgical audit, although local validation and periodic recalibration are recommended before routine implementation.***

Keywords: General surgery; P-POSSUM; Postoperative complications; Risk assessment

1. Introduction

Surgical care is an indispensable component of modern health systems and contributes substantially to the prevention of disability and premature mortality, with a significant proportion of the global burden of disease requiring surgical intervention at some point in the course of illness [1]. General surgery encompasses elective procedures for benign and malignant conditions as well as emergency operations performed for life threatening surgical emergencies. Despite continuous advances in surgical technique, anaesthetic safety, and perioperative care, postoperative morbidity and mortality remain persistent concerns worldwide [2].

Postoperative complications contribute significantly to prolonged hospital stay, increased healthcare costs, readmissions, and reduced quality of life, and mortality following surgery, although relatively infrequent in elective procedures, remains unacceptably high in emergency general surgery, particularly in patients with advanced physiological derangement and comorbid illness [3]. These adverse outcomes are influenced by a complex interaction between patient physiology, disease severity, operative complexity, and perioperative care quality, so that assessment of surgical outcomes requires careful adjustment for baseline patient risk rather than reliance on crude morbidity and mortality rates, which fail to account for differences in case mix and procedural complexity [4].

To address this limitation, risk adjusted surgical audit has emerged as a cornerstone of quality improvement in surgical practice, enabling identification of genuine deviations from expected performance and facilitating targeted intervention, benchmarking, accreditation, and informed consent in high-risk surgical patients [5, 6]. At the individual patient level, reliable estimation of postoperative morbidity and mortality assists clinicians in optimising patients prior to surgery, planning perioperative monitoring, allocating critical care resources, and triaging high risk patients, which is especially important in emergency general surgery where time for optimisation is limited [7, 8].

Several scoring systems have been developed to estimate perioperative risk. The American Society of Anesthesiologists physical status classification is simple but subjective and does not incorporate operative factors or acute physiological derangement, while comorbidity-based indices such as the Charlson and Elixhauser scores quantify disease burden but were designed primarily for administrative data analysis rather than real time surgical decision making [9–11]. The Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) addressed these gaps by combining twelve physiological variables with six operative variables, each assigned an exponential score, and applying logistic regression to predict postoperative morbidity and mortality [12]. However, subsequent validation studies identified a consistent tendency of POSSUM to overpredict mortality, particularly in low-risk surgical patients, which limited its accuracy for outcome benchmarking [13].

The Portsmouth modification of POSSUM (P-POSSUM) was therefore developed, retaining the original physiological and operative variables but employing a revised regression equation to improve calibration of mortality prediction, and it has since been widely adopted as a preferred tool for predicting postoperative mortality in general, emergency, and gastrointestinal surgery [14, 15]. Its performance in predicting postoperative morbidity has, however, been less consistent, with discrepancies attributed to differences in the definition of morbidity, heterogeneity of surgical procedures, and variation in perioperative care practices [16]. Furthermore, in low- and middle-income countries, where patients often present late with advanced pathology, malnutrition, and multiple untreated comorbidities, and where emergency surgery constitutes a large share of the surgical workload, the applicability of such risk prediction tools requires local validation [17].

In the Indian context, general surgery units frequently manage high patient volumes with limited resources, and emergency admissions constitute a substantial proportion of the workload, underlining the importance of locally generated evidence to guide the application of risk prediction models and support context appropriate perioperative decision making. Therefore, the involvement of physiological derangement, operative severity, and case mix heterogeneity in determining surgical outcome suggests a need for further evaluation of P POSSUM in general surgery populations comprising both elective and emergency cases. This study aims to evaluate the effectiveness of the Portsmouth-POSSUM (P-POSSUM) scoring system in predicting surgical outcomes among patients undergoing general surgery.

2. Materials and Methods

This prospective observational study was conducted in the Department of General Surgery, Baba Raghav Das Medical College, Gorakhpur, Uttar Pradesh, India, over a period of one year, after obtaining approval from the Institutional Human Ethics Committee (IEC No: 294(V)/IHEC/2025).

Sample size: A total of 100 patients undergoing major general surgical procedures were enrolled during the study period on the basis of the inclusion and exclusion criteria below.

Inclusion criteria: Adult patients aged more than 18 years admitted to the surgical emergency or elective surgical wards and undergoing major general surgical procedures (e.g., laparotomy, bowel resections), who gave written informed consent were included in the study.

Exclusion criteria: Patients aged less than 18 years, patients undergoing minor surgical procedures under local anaesthesia, patients refusing consent, patients with trauma or burns, and patients requiring immediate lifesaving procedures in whom preoperative assessment was not feasible were excluded from the study.

Study Procedure: After obtaining informed consent, all patients underwent detailed history taking and clinical examination, and their demographic characteristics and comorbidities were recorded. Routine and specific investigations, including complete blood count, renal function test, liver function test, serum electrolytes, and electrocardiogram, were performed for each patient. The P-POSSUM (Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity) scoring system was applied to predict outcomes, using twelve physiological parameters, namely age, cardiac signs, respiratory signs, electrocardiogram findings, systolic blood pressure, pulse rate, Glasgow Coma Scale score, haemoglobin, white blood cell count, blood urea, serum sodium, and serum potassium, and six operative parameters, namely operative severity, presence of multiple procedures, total blood loss, peritoneal soiling, presence of malignancy, and mode of surgery. Notably, predicted morbidity and mortality were calculated preoperatively using the standard P-POSSUM logistic regression equations, and all patients were followed up for a period of 30 days postoperatively to record observed morbidity and mortality, which were then compared with the predicted rates.

Statistical analysis: Data were entered in Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 23.0. Descriptive statistics were used to summarise the demographic, clinical, and operative characteristics of the study population, and results were presented as ranges, means with standard deviation, medians, and percentages. The Chi square test was used to compare categorical variables, and the independent samples Student's t test was used to compare continuous variables between groups, while comparisons among more than two groups were performed using analysis of variance (ANOVA). Univariate and multivariable logistic regression analyses were performed to identify independent predictors of morbidity and mortality, with results expressed as odds ratios. Notably, diagnostic accuracy of the P-POSSUM score was assessed by plotting the area under the receiver operating characteristic (ROC) curve, along with sensitivity, specificity, positive and negative predictive values, and likelihood ratios for positive and negative results. A p value of less than 0.05 was considered statistically significant.

Ethical considerations: The study was conducted in accordance with the approval of the Institutional Human Ethics Committee and the principles of the Declaration of Helsinki, 2013 revision. Written informed consent was obtained from all participants, and confidentiality and data protection were maintained throughout the study.

3. Results

The study included 100 patients undergoing major general surgery, with a predominance of males (57%). The largest proportion of participants was aged 61–80 years (38%). Hypertension (35%) and diabetes mellitus (29%) were the most common comorbidities, while malignancy (22%), coronary artery disease (15%), COPD (13%), and chronic kidney disease (12%) were less prevalent, indicating a substantial burden of cardiovascular and metabolic comorbidities in the study population (Table 1/Fig. 1).

Table 1: Demographic characteristics of the study population (N=100)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	18–40	35	35
	41–60	27	27
	61–80	38	38
Sex	Male	57	57
	Female	43	43
Comorbidities	Hypertension	35	35
	Diabetes Mellitus	29	29
	Chronic Kidney Disease	12	12
	COPD	13	13
	Coronary Artery Disease	15	15
	Malignancy	22	22

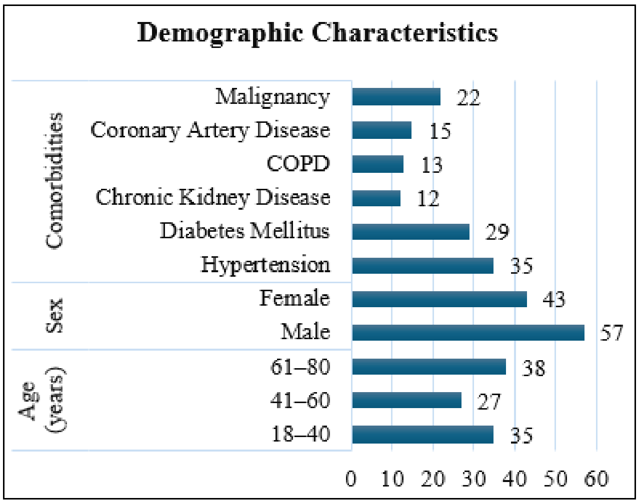

Figure 1: Demographic characteristics of the study participants

The majority of patients underwent elective (58%) and major (59%) surgical procedures, with 35% requiring multiple procedures. The mean predicted morbidity and mortality were 26.27% and 15.72%, respectively. Postoperative morbidity occurred in 37% of patients, while 39% required ICU admission and 14% required ventilatory support. The mean hospital stay was 9.75 days, and the 30-day mortality rate was 12%, indicating a considerable postoperative burden despite predominantly elective surgical management (Table 2).

Table 2: Perioperative and postoperative characteristics of the study population (N=100)

Variable	Category / Value	n (%) / Mean ± SD
Type of Surgery	Elective	58 (58.0)
	Emergency	42 (42.0)
Operative Severity	Major	59 (59.0)
	Complex Major	41 (41.0)
Multiple Procedures	Yes	35 (35.0)
	No	65 (65.0)
Estimated Blood Loss (mL)	Mean ± SD	**641.51 ± 316.22**
	Range	**107–1195**
Physiological Score	Mean ± SD	**29.93 ± 10.49**
	Range	**12–49**
Operative Score	Mean ± SD	**17.60 ± 6.37**
	Range	**6–29**
Predicted Morbidity (%)	Mean ± SD	**26.27 ± 8.23**
	Range	**5.0–43.5**
Predicted Mortality (%)	Mean ± SD	**15.72 ± 5.20**
	Range	**1.2–33.1**
30-day Morbidity	Yes	37 (37.0)
	No	63 (63.0)
ICU Admission	Yes	39 (39.0)
	No	61 (61.0)
Ventilator Support	Yes	14 (14.0)
	No	86 (86.0)
Length of Hospital Stay (days)	Mean ± SD	**9.75 ± 3.63**
	Range	**4–21**
30-day Mortality	Survived	88 (88.0)
	Expired	12 (12.0)

P-POSSUM underpredicted postoperative morbidity and overpredicted mortality in the study cohort. Patients who developed postoperative morbidity had significantly higher predicted morbidity scores than those without morbidity (29.20% vs. 24.55%; p = 0.006). Although patients who died had higher predicted mortality scores than survivors (17.83% vs. 15.44%), the difference was not statistically significant (p = 0.137) (Table 3).

Table 3: Performance of the P-POSSUM score in predicting postoperative outcomes

Outcome	Predicted (%) / Mean ± SD	Observed n (%)	Test statistic	p-value
Overall Morbidity	26.27 ± 8.23	37 (37.0)	–	–
Overall Mortality	15.72 ± 5.20	12 (12.0)		
Predicted Morbidity by Observed Morbidity				
Morbidity Present	29.20 ± 8.57	37 (37.0)	t = 2.823	0.006
Morbidity Absent	24.55 ± 7.57	63 (63.0)		
Predicted Mortality by Observed Mortality				
Expired	17.83 ± 3.75	12 (12.0)	t = -1.501	0.137
Survived	15.44 ± 5.32	88 (88.0)		

Receiver operating characteristic curve analysis showed that the predicted morbidity score had significant discriminatory ability for 30-day morbidity, with an area under the curve (AUC) of 0.644 (standard error 0.059, 95% confidence interval 0.528 to 0.760, p=0.017). In contrast, the predicted mortality score showed an AUC of 0.638 for 30-day mortality (standard error 0.082, 95% confidence interval 0.478 to 0.798, p=0.121), which did not reach statistical significance (Table 4/Fig. 2 and 3).

Table 4: Diagnostic accuracy of the P-POSSUM score for predicting postoperative outcomes

Outcome	AUC	Standard Error	95% CI	p-value	Interpretation
30-day Morbidity	0.644	0.059	0.528–0.760	0.017	Significant predictive ability
30-day Mortality	0.638	0.082	0.478–0.798	0.121	Not statistically significant

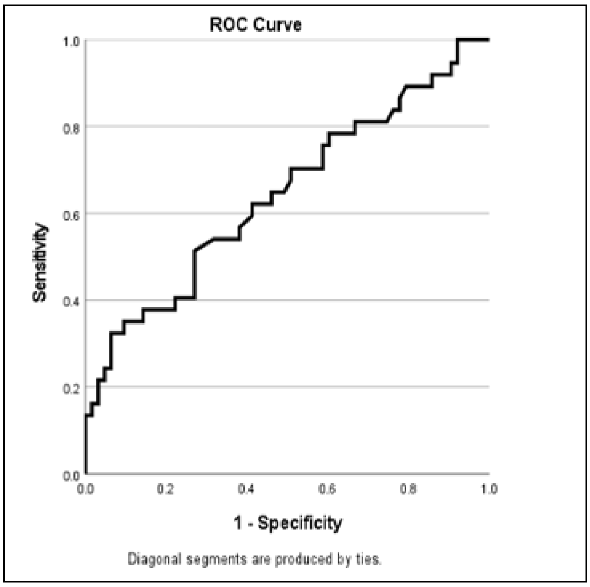

Figure 2: ROC curve showing the performance of predicted morbidity in predicting observed morbidity

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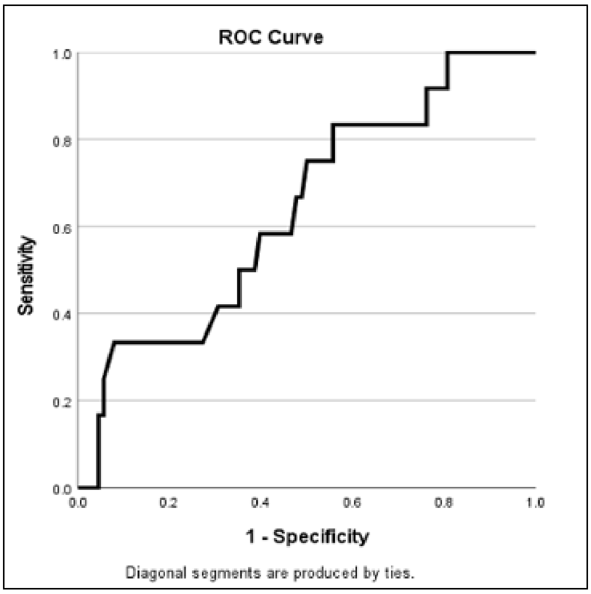

Figure 3: ROC curve showing the performance of predicted mortality in predicting observed mortality

Multivariable logistic regression identified the physiological score (adjusted OR = 5.027, p = 0.019) and estimated blood loss (adjusted OR = 3.999, p = 0.038) as independent predictors of 30-day postoperative morbidity. For 30-day mortality, only age was independently associated with the outcome (p = 0.002), whereas the physiological score, operative score, and predicted mortality were not significant independent predictors (Table 5).

Table 5: Multivariable logistic regression analysis for predictors of postoperative morbidity and mortality

Variable	30-Day Morbidity Adjusted OR	p-value	30-Day Mortality Adjusted OR	p-value
Physiological Score	5.027	0.019	1	0.993
Operative Score	1.035	0.314	1.003	0.961
Age (years)	1	0.991	0.912	0.002
Estimated Blood Loss (mL)	3.999	0.038	—	—
Predicted Mortality (%)	—	—	0.89	0.236

The physiological score showed a strong positive correlation with both predicted postoperative morbidity (r = 0.632, p < 0.001) and mortality (r = 0.613, p < 0.001). The operative score demonstrated moderate positive correlations with predicted morbidity (r = 0.491, p < 0.001) and mortality (r = 0.440, p < 0.001). Predicted morbidity and mortality were also significantly positively correlated (r = 0.540, p < 0.001) (Table 6).

Table 6: Correlation between clinical scores and predicted postoperative outcomes

Variables	Correlation Coefficient (r)	p-value
Physiological Score vs Predicted Morbidity (%)	0.632	<0.001
Physiological Score vs Predicted Mortality (%)	0.613	<0.001
Operative Score vs Predicted Morbidity (%)	0.491	<0.001
Operative Score vs Predicted Mortality (%)	0.44	<0.001
Predicted Morbidity (%) vs Predicted Mortality (%)	0.54	<0.001

4. Discussion

In this prospective observational study, 100 patients undergoing major general surgical procedures were evaluated to assess the effectiveness of the P-POSSUM scoring system in predicting postoperative morbidity and mortality. Males comprised 57% of the study population and the majority of patients were in the 61 to 80 years age group, followed closely by the 18 to 40 years group. **Shekar et al. (2023)** reported a younger cohort, with most participants aged 31 to 40 years (43%) and only 2% aged 61 to 70 years, and a mean age of 37 years [1]. **Manoharan and Vijayalakshmi (2019)** similarly reported a predominance of patients in the 40 to 49 years age group (26.6%) [2]. In contrast, **Anbarasu and Chandak (2019)** reported that 47% of their patients were aged over 50 years, with a higher concentration of patients aged 60 to 70 years in the emergency surgery group, a pattern broadly consistent with the older age distribution observed in the present study [3]. **Hong et al. (2017)** reported a mean age of 61.7 ± 13.1 years in patients undergoing gastrectomy, while **Johns et al. (2020)**, studying hip fracture patients, reported a much older median age of 88 years [4, 5]. Taken together, these observations confirm that major general surgical interventions are commonly performed in patients of advancing age with substantial systemic comorbidity, which is consistent with the comorbidity profile in the present study, where hypertension, diabetes mellitus and malignancy were the most frequent comorbid conditions.

Regarding operative characteristics, elective surgery accounted for 58% of procedures in the present study, with the remainder performed as emergencies. This proportion is broadly comparable to that reported by **Manoharan and Vijayalakshmi (2019)**, who documented emergency and elective surgery rates of 57.8% and 42.2% respectively, and contrasts with **Anbarasu and Chandak (2019)** and **Tyagi et al. (2017)**, both of whom reported a higher proportion of emergency procedures, at 70% and 78% respectively [2, 3, 6]. The mean blood loss in the present study (641.51 ± 316.22 mL) reflects the operative complexity of the major and complex major procedures included, consistent with the finding across these studies that operative severity, blood loss, and peritoneal contamination are important drivers of P-POSSUM operative scores and, consequently, of predicted risk.

The mean physiological score in the present study was 29.93 ± 10.49 and the mean operative score was 17.60 ± 6.37, both of which were higher than those reported by **Shekar et al.**

(2023) (physiological score 24.57, operative score 19.01) and by **Tyagi et al. (2017)** (physiological score 17.56 ± 7.6, operative score 17.76 ± 4.5), suggesting a somewhat greater burden of preoperative physiological derangement in the present cohort [1, 6]. The mean predicted morbidity of 26.27 ± 8.23% in this study was lower than the observed 30-day morbidity of 37.0%, indicating that P-POSSUM underpredicted morbidity in this population. This finding differs from that of **Tyagi et al. (2017)**, who observed the opposite pattern, with observed morbidity of 42% falling below the predicted rate of 54%, and from **Anbarasu and Chandak (2019)**, who similarly reported observed morbidity (41%) lower than predicted (54%) [3, 6]. **Hong et al. (2017)**, however, reported closer agreement, with observed morbidity of 34.0% closely matching the POSSUM predicted rate of 36.6% [4]. These discrepancies across studies reinforce the previously described inconsistency of POSSUM based models in predicting postoperative morbidity, which has been attributed to variation in the definition of morbidity, heterogeneity of surgical procedures, and differences in perioperative care practice.

In contrast to the morbidity findings, the mean predicted mortality in the present study (15.72 ± 5.20%) exceeded the observed 30-day mortality of 12.0%, indicating overprediction of mortality, a pattern that is consistent with the well described tendency of POSSUM based scores to overestimate mortality risk. This pattern mirrors the findings of **Tyagi et al. (2017)**, who reported observed mortality of 12% against a P-POSSUM predicted rate of 14%, and of **Anbarasu and Chandak (2019)**, who reported observed mortality of 11% against a predicted rate of 13% [3, 6]. **Shekar et al. (2023)** and **Johns et al. (2020)** likewise reported observed mortality below the corresponding P-POSSUM predictions [1, 5]. **Hong et al. (2017)** reported a similar pattern, with an observed to expected mortality ratio of 0.91 for P-POSSUM [4]. These consistent findings across diverse surgical populations support the conclusion that, while P-POSSUM was specifically developed to correct the overprediction of mortality inherent in the original POSSUM model, some degree of residual overprediction persists across varied clinical settings, including the present cohort.

In the present study, predicted morbidity was significantly higher in patients who actually developed morbidity (29.20 ± 8.57%) compared with those who did not (24.55 ± 7.57%, p=0.006), and receiver operating characteristic analysis confirmed statistically significant discriminatory ability for morbidity prediction (AUC 0.644, p=0.017). This finding aligns with the observations of **Shekar et al. (2023)**, who reported an AUC of 0.666 for POSSUM and 0.664 for P-POSSUM in predicting morbidity [1]. For mortality, although predicted mortality was numerically higher in patients who died (17.83 ± 3.75%) than in survivors (15.44 ± 5.32%), this difference did not reach statistical significance (p=0.137), and the corresponding AUC of 0.638 also did not reach significance (p=0.121). This finding contrasts with several previous reports of strong discriminatory performance for mortality prediction, including **Shekar et al. (2023)**, who reported mortality AUCs of 0.818 and 0.836 for POSSUM and P-POSSUM respectively, and **Anbarasu and Chandak (2019)**, who reported 98% sensitivity and 100% specificity for P-POSSUM in mortality prediction [1, 3]. The relatively modest discriminatory performance for mortality observed in the present study may reflect the smaller number of mortality events (n=12) in this cohort, which limits statistical power, as well as case mix differences between studies.

On multivariable analysis, the physiological score and estimated blood loss were identified as independent predictors of postoperative morbidity, while age was the only independent predictor of mortality. This is broadly consistent with **Tamijmarane et al. (2008)**, who found that the physiological score and white cell count independently predicted postoperative complications following pancreatic surgery, and with **Tyagi et al. (2017)**, who reported significant associations between mortality and multiple physiological parameters including cardiorespiratory status, pulse rate, Glasgow Coma Scale score, and electrolyte derangement [6, 7]. The identification of age as an independent predictor of mortality in the present study is consistent with the broader literature on perioperative risk, in which advancing age is repeatedly shown to be a critical determinant of survival following major surgery, as also emphasised by **Johns et al. (2020)** in a much older hip fracture cohort [5].

The significant positive correlations between physiological score and predicted morbidity and mortality, along with the moderate correlations for operative score, support the internal consistency of the P-POSSUM model and reinforce that increasing physiological derangement and operative severity are associated with higher predicted postoperative risk. Overall, P-POSSUM demonstrated moderate predictive performance, with reasonable discrimination for morbidity but limited accuracy for mortality. The model tended to underpredict morbidity and overpredict mortality, consistent with findings from previous studies, highlighting the need for local validation before its use in surgical audit and benchmarking.

5. Conclusion

The present study demonstrates that the P-POSSUM scoring system is a useful tool for perioperative risk stratification in patients undergoing major general surgery. While it showed moderate accuracy in predicting postoperative morbidity, its performance for mortality prediction was limited, with a tendency to underpredict morbidity and overpredict mortality. Higher physiological scores and greater intraoperative blood loss were independent predictors of postoperative morbidity, whereas advancing age independently predicted 30-day mortality. These findings support the use of P-POSSUM as an adjunct for preoperative risk assessment, patient counselling, and surgical audit; however, local validation and periodic recalibration are recommended before its routine use for benchmarking surgical outcomes.

References

[1] Weiser TG, Haynes AB, Molina G, et al. Estimate of the global volume of surgery in 2012: an assessment supporting improved health outcomes. *Lancet* 2015; 385 Suppl 2: S11.

[2] Sb D, P B, S N. Incidence and Risk Factors of Postoperative Complications in General Surgery

Patients. *Cureus*; 14. Epub ahead of print 1 November 2022.

[3] Mullen MG, Michaels AD, Mehaffey JH, et al. Risk Associated With Complications and Mortality After Urgent Surgery vs Elective and Emergency Surgery. *JAMA Surg* 2017; 152: 768–774.

[4] Elbahi MK, Fadlelmola Abdalla Mohamednour M, Mukhtar FS, et al. Perioperative Patient Safety and Surgical Complications: A Comprehensive Review of Current Evidence and Improvement Strategies. *Cureus* 2025; 17: e99959.

[5] Daley J, Henderson WG, Khuri SF. Risk-adjusted surgical outcomes. *Annu Rev Med* 2001; 52: 275–287.

[6] Pillai SB, van Rij AM, Williams S, et al. Complexity- and risk-adjusted model for measuring surgical outcome. *Br J Surg* 1999; 86: 1567–1572.

[7] Lavezzo B, Biancofiore G, Luca E, et al. Planning intensive care unit admission after elective major abdominal surgery: good clinical practice document by SIAARTI-SIC-ANIARTI. *J Anesth Analg Crit Care* 2025; 5: 20.

[8] Protopapa KL, Simpson JC, Smith NCE, et al. Development and validation of the Surgical Outcome Risk Tool (SORT). *Br J Surg* 2014; 101: 1774–1783.

[9] Mehta HB, Dimou F, Adhikari D, et al. Comparison of Comorbidity Scores in Predicting Surgical Outcomes. *Med Care* 2016; 54: 180–187.

[10] Gutacker N, Bloor K, Cookson R. Comparing the performance of the Charlson/Deyo and Elixhauser comorbidity measures across five European countries and three conditions. *Eur J Public Health* 2015; 25 Suppl 1: 15–20.

[11] Grigorescu B-L, Săplăcan I, Petrișor M, et al. Perioperative Risk Stratification: A Need for an Improved Assessment in Surgery and Anesthesia-A Pilot Study. *Medicina (Kaunas)* 2021; 57: 1132.

[12] Copeland GP, Jones D, Walters M. POSSUM: a scoring system for surgical audit. *Br J Surg* 1991; 78: 355–360.

[13] Ngulube A, Muguti GI, Muguti EG. Validation of POSSUM, P-POSSUM and the surgical risk scale in major general surgical operations in Harare: A prospective observational study. *Ann Med Surg (Lond)* 2019; 41: 33–39.

[14] Tyagi A, Nagpal N, Sidhu DS, et al. Portsmouth physiological and operative severity score for the Enumeration of Mortality and morbidity scoring system in general surgical practice and identifying risk factors for poor outcome. *J Nat Sci Biol Med* 2017; 8: 22–25.

[15] Mercer S, Guha A, Ramesh V. The P-POSSUM scoring systems for predicting the mortality of neurosurgical patients undergoing craniotomy: Further validation of usefulness and application across healthcare systems. *Indian J Anaesth* 2013; 57: 587–591.

[16] Bürtin F, Ludwig T, Leuchter M, et al. More than 30 Years of POSSUM: Are Scoring Systems Still Relevant Today for Colorectal Surgery? *J Clin Med* 2023; 13: 173.

[17] GlobalSurg Collaborative. Mortality of emergency abdominal surgery in high-, middle- and low-income countries. *Br J Surg* 2016; 103: 971–988.

[18] Shekar N, Debata P, Debata I, et al. 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* 2023; 15: e40850.

[19] Manoharan GV, Vijayalakshmi G. Evaluation of POSSUM scoring system in patients undergoing laparotomy. *International Surgery Journal* 2019; 6: 512–517.

[20] Anbarasu K, Chandak R. Efficacy of the P-POSSUM scoring system as a prognostic indicator in patients undergoing emergency laparotomy. *International Surgery Journal* 2019; 6: 3600–3607.

[21] Hong S, Wang S, Xu G, et al. Evaluation of the POSSUM, p-POSSUM, o-POSSUM, and APACHE II scoring systems in predicting postoperative mortality and morbidity in gastric cancer patients. *Asian J Surg* 2017; 40: 89–94.

[22] Johns WL, Strong B, Kates S, et al. POSSUM and P-POSSUM Scoring in Hip Fracture Mortalities. *Geriatr Orthop Surg Rehabil* 2020; 11: 2151459320931674.

[23] Tamijmarane A, Bhati CS, Mirza DF, et al. Application of Portsmouth modification of physiological and operative severity scoring system for enumeration of morbidity and mortality (P-POSSUM) in pancreatic surgery. *World J Surg Oncol* 2008; 6: 39.