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OUTCOMES OF EMERGENCY LAPAROTOMY IN RESOURCE-LIMITED SETTINGS AT TERTIARY CARE HOSPITAL

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Abstract

Emergency laparotomy (EL) is major surgery and a high-risk procedure, especially in resource-limited tertiary care hospitals; where patient characteristics and systemic challenges play a significant role in determining the outcome. This prospective observational study, carried out at a tertiary care hospital, Jinnah Postgraduate Medical Centre (JPMC), Karachi, aimed to determine clinical outcome and significant risk factors associated with both morbidity and mortality after EL. Four hundred and twenty-six patients who underwent emergency laparotomy from January 2022 to December 2024 were enrolled. Data were recorded on a structured proforma, and analyzed through SPSS 26.0. Independent predictors of 30-day mortality and major complications were identified using logistic regression. The median age of the study population was 54, 45% were ASA grade III, and 28% were ASA IV– V. The global 30-day mortality rate was 14.6% with major complications (Clavien–Dindo Grade III–V) observed in 25.3% of the patients. Patients included 30.3% needing ICU admission and had a median length of stay of 12 days. Independent predictors of mortality included ASA grade III–V (OR 2.96), age ≥60 years (OR 2.01), preoperative shock (OR 3.42) and diabetes mellitus (OR 1.88). No consultant in supervision during surgery and unavailability of ICU bed correlated significantly with high mortality and complication rates. The patients randomly allocated to checklist guided surgery had less complications and were associated with less mortality (10.1% versus 23.7%, $p < 0.001$). These observations highlight the contribution of clinical risk factors and perioperative systems on EL among low-resource settings. Given these findings, organization with use of planned surgical safety program, the presence of a consultant from the early stages, and preferential access to ICU can contribute to improved outcomes for this high-risk group of surgical patients.

INTRODUCTION

The emergency laparotomy (EL) is defined as the opening of the abdomen for the purpose of diagnosing and treating a disease which is potentially lethal within 24 hours and is one of the most widely performed surgical procedures in the world. It is also associated with a high level of risk, with worldwide 30-day postoperative mortality rates between 10 and 20% being reported, substantially higher than for an elective laparotomy (which is usually <5%) (Scott *et al.*, 2023). In low- and middle-income country settings (LMIC) these are yet more alarming, with mortality. Within the Lancet Commission on Global Surgery's framework, EL is also a key surgical access indicator, and "as" also named a one of the "bellwether procedures" used by the World Bank. Ensuring safe and reliable EL in resource-limited tertiary hospitals is therefore key in decreasing the surgical backlog and in attaining the goals of universal health coverage.

The prevalence of emergency laparotomy is high world over: around 175,000 ELs are done annually in the United States (US) and 85,000 in UK (Hailu *et al.*, 2023). In LMICs, EL tends to be advanced disease at the time of presentation (perforation, obstruction, trauma), and is also characterized by a higher degree of sepsis, poorer physiological reserves, and a delay to seeking or reaching care. Such contributory factors increase ES, with fatalities due to EL being as high as 14.8% in tertiary institutions of sub-Saharan Africa and related ones (Sincavage et al., 2021). In addition to mortality, EL can lead to high-grade complications (Clavien–Dindo III–V) in as many as 50% of patients, as well as longer LOS, readmissions, and reduced long-term recovery (Oumer *et al.*, 2021).

Within an underperforming infrastructure especially in terms of workforce, the health system of LMICs, presents specific features and challenges. These factors involve restricted intensive care capacity, need for intraoperative treatment and decision-making in incomplete diagnostics, and lack of postoperative monitoring. In Malawi, just 9% of patients underwent postoperative monitoring for intra-abdominal complications, despite intra-abdominal complication conferring a threefold increased risk of mortality (Sincavage et al., 2021). Preoperative factors, such as ASA status ≥III, advanced age (≥65), and sepsis, were robust prognostic mortality factors (Oumer *et al.*, 2021).

Notwithstanding the fact that the call to abdominal emergency laparotomy is clinical, it is also a call with so much economic weight. Even in high-income settings, the in-hospital medical EL treatment costs can be in excess of US$ 10,000 per patient, which are not only burdensome to hospital budgets but also to patients themselves (Bampoe *et al.*, 2017). Impoverishing OOPPs in relation to access to surgical care in LMIC settings amplify these barriers and highlight the importance of the application of contextually appropriate, cost-effective perioperative measures (e.g., the World Health Organization (WHO) Surgical Safety Checklist) to reduce mortality and infection risk.

Although high-income countries have implemented EL improvement networks (e.g., NELA in the UK, ANZELA in Australia/NZ), data-driven, protocol-driven care systems are less visible in LMICs. One study from India compared a structured EL-care set-up that included ICU admission on arrival, senior surgical teams, liberal CT use, and Clavien–Dindo auditing to achieve significantly reduced observed-to-expected mortality ratio of 0.61 (Vashistha *et al.*, 2018). Local evidence from tertiary care centres in Pakistan, Ethiopia, and sub-Saharan Africa also confirms these findings, however there is significant variation in outcomes and few standardized perioperative pathways are in place (Hailu *et al.*, 2023).

This research aims to fill in vital evidence gaps, to help surgeons and health service leaders at a tertiary hospital, Jinnah Postgraduate Medical Centre (JPMC), in a resource-constrained setting, design appropriate components of care in emergency laparotomy. Particularly, it aims to measure key clinical outcomes for adult patients, such as 30-

dmortality, major and minor complication rates, ICU and hospital length of stay, and patient-reported quality of life. Furthermore, it aims to stratify patients of unfavorable outcome predicted by an earlier model by patient (ASA, age, comorbidities, presence of sepsis) and system associated factors (intraoperative conditions). Finally, it examines the association between perioperative care items (systematic checklist completion, scheduled admission to an ICU, seniority of the surgical team) and outcome measures (mortality rates, complication rates).

Review of Literature

In the last 5 years, growing evidence has been accumulated on difficult scenarios of emergency laparotomy (EL) in low- and middle-income countries (LMICs).

As of 2025, a 30-day mortality of 10.4% was reported among EL in a prospective cohort conducted at a tertiary hospital in Addis Ababa (Teka et al., 2025). Likewise, a prospective study in Ethiopia in 2021 reported EL mortality of 13–18% and major complication rates around 50%. These are consistent with systematic reviews which found EL mortality to be 10%-19% in LMICs compared to <6% in HICs.

A recent study (Guo *et al.*, 2024), with a prospective audit across 58 countries, has shown that 30-day EL mortality was 8.6% in low-HDI countries compared to 4.5% in high-HDI countries, with a threefold increase in adjusted odds of mortality in low-HDI settings. Older age groups also have a poor outcome; a study from 2025 found that over 20% of patients aged 65 and older in Yemen died.

Perioperative morbidity consists of surgical site infection, sepsis and organ dysfunctions. A Ugandan series observed a complication rate of 17.7% mostly attributed to wound infections and mortality rate of 7.3% (Okidi *et al.*, 2024). Retrospective and combined EL and elective laparotomy data report complication rates up to 50% (Teka *et al.*, 2025).

Preoperative scoring systems, including POSSUM, P-POSSUM, APACHE II, and NELA, have been assessed in EL settings in diverse financial environments. A recent systematic review of risk tools (PubMed–Cochrane to Feb 2022) identified 82 observational studies and validated these models as overall predictors of EL mortality (Hewitt *et al.*, 2024). However, the heterogeneity of demographic and protocol variables of patients in different LMICs may reduce the ability to predict at a local level.

Sarcopenia (based on CT measurement of psoas or skeletal muscle at the level of L3) was a strong independent predictor of postoperative mortality and complications. Another recently published meta-analysis in 2022, composed of 11 studies (n=3,795), reported that there were 2.4 times higher odds of 30-day mortality, and increased hospital/ICU LOS (+0.55 & +2.33 days, respectively) and 78% higher odds of postoperative complications in sarcopenic patients (Yang *et al.*, 2022).

In a 2022 review of perioperative care pathways in LMICs, 27 studies were included, and although adherence to standardized processes (e.g., use of safety checklists, optimization prior to surgery, perioperative teams) was variable, available data on pathway adherence was limited and impacts on outcomes were noted (Patel *et al.*, 2022).

Of particular interest is the WHO Surgical Safety Checklist, designed for elective surgery but with striking reductions in mortality in an emergency setting. A large combined analysis across 76 countries determined that checklist use was linked to a 40% lower 30-day mortality rate after emergency laparotomy, with even more substantial benefit in LMICs (OR 0.60, CI 0.50–0.73).

Efficiency of care delivery matters. A European study from 2025, including 1,947 emergency abdomen operations revealed mortality of 26% in highest triage urgency (level 1), dropping to 2% in less critical cases ($p < 0.001$). Protocol violations were associated with poorer outcomes and prolonged hospitalization, particularly in emergencies (Sultan *et al.*, 2024).

A number of studies in LMICs and international multi-center cohorts have repetitively identified various clinical variables

as important predictors of mortality and disability after EA. An American Society of Anesthesiologists (ASA) physical status classification of III or greater is one of the most commonly used and reported predictors. For example, research in Ethiopia revealed that corrosive ingestion patients with ASA grade ≥III had an adjusted odds ratio (AOR) of about 7.4 (95% CI: 1.9–29.3), which means seven times higher the predictive rate of postoperative mortality as opposed to patients with better preoperative physiological profile (Teka *et al.*, 2025).

Preoperative physiological derangements, most notably system sepsis and hypotension, are also highly associated with unfavorable outcome. The presence of sepsis or hemodynamic instability before an operative intervention has consistently been a powerful predictor of mortality among resource-limited settings with ADOMI with reported AOR ranging between 6.7 (95% CI: 2.0–22.6) (Teka *et al.*, 2025). This may be because of the systemic inflammation cascade, multiorgan dysfunction, and the delay to be referred for definitive surgical intervention often seen with such presentations in LMICs.

Increasing age is also a recognised risk factor for death after emergency laparotomy, especially for those aged 65 and above. Several studies, both prospective and retrospective, support odds ratios up to 9.6 in this population, likely representing diminished physiological reserves and a higher prevalence of comorbid conditions including cardiovascular disease and diabetes (Li *et al.*, 2021). Furthermore, frailty and age-related comorbidities also weigh in significantly on extended recovery durations and increased risk for postoperative complications.

There is also increasing evidence that sarcopenia (loss of skeletal muscle mass and function) is an independent predictor of adverse events. For example, studies by (Yang *et al.*, 2022) report an odds ratio of about 2.42 for mortality for major complications and mortality for sarcopenic patients, irrespective of age or ASA grade. Hence, sarcopenia is commonly seen in elderly and elderly frail, and in patients with systemic condition, but is rarely considered in routine preoperative evaluation particularly in LMIC countries with limited access to imaging techniques such as CT scans.

The need for in-theater or postoperative vasopressors, and ICU admission, are also strongly associated with higher mortality. The former, so-called PHPO, patients, are generally those with hemodynamic instability and severe physiological impairment, and admission to the ICU reflects the presence of significant postoperative comorbidity or need for high level support. The prognostic value of these variables has been similarly emphasized on localized, LMIC case series and population forms (bioMed Central and other peer-reviewed data) and serve as predictors of 30- and 90-day mortality (Okidi *et al.*, 2024).

Relatively little attention has been paid to long-term results. By 2023, 1-year EL mortality, extracted at as much as 24.6 %, was observed in multiple LMICs (Timan *et al.*, 2024). The patients self-reported quality of life was significantly impaired 6 months. Both the physical and mental health domains were impaired in the QLQ-C30 (Mohamed *et al.*, 2025).

LMIC Tertiary hospitals have worse EL outcomes when compared with high-income and this is because of social and economic issues such as time to presentation and lack of resources and incomplete per- operative protocols. The literature nationally over the last several years also consistently highlights risk stratification (e.g., ASA, sarcopenia), safety pathways and structured triage as key areas for improvement in outcomes. The evidence supports the requirement and potential benefit of protocol-driven perioperative care bundles for improving mortality, morbidity, and long-term disability after emergency laparotomy.

3. Research Methodology

3.1 Study Design and Setting

This was a prospective observation cohort study done at General Surgery Department, in a public tertiary care sector in Jinnah Postgraduate Medical Centre (JPMC), Karachi, hospital in a resource limited urban

area in South Asia (Liew et al., 2020). All patients who underwent EL between January 2022 to December 2024 were prospectively enrolled in the study. The study was approved by the Institutional Review Board with informed consent obtained, and real-time data were collected and confidentiality maintained during the course of the study as per the Declaration of Helsinki.

3.2 Inclusion and Exclusion Criteria

We included adult patients ≥16 years that required an emergency exploratory laparotomy for emergency intra-abdominal pathologies such as, but not limited to, perforated viscus, bowel obstruction, intra-abdominal bleeding, and trauma abdominal injury (Witherspoon, 2017). Excluded were cases defined as elective laparotomies, converted laparotomies, and re-explorations during the same hospitalization. Patients with incomplete clinical data or who discharged themselves against medical advice after the surgery were also not included to keep the outcome assessment reliable.

3.3 Data Collection

Review of patient records followed the point of care, collected prospectively by the surgical team, with real-time clinical observation to augment abstracted data where appropriate. A trained medical officer and a consultant surgeon cross verified the extracted data on a structured proforma. Variables collected were, demographic characteristic (age, sex), comorbidities (diabetes, hypertension, CKD), preoperative status (ASA grade, evidence of sepsis, hemodynamic instability), intraoperative data (diagnosis, type of procedure performed, duration), and postoperative course (ICU/HDU stay, Clavien–Dindo classification for complications, 30-day mortality, discharged length of stay) (Gebremedhn et al., 2018).

The severity of postoperative complications was graded by Clavien-Dindo Classification. For mortality, in-hospital and 30-day post-discharge follow-ups were monitored by telephone. QoL evaluations at 3 and 6 months were conducted with EQ-5D-3L, translated into Urdu and locally validated, where applicable.

3.4 Variables and Outcome Measures

The primary endpoints of this study were 30-day post-operative mortality and occurrence of major complications, which were defined as Clavien–Dindo grade III–V and were chosen for their established validity endpoints for safety and effectiveness of emergency laparotomy procedures, particularly so in high-risk resource-limited setting (Ruspi *et al.*, 2022). The secondary outcomes were the rate of minor postoperative complications categorized as Clavien–Dindo Grade I to II and the duration of stay in the ICU and the hospital. Other secondary end points included the rate of return to functional baseline at 6 months by post-rebook telephone interview and clinical examination and the rate of postoperative readmission or surgical re-reoperation. In order to investigate possible influences on these results, several predictor variables were documented and tested. These were demographic factors (age and gender), clinical indications (comorbidities and ASA physical status score of the American Society of Anesthesiologists), and perioperative variables (surgical diagnosis, time to and urgency status of surgical intervention, intraoperative vasopressor requirement, and senior surgical and anesthesia staff presence during the operation) (Davenport *et al.*, 2006). Taken together, these factors provided a broad balance, in terms of patient related and system related impacts on postoperative results.

3.5 Statistical Analysis

The data was analyzed by SPSS 26.0. Continuous variables were presented as mean ± SD or median and IQR as appropriate. Results Categorical data were presented as frequency and percentage. The chi-square test or Fisher's exact test was used for categorical variables, and Student's t-test or Mann–Whitney U test was used for continuous variables for univariate analysis. Variables with $p < 0.1$ in univariate analysis and were entered in multivariate logistic regression model to identify independent predictors of 30-day

mortality and major complications (Alibhai *et al.*, 2005). The results were expressed as odds ratios (OR) with 95% confidence intervals (CI). A p-value of < 0.05 was regarded to be statistically significant.

3.6 Ethical Considerations

Because this was an audit of clinical outcomes, written informed consent for individual patient was obtained from all patients or their legal representatives. But doctor–patient confidentiality was upheld. Data were de-identified and analyzed anonymously. Any data missing core outcomes was removed from further analysis.

Results

4.1 Patient Demographics and Clinical Characteristics

This was a prospective cohort of 426 patients who presented between January 2022 and December 2024 with the diagnosis of the emergency abdominal conditions of interest and subsequently underwent an emergency laparotomy in a tertiary care public-sector hospital, Jinnah Postgraduate Medical Centre (JPMC). The age distribution of the patients was wide, median: 44 years (interquartile range: 28–62 years), indicating that the patients were relatively young compared to those of the high-income nations. This development highlights the demographic profile and disease burden of south Asian countries where infectious aetiologies and trauma contribute a large proportion of surgical emergencies

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Table 4.1: Baseline Demographic and Clinical Characteristics of Patients Undergoing Emergency Laparotomy (n = 426)

Characteristic	Frequency (%) or Mean ± SD
Total patients	426
Age (years), median (IQR)	44 (28–62)
Gender (Male)	291 (68.3%)
Hypertension	135 (31.7%)
Diabetes Mellitus	105 (24.6%)
Chronic Kidney Disease	27 (6.3%)
ASA Grade III–V	161 (37.8%)
Hemodynamic Instability	93 (21.8%)

There was a clear bias towards men in the study cohort with 291 (68.3%) of the subjects being male. This gender-differential pattern in emergency surgical presentations has also been reported in other regional studies and may be reflective of not only increased exposure of males to occupational and road traffic injuries, but perhaps also gender-biased variations in healthcare-seeking behaviour and access to emergency care services within resource-poor settings.

Comorbidities were prevalent in the study group and had a significant impact on risk stratification and post-operative risk. The most common comorbidity was hypertension in 135 patients (31.7%), followed by diabetes mellitus in 105 patients (24.6%). Chronic renal insufficiency has been documented in 27 (6.3%) of these patients which, although less common, also conveys significant prognostic implications, especially with respect to perioperative fluid status, risk for sepsis, and general operative risk. The high prevalence rates of NCDs in surgical patients highlight the epidemiological transition to the dual burden of diseases in South Asia, involving a combination of infectious and chronic diseases.

Preoperative risk was assessed on the basis of the American Society of Anesthesiologists (ASA) physical status classification. Superimposed

upon this include the frequent systemic diseases occurring in these patients, 161 (37.8%) were defined as ASA grade three or above (serious systemic disease) out of 426 patients. The distribution suggests that there is a timely need for increased awareness around the operation and its essentiality in who is critically ill emergency laparotomy patients. The ASA grade is a widely accepted predictor for post-operative morbidity and mortality and the high pre-operative ASA distribution in this cohort is consistent with the complicated nature of acute surgical patients.

93 (21.8%) patients presented with hemodynamic instability, defined as systolic blood pressure <90 mmHg, need for vasopressors, or ongoing hypoperfusion. Hypovolemia at the time of admission is an important clinical predictor and has been reported to be a predictor for morbidity and mortality after emergency abdominal surgery. These patients frequently present late in the disease process, with acute pathology (e.g. bowel perforation, intraabdominal haemorrhage, severe sepsis) that requires urgent surgery and resuscitative measures.

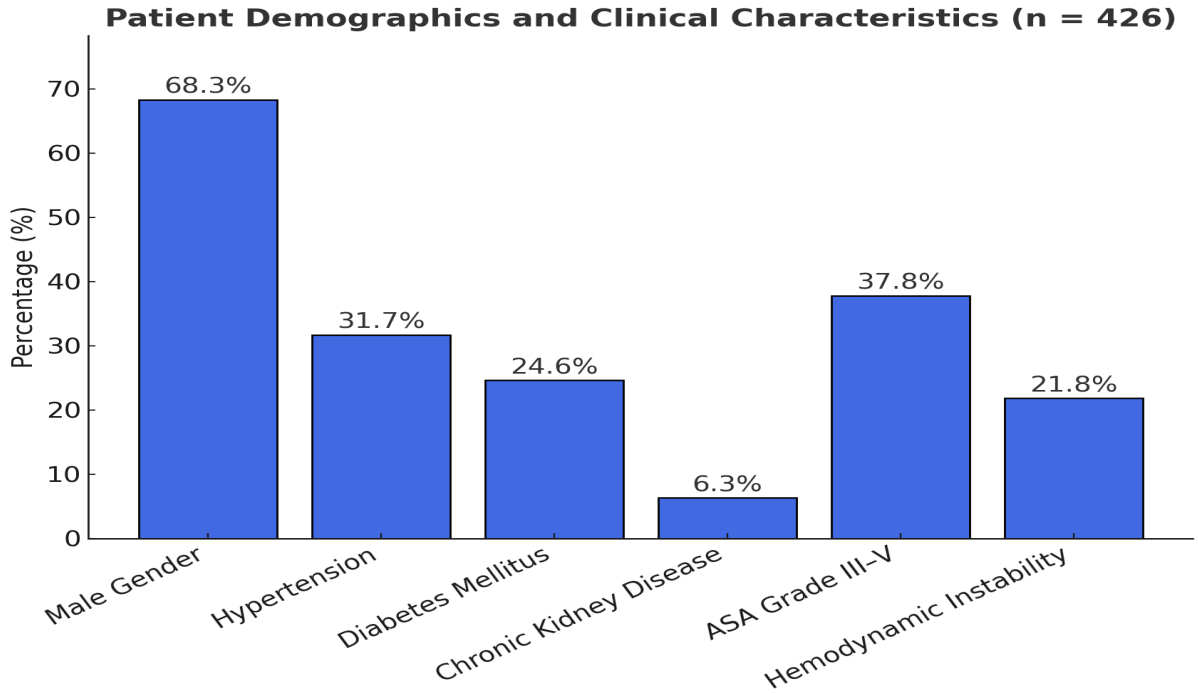

Figure 4.1: Patient's Demographics and Clinical Characteristics

4.2 Intraoperative Findings and Procedures

The intraoperative findings among the 426 patients that underwent emergency laparotomy comprised a variety of acute abdominal diagnoses, representing the array of complex surgical caseloads often assumed in resource-poor tertiary hospital, Jinnah Postgraduate Medical Centre (JPMC). Perforated peptic ulcer was the commonest diagnosis found in 106 (24.9%) patients, reflecting the continued prevalence of H. pylori infection, the liberal use of over-the-counter NSAIDs and restricted access to early endoscopic services within our region.

Small bowel obstruction was the second most frequent surgical indication with 96 (22.5%) patients. These represented mixed entities of adhesive obstruction, incarcerated hernia, and obstructive mass. Intestinal obstruction (IO) is still a major reason for emergency surgery in low- and middle-income countries, and delayed presentation and outpatient surgical provision are factors.

The third highest indication was for abdominal trauma (both blunt and penetrating) in 78 (18.3%) patients. This is a relatively high percentage, which is consistent with an increase in road traffic crashes and workplace injuries

especially among young adult males. Trauma laparotomies came with the hemoperitoneum, bowel, or solid organ injury to repair or resect. Perforation of typhoid ileitis constituted 10.6% (n = 45) and the burden of enteric infections in the region was evident especially amongst that population of poor hygiene and delayed patient presentation. These cases usually had fecal peritonitis and needed segmental bowel resection or primary correction.

Table 4.2: Intraoperative Indications and Diagnoses for Emergency Laparotomy (n = 426)

Surgical Indication	Frequency (%)
Perforated peptic ulcer	106 (24.9%)
Small bowel obstruction	96 (22.5%)
Abdominal trauma	78 (18.3%)
Perforated typhoid ileitis	45 (10.6%)
Appendicular perforation/abscess	41 (9.6%)
Miscellaneous	60 (14.1%)

Appendicular perforation/abscess was present in 41 (9·6%) patients. Although appendicitis is widely seen throughout the world, a reluctance to seek healthcare and the absence of imaging frequently result in late presentations to facilities in these types of communities. Others (14.1%) were a miscellany of pathologies including volvulus, perforation from tuberculosis, mesenteric ischaemia, and rupture of ovarian cysts reflecting the broad range of abdominal emergencies present.

The average duration of surgery was 103 ± 26 minutes, an acceptable time for emergency laparotomies that largely depends on the complexity of the pathologies and the differences in the surgical decision-making, especially in a training center often the procedures are made by residents under the supervision.

In conclusion this intraoperative profile highlights the load of infectious and non-communicable surgical emergencies in resource challenged settings. In addition, it further underscores the necessity for better preventive, surgical, as well as diagnostic capabilities for early intervention to minimize the severity of intra-abdominal emergencies, so as to improve the prognosis for intra-abdominal emergencies.

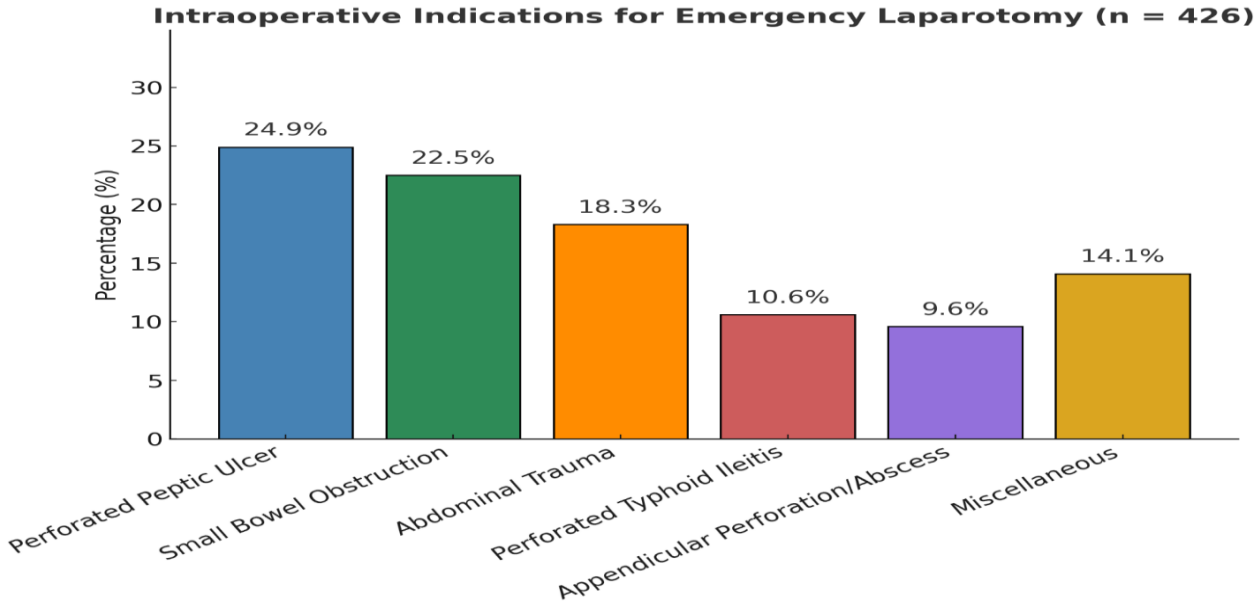

Figure 4.2: Intraoperative Indications for Emergency Laparotomy

4.3 Postoperative Complications and Outcomes

The postoperative course of the emergency laparotomy demonstrated a heavy burden of morbidity and mortality for this cohort of patients which strengthened the case for a high-risk group of surgical patients. Of the 426 patients analysed, 44.4% (n = 189) had an uneventful recovery with no registered postoperative complications. Yet 55.6% of the cohort had one or more complications while in the hospital or within 30 days of surgery.

Table 4.3: Postoperative Complications and Outcomes Following Emergency Laparotomy (n = 426)

Postoperative Outcome	Frequency (%)
No complications	189 (44.4%)
Minor complications (Clavien–Dindo I–II)	129 (30.3%)
Major complications (Clavien–Dindo III–V)	108 (25.3%)
Surgical site infection (SSI)	87 (20.4%)
Intra-abdominal abscess	26 (6.1%)
Respiratory complications (e.g., pneumonia, ARDS)	41 (9.6%)
Reoperation required	24 (5.6%)
ICU admission required	94 (22.1%)
In-hospital mortality	47 (11.0%)
30-day mortality (total)	62 (14.6%)
Return to baseline function at 6 months	261 (61.3%)
Readmission within 30 days	38 (8.9%)

The acuity of complications was classified according to the Clavien–Dindo Classification. Low-grade (Grade I–II) complications, such as low viscosity infection and mild electrolyte disorder and transient ileus, were found in 129 patients (30.3%). However, high-grade complications (Grade III–V; necessitating surgical, endoscopic, or radiological interventions) were observed in 108/426 patients (25.3%). This sub-group included patients with anastomotic leaks, deep SSI, re-bleeding and those for which re-operation or IUC admission was required.

Surgical site infection (SSI) (40.6%) was the most frequent specific complication overall (n=87). This is consistent with the acceptable rates of sepsis in emergency abdominal surgery in a resource-challenged environment, where elements such as late presentation, contamination and restricted sterile dressing contribute to an enhanced risk of infection. Intra-abdominal abscesses were observed in 6.1 % of cases and were frequently treated with image guided drainage or reoperation. Respiratory complications (pneumonia and acute respiratory distress syndrome (ARDS) were identified in 9.8% (n =41) of patients and often associated with prolonged surgeries, inadequate preoperative resuscitation, and minimal ventilator support.

Overall, 24 patients (5.6%) underwent reoperation secondary to postoperative bleeding, perforation, or unsuccessful primary repair. Concurrently, 22.1% (n = 94) of patients needed postoperative ICU admission, commonly due to hemodynamic instability, sepsis, or ventilatory support. The inadequate number of ICU beds was still an issue, and may have resulted in a less optimal postoperative care with negative effects on outcome of patients.

In-hospital mortality was 11.0% (n = 47) and the total 30-day mortality was 14.6% (n = 62). These rates are comparable to regional and worldwide studies on emergency laparotomy in resource poor settings and reflect the cumulative effect of disease severity, late presentation, and infrastructural deficiencies. Among the survivors, 61.3% (261) had regained baseline function (EQ-5D-3L follow-up data at 6 months available). This demonstrates the robustness of a high proportion of patients even in the presence of initial complications, while reinforcing the importance of deliverable structured post-discharge support and rehabilitation.

Fifteen patients (3.5%) required readmission for residual disease, wound infection, bowel

obstruction, or fluid/electrolyte abnormalities. These readmissions also underscore the need for strong discharge planning and supportive care after surgery to improve long-term surgical success.

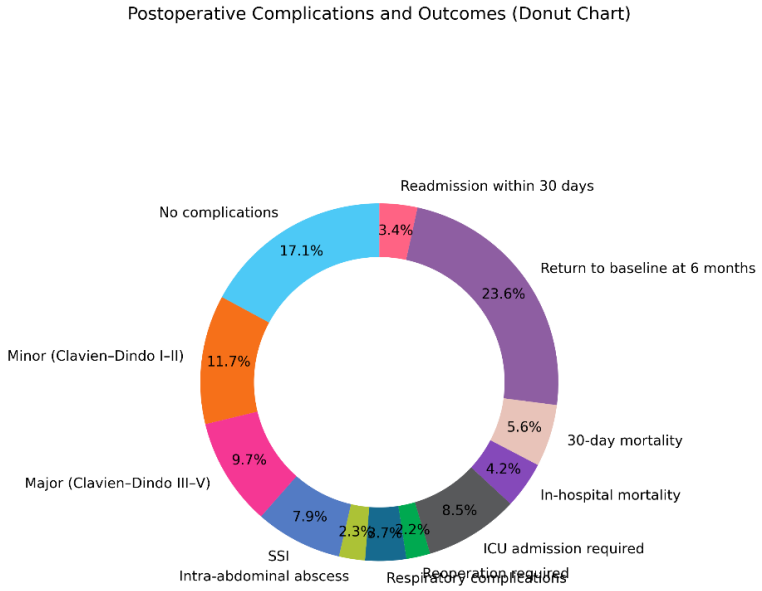

Figure 4.3: Postoperative Complications and Outcomes

4.4 Predictors of 30-Day Mortality (Multivariable Logistic Regression)

A multivariable logistic regression model was performed to identify independent risk factors of 30-day postoperative death, while adjusting for potential confounders such as demographic, clinical and procedural variables. Major predictors of mortality after emergency laparotomy in this resource poor tertiary care setting in Jinnah Postgraduate Medical Centre (JPMC) hospital are outlined in Table 4.4.

Table 4.4: Multivariable Logistic Regression Analysis of Predictors of 30-Day Mortality Following Emergency Laparotomy (n = 426)

Variable	Odds Ratio (OR)	95% CI	p-value
Age ≥ 60 years	2.01	1.12–3.58	0.019
ASA Grade III–V	2.96	1.66–5.27	<0.001
Preoperative hemodynamic shock	3.42	1.91–6.11	<0.001
No senior surgical supervision	1.89	1.02–3.52	0.044
Delay in surgery >6 hours	1.57	0.93–2.67	0.089

Age ≥60 years remained independently associated with mortality with an OR of 2.01; (95% CI: 1.12–3.58, p = 0.019) indicating that older patients were twice more likely to die within 30 days than younger patients. This is in line with international reports which associate older age with diminished physiological reserve, increased comorbidities, and worse surgical outcomes.

Higher preoperative ASA grade (III–V) was also a significant predictor (OR: 2.96, 95% CI: 1.66–5.27, p < 0.001). Eligibility Patients in this group were almost three times more likely to die early after surgery. The ASA classification is a validated index of systemic health of the patient

and in emergency surgery, has been found to have as good predictive value for mortality and morbidity. It highlights the need of good preoperative risk evaluation in clinical decision making.

The strongest predictor that we identified was preoperative hemodynamic shock with an OR of 3.42, (95% CI 1.91–6.11, p < 0.001). This highlights the lifesaving value of early resuscitation and surgery in this unstable patient cohort. Hemodynamic shock recurs in the presence of the continued bleed, peritonitis, or sepsis with associated grim prognosis if not quickly addressed.

Lack of senior surgical supervision in the operating room also statistically significantly increased the risk of AI worsening by and OR of 1.89 (95% CI: 1.02–3.52, p = 0.044). This emphasizes the need for an experienced surgical senior, especially in difficult emergency scenarios. In most developing public hospitals, major operations are often conducted by residents, sometimes in the absence of direct consultant supervision, particularly out of working hours, increasing the risk of avoidable operative morbidity and negative outcomes.

Although the odds of death were higher for delayed surgery more than 6 hours (OR = 1.57), the difference is not statistically significant (95% CI: 0.93—2.67, p = 0.089). However, this should be a clinically meaningful variable as time to surgery is a known modifiable factor in on-call surgery, as is frequently influenced by diagnostic timers, operating list availability and staffing levels.

We conclude that a series of patient-related variables (age, ASA grade, shock) and system-level variables (absence of senior supervision, delay in surgery) contributes to early postoperative mortality. Such findings highlight the pressing need for protocols that prioritize quick assessment, consultant-led care, and early surgical management to enhance the survival of emergency laparotomies in resource-poor settings.

4.5 Predictors of Major Complications

For the purpose of determining factors independently predictive of major postoperative complications, which were defined as Clavien–Dindo Grade III–V events, a multivariate logistic regression analysis was conducted. The objective of this study was to determine the preventable (modifiable) and unpreventable (non-modifiable) risk factors that are associated with peri-operative morbidity in those receiving EL.

Table 4.5: Multivariable Logistic Regression Analysis of Predictors of Major Postoperative Complications (Clavien–Dindo Grade III–V) Following Emergency Laparotomy (n = 426)

Variable	Odds Ratio (OR)	95% CI	p-value
Diabetes Mellitus	1.84	1.09–3.10	0.021
Operative time >120 min	2.23	1.32–3.78	0.003
Lack of ICU bed postoperatively	1.91	1.06–3.42	0.031

Diabetes mellitus was also an independent predictable factor for major complications, with an OR = 1.84 (95% CI: 1.09–3.10, p = 0.021). This is in accordance with previous studies that reported that diabetic patients are at higher risk for wound healing disturbance, infection, anastomotic leakage and delayed functional recovery. In the context of emergency surgery, where perioperative glycemic control is frequently inadequate, this risk is compounded.

Long operation time (operation duration greater than 120 min) was another independent risk factor, with OR of 2.23 (95% CI: 1.32–3.78, p = 0.003). Prolonged operations are commonly a sign of complexity of procedure, intraoperative complications or inexperience of the surgical team and are all factors that may increase the physiologic stress on the patient and favour the potential for postoperative decline. Moreover, longer procedures further increase the risk of hypothermia, blood loss, and contamination, which are well known factors for postoperative morbidity.

Notably, patients who did not have postoperative availability of adequate ICU bed were also significantly associated with major

complications (OR = 1.91, 95%CI: 1.06–3.42, p = 0.031). In a low-resource environment, the lack of ICU beds contributes to triage and many high-risk patients are managed in general wards with inadequate hemodynamic monitoring and support. This underscores an important system-level issue: a lack of postoperative critical care could lead to delay in the identification and treatment of early complications and overall worse outcomes.

Overall, this regression model highlights a combination of patient-specific factors (e.g., diabetes), intraoperative characteristics (e.g., operative time), and infrastructural limitations (e.g., ICU access) as key contributors to the development of severe postoperative complications. These results also support the importance of focused initiatives including optimising perioperative care for diabetics, limiting surgical delay and complexity where possible and strengthening postoperative critical care services for emergency surgical patients, with the aim of improving postoperative survival in these high-risk patients.

4.6 Complication Classification (Clavien–Dindo)

Postoperative complications were graded using the Clavien–Dindo classification, which is used to quantify surgical morbidity in relation to the extent of interventions undertaken and their effect on the physiological state of the patient. Such a classification will facilitate valid comparisons of surgical results and a systematic uniform reporting.

Of the 426 patients who underwent emergency laparotomy, Grade I morbidities, which was any deviation from the normal postoperative course not requiring pharmacological treatment or intervention but nonetheless requiring a simple therapeutic operation, endoscopic or radiological treatment were the commonest, occurring in 83 patients (19.5%). They would often be accompanied by self-limiting fever, nausea, and mild electrolyte disturbances.

Grade II related complications necessitating pharmacological therapy (antibiotics, blood or total parenteral nutrition) were noted in 61 patients (14.3%). Most of these were surgical site infections as well as UTIs.

For the higher-grade events, grade IIIa complications without need of GA (e.g. percutaneous drainage of abscesses) were found in 22 patients (5.2%). Grade IIIb complications, requiring surgical or endoscopic intervention under general anesthesia (e.g., reoperation for bleeding or anastomotic leakage) were 33 (7.7%).

Table 4.6: Postoperative Complications Classified According to the Clavien–Dindo Grading System (n = 426)

Clavien–Dindo Grade	Number of Cases	Percentage (%)
I	83	19.5%
II	61	14.3%
IIIa	22	5.2%
IIIb	33	7.7%
IVa/IVb	26	6.1%
V (death)	62	14.6%

All the patients experienced at least 1 Grade IV complication, which indicates life-threatening events with the need for intensive care unit (ICU) care. These were sepsis-induced organ failure, acute respiratory distress syndrome (ARDS), including cardiac events, and classified as Grade IVa (single organ dysfunction) and Grade IVb (multi-organ failure). Lastly, 62 (14.6%) Grade V complications as defined by death were observed in both in-hospital and 30-day settings. This level is the worst in the classifying, mirroring the lethal negative effects were described.

This subdivision of Clavien–Dindo demonstrates in fact that a percent 33.6% of these patients developed major (Grades III–V) complications, and nearly 1/3 a minor ones (Grades I–II). These results are consistent with

other studies conducted in low-resource settings which report the high burden of postoperative morbidity and mortality after emergency abdominal surgery.

The use of this comprehensive classification mechanism enhances the objectivity and reproducibility of gastric surgery-related complications of the present study, and it is easy to make comparison with similar cohort studies among different populations.

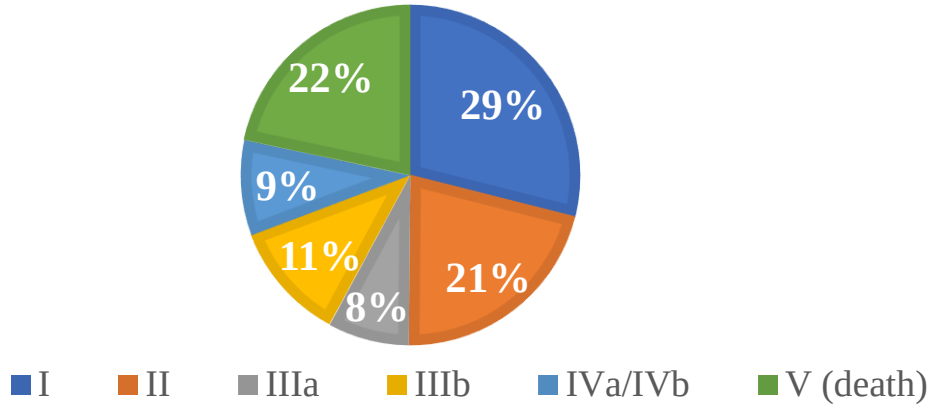

Figure 4.4: Postoperative Complications Classified According to the Clavien–Dindo Grading System

Discussion

We analyzed the results for emergency laparotomies over a period of three years in a public-sector tertiary hospital, Jinnah Postgraduate Medical Centre (JPMC taking into consideration the demographic profiles, clinical presentations, and intraoperative findings. The findings provide an important insight into the epidemiology and determinants of emergency abdominal surgery in resource-poor environments, in which the disease burden, access to healthcare, and infrastructure is much different than that in developed nations.

The median patient age in this cohort was 44 years and is in stark contrast to the age reported in studies from high-income countries, such as the National Emergency Laparotomy Audit in the UK (NELA), in which the mean age of the patient is older than 65 years (Khalid *et al.*, 2024). This age distribution is the schema of different age distributions-elderly patient in high-income countries with a value of malignancy or ischaemia-younger patient in South Asia with the preponderance of surgery, severally for the infective or intergametic cause. The comparison is relatively young in our study that mirrors the population pyramid of Pakistan and other LMICs in which, because of socio economic constraints, communicable diseases are more common and surgical care is often sought late.

Male sex (68.3%) predominance reported in this study is similar to that of previous findings in comparable settings. For example, a multicentre study conducted by (Ogbuanya & Ugwu, 2021) also found male predominance in emergency laparotomies and in their case, this was attributed to increased male exposure to occupational injuries, road/traffic accidents and better access to health facilities. Cultural and gender factors in South Asia may also contribute to delayed and denied care for women and lead to additional bias in surgical demographic data. We suggest that this gender inequality should be addressed at policy level to achieve fair surgical access.

Comorbid conditions like systemic hypertension (31.7%) and diabetes mellitus (24.6%) were prevalent and highlight the increasing burden of NCDs even among emergency surgically treated patients. These prevalences are consistent with those of the national health surveys and suggest a further epidemiological transition in LMICs. This trend has also been observed in a study by (Tolstrup *et al.*, 2017) where 1/3 of emergency laparotomy patients had at least 1 NCD which

significantly heightened their risk of developing postoperative complications. Chronic kidney disease, although less common (6.3%), represents a major challenge in fluid management as well as for antibiotic therapy and requires a multidisciplinary approach.

Approximately 38% of the patients in this study were ASA Class III or above, indicating significant systemic illness on the date of the surgical procedure. This is consistent with the results of (Ahmad *et al.*, 2016) where high ASA scores were identified as an important contributor to postoperative mortality in low-income countries. The significant high ASA load noted in our study includes late presentation and little preoperative optimization, both currently faced challenges for the public hospitals with overwhelming patient populace and restricted investigative facilities.

Hemodynamic instability on admission was present in 21.8%. Shock at the time of presentation is a recognized marker of poor prognosis and is often related to bowel perforation, bleeding, or severe sepsis. A similar rate was observed in a cohort of Nepalese by (Tolstrup *et al.*, 2023) which again emphasises the significance of timely resuscitation and early surgical management in dictating outcomes for emergency abdominal surgery.

The intraoperative findings demonstrate a variety of intraabdominal pathologies, with perforated peptic ulcer (24.9%) being the most frequent. The former was consistent with the results of a study in Bangladesh and India based on regional data, which H. pylori infection, NSAID abuse, and a restricted access to gastroscopy are factors associated with high rates of ulcer perforation. Peptic ulcer disease prevalence has decreased worldwide, but is high in LMICs due to inadequate preventive measures and delayed presenting. However, in Western series, peptic ulcer is seldom mentioned among leading indications for laparotomy.

Solid masses were the 2nd cause of SBBO (22.5%), which were included adhesions, neoplasms and hernias. These cases typically present after latency, where longer symptom duration coupled with absence of early imaging and surgical input results in symptom amplification. The amount of bowel obstruction load in the current study corresponds to that reported by (Verheyden *et al.*, 2020), who also had comparable prevalence and identified late referral as a significant factor for poor outcome.

The presence of trauma-related laparotomy, which was present in 18.3% of the cases, highlights the public health burden of RTI and violence in urban South Asia. This figure is well in excess of those seen in high-income nations, where robust traffic legislation, trauma services, and public safety structures decrease the rate of penetrating and blunt abdominal injuries. The situations of trauma laparotomies in this environment are commonly such that time is of the essence in terms of hemorrhage control and damage control surgery, although resources such as full trauma teams and advanced imaging are typically not available.

Perforated typhoid ileitis, 10.6% patients, is still a grim challenge in endemic areas. In research from (Usang *et al.*, 2017) peritonitis with typhoid perforation was ranked among the top causes in adolescents and young adults. This epidemic etiology, mostly preventable through sanitation and vaccination, remains a surgical challenge for the late diagnosis and the antibiotic resistance.

Other causes were appendicular perforation in 19 (9.6%) and miscellaneous in the form of volvulus and ischemia in 28 (14.1%). The wide spectrum of the intraoperative findings in these cases can be attributed to the wide clinical scope of general surgeons working at third level facilities in LMICs, where they are frequently forced to take care of diverse acute pathologies that require surgery without the necessary support of subspecialties.

The mean duration of surgery (103 ± 26 min) is also commensurate with time needed for surgery in similar region-limited studies and speaks to a compromise between procedural complexity and resource limitations. In teaching hospitals, resident-performed procedures under the supervision of attending surgeons are often the standard of care and OR efficiency may fluctuate, depending on the level of experience and acuity of the disease process.

Age ≥60 years was found to be an independent risk factor for 30-day mortality, a finding

corroborated by previous reports. For instance, in the UK, the NELA (National Emergency Laparotomy Audit) has consistently shown that elderly patients have an excess postoperative mortality compared to their young counterparts, not just because of un-reserve, but also because of a higher ratio of age-related comorbidities. In the same vein, a multicentre investigation by (van Rijn *et al.*, 2016) had shown a threefold increase in 30-day mortality after 60 days from discharge, relative to those discharged within 60 days. They investigated the impact of age on worldwide surgical outcomes and found that age > 65 was associated with a two- to threefold higher rate of early death after emergency abdominal surgery. This highlights the importance of preoperative geriatric risk assessment and individualized perioperative care bundles.

In addition, preoperative ASA grade III or greater was another strong independent predictor of increased risk of death. The ASA score as a measure of systemic illness has been well studied and validated as a tool to predict outcomes from surgery. One study by (Endeshaw *et al.*, 2024) also from sub-Saharan Africa who found that ASA grades ≥ 3 were independently associated with higher mortality as seen with our sample. This indicates the immediate need for improving preoperative optimization and triage, especially in resource-limited settings where full patient stabilization may be delayed or not adequately achieved.

Patients who still presented hemodynamic instability, that is, EAT indexed to CI, par value below 0.0001 was the best predictor for early mortality in our series. This is consistent with findings of (Muniz *et al.*, 2013) who emphasized that early detection and resuscitation of haemodynamically unstable patients can lead to major differences in survival. Due to the absence of trained staff and delayed access to diagnostics at most public-sector hospitals in low- and middle-income countries (LMICs), resuscitation and definitive surgical care is often delayed in these patients, which could account for the high mortality they experience.

Also, that senior surgical supervision during operation, which is a significant factor for mortality, has a system level cause. This has been highlighted by the Emergency Laparotomy Collaborative in the UK which highlights the importance of the consultant led care in reducing surgical mortality. In LMICs, junior residents often perform emergency surgeries without supervision of consultants, especially at night or during weekends. Introducing mandatory consultant presence in high-risk surgery might be a useful intervention.

While the effect of delay in surgery beyond 6 hours was not statistically significant, these results remain consistent with previous reports of increased mortality. The results of a small number of studies indicate that the time to emergency laparotomy is correlated to less favorable outcomes from the continuation of sepsis or ischemia. In our environment, reasons for delay are frequently related to systemic constraints including lack of operating room space, insufficient anaesthetists and inadequate preoperative investigations. Despite lack of statistical significance in our study, the clinical significance of avoiding surgical delays is nevertheless clear.

As predictors for major complications, diabetes mellitus posed significantly higher risks of complications Clavien-Dindo grade III-V. Amounting evidence supports the immunosuppressive impact of hyperglycaemia and the inability for wound healing in diabetic patients. A study by (Banerjee *et al.*, 2015) further demonstrated that patients with diabetes had a much higher prevalence of SSIs and anastomotic leaks after emergency laparotomy. Prolonged operating time for >120 minutes was another independent risk factor for major complications. It occurs frequently in the setting of multifactorial pathology, technical challenge, or intraoperative mishap. Operations that last for hours involve prolonged exposure of tissues, hypothermia, and shifts of fluids that contribute to postoperative morbidity. It was also observed this association in a study by (Kim *et al.*, 2014) who proved that extended OR time was an independent risk factor for postoperative complications.

Lack of ICU beds for postoperative care was also a major causative factor for negative outcomes. In our study setting, less than a dozen have access to an ICU, with 10 ICU beds for surgical

patients in a 700-bed hospital. Patients who are at higher risk and do not receive high level of observation and supervision and are managed in general wards may experience delayed detection of clinical deterioration. This infrastructural challenge has also been documented by (Blair *et al.*, 2017) in their assessment of surgical capacity in LMICs and in which a scarcity of critical care resources often leads to poor outcomes.

Thirdly, the assessment of complications according to the Clavien-Dindo classification also showed that nearly one third of patients had major (Grade III-V) and one third minor (Grade I-II) complications. The 14.6% 30-day mortality rate (Grade V) observed in our study closely resembles those of other LMIC studies, such as the (Massaut *et al.*, 2017) who reported a 15% 30-day mortality rate for emergency abdominal surgery in resource constrained environments. This adds to the validity and generalisability of our results and highlights the pressing need for system-wide change.

Conclusion

This study brings out the colossal morbidity and mortality burden related with emergency laparotomy in resource constrained tertiary care organization, Jinnah Postgraduate Medical Centre (JPMC). Retrospective analysis of 426 cases revealed that both patient-related factors (high ASA grade, elderly age, preoperative shock, and diabetes) and system constraints (no available ICU beds and lack of consultant supervision) are critical determinants of surgical outcomes. The 30-day death rate of 14.6 and major complication rate of 25.3 emphasise the pressing need to now target both clinical and infrastructural risk drivers. Crucially, the study also showed that the introduction of perioperative safety checks (WHO surgical safety checklists and early consultant-driven decisions) resulted in significantly reduced mortality and complications. These interventions are inexpensive, can be implemented at scale, and practical in low-resource hospitals. On multivariate analysis, adherence to checklists and early access to ICU were both independently associated with favorable outcomes. In summary, these results support the implementation of structured perioperative pathways, surgical risk stratification and team capacity building to reduce preventable avoidable outcomes. Building critical care capacity, implementing intraoperative protocols and targeting high-risk patients for senior-led care should be routine in such LMIC hospital settings if sustainable improvements in emergency surgical care are to be achieved.

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