The clinical profile of abdominopelvic injury and the determinants of length of stay and mortality in the intensive care unit of a tertiary hospital

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Background. Associated with preventable mortality, 50% of abdominopelvic patients require an intensive care unit (ICU). Limited ICU beds in South Africa are significantly impacted by prolonged stays, with 20% of prolonged stays being a result of abdominopelvic injuries.
Objective. To describe the clinical profile and the determinants of length of stay and mortality in patients with abdominopelvic injury admitted to a tertiary hospital ICU.
Methods. A retrospective analysis of abdominopelvic injury patients admitted to the surgical ICU at Tygerberg Hospital from January 2021 to December 2023. Using REDCap, demographic and clinical profile data were captured from the Electronic Content Management system. Negative binomial and logistic regression models were used to examine the determinants of length of stay and ICU mortality. respectively.
Results. Of the 82 eligible participants, 79.3% were male, mean age of 36.5 years (95% confidence interval (CI) 33.8 - 39.1), with isolated abdominal injury accounting for 14.6% of cases. The median length of ICU and hospital stay was 5 days (interquartile range (IQR) 3 - 13), and 19 days (IQR 9 - 40.5), respectively, with age, acute physiology and chronic health evaluation (APACHE II) score, shock index and relook surgery being the key determinants of length of ICU stay. Further to these factors, ICU mortality was associated independently with serum lactate levels (odds ratio 1.37 (95% CI 1.04 - 1.80) with the crude mortality rate (CMR) being 29.3%.
Conclusion. The majority of abdominopelvic injuries admitted to the ICU are non-isolated, with age, APACHE II score, shock index and relook surgery key determinants of ICU length of stay. Further, ICU mortality is associated with serum lactate levels. Adequate resuscitation and optimising initial surgery may help reduce patients' stay in the ICU, and mortality.

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Contribution of study
In South Africa, where the burden of trauma is quite high, this study provides context-specific insights, general overview of abdominal trauma patients needing ICU care, valuable cognisance of the key determinants of ICU morbidity and the predictive role of serum lactate with regard to ICU mortality following abdominal trauma.

Abdominopelvic injury occurs in one-third of all trauma patients, with a 1 - 20% mortality globally;[1] however, trauma-related death caused by abdominal injury alone is usually preventable with close monitoring.[2] Although mortality associated with abdominal injury is preventable, in South Africa (SA), where the burden of trauma is high,[3] both blunt and penetrating abdominal injury continue to significantly impact the health system, with an ever-increasing morbidity and mortality burden seen annually.[4] About 50% of hospitalised trauma patients globally will require an intensive care unit (ICU) or a high-care unit (HCU) admission;[5] however, with the limited resources in SA, this worsens the prognosis associated with abdominal injury in the country.

ICUs are highly specialised units, designed for close patient monitoring, rapid intervention, and treatment of acute and usually reversible disease. Globally, ICUs/HCUs are labour intensive requiring a lot of resources, and this can be challenging in resource-limited countries such as SA. In 2019, Mahomed *et al.*[6] demonstrated that although significantly lower than that of high-income countries (HICs),

the average cost per day in a public sector trauma ICU in SA was ZAR 17 021 with slight differences across provinces. With an estimated population of 60 million in the country, there are 4 168 ICU/HCU beds. with 42.8% of these in the public sector, with the majority of these beds located in 3 of the 9 provinces in SA.[7] The public sector bed:population ratio in the Free State, Gauteng and Western Cape provinces was less than 1:20 000.[7] With these significant limitations in ICU/HCU care in SA, prolonged ICU admissions are associated with worse patient outcomes, high healthcare costs, significant socioeconomic impact on families and multiple ethical dilemmas.[8]

In order to improve the quality of care and efficiently manage healthcare provision cost in the country, one of the primary goals in ICU/HCU management aside from mitigating mortality is to prevent prolonged ICU/HCU admissions.[9] Several factors have been shown to be associated with mortality and prolonged ICU admissions in patients with abdominal injury, with the commonest factors being age, gender, type of admission (elective or emergency), severity of illness (within 24 hours of admission), primary pathology or diagnosis on admission, and the presence of comorbidities.[10-12] Despite the high burden of trauma including abdominal injuries, the limited ICU/HCU care available to manage trauma patients, and the relatively young population in SA, limited context-specific data exist. In this article, we describe the clinical profile of abdominal injury patients admitted to a public sector ICU and evaluate the determinants of length of stay and ICU mortality.

Methods

Study design, settings, participants, and ethical considerations

Study design

For this study, a retrospective analysis of data collected from January 2021 to December 2023, on all abdominal injury patients admitted to the A1W ICU of Tygerberg Hospital (TBH) was done. Patients with abdominal injury are commonly admitted to the A1W ICU if they need ionotropic/vasopressor support, mechanical ventilation, or advanced monitoring.

Study settings

TBH is a public tertiary hospital located in Parow, Cape Town, in the Western Cape Province of SA, servicing an average population of over 4.8 million people, the majority of whom have a low socioeconomic status (Supplementary Figure 1). It is the largest academic hospital in the Western Cape, with 1 384 active beds. The 14-bed A1W ICU is one of 10 ICUs in TBH, and it is the largest ICU in the hospital in terms of bed capacity. It is specially designed to accommodate most surgical and trauma patients requiring ICU/HCU admission. The unit is a 24-hour, closed-ICU manned by 4 fulltime specialists, 5 - 7 surgical and anaesthesia trainee-doctors who rotate through the unit, 45 nurses, 1 physiotherapist, 1 dietician, 2 clinical technicians and 5 domestic staff. The unit admits approximately 250 patients per year, with 40% of these admissions being due to trauma. Data of patients admitted to the unit are recorded in the clinical user records of the unit and on the hospital's electronic records system (Electronic Content Management (ECM)).

Participants

Inclusion criteria. All consecutive patients above 18 years with abdominal injury admitted to the A1W ICU within the period in review were included in the analysis, with isolated abdominal injury being defined as injury limited to structures of the abdomen and/or any of the intra-abdominal organs.[13,14]

Exclusion criteria. Pregnant women, polytrauma patients, patients who did not meet the Western Cape ICU admission criteria[15] and patients admitted to the ICU for <24 hours or >60 days were excluded.

Ethical considerations and regulatory compliance

This study was performed in compliance with the Declaration of Helsinki and the Department of Health (DoH) Guidelines for Good Clinical Practice. Ethical approval was received from the Health Research and Ethics Committee (HREC) and it included an approval for a waiver of informed consent from participants. This was a retrospective study with minimal risk to participants, and it was practically impossible to obtain consent from all the participants. Data accessed for this study were in the care of the facility (TBH) and remain the property of the Western Cape DoH. Consent to gain access to patient information was obtained from the facility manager of TBH and the facility manager acted as custodian of all the folders.

Data management plan

REDCap, a secure data collection tool, was utilised in data collection. REDCap has remarkable data protection features, with password access granted only to the principal investigator and supervisors of this study. Participant data were kept confidential and shared in accordance with the Protection of Personal Information Act (POPIA). Anonymity was ensured by removing all identifying information from the dataset. Each participant received a study-specific ID for analysis. The primary investigator and supervisors had exclusive access to the collected data, stored securely on the institution's website with password protection. The data collected remain the institution's intellectual property. No monetary incentives, compensation or payment in kind was offered to study participants, the facility manager or the facility.

Data collection, extraction, and definitions

The patients' notes and records were accessed electronically on the TBH OpenText ECM system. ECM is password protected and only hospital staff members and approved university staff members may access the program with their individual username and password.

Using REDCap, the following data were extracted from the TBH National Health Laboratory Service (NHLS) laboratory information system (TrakCare, InterSystems, USA), the ECM and electronic continuity of care record (ECCR) systems:

1. Demographic information (including age, gender, and occupation (as a proxy of socioeconomic status (SES)); clinical history and examination (history of chronic illnesses and other comorbidities with emphasis on cardiovascular disease (CVD), type 2 diabetes mellitus (T2DM), and chronic renal failure (CRF), previous surgeries or hospital admissions, weight, admitting vitals – systolic blood pressure (SBP), heart rate (HR), shock index (calculated by dividing the HR by SBP)).
2. Clinical profile variables – type of abdominal injury (including blunt and/or penetrating injury) and mechanism of injury (including motor vehicle accident (MVA), pedestrian vehicle accident (PVA), gunshot wound (GSW), stab, and other); type and grade of organ involvement (abdominopelvic viscous injury – liver, spleen, retroperitoneal haematoma, genitourinary, ruptured diaphragm, pelvic fracture, and other); time from injury to hospital admission; how the diagnosis was made, clinically only, or clinically with investigations (fasting computed tomography (CT/FAST)); associated injuries including head, chest, orthopaedic/soft-tissue, other head/neck injuries, maxillofacial, spinal, and vascular;

severity of injury graded as mild, moderate, severe based on either modified injury severity score (ISS), abbreviated injury scale (AIS), or blunt abdominal trauma scoring system (BATSS); [16] severity of illness on admission at ICU including acute physiology and chronic health evaluation (APACHE) II score and sequential organ failure assessment (SOFA) score; and mechanical ventilation (defined by number of days requiring ventilation); worst laboratory results in the first 24 hours of admission including lactate, full blood count (FBC), serum urea, creatinine and bilirubin, and international normalised ratio (INR); ICU course including number of relook surgeries.

3. Primary outcome variables – in-ICU mortality, length of ICU admission and length of hospital admission.
4. Secondary outcome variables – median ventilatory days, prolonged ICU stay (defined as >7 days), prolonged hospital stay (defined as >12 days) and number of relook surgeries.

Length of ICU and hospital admission, which are part of the primary outcomes, were defined as the number of calendar days from ICU/hospital admission to ICU/hospital discharge or mortality. Prolonged ICU admission was defined as ICU admission >7 calendar days, and prolonged hospital admission was defined as >12 calendar days; these cut-offs are in tandem with other studies.[17,18] Cardiometabolic disease (CMD) refers to specific interrelated conditions; CVD, T2DM and CRF, which all have metabolic derangement as risk factors for their development.[19]

Data analysis and sample size calculation

Data analysis

The data were analysed using RStudio version 2021.09.1 Build 372 for Mac Os (Posit, USA) and Microsoft Excel for Mac (version 16.92) (Microsoft Corp, USA). Data on continuous variables were presented as mean with 95% confidence interval (CI) for normally distributed data, and as median with interquartile range (IQR) for non-normally distributed data (normality was determined with the Shapiro-Wilk test and graphically with histograms). Data on categorical variables were presented as frequencies and/or percentages (proportions). Bivariate analysis (not shown), consisting of either a simple linear regression (for a parametric dependent variable) or a Spearman's correlation (for a non-parametric dependent variable), was used to identify significant determinants of ICU mortality, length of ICU admission and length of hospital admission guided by expert knowledge. Following the bivariate analysis, multivariate analysis was done using negative binomial regression and logistic regression to evaluate the determinants of length of ICU admission and ICU mortality, respectively. Results were presented as incidence rate ratio (IRR) and odds ratio (OR) with 95% CI, respectively.

Sample size calculation

The sample size included all patients with abdominal injury admitted to the A1W ICU within the study period. As all patients with abdominal injury are included in this descriptive retrospective study, there was no specific sample selection.

Results

Selection of participants, sociodemographics, clinical profile and biochemistry

Of the 209 trauma patients admitted to the A1W ICU during the study period, 84 suffered from abdominopelvic trauma. Two patients with missing data were further excluded, leaving 82 participants for the analysis (Supplementary Figure S2).

Details of the sociodemographics, clinical profile and first 24-hour biochemistry of patients are shown in Table 1. The average age of the patients was 36.5 years (95% CI 33.8 - 39.1). Among them, 79.3% were male, 65.9% were unemployed, 13 patients had comorbidities, with 6 diagnosed with CMD, and 41.5% had an exploratory laparotomy on admission, while 9.8% had damage-control surgery. The mean admitting SBP and HR were 132.4 mmHg (95% CI 125.5 - 139.4), and 113.3 bpm (95% CI 108.9 - 117.7) respectively, with a median shock index of 0.8 (25th quartile (Q1), 75th quartile (Q3) 0.7, 1.1). The median APACHE II score was 10.0 (Q1, Q3 4.0, 17.0), the median length of ICU stay, and length of hospital stay were 5.0 days (Q1, Q3 3.0, 13.0) and 19.0 (Q1, Q3 9.0, 40.5), respectively. Approximately 53.6% required vasopressors, and 95.1% required ventilatory support, with the median ventilatory days being 5.0 days (Q1, Q3 2.0, 13.0). The mean haemoglobin was 10.4 g/dL (95% CI 9.9 - 10.9), the median INR was 1.3 (Q1, Q3 1.2, 1.5) and the median lactate was 3.0 mmol/L (Q1, Q3 1.1, 5.8). Further details of the admitting biochemistry of patients stratified by injury association status are shown in supplementary Table 1.

Details of the abdominal injury of patients

Table 2 shows details of the abdominal injury in patients admitted to the ICU during the study period. The majority of patients (80.5%) had additional injuries (non-isolated injuries), with cardiorespiratory injuries being the most common additional injury (30 cases). Blunt abdominal injuries accounted for 61.0% of the injuries admitted to the ICU, with 34.1%, 30.5%, 19.5% and 4.9% being as a result of MVAs, GSWs, PVAs and stabbing, respectively. The majority of patients (48.9%) had an ISS of severe, and 50.0% admitted to the ICU were classified as severely ill on the day of admission, with 30.5% requiring relook surgery.

Determinants of length of ICU stay and ICU mortality

Older age (>41 years), a higher shock index, having a moderate injury severity, and undergoing relook surgery were significantly associated with increases in the length of ICU stay, with IRR of 2.32 (p=0.007), 2.97 (p=0.010), 1.67 (p=0.025) and 2.42 (p<0.001), respectively. However, increasing APACHE II score was associated with shorter ICU stays (IRR 0.97, p=0.010). Full details of the negative binomial regression models are shown in Table 3.

Fig. 1 is the forest plot showing factors significantly associated with ICU mortality, and supplementary Table 2 shows the OR of factors associated with ICU mortality. APACHE II score, ICU length of stay, and lactate levels are significant predictors of ICU mortality, with higher values increasing the odds of ICU mortality: 1.294 (p=0.017), 1.528 (p=0.008), and 1.371 (p=0.022), respectively. However, age (OR 0.835, p=0.032) and length of hospital stay (OR 0.704, p=0.004) were associated with reduced odds of ICU mortality.

Interactions of the different prevalences of length of ICU and hospital stay

Fig. 2 illustrates the interactions between different dichotomous prevalence rates of ICU and hospital length of stay stratified by associated injury status. For patients with isolated abdominal injury, 50% had a normal ICU length of stay with a prolonged hospital stay. However, for patients with non-isolated abdominal injury, 34.8% had both a prolonged ICU and prolonged hospital length of stay, while 34.8% had a normal ICU and hospital length of stay.

Table 1. Sociodemographic characteristics, clinical profile, and 1st 24-hour biochemistry of patients with abdominal injury admitted to the surgical ICU (*N*=82)

	n (%)*
Sociodemographic	
Age (years), mean (95% CI)	36.5 (33.8 - 39.1)
Gender	
Female	17 (20.7)
Male	65 (79.3)
Occupation	
Unemployed	54 (65.9)
Informal	16 (19.5)
Formal	6 (7.3)
Unspecified	6 (7.3)
Clinical profile	
Has a history of comorbidities	
Yes	13 (16.0)
No	58 (70.7)
Unknown	11 (13.6)
Known comorbid conditions	
TB	1.0 (1.2)
CMD	6.0 (7.3)
RVD	3.0 (3.7)
Mental illness	2.0 (2.4)
Index surgery	
Exploratory laparotomy	34 (41.5)
Exploratory laparotomy + other	13 (15.8)
Damage control surgery	8 (9.8)
Limb surgery or amputation	9 (11.0)
Tracheostomy + other	4 (4.9)
Not specified	9 (11.0)
Other	5 (6.0)
Admitting SBP (mmHg), mean (95% CI)	132.4 (125.5 - 139.4)
Admitting HR (bpm), mean (95% CI)	113.3 (108.9 - 117.7)
Shock index, median (Q1, Q3)	0.8 (0.7, 1.1)
APACHE II score, median (Q1, Q3)	10.0 (4.0, 17.0)
Highest SOFA score, median (Q1, Q3)	6.0 (3.0, 10.0)
Requiring ventilation	
Yes	78.0 (95.1)
Days of mechanical ventilation, median (Q1, Q3)	5.0 (2.0, 13.0)
Requiring inotropes/vasopressors	
Yes	44 (53.6)
No	35 (42.7)
Unknown	3 (3.7)
Time from injury to facility	
>24 hours	7 (8.5)
12 - 24 hours	9 (11.0)
6 - 12 hours	21 (25.6)
<6 hours	22 (26.8)
Not specified	23 (28.1)
Length of ICU stay, median (Q1, Q3)	5.0 (3.0, 13.0)
Length of hospital stay, median (Q1, Q3)	19.0 (9.0, 40.5)
Biochemical profile 1st 24 h of ICU admission	
Lactate (mmol/L), median (Q1, Q3)	3.0 (1.1, 5.8)
Haemoglobin (g/dL), mean (95% CI)	10.4 (9.9 - 10.9)
White cell count (× 10^9/L), median (Q1, Q3)	8.6 (5.4, 13.9)
Platelets (× 10^9/L), median (Q1, Q3)	144.0 (105.0, 204.0)
Clotting, INR, median (Q1, Q3)	1.3 (1.2, 1.5)
CRP (mg/L), median (Q1, Q3)	167.0 (79.0, 299.5)
Urea (mmol/L), median (Q1, Q3)	6.9 (4.9, 9.1)
Creatinine (µmol/L), median (Q1, Q3)	92.5 (72.5, 144.8)

* Unless otherwise indicated.
CI = confidence interval, TB = tuberculosis, CMD = cardiometabolic disease, RVD = retroviral disease, SPB = systolic blood pressure, HR = heart rate, bpm = beats per minute, Q1 = 25th quartile, Q3 = 75th quartile, APACHE = acute physiology and chronic health evaluation, SOFA = sequential organ failure assessment, INR = international normalised ratio, CRP = C-reactive protein.

Discussion

Key findings

In this retrospective analysis of patients with abdominal injury admitted to the ICU, we show that the majority were non-isolated injuries, required ventilatory and vasopressor support, with CMD being the major comorbidity. Blunt abdominal injuries, primarily caused by MVAs, were the most common. Most patients had a severe ISS and moderate illness severity at admission, as indicated by a low median APACHE II score. Older age, moderate ISS, increasing shock index, and undergoing relook surgery were significantly associated with increasing length of ICU stay, while increasing APACHE II score was associated with shorter ICU stays. APACHE II, ICU length of stay and serum lactate levels significantly predicted ICU mortality. Patients with isolated abdominal injury had a higher prevalence of normal ICU length of stay with a prolonged hospital stay.

Discussion of key findings

In this retrospective analysis of ICU-admitted patients with abdominal trauma, we observed that most were non-isolated injuries, required ventilatory and vasopressor support, with cardiometabolic disease (CMD) being the most common comorbidity. These findings are in tandem with previous studies. Firstly, the prevalence of non-isolated abdominal injury varies from region to region, with a study carried out in Tanzania reporting a prevalence of 65.4%.[20] Further, in the ICU setting patients admitted with abdominal injury often present with multiple injuries; this was highlighted in a study by Alqarafi *et. al.*[21] Secondly, several studies have shown the need for mechanical ventilation and vasopressors in trauma patients, with the number of ventilator days a predictor of ICU mortality and length of stay.[22-24] A possible explanation for this is the fact that abdominal injury patients requiring ICU support have multiple injuries usually involving the chest. These patients are usually acutely ill and thus they require organ support, especially in the first 24 hours following the injury. Finally, the increasing global burden of obesity and obesity-related diseases[25,26] has led to an increased prevalence of CMD among trauma patients. CMD disproportionately affects Africans compared with other ethnic groups[27] and affects people of African descent at a much younger age compared with other ethnic groups.[28,29] With a relatively young population,[30] South Africans are impacted more by CMD compared with Western populations and it is no surprise that CMD accounted for the majority of comorbidities seen in patients with abdominal injury in the ICU.

The majority of patients had blunt abdominal injury from MVAs, a severe ISS and moderate illness severity on admission, supported by a low median APACHE II score. Similarly, Ntundu *et al.*[20] in a prospective observational study carried out in a single centre in northern Tanzania, concluded that blunt abdominal injury was common and mostly associated with RTAs,[20] and these findings were corroborated in other studies.[1,17] In addition, prior studies have

Table 2. Details of the abdominal injury with which patients were admitted to the surgical ICU in a public sector tertiary hospital, *n*=82 patients

	n (%)
Injury association status	
Isolated abdominal injury	12 (14.6)
Non-isolated abdominal injury	66 (80.5)
Not specified	4 (4.9)
Type of abdominal injury	
Blunt	50 (61.0)
Penetrating	30 (36.6)
Both	2 (2.4)
Mechanism of injury	
GSW	25 (30.5)
Stab/impale	4 (4.9)
GSW + stab	1 (1.2)
PVA	16 (19.5)
MVA	28 (34.1)
Other	8 (9.8)
Associated systems	
Head (TBI/facial injury)	20 (24.4)
Chest/cardiorespiratory	30 (36.6)
Genitourinary	11 (13.4)
Spine fractures	17 (20.7)
Limb fractures	20 (24.4)
Associated solid organ injury	
Liver injury	
Grade 1 - 3	10.0 (12.1)
Grade >3 - 5	7.0 (8.5)
Splenic injury	
Grade 1 - 3	11 (13.4)
Grade >3 - 5	5.0 (6.1)
Renal injury	
Grade 1 - 3	3.0 (3.7)
Grade >3 - 5	5.0 (6.1)
Pancreatic injury	8.0 (9.8)
Diaphragmatic injury	6.0 (7.3)
Bowel perforation	
Yes	25 (30.5)
Injury severity	
Severe	40 (48.9)
Moderate	21 (25.6)
Mild	2 (2.4)
Unspecified	19 (23.2)
Severity of illness on admission	
Moderate	41 (50.0)
Severe	30 (36.6)
Unspecified	11 (13.4)
Patient required relook surgery	
No	52 (63.4)
Yes	25 (30.5)
Unspecified	5 (6.1)

GSW = gun shot wound, MVA = motor vehicle accident,
PVA = pedestrian vehicle accident, TBI.= traumatic brain injury.

Table 3. Determinants of length of ICU stay as derived from negative binomial regression

Length of ICU stay	IRR	*p*-value	95% CI
Age category (years)			
Ref: 18 - 28			
29 - 34.5	0.96	0.91	0.52 - 1.80
35 - 40	1.00	0.10	0.56 - 1.80
>40+	2.33	0.01	1.26 - 4.31
APACHE score	0.97	<0.00	0.95 - 0.99
Shock index	2.97	0.01	1.30 - 6.79
Injury severity			
Ref: Severe			
Moderate	1.67	0.03	1.07 - 2.61
Relook surgery			
Yes	2.42	<0.00	1.54 - 3.81

demonstrated the validity of ISS and the APACHE score[31] in stratifying and predicting mortality associated with trauma, ISS provides a reliable measure of anatomical injury severity, while APACHE II is a better predictor of short-term ICU outcomes.[32] The majority of patients having a severe ISS aligns with a similar study carried out in Tanzania, where the majority of patients admitted to the ICU with abdominal injury had high ISSs.[17] However, patients with moderate illness severity on admission, supported by a low median APACHE II score, were in contrast to what we hypothesised and most of the literature available. A possible explanation for this finding is the fact that, owing to the limited ICU beds in SA, the admission criteria for patients with trauma is quite stringent, with only patients with a very good chance of recovery and benefiting from ICU care admitted. In addition, SA bears a high trauma burden, and studies indicate that approximately half of trauma victims die before reaching tertiary level facilities with ICU support, owing to factors like prolonged prehospital times, limited EMS resources, and frequent scene fatalities.[33,34]

Our study aligns with existing literature, indicating that older age, moderate ISS, increasing shock index, and relook surgery are significantly associated with prolonged ICU stays. These factors have been widely recognised as contributors to critical illness progression and extended hospitalisation.[11,18] Intuitively, increasing ISS is associated with increased mortality, and seen as a predictor of mortality rather than an indicator of morbidity.[35] Limited data exist on the predictive role of ISS with regard to morbidity; hence our finding of moderate ISS being associated with prolonged ICU stay. A marker of morbidity serves as bed rock for further evaluation of the ISS. In addition, shock index has been shown to be associated with mortality in geriatric populations;[36] however, our population was largely young (mean age 36.5 years), suggesting that the shock index is also predictive of morbidity in a younger population. Interestingly, a higher APACHE II score was associated with shorter ICU stays, possibly reflecting increased mortality or rapid deterioration in more severely ill patients, as previously described in ICU mortality prediction models.[37]

Our findings highlight APACHE II score, ICU length of stay, and serum lactate levels as significant predictors of ICU mortality. Traditionally, APACHE II score and ICU length of stay, which is a marker of ICU morbidity, have been shown to be significant predictors of ICU mortality.[38] Findings of our study further consolidate these factors as key predictors of ICU mortality. Elevated lactate has long been established as a marker of poor perfusion and higher mortality risk in critically ill trauma patients.[39]

Lastly, patients with isolated abdominal injuries demonstrated a higher prevalence of normal ICU length of stay but prolonged hospital admission. This may suggest that while their ICU course was less complicated, post-ICU care, including surgical recovery and rehabilitation, required extended hospitalisation, a pattern previously noted in abdominal trauma studies.[40]

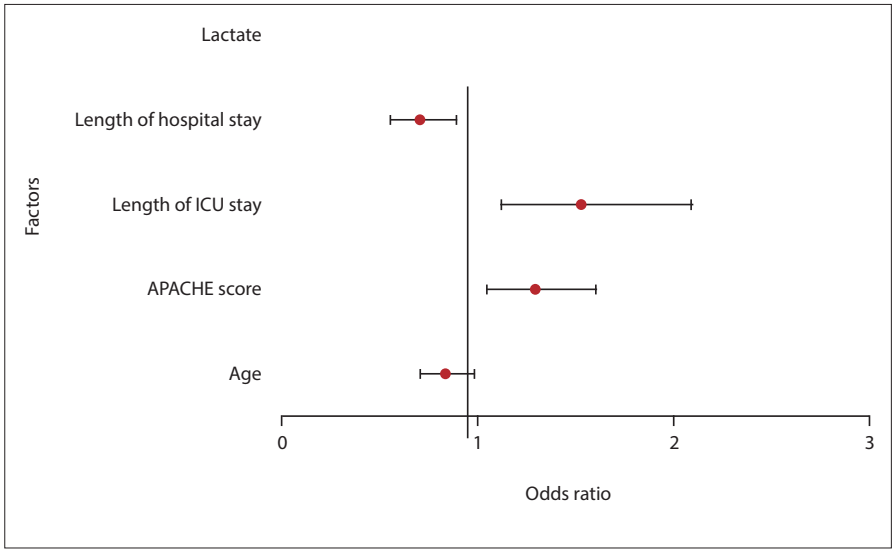

Fig. 1. Forest plot showing significant factors associated with ICU mortality.

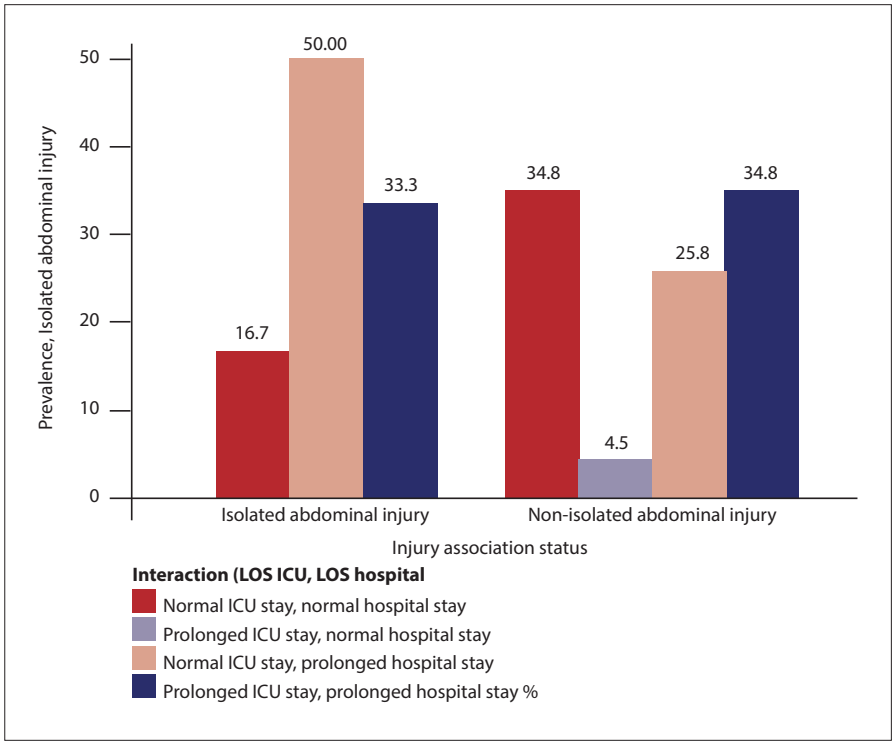

Fig. 2. Interactions of the different prevalence of length of ICU and hospital stays by injury status.

Strengths and limitations

This study was based on a retrospective analysis of ICU patients, providing insights into real-world clinical outcomes for abdominal trauma patients in a public sector tertiary ICU. The study evaluated multiple clinical factors (age, shock index, relook surgery, ISS, APACHE II score), providing a broad understanding of ICU stay determinants. Abdominal injury is common with preventable mortality associated with it, and this study adds to the limited data available on ICU outcomes for these patients, especially in a public sector setting. Further, this study highlights crucial predictors of ICU mortality, including APACHE II score, ICU length of stay, and serum lactate levels, which are valuable for risk stratification. Our findings can inform ICU management strategies, guiding clinicians in optimising patient care and predicting patient outcomes.

A key limitation to this study also lies in the fact that it was a retrospective analysis, with intrinsic selection bias and missing data. In addition, the study was conducted in one public tertiary ICU; the findings may not be generalisable to other settings, including private hospitals or ICUs in different regions. The study focused on ICU and hospital stay duration but does not assess long-term functional outcomes or post-discharge complications.

Conclusion

In this retrospective analysis of abdominal trauma in a public sector tertiary ICU, several factors were associated with a longer ICU stay, including older age, a higher shock index, undergoing relook surgery, and moderate ISS. However, a higher APACHE II score was linked to shorter ICU stays. Additionally, APACHE II, ICU length of stay, and serum lactate levels were significant predictors of ICU mortality. Patients with isolated abdominal injuries were more likely to have a normal ICU stay but experienced prolonged hospitalisation.

Data availability. The data used for this study are available from the authors on request.

Declaration. No part of this work was generated by artificial intelligence (AI) or assisted technology.

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Author contributions. YKM and SC conceived the study, TM and RS assisted with data entering, while YKM performed the statistical analysis assisted by a university-approved biostatistician. The manuscript was written by YKM, supervised by SC and NRS, in co-operation with all co-authors. All authors read and approved the final version of the manuscript.

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1. Wiik Larsen J, Søreide K, Søreide JA, Tjosevik K, Kvaløy JT, Thorsen K. Epidemiology of abdominal trauma: An age- and sex-adjusted incidence analysis with mortality patterns. Injury 2022;53(10):3130-3138. https://doi.org. 10.1016/j.injury.2022.06.020
2. Haddad SH, Yousef ZM, Al-Azzam SS, et al. Profile, outcome and predictors of mortality of abdomino-pelvic trauma patients in a tertiary intensive care unit in Saudi Arabia. Biomed Res Int 2007;9(1):591-594. https://doi.org/10.1016/j.injury.2014.07.025
3. Moodley NB, Aldous C, Clarke DL. An audit of trauma-related mortality in a provincial capital in South Africa. S Afr J Surg 2014;52:101-104. https://doi.org/10.7196/sajs.1995
4. Mnguni MN, Muckart DJJ, Madiba TE. Abdominal trauma in Durban, South Africa: Factors influencing outcome. Int Surg 2012;97(2):161-168. https://doi.org/10.9738/cc84.1
5. Prin M, Li G. Complications and in-hospital mortality in trauma patients treated in intensive care units in the United States, 2013. Inj Epidemiol 2016;3(1). https://doi.org/10.1186/s40621-016-0084-5
6. Mahomed S, Mahomed OH. Cost of intensive care services at a central hospital in South Africa. S Afr Med J 2019;109(1):35–39. https://doi.org/10.7196/samj.2018.v109i1.13268
7. Bhagwanjee S, Scribante J. National audit of critical care resources in South Africa - unit and bed distribution. S Afr Med J 2007;97(12 Pt 3):1311-1314.

8. Van der Merwe E, Baker D, Sharp G, van Niekerk M, Paruk F. Long-stay medical-surgical intensive care unit patients in South Africa: Quality of life and mortality 1 year after discharge. S Afr Med J 2022;112(3):227-233.
9. Gruenberg DA, Shelton W, Rose SL, Rutter AE, Socaris S, McGee G. Factors influencing length of stay in the intensive care unit. Am J Crit Care 2006;15(5):502-509.
10. Toptas M, Samanci NS, Akkoc E, et al. Factors affecting the length of stay in the intensive care unit: Our clinical experience. Biomed Res Int 2018;9438046. https://doi.org/10.1155/2018/943804.
11. Arabi Y, Venkatesh S, Haddad S, Shimemeri AAL, Malik SAL. A prospective study of prolonged stay in the intensive care unit: Predictors and impact on resource utilisation. Int J Quality Health Care 2002;14(5):403-410. https://doi.org/10.1093/intqhc/14.5.403
12. Osuagwu UL, Xu M, Piya MK, Agho KE, Simmons D. Factors associated with long intensive care unit (ICU) admission among inpatients with and without diabetes in South Western Sydney public hospitals using the New South Wales admission patient data collection (2014–2017). BMC Endocr Disord 2022;22(1):1-10. https://doi.org/10.1186/s12902-022-00933-8
13. Association for the Advancement of Automotive Medicine. The Abbreviated Injury Scale 2005 - Update 2008. Barrington, IL: Association for the Advancement of Automotive Medicine, 2008.
14. Association for the Advancement of Automotive Medicine. Abbreviated Injury Scale: 2015 Revision (6th ed.). Chicago, IL: Association for the Advancement of Automotive Medicine , 2018.
15. Western Cape Department of Health. 14 May 2020. Western Cape Critical Care Triage Tool. https://datacartographer.com/covid/#/ (accessed 14 May 2024)
16. Shojaee M, Faridaalaee G, Yousefifard M, et al. New scoring system for intra-abdominal injury diagnosis after blunt trauma. Chinese J Traumatol - English Edition 2014;17(1):19-24.
17. Chalya PL, Mabula JB. Abdominal trauma experience over a two-year period at a tertiary hospital in north-western Tanzania: A prospective review of 396 cases. Tanzan J Health Res 2013;15(4):230-239.
18. Lefering R, Waydhas C. Prediction of prolonged length of stay on the intensive care unit in severely injured patients - a registry-based multivariable analysis. Front Med (Lausanne) 2024;11:1358205.
19. Roth GA, Mensah GA, Johnson CO, et al. Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019: Update from the GBD 2019 Study. J Am Coll Cardiol 2020;76(25):2982–3021. https://doi.org/10.1016/j.jacc.2020.11.010
20. Ntundu SH, Herman AM, Kishe A, et al. Patterns and outcomes of patients with abdominal trauma on operative management from northern Tanzania: A prospective single centre observational study. BMC Surg 2019;19(1):69. https://doi.org/10.1186/s12893-019-0530-8
21. Alqarafi A, Alhazmi A, Alawfi A, Alruhaili E, Alebrahaimi F, Sebeih S. The patterns of abdominal trauma and factors associated with ICU admission in a major trauma center in Medina. Australasian Med J 2019;12. https://doi.org/10.21767/AMJ.2018.3554
22. Benns M, Sarani B, Corcos AC. Ventilator management of trauma patients. In: Tisherman SA, Forsythe RM, Kellum JA, eds. Trauma Intensive Care. New York: Oxford University Press, 2013. https://doi.org/10.1093/med/9780199777709.003.0008
23. Hardcastle TC, Muckart DJJ, Maier R V. Ventilation in trauma patients: The first 24 h is different! World J Surg 2017;41(5):1153-1158. https://doi.org/10.1007/s00268-016-3530-1
24. Richardson JD, Adams L, Flint LM. Selective management of flail chest and pulmonary contusion. Ann Surg 1982;196(4):481-487. https://doi.org/10.1097/00000658-198210000-00012
25. World Health Organisation. WHO Fact sheets. Obesity and overweight, 2024. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight (accessed 29 October 2025).
26. World Health Organisation. Report on the status of major health risk factors for noncommunicable diseases: WHO African Region 2015. https://www.afro.who.int/publications/report-status-major-health-risk-factors-noncommunicable-diseaseswho-african-region (accessed 29 October 2025).
27. Commodore-Mensah Y, Himmelfarb CD, Agyemang C, Sumner AE. Cardiometabolic health in african immigrants to the United States: A call to re-examine research on African-descent populations. Ethn Dis 2015;25(3):373-380. https://doi.org/10.18865/ed.25.3.373
28. Mensah D, Ogungbe O, Turkson-Ocran RAN, et al. The Cardiometabolic Health of African Immigrants in High-Income Countries: A Systematic Review. Int J Environ Res Public Health 2022 Jun;19(13). https://doi.org/10.3390/ijerph19137959
29. Mills KT, Bundy JD, Kelly TN, et al. Global Disparities of Hypertension Prevalence and Control. Circulation 2016;134(6):441–450. https://doi.org/10.1161/CIRCULATIONAHA.115.018912
30. World Health Organization. Country Cooperation Strategy: South Africa. WHO 2018;(May):1–2. https://www.who.int/publications/i/item/WHO-CCU-18.02-South-Africa (accessed 23 January 2025).
31. Rapsang AG, Shyam DC. Scoring Systems of Severity in Patients with Multiple Trauma. Cirugía Española (English Edition) 2015;93(4):213–21. https://www.sciencedirect.com/science/article/pii/S2173507715000745 (accessed 25 January 2025).
32. Dossett LA, Redhage LA, Sawyer RG, May AK. Revisiting the validity of APACHE II in the trauma ICU: Improved risk stratification in critically injured adults. Injury 2009;40(9):993–998. https://doi.org/10.1016/j.injury.2009.03.004
33. Dixon J, de Vries S, Fleischer C, et al. Preventable trauma deaths in the Western Cape of South Africa: A consensus-based panel review. PLOS Global Public Health 2024;4(5):e0003122. https://doi.org/10.1371/journal.pgph.0003122
34. Finn J, Dixon JM, Moreira F, et al. Patterns of on-scene and healthcare system trauma deaths in the Western Cape of South Africa. World J Surg 2024;48(2):320-330. https://doi.org/10.1002/wjs.12043
35. Elgin LB, Appel SJ, Grisham D, Dunlap S. Comparisons of Trauma Outcomes and Injury Severity Score. J Trauma Nurs 2019;26(4). https://doi.org/10.1097/jtn
36. Pandit V, Rhee P, Hashmi A, et al. Shock index predicts mortality in geriatric trauma patients: An analysis of the National Trauma Data Bank. J Trauma and Acute Care Surg 2014;76(4). https://journals.lww.com/jtrauma/fulltext/2014/04000/shock_index_predicts_mortality_in_geriatric_trauma.30.aspx (accessed 25 January 2025).
37. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med 1985;13(10):818-829.
38. Rocker G, Cook D, Sjokvist P, et al. Clinician predictions of intensive care unit mortality. Crit Care Med 2004;32(5):1149-1154. https://doi.org/10.1097/01.ccm.0000126402.51524.52.
39. Mikkelsen ME, Miltiades AN, Gaieski DF, , et al. Serum lactate is associated with mortality in severe sepsis independent of organ failure and shock. Crit Care Med 2009;37(5):1670-1677. https://doi.org/10.1097/ccm.0b013e31819fcf68
40. Oyeniyi BT, Fox EE, Scerbo M, Tomasek JS, Wade CE, Holcomb JB. Trends in 1029 trauma deaths at a level 1 trauma center: Impact of a bleeding control bundle of care. Injury 2017;48(1):5-12. https://doi.org/10.1016/j.injury.2016.10.037

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