e-ISSN: 2722-3558

Sriwijaya Journal of Surgery

[SJS]

https://sriwijayasurgery.com

A Preliminary Retrospective Analysis of the Blunt Abdominal Trauma Scoring System (BATSS) in a High-Prevalence Cohort: A Single-Center Indonesian Experience

Akbar Rizky Wicaksana[1*], Alsen Arlan[2], Theodorus[3]

[1]Specialized Residency Training Program, Department of Surgery, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

[2]Division of Digestive Surgery, Medical Staff Group/Department of Surgery, Dr. Mohammad Hoesin General Hospital, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

[3]Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

ARTICLE INFO

Keywords:
BATSS
Blunt abdominal trauma
Diagnostic accuracy
Scoring system
Triage

***Corresponding author:**
Akbar Rizky Wicaksana

E-mail address:
akbar.rizkyw@gmail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/sjs.v8i2.136

ABSTRACT

Introduction: The triage of blunt abdominal trauma (BAT) is a critical challenge, and the utility of clinical scoring systems like the blunt abdominal trauma scoring system (BATSS) requires validation in diverse clinical settings. This study aimed to provide a preliminary, critical appraisal of the BATSS's diagnostic performance and the behavior of its individual components in a unique, high-risk cohort at a tertiary Indonesian trauma center. **Methods:** A retrospective analysis was conducted on 37 BAT patients who underwent definitive diagnostic evaluation (CT scan or laparotomy) between July 2021 and July 2025 in Palembang, Indonesia. The cohort was noted to have a significant selection bias, with an intra-abdominal injury (IAI) prevalence of 91.9% (34 injured, 3 uninjured). A component-level analysis of the seven BATSS variables was performed alongside a standard diagnostic accuracy assessment using an ROC curve to determine the optimal cut-off. **Results:** The cohort was predominantly young males injured in traffic accidents. The ROC analysis demonstrated poor discriminatory power (AUC = 0.525). At an optimal cut-off of 8.5, BATSS showed a sensitivity of 82.4% and a statistically unstable specificity of 33.3% (95% CI: 0.8% to 90.6%). The PPV was 93.3%, while the NPV was critically low at 14.3%. Component analysis revealed that sensitivity was primarily driven by high-point variables like a positive FAST scan, while low specificity was associated with non-specific signs like abdominal tenderness. **Conclusion:** In this high-prevalence, pre-selected cohort, BATSS failed to perform as a reliable triage tool. Its poor specificity and dangerously low NPV render it unsuitable and unsafe for ruling out IAI. The score's apparent sensitivity was driven by variables that already indicate a high-risk patient, suggesting the score adds little value to standard clinical assessment. This preliminary study highlights the critical need for robust, large-scale validation before clinical adoption and suggests BATSS may be inappropriate for settings with a high pre-test probability of injury.

1. Introduction

Trauma persists as a formidable global health crisis, representing a primary cause of death and disability, particularly among younger populations.[1] It is not a singular disease but a spectrum of complex pathologies initiated by the transfer of kinetic energy to the human body. Within this spectrum, blunt abdominal trauma (BAT) represents a frequent and particularly perilous entity, constituting up to 75% of all significant blunt injuries. The modern world, defined by high-speed transportation and industrial activity, creates an environment where the forces imparted during collisions, falls, and accidents can far exceed the structural tolerance of the human torso.[2] The abdomen, a compliant cavity housing a dense array of vital organs without the rigid protection of the thorax, is exquisitely susceptible to these forces. The consequences are diverse and severe, ranging from immediate exsanguination from solid organ rupture to delayed sepsis from hollow viscus perforation.[3] The pathophysiology of intra-abdominal injury (IAI) in BAT is a direct function of the mechanism and magnitude of the force applied.[4] Deceleration injuries, the hallmark of motor vehicle collisions, cause differential movement of internal structures, leading to shearing forces at points of anatomical fixation. This can result in devastating vascular avulsions at the hilum of the spleen or liver, or transection of the small bowel at the ligament of Treitz. Direct compressive forces, such as a blow from a steering wheel, can crush organs against the vertebral column, leading to parenchymal fractures in the liver, spleen, or pancreas, and "burst" injuries in hollow organs when intraluminal pressure spikes within a closed loop.[5] Understanding these mechanisms is fundamental to appreciating the diagnostic challenge: injuries can be multiple, complex, and clinically silent in the initial post-injury phase.

The emergency management of BAT is a race against time, governed by the principle of the "golden hour," during which rapid and accurate diagnosis is paramount to survival.[6] However, the initial clinical assessment is notoriously fallible. The classic signs of peritonitis or hemorrhagic shock are often late manifestations, appearing only after significant physiological insult has occurred. The clinical picture is frequently obscured by confounding factors; altered mental status from a concomitant traumatic brain injury or intoxication can render a patient unable to localize pain, while the intense pain from a femur or pelvic fracture can easily distract both the patient and the clinician from a developing abdominal catastrophe.[7] This unreliability of the physical examination places a heavy burden on adjunctive diagnostic tools to unmask the occult injury. The diagnostic algorithm for BAT has been revolutionized over the past three decades. The invasive and often non-specific diagnostic peritoneal lavage (DPL) has been largely replaced by the Focused Assessment with Sonography for Trauma (FAST). The FAST exam is a rapid, non-invasive bedside tool that has become an essential component of the primary trauma survey, enabling the detection of hemoperitoneum, the sonographic signature of intra-abdominal bleeding. In a hemodynamically unstable patient, a positive FAST is a clear mandate for immediate surgical exploration.[8] Yet, the FAST exam has well-defined limitations; it is insensitive to retroperitoneal hemorrhage, contained solid organ hematomas, diaphragmatic ruptures, and the vast majority of bowel and mesenteric injuries. For the larger cohort of hemodynamically stable patients, multidetector contrast-enhanced computed tomography (CT) has become the undisputed gold standard. CT provides unparalleled anatomical detail, allowing not only for the diagnosis of injury but also for its precise grading, a critical factor that has enabled the widespread and successful adoption of non-operative management (NOM) for many solid organ injuries.

Despite its diagnostic power, the indiscriminate use of CT is neither feasible nor desirable. CT scanning entails significant logistical hurdles, including transporting a potentially unstable patient away from the resuscitation area. It involves substantial costs, a critical consideration in all healthcare systems, and exposes patients to a significant dose of ionizing radiation, a concern particularly in young patients and for whom repeat scans may be necessary. In many parts of the world, including parts of Indonesia, immediate 24/7 access to a high-quality CT scanner and expert radiological interpretation is not guaranteed, creating a diagnostic gap that needs to be filled. This gap has led to the development of clinical scoring systems, which aim to standardize risk stratification by combining objective clinical findings into a predictive score. The blunt abdominal trauma scoring system (BATSS) is one such tool, developed to predict the probability of IAI needing intervention. It integrates seven variables—hypotension, tachycardia, abdominal pain, abdominal tenderness, lower chest wall signs, pelvic fracture, and a positive FAST result—into a weighted 24-point scale.[9] Each variable was chosen for its statistical association with significant injury. Hypotension and a positive FAST carry the most weight, reflecting their strong correlation with major hemorrhage. The theoretical appeal of BATSS is its potential to serve as a rapid, evidence-based tool at the bedside, helping clinicians to make more rational decisions about resource allocation and to expedite the care of the most severely injured patients.[10] However, the promise of any scoring system is contingent on its performance in the real world, outside of the controlled environment of its developmental study. The trauma community remains divided on whether these scores offer a tangible benefit over the "clinical gestalt" of an experienced surgeon.

The translation of a clinical scoring system into a new environment is not a simple act of implementation; it is an act of validation. Performance can be dramatically altered by local factors, including injury mechanisms, patient physiology, and healthcare system processes. While BATSS has been studied, its external validity in the unique epidemiological landscape of Southeast Asia remains largely unknown. This study, therefore, was conceived not as a definitive validation but as a preliminary, exploratory analysis to critically appraise the performance of BATSS in the specific context of a high-volume Indonesian trauma center. The primary aim was twofold: first, to assess the overall diagnostic accuracy metrics of the BATSS in our unique, high-prevalence cohort; and second, to move beyond this global assessment by performing a granular, component-level analysis to understand the behavioral characteristics of the score's constituent parts.

2. Methods

This study was conducted as a retrospective, exploratory, single-center diagnostic accuracy analysis. The primary objective was to evaluate the performance of the BATSS against a definitive reference standard for the diagnosis of IAI. The study adhered to the Standards for Reporting of Diagnostic Accuracy Studies (STARD) guidelines where applicable for retrospective designs. The study was conducted in full accordance with the ethical principles outlined in the Declaration of Helsinki. The complete research protocol was submitted to the institutional review board, the Ethics Committee of Dr. Mohammad Hoesin General Hospital Palembang, and was granted a formal ethical exemption (No.DP.04.03/D.XVIII.06.08/ETIK/202/2025). As the study relied exclusively on the retrospective review of de-identified data from existing medical records, the committee waived the need for individual patient informed consent. Strict protocols were enforced to maintain data anonymity and patient confidentiality throughout the research process. The study was performed at Dr. Mohammad Hoesin General Hospital in Palembang, Indonesia, the primary tertiary referral hospital and designated trauma center for the province of South Sumatra. Patient data were identified and extracted from the hospital's comprehensive medical records archive. The study period included all eligible patients admitted from July 1st, 2021, to July 31st, 2025. The source population comprised all patients aged 17 years and older who presented to the emergency department with a primary diagnosis of blunt abdominal trauma. Inclusion in the final analytical cohort was contingent upon patients having undergone a definitive investigation to either confirm or exclude the presence of IAI. This was defined as the completion of a contrast-enhanced CT scan of the abdomen and pelvis or an exploratory laparotomy. Patients with incomplete medical records that precluded the calculation of a full BATSS or the ascertainment of the final diagnosis were excluded. Additionally, patients with penetrating trauma or those under the age of 17 were excluded. It is critical to acknowledge that these inclusion criteria create a significant and inherent selection bias. The resulting cohort is not representative of the entire undifferentiated population of BAT patients who present to the emergency department. Instead, it represents a highly filtered subgroup of patients in whom the pre-test probability of significant injury was already deemed high enough by the treating clinicians to warrant advanced imaging or surgical intervention. This selection bias leads to a cohort with a very high prevalence of IAI, a factor that is known to profoundly influence certain diagnostic accuracy metrics, particularly positive and negative predictive values. This study, therefore, evaluates the performance of BATSS within a high-risk population, not as a general screening tool for a low-risk population.

A standardized data extraction form was developed to ensure systematic and consistent data collection. A single investigator reviewed the medical records to minimize inter-rater variability. The following data points were meticulously extracted for each patient: Demographic and Trauma Data: Age, gender, and mechanism of injury; BATSS Component Variables: Each of the seven variables required for the BATSS calculation was extracted from the initial clinical assessment documented in the emergency department records. These included: Hemodynamic Status: First recorded heart rate and systolic blood pressure, Physical Examination: Documented presence of abdominal pain, and findings of abdominal tenderness, guarding, or rigidity, Associated Injuries: Evidence of lower chest wall injury (bruising, tenderness, or fractures of ribs 6-12) and radiological confirmation of a pelvic fracture, FAST Result: The documented result of the initial FAST examination; Reference Standard Outcome: The definitive diagnosis of the presence or absence of IAI was determined from the official, final reports of abdominal CT scans or the detailed findings documented in the operative notes from exploratory laparotomy.

All statistical analyses were performed using SPSS software (Version 26.0, IBM Corp., Armonk, NY). The cohort was characterized using descriptive statistics. Continuous variables were reported as mean ± standard deviation, while categorical variables were reported as frequencies and percentages. A standard diagnostic accuracy assessment was performed. A Receiver Operating Characteristic (ROC) curve was generated, and the area under the curve (AUC) with its 95% confidence interval (CI) was calculated to assess the overall discriminatory ability of the total BATSS score. The optimal cut-off value was determined from the Youden's index on the ROC curve to maximize sensitivity for screening. Using this cut-off, a 2x2 contingency table was used to calculate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), along with their 95% CIs. To address the study's exploratory aims, two secondary analyses were conducted.A component-level analysis was performed to describe the frequency of each of the seven positive BATSS variables within the overall cohort. These frequencies were then compared between the IAI-positive and IAI-negative groups using Fisher's exact test, given the small sample size. A stratified analysis was conducted to evaluate the performance of the BATSS using the originally published risk strata: Low Risk (<8), Moderate Risk (8-11), and High Risk (≥12). The diagnostic metrics were calculated using cut-offs of ≥8 and ≥12 to allow for direct comparison with the foundational literature on the BATSS.

3. Results

Figure 1 provides a comprehensive and multi-faceted schematic overview of the demographic and trauma-related characteristics of the 37-patient cohort central to this investigation. The cohort is overwhelmingly composed of males, who represent 78.4% of the patients. This pronounced male predominance is a consistent finding in trauma literature worldwide and reflects gender-based differences in risk-taking behaviors, occupational exposures, and involvement in high-velocity activities. This is complemented by the age analysis, which shows that the vast majority of patients (67.6%) fall within the 19-to-40-year age bracket. This demographic concentration highlights that severe blunt abdominal trauma is predominantly a disease of young, economically productive adults, amplifying its societal impact through loss of life and disability during peak working years. Traffic accidents were responsible for an overwhelming 89.2% of cases, establishing high-velocity vehicular collisions as the principal source of severe abdominal trauma in this population. The minimal contribution from falls (5.4%) and other causes (5.4%) further emphasizes the specific and preventable nature of these life-threatening events. This finding points directly to the urgent need for targeted public health interventions related to road safety, vehicle standards, and post-crash care systems. Finally, and perhaps most critically from a clinical standpoint, the "Overall Injury Profile" panel reveals a startlingly high prevalence of confirmed Intra-Abdominal Injury (IAI), with 91.9% of the cohort (34 of 37 patients) having sustained significant internal damage. This metric is fundamental to understanding the context of the entire study; the cohort is not a representation of all patients with blunt abdominal trauma but rather a highly filtered, pre-selected group of high-risk individuals in whom the clinical suspicion for severe injury was already substantial. This exceptionally high pre-test probability of disease is a crucial lens through which all subsequent diagnostic analyses must be viewed, as it profoundly influences the performance and interpretation of any predictive tool. In essence, Figure 1 illustrates that the typical patient in this study was a young male, injured in a traffic accident, who presented with a near-certainty of having a significant and potentially life-threatening intra-abdominal injury.

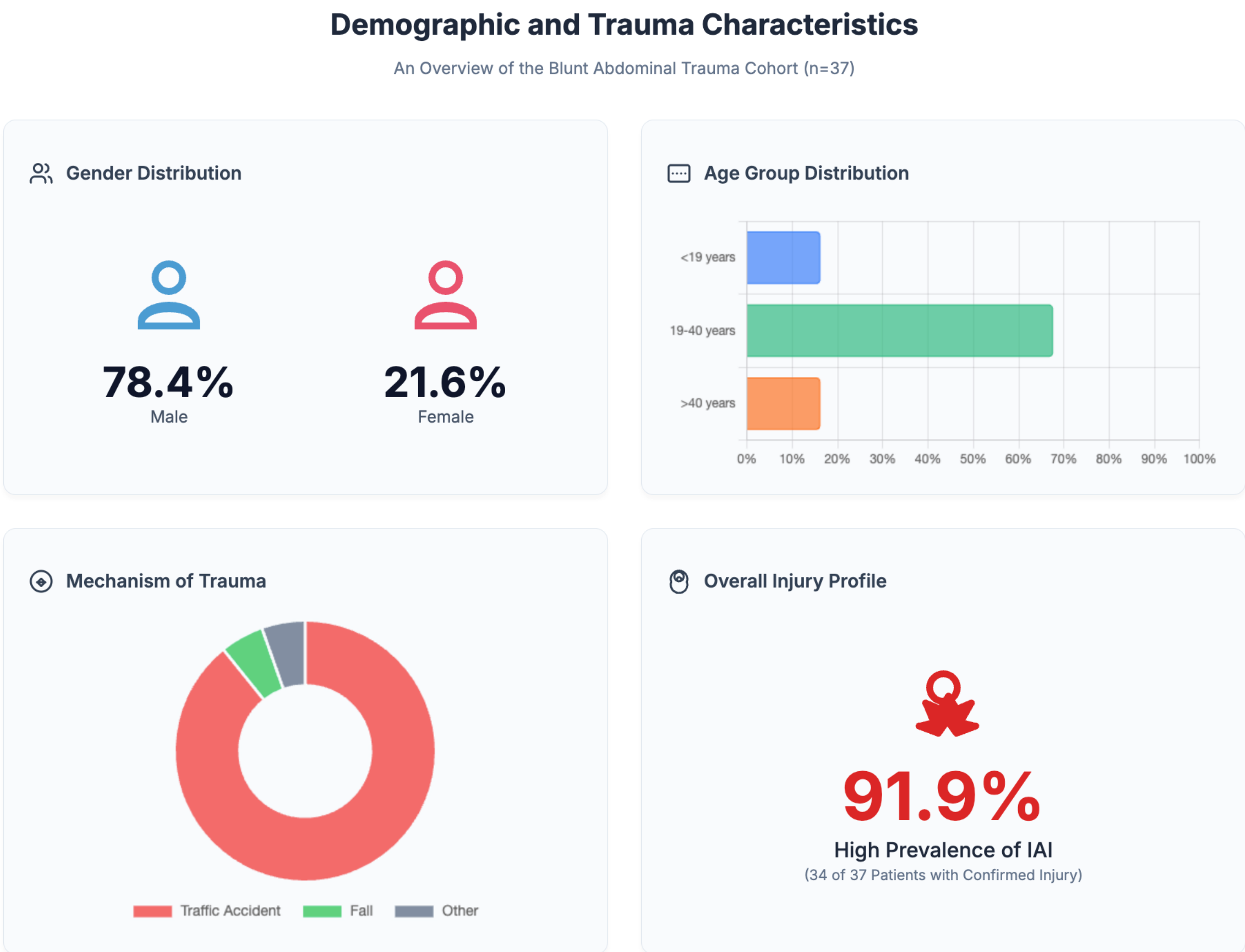


Figure 1. Demographic and trauma characteristics.

Figure 2 offers a granular deconstruction of the clinical and anatomical characteristics of the high-risk patient cohort, providing critical context for the performance of the blunt abdominal trauma scoring system (BATSS). The "BATSS Risk Category Distribution" provides the initial and most striking evidence of the cohort's high-acuity nature. The bar chart clearly demonstrates that a significant majority of the patients, 62.2%, were stratified into the "High Risk" category (score ≥12) based on the originally published BATSS criteria. This finding is reinforced by the "Key BATSS Statistic" panel, which reports a mean BATSS score of 11.84 (± 4.75) for the entire group. A mean score bordering on the high-risk threshold indicates that the average patient in this study presented with multiple clinical indicators of severe trauma, such as hemodynamic instability or a positive FAST scan. This is not a cohort of patients with minor abdominal contusions; rather, it is a population already exhibiting significant physiological derangement at the time of their initial evaluation, a fact that is central to interpreting the subsequent performance of the scoring system. Shifting from clinical scoring to anatomical findings, the "Organ Type Injured" panel reveals a fascinating and somewhat unexpected balance in the types of injuries sustained. The donut chart illustrates a near-even split between injuries to solid organs (43.2%) and hollow viscus organs (40.5%), with a smaller proportion having mixed injuries (8.1%). This finding is clinically significant because solid organ injuries, which typically lead to hemorrhage, and hollow viscus injuries, which lead to peritonitis, often have different clinical presentations and temporal profiles. The balanced distribution suggests that any diagnostic tool applied to this population must be capable of detecting both of these distinct pathophysiological processes with equal efficacy. Finally, the "Most Frequently Injured Organs" panel provides specific anatomical detail that challenges some conventional expectations in blunt trauma. While the liver and spleen are often cited as the most commonly injured organs, this cohort demonstrated a predominance of colon injuries, which were identified in 8 patients. This was followed by the liver (6 patients) and spleen (4 patients), with the pancreas and jejunum also showing notable involvement. This specific injury signature may reflect regional patterns in trauma mechanisms or patient transport and underscores the importance of local epidemiological data. The high frequency of colonic and jejunal injuries, which can be diagnostically challenging in their early stages, further highlights the need for a highly sensitive and specific triage tool.

Figure 3 provides the most critical and revealing analysis of the manuscript, moving beyond the global performance metrics to dissect the behavior of the individual components of the blunt abdominal trauma scoring system (BATSS). The main grouped bar chart, "Component Frequency by Injury Status," visually tells the story. For the IAI-positive group (n=34), there is a wide distribution in the prevalence of the different signs. However, for the IAI-negative group (n=3), a stark pattern emerges: the first two variables, abdominal pain and tenderness, are present in 100% of these uninjured patients, while the next four, more objective variables—Positive FAST, Tachycardia, Hypotension, and Pelvic Fracture—are present in 0%. This powerful visual dichotomy is the key to understanding the score's paradoxical performance. The "High-Impact Variables ('Action Drivers')" panel highlights the components that were exclusively present in patients with confirmed IAI. These are not subtle diagnostic clues; they are definitive markers of severe physiological derangement or high-energy trauma. Hypotension, tachycardia, a positive FAST scan, and a pelvic fracture are each, in their own right, major red flags in a trauma assessment. Their complete absence in the uninjured group confirms their high specificity for significant injury. The BATSS derives nearly all of its ability to correctly identify severely injured patients from these powerful, albeit often late-stage, indicators. Conversely, the "Low-Specificity Variables ('Clinical Noise')" panel exposes the score's fundamental weakness.

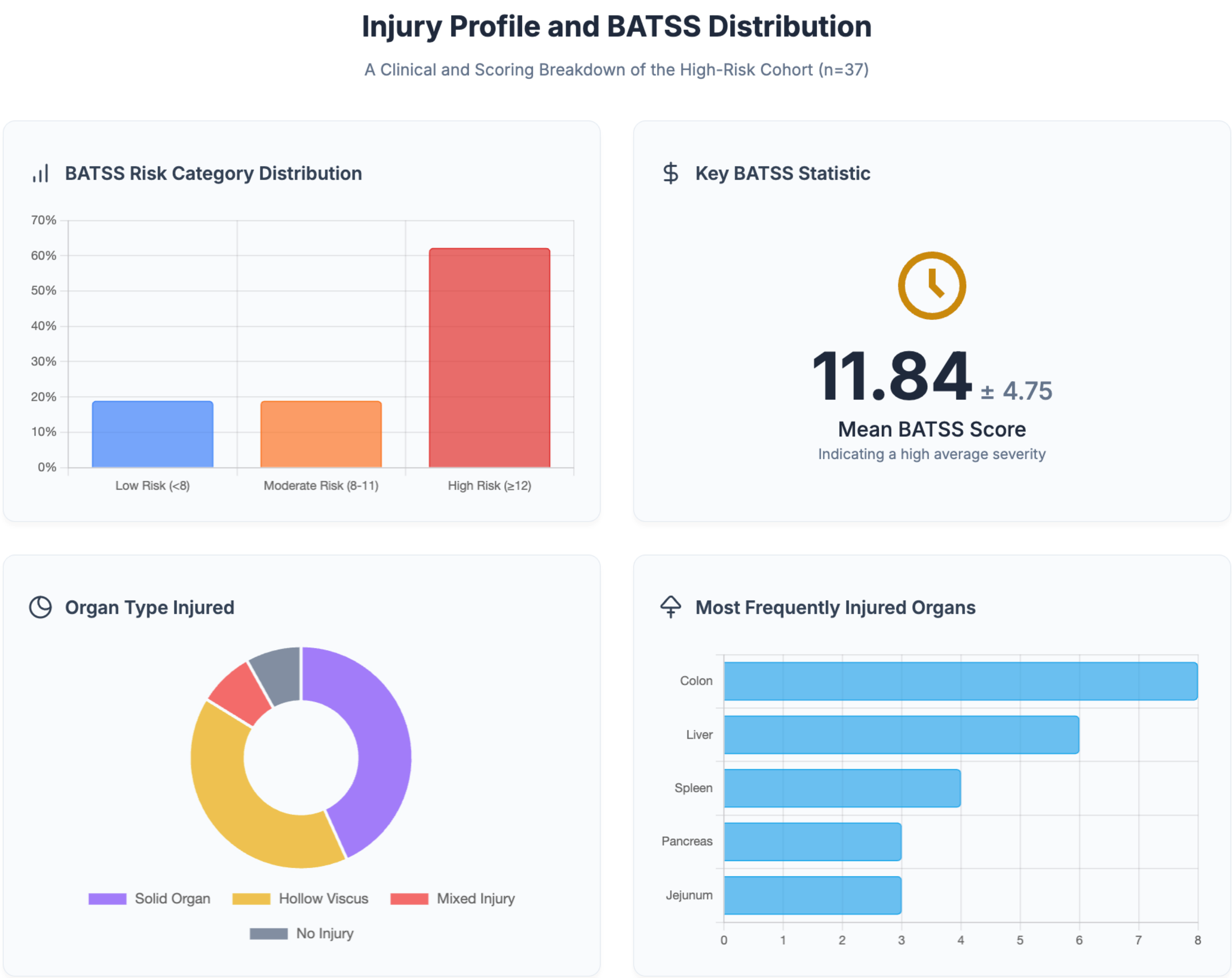


Figure 2. Injury profile and BATSS distribution.

Abdominal tenderness and pain were ubiquitous, found in 100% of the uninjured patients. Pathophysiologically, this is expected, as any significant blunt force to the abdomen will cause pain and tenderness from the abdominal wall contusion itself, irrespective of deeper injury. These signs offer no discriminatory value in this cohort. More strikingly, chest wall injury was actually more prevalent in the uninjured group than the injured group (33.3% vs 11.8%). By incorporating these non-specific and sometimes misleading variables, the BATSS introduces significant "noise" into its calculation, which is the primary driver of its high false-positive rate and consequently poor overall specificity.

Figure 4 provides a comprehensive and scientifically elegant dashboard summarizing the primary diagnostic accuracy of the blunt abdominal trauma scoring system (BATSS) as determined in this study. This multi-paneled figure synthesizes the core statistical findings, allowing for an immediate and holistic understanding of the score's performance at the statistically optimized cut-off of ≥8.5. The top-left panel displays the receiver operating characteristic (ROC) curve, a fundamental graphical representation of a diagnostic test's performance. The blue line, representing the BATSS, plots the true positive rate (Sensitivity) against the false positive rate (1-Specificity) across all possible score thresholds.

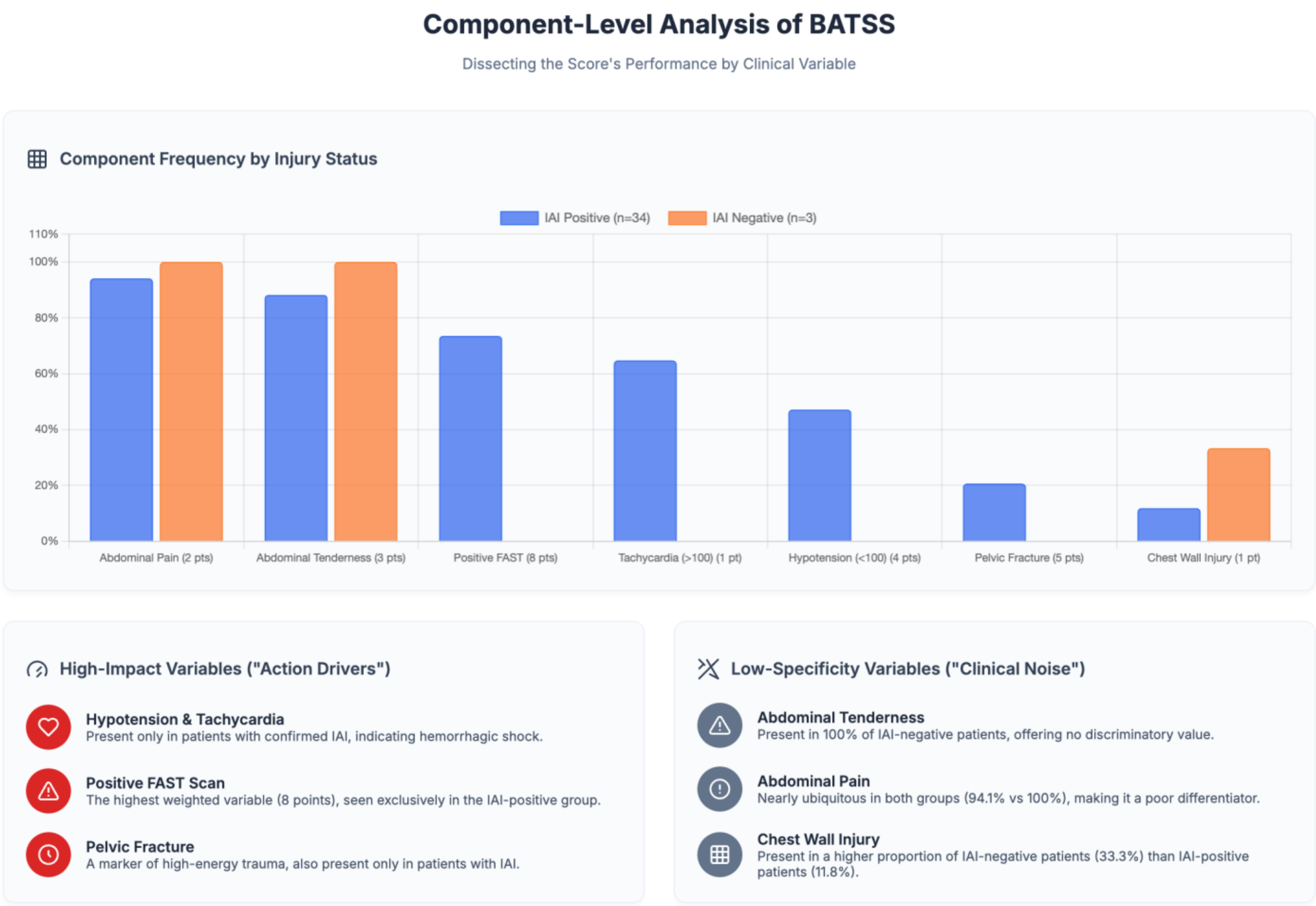


Figure 3. Component-level analysis of BATSS.

Its proximity to the dashed red "Line of No-Discrimination" (which represents the performance of random chance) is a stark visual indicator of the score's limited ability to distinguish between injured and uninjured patients. This is quantitatively confirmed in the top-right panel, which highlights the Area Under the Curve (AUC). The reported AUC of 0.525 is profoundly low, indicating that the overall discriminatory power of the BATSS in this specific cohort is only marginally better than a coin flip. The bottom-left panel presents the 2x2 Contingency Table, which is the foundational data for all subsequent metrics. It clearly shows the distribution of the 37 patients: 28 true positives, 6 false negatives, 2 false positives, and only 1 true negative. This table is crucial as it visually demonstrates the severe class imbalance that underpins the study's findings, with a nearly non-existent cohort of uninjured patients, making any conclusions about the score's performance in ruling out injury statistically fragile. Finally, the bottom-right panel translates the raw data from the contingency table into the four key clinical metrics that are most relevant to a practicing surgeon. As shown in Figure 4, the BATSS achieves a high sensitivity (82.4%) and a correspondingly high positive predictive value (PPV) (93.3%). These metrics suggest that a positive test is likely to be correct in identifying an injured patient. However, this apparent strength is completely undermined by the critically poor performance in the other two metrics. The specificity is exceptionally low at 33.3%, with a wide confidence interval indicating profound statistical uncertainty. Most alarmingly, the negative predictive value (NPV) is a mere 14.3%, rendering the score clinically dangerous and entirely unreliable for excluding the presence of an intra-abdominal injury. Figure 4 scientifically and narratively encapsulates the central paradox of the study: the BATSS is a tool that appears sensitive on the surface but ultimately fails as a reliable triage instrument due to its inability to correctly classify uninjured patients.

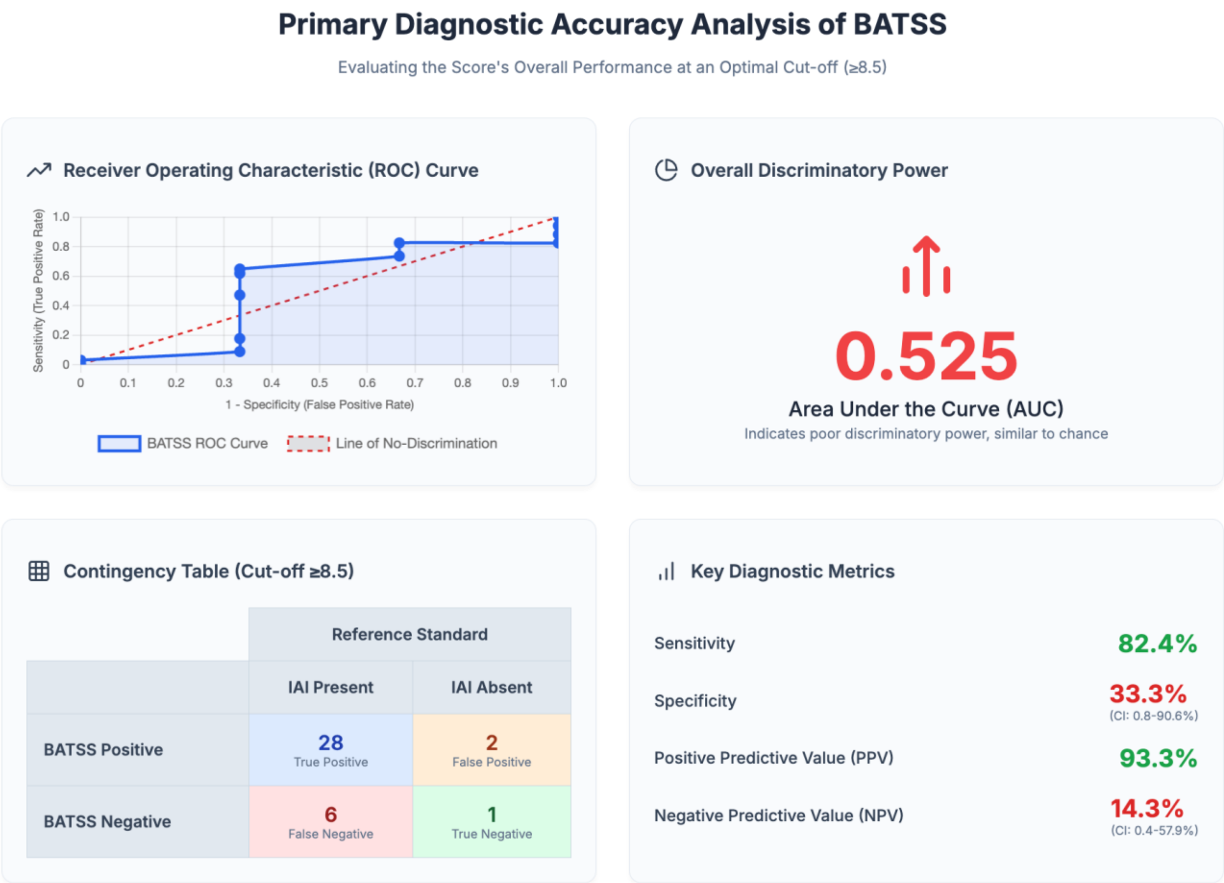
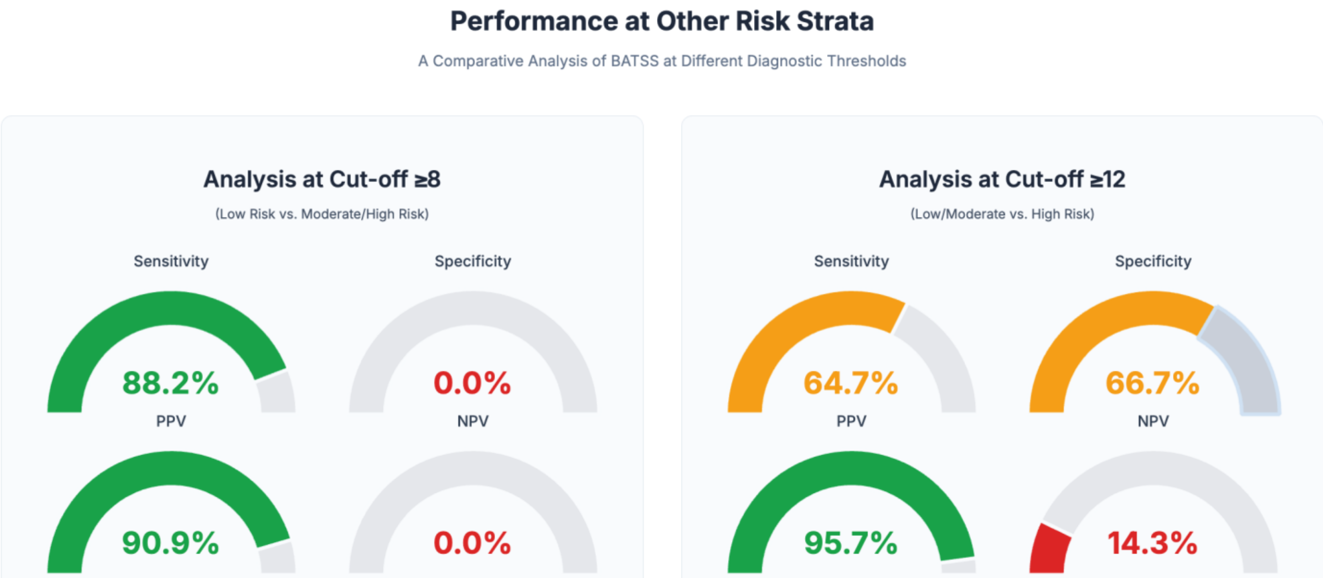


Figure 4. Primary diagnostic accuracy analysis of BATSS.

Figure 5 presents a critical and highly informative comparative analysis of the blunt abdominal trauma scoring system's (BATSS) performance when evaluated at two distinct, clinically relevant diagnostic thresholds derived from the original literature: a cut-off of ≥8 and a more stringent cut-off of ≥12. This side-by-side visualization is essential for understanding the inherent trade-offs between sensitivity and specificity as the diagnostic bar is raised, and it powerfully illustrates the profound limitations of the score within this high-risk cohort, regardless of the threshold applied.

The left panel of Figure 5 details the analysis at a cut-off of ≥8, which corresponds to separating "Low Risk" patients from those at "Moderate or High Risk." At this threshold, the score functions as an extremely sensitive net, achieving a sensitivity of 88.2%. This indicates that it correctly identified 30 out of the 34 injured patients, missing only four. While this high sensitivity is a desirable trait for a screening tool, it is rendered clinically meaningless by a complete failure in specificity, which plummeted to 0.0%. This catastrophic result signifies that the score was entirely unable to correctly identify a single uninjured patient;

all three non-injured individuals in the cohort scored ≥8, resulting in a 100% false-positive rate for that group. The consequence of this is a negative predictive value (NPV) of 0.0%, the most dangerous possible outcome for a triage tool. This demonstrates that a "Low Risk" score (<8) provided absolutely no reassurance and was, in fact, always wrong in this cohort. The right panel of Figure 5 provides a stark contrast, analyzing the score at the higher cut-off of ≥12, which isolates only the "High Risk" patients. As expected, increasing the threshold dramatically alters the performance characteristics. Sensitivity drops significantly to 64.7%, meaning the score now fails to identify more than a third of patients with confirmed intra-abdominal injuries (12 false negatives). This renders it an inadequate screening tool, as it misses a substantial number of significant injuries. In exchange for this loss of sensitivity, the specificity shows some improvement, rising to 66.7%. The score is now better able to correctly identify uninjured patients, correctly classifying two out of the three. However, this specificity is still modest and, given the small sample size, statistically unstable. While the positive predictive value (PPV) remains very high at 95.7%, the clinically crucial NPV shows only a marginal, and still entirely unacceptable, improvement to 14.3%. Figure 5 masterfully encapsulates the clinical and diagnostic dilemma presented by the BATSS in this study. It demonstrates that there is no clinically viable balance to be found by adjusting the score's threshold. A low threshold (≥8) is sensitive but dangerously non-specific and misleading. A high threshold (≥12) sacrifices too much sensitivity to be safe for screening. The persistent and critically low NPV across both strata is the key takeaway, proving that regardless of how it is stratified, the BATSS cannot be used to safely rule out intra-abdominal injury in this patient population.



Contingency Data

	IAI Present	IAI Absent
BATSS ≥8	30 TP	3 FP
BATSS <8	4 FN	0 TN

Contingency Data

	IAI Present	IAI Absent
BATSS ≥12	22 TP	1 FP
BATSS <12	12 FN	2 TN

Figure 5. Performance at other risk strata.

4. Discussion

The results of this study offer a sobering and highly nuanced perspective on the real-world application of the blunt abdominal trauma scoring system. While conceived as a tool to bring objectivity and efficiency to trauma triage, our analysis within a high-risk Indonesian cohort reveals a performance profile that is not only suboptimal but potentially misleading if interpreted without a deep understanding of its inherent biases and the pathophysiology of trauma itself. The overarching conclusion is not simply that the score "works" or "does not work," but rather that its behavior is complex, context-dependent, and driven by a fundamental tension between its different components.[11] Before interpreting any performance metric, it is imperative to address the profound impact of selection bias on this study's findings. Our cohort, by design, consisted only of patients in whom clinical suspicion for IAI was already high enough to trigger a definitive workup with CT or laparotomy. This resulted in a population with an IAI prevalence of 91.9%, a figure far higher than the 12-15% typically cited in unselected BAT populations. This high pre-test probability fundamentally alters the meaning of the predictive values. The high PPV of 93.3% is less a testament to the score's accuracy and more a reflection of the baseline reality that almost every patient in the sample was injured.[12] In such an environment, any positive test is likely to be a correct one.

Conversely, the critically low NPV of 14.3% is equally a product of this high prevalence.[13] This finding is perhaps the single most important clinical message of this paper: in our high-risk cohort, a low BATSS score was virtually useless for providing reassurance. A negative test result barely decreased the likelihood of injury. This starkly contrasts with studies in lower-prevalence populations that reported more clinically acceptable NPVs. This discrepancy underscores a crucial principle of diagnostic testing: predictive values are not intrinsic properties of a test but are highly dependent on the prevalence of the disease in the population being tested. Our study suggests that in a filtered, high-risk population, the BATSS loses its ability to effectively rule out injury. Furthermore, the extreme class imbalance (34 injured vs. 3 uninjured) renders the calculation of specificity statistically fragile and clinically uninterpretable. The point estimate of 33.3% is based on a single true negative and two false positives. The 95% confidence interval, spanning nearly the entire possible range from 0.8% to 90.6%, transparently communicates this profound uncertainty. Therefore, no credible conclusion about the score's true specificity can be drawn from this dataset. The AUC of 0.525, indicating performance barely distinguishable from chance, is the most honest reflection of the score's failure to discriminate between injured and uninjured patients within this specific, imbalanced cohort.[14]

The most insightful findings of this study emerge from the secondary component-level analysis, which allows us to move beyond the flawed global metrics and understand the internal mechanics of the score. The BATSS is not a homogenous tool but a composite of two functionally distinct types of variables: high-yield "Action Drivers" and low-specificity "Clinical Noise." The Action Drivers are the objective, high-point variables: a positive FAST (8 points), hypotension (4 points), and tachycardia (1 point).[15] Our analysis showed that these findings were present exclusively in patients with confirmed IAI. These are not merely predictive markers; they are clear, unambiguous signs of major physiological insult—namely, significant hemoperitoneum and decompensated shock. A trauma surgeon seeing a patient with these signs does not require a scoring system to identify them as high-risk; these findings are, in themselves, direct triggers for immediate action, often bypassing further diagnostics for a direct trip to the operating room. The BATSS's high sensitivity is almost entirely powered by these variables. In essence, the score is highly sensitive because it effectively identifies patients who are already in, or on the verge of, extremis. In this context, the score is not making a subtle diagnosis; it is simply documenting a crisis that is already clinically apparent. The clinical noise is generated by the subjective, low-point variables: abdominal pain (2 points) and tenderness (3 points).[16] Our analysis showed these were nearly ubiquitous, present in almost all patients, including 100% of the small cohort without IAI. This demonstrates their complete lack of specificity. The pathophysiology of trauma makes this unsurprising.[17] Any significant kinetic impact to the torso will cause pain. This pain can arise from benign sources like abdominal wall contusions, rectus sheath hematomas, or referred pain from lower rib fractures, all of which are common in BAT. These conditions can produce impressive tenderness and guarding, mimicking the peritonism of an IAI. By assigning a total of 5 points to these unreliable signs, the BATSS systematically over-scores patients with non-IAI injuries, leading to a high false-positive rate and destroying its specificity. These variables do not clarify the clinical picture; they amplify the inherent ambiguity of the post-traumatic abdominal exam.

The true value of any clinical decision rule is not in identifying the black-and-white cases—the clearly dying or the clearly uninjured—but in helping to navigate the vast clinical "gray zone." This zone is occupied by the most common trauma patient: the one who is hemodynamically stable but has a tender abdomen and an equivocal mechanism of injury. This is precisely where a clinician needs a tool to help decide between watchful waiting and a CT scan. Our component analysis strongly suggests that the BATSS fails in this critical scenario. Consider a stable patient (no hypotension/tachycardia) with a negative FAST and no pelvic fracture, but with a tender abdomen. This patient would score 3 points for tenderness, placing them in the "Low Risk" category (<8). However, our study, with its 0% NPV at this threshold, shows that this stratification is dangerously unreliable. This patient could easily be harboring an occult, contained injury that the score is structurally blind to. The score fails because its only inputs for this gray-zone patient are the noisy, non-specific signs of pain and tenderness. By failing here, the score fails in its primary purpose. It merely confirms the obvious in the critically ill and provides false reassurance in the deceptively stable, making it a poor tool for practical triage. The low NPV is a direct reflection of this pathophysiological blind spot. A low score does not equate to the absence of injury; it may simply mean the absence of overt, decompensated injury at a single point in time.[18]

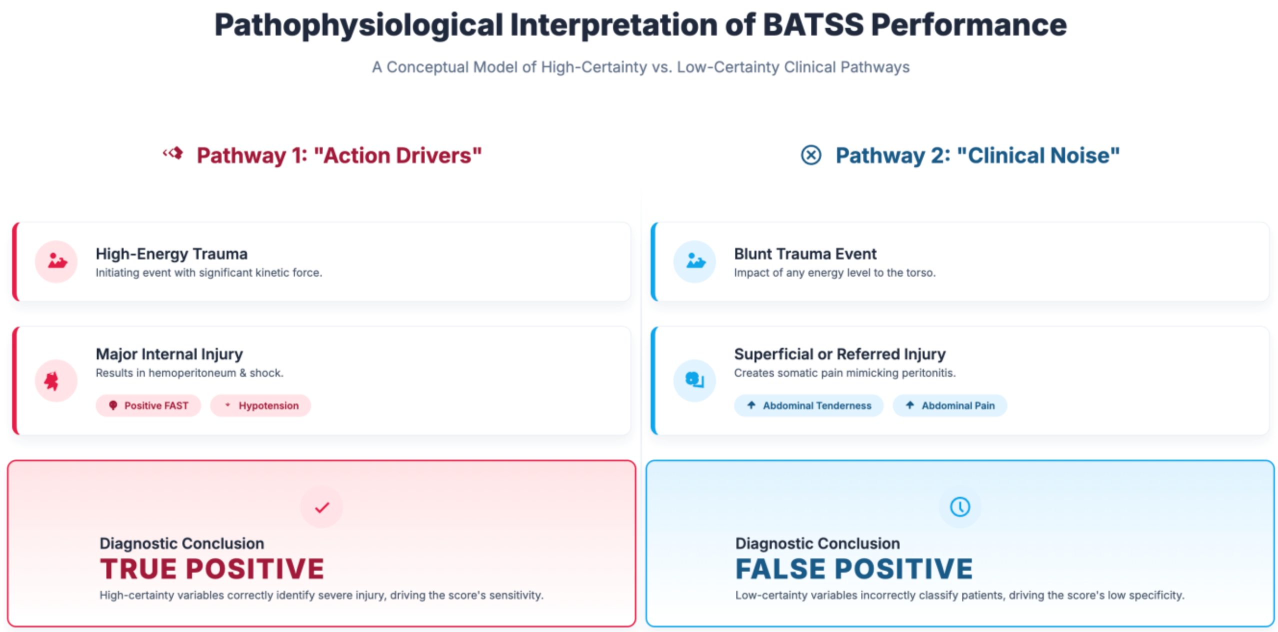


Figure 6. Pathophysiological interpretation of BATSS performance.

A central finding of this investigation is the paradoxical performance of the BATSS, which behaves as a tool of two extremes: high sensitivity undermined by poor specificity.[19] To elucidate the underlying reasons for this dichotomy, a conceptual model was developed, as depicted in Figure 6. This schematic visually deconstructs the BATSS into two distinct pathophysiological pathways, each driven by a different class of clinical variables. The model posits that the score's overall performance is not monolithic but is rather the net result of a high-certainty pathway ("Action Drivers") functioning in parallel with a low-certainty pathway ("Clinical Noise"). Figure 6 illustrates Pathway 1, termed "Action Drivers," which represents the high-specificity, reliable component of the score. This cascade begins with a high-energy trauma event, which provides the necessary kinetic force to cause a major internal injury, such as a solid organ rupture or a significant vascular tear. The direct and immediate pathophysiological consequence of such an injury is internal hemorrhage, leading to the clinically detectable states of hemoperitoneum and, if severe enough, hemorrhagic shock. These states manifest as objective, high-yield clinical signs that correspond to the most heavily weighted components of the BATSS: a positive FAST scan and hypotension. Because these signs are direct and unambiguous markers of severe internal bleeding, they act as powerful and reliable drivers of a high score. This pathway demonstrates why the BATSS retains high sensitivity; it is structurally biased to correctly identify patients who are already in a state of physiological crisis, thus leading to a definitive "true positive" diagnostic conclusion. Conversely, Pathway 2, termed "Clinical Noise," illustrates the low-specificity, unreliable component of the score. This pathway can be initiated by a blunt trauma event of any energy level, often one insufficient to cause IAI but capable of producing superficial or referred injuries, such as an abdominal wall contusion, a rectus sheath hematoma, or lower rib fractures. The pathophysiological result is the generation of somatic pain, which, while intense, is a non-specific clinical sign that frequently mimics the visceral pain of true peritonitis.[20] This somatic pain triggers the low-point, subjective components of the BATSS, namely abdominal tenderness and pain. As these signs are common in trauma patients both with and without IAI, they introduce significant statistical "noise" and diagnostic ambiguity. This pathway explains the score's poor specificity, as it systematically misclassifies patients without IAI as being at risk based on these unreliable.

In a resource-rich environment, the low specificity of BATSS might lead to acceptable costs, namely an increase in negative CT scans. However, in a resource-limited setting like many Indonesian hospitals, the implications are more severe. A tool with a high false-positive rate, if adopted as a primary screening instrument, would likely lead to a significant *increase* in the utilization of a scarce and expensive resource (CT scanners). By flagging numerous patients with only abdominal wall injuries as needing further imaging, the system could become overwhelmed, potentially delaying the scan for a patient with a more subtle but critical injury. The tool, therefore, risks becoming counterproductive to its goal of rationalizing resource use. Based on our findings, the pragmatic clinical role for BATSS in our institution would be extremely limited. It cannot be used to rule out injury. Its only potential use is as an objective communication tool to document the severity of patients who are already identified as high-risk by their primary clinical signs. For instance, stating a patient has a "BATSS of 17" might be a concise way to communicate to a consultant that the patient is hypotensive with a positive FAST, but it adds no new diagnostic information.

5. Conclusion

This preliminary, retrospective analysis of the blunt abdominal trauma scoring system in a high-risk Indonesian cohort reveals a tool with a deeply paradoxical and ultimately flawed performance profile. The study, while limited by its sample size and inherent selection bias, provides a critical insight: the BATSS, in this context, fails as a balanced and reliable triage instrument. Its high sensitivity is an artifact of its ability to detect overt hemorrhagic shock, a task for which a scoring system is largely superfluous. This sensitivity is paid for with a profoundly poor specificity, driven by a reliance on non-specific clinical signs, and a dangerously low negative predictive value that makes it unsafe for ruling out injury, especially in the critical "gray zone" patient. The implementation of BATSS in a similar high-prevalence setting or a resource-constrained environment could paradoxically increase the burden on diagnostic imaging services. This work underscores that clinical scoring systems are not universally applicable and require rigorous, context-aware validation. Future research should focus on developing tools that provide genuine diagnostic value in the ambiguous cases, rather than simply confirming the obvious in the critically ill. Until such a tool is developed, the astute clinical judgment of the experienced surgeon, supported by serial examination and a judicious use of imaging, remains the irreplaceable cornerstone of blunt abdominal trauma management.

6. References

1. Nasr Isfahani M, Nasri Nasrabadi E, Rabiei Z, Fatemi NA-S, Heydari F. Enhancing clinical risk assessment in pediatric blunt abdominal trauma: a novel scoring system using ultrasound and laboratory data. BMC Emerg Med. 2025; 25(1): 34.
2. Shojaee M, Sabzghabaei A, Heidari A. Efficacy of new scoring system for diagnosis of abdominal injury after blunt abdominal trauma in patients referred to emergency department. Chin J Traumatol. 2020; 23(3): 145–8.
3. Ochoa B, Streck C. Pediatric blunt abdominal trauma evaluation and management pathways. Curr Trauma Rep. 2023; 9(4): 121–31.
4. Dev H, Kikiros C. Blunt abdominal trauma resulting in pancreatic injury in a pediatric patient in Australia: a case report. J Trauma Inj. 2023; 36(3): 310–4.
5. Özpek A, Yıldırak MK, Ezberci F. Hollow viscus injury due to blunt abdominal trauma: a tertiary trauma center experience. Ulus Travma Acil Cerrahi Derg. 2024; 30(2): 123–8.
6. Kannaian M, Bezawada BR, Vinod, Bose SC. A retrospective study on intestinal injury from blunt abdominal trauma. Albanian J Trauma Emerg Surg. 2025; 9(1): 1613–7.
7. Kim J, Kim S, Kwak D, Choi D. Treatment of placental abruption following blunt abdominal trauma: a case report. J Trauma Inj. 2025; 38(1): 61–5.
8. Li Y, Hu S, Ding W, Jia Z, Xue T, Jiang L. Efficacy and safety of renal artery embolization for blunt traumatic renal hemorrhage: a multicenter study. Abdom Radiol (NY). 2025.
9. Ben Ismail I, Tounsi MK, Sghaier M, Boujemaa M, Zenaidi H, Zoghlami A. Isolated mesocolon injury and sigmoid colon necrosis secondary to abdominal blunt trauma. Trauma Case Rep. 2025; 58(101208): 101208.
10. Mehta C, Shingade RG, Patel J, Parmar G. Isolated complete jejunal transection after blunt abdominal trauma: CT imaging. J Clin Diagn Res. 2016; 10(3): TD05-6.
11. Kar S, Mohapatra V, Rath PK. Isolated mesenteric vascular injury following blunt abdominal trauma leading to massive segmental gangrene of small gut: a case report. J Clin Diagn Res. 2016; 10(9): PD16–7.
12. Ndour O, Camara S, Tendart V, Fall AF, Gassama F, Mbaye P, et al. Blunt abdominal trauma in child: Epidemiological, diagnostic, and therapeutic analysis of 55 cases. Afr J Trauma. 2017; 6(1): 11.
13. Davoodabadi A, Marzban F, Ghafoor L, Talari HR, Abdolrahim-Kashi E, Akbari H, et al. Diagnostic value of serial ultrasound in blunt

abdominal trauma. Arch Trauma Res. 2017; 6(2).

14. Sangeen DMA, Jehangir DM, Rassieq D, Bisma D. Is sentinel clot sign on computed CT scan helpful in localization of primary site of bleeding in patients with blunt abdominal trauma: a retrospective study. Int J Radiol Diagn Imaging. 2020; 3(3): 25–7.
15. Hemachandran N, Gamanagatti S, Sharma R, Kumar A, Gupta A, Kumar S. Unidentified bright objects of spleen on arterial phase CT: mimicker of splenic vascular injury in blunt abdominal trauma. Diagn Interv Radiol. 2021; 27(4): 497–503.
16. Achatz G, Schwabe K, Brill S, Zischek C, Schmidt R, Friemert B, et al. Diagnostic options for blunt abdominal trauma. Eur J Trauma Emerg Surg. 2022; 48(5): 3575–89.
17. Kamal D, Kacimi O, Tabakh H, Touil N, Siwane A, Chikhaoui N. Giant biloma following a blunt abdominal trauma: a rare case report and review of literature. Am J Diagn Imaging. 2023; 9(4): 52.
18. Golikhatir I, Sazgar M, Jahanian F, Mousavi Amiri SJ, Aminiahidashti H. Comparison of the diagnostic accuracy of CT scan with oral and intravenous contrast versus CT scan with intravenous contrast alone in the diagnosis of blunt abdominal trauma. Chin J Traumatol. 2023; 26(3): 174–7.
19. Mhina P, Lazaro E, Uisso F, Moshi C. Focused assessment with sonography for trauma correlated with intraoperative findings among patients with blunt abdominal trauma. Am J Diagn Imaging. 2024; 1.
20. Bašković M, Keretić D, Lacković M, Borić Krakar M, Pogorelić Z. The diagnosis and management of pediatric blunt abdominal trauma-a comprehensive review. Diagnostics (Basel). 2024; 14(20): 2257.