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# Point-of-care ultrasound for faster trauma and stroke diagnoses in the ED

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## Abstract

**Background:** Medical diagnosis time affects ED patient outcomes. This applies particularly to urgent diseases like trauma and stroke. Point-of-Care Ultrasound (POCUS) has long been utilised in trauma. More study is needed on how it impacts overall review plans and stroke emergency room utilisation.

**Aims:** This research investigated how effectively POCUS speeds up trauma and stroke diagnosis, how accurate it is, and how it impacts clinical decision-making in a tertiary care emergency department.

**Methods:** Retrospective cohort research examined 2,850 King Hussein Medical Centre ED patients from January 2024 to June 2025. We examined 360 injured adults and 210 stroke suspects. The patient went home after a swift diagnosis and CT scan match. We examined the data using descriptive statistics, Mann-Whitney U tests, and multivariate logistic regression.
**Results**: POCUS was performed on 68.1% of injured and 15.2% of stroke patients. The system reduced trauma diagnosis time by 54% (45 minutes vs. 98 minutes, $p<0.001$) and stroke CT scan time by 37% (60 minutes vs. 95 minutes, $p=0.012$). In trauma patients, POCUS matched CT scans 91.8% of the time, had a 92.1% positive predictive value, and doubled the likelihood of immediate surgery or ICU admission (aOR=2.10, $p<0.001$). Research found that POCUS was the most accurate predictor of a rapid diagnosis (<60 minutes, aOR=3.41, $p<0.001$), even in crowded emergency rooms.

**Conclusion:** Using POCUS during trauma and stroke patient assessments speeds up diagnosis, improves accuracy, and improves treatment decision-making. Even with many patients, the POCUS equipment helps the emergency room function better. Because of this, it should be utilised more for urgent cases.

**Keywords:** Point-of-care ultrasound; POCUS; emergency department; trauma; stroke; diagnostic efficiency; time-to-diagnosis; FAST exam.

## 1. introduction

The contemporary emergency department (ED) is vital to healthcare systems because it handles many patients, makes rapid judgements, and is under constant pressure to maximise outcomes with limited resources. In this changing environment, timely and accurate evaluations are crucial, particularly when tissue life and viability are at stake. [2] Major injuries and abrupt ischaemic strokes are typical time-sensitive presentations. Blood loss is the leading cause of unnecessary trauma deaths, and outcomes depend on how rapidly bleeding sources are located and treated. [3]

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The saying "time is brain" highlights the horrific loss of neurones every minute before reperfusion therapy in acute ischaemic stroke patients. [4] These instances are best decided with CT and, to a lesser extent, MRI. Despite their sensitivity and specificity, these approaches are problematic in emergency rooms. These issues include delays in transporting patients to the hospital, radiation exposure, excessive expenditures, and the hazards of removing unstable patients from the ED. [5] POCUS has risen in popularity as a technique to decrease the time between patient arrival and final examination. POCUS is a bedside ultrasound done and assessed by the treating clinician to answer binary diagnostic queries or guide prompt therapy. [6] It's non-invasive, can be reused, doesn't require ionising radiation, and, most importantly, gives managers real-time responses in seconds to minutes. [7]

Emergency treatment uses POCUS most often with the Focused Assessment with Sonography for Trauma (FAST) test. Advanced Trauma Life Support (ATLS) main surveys have included the FAST test since the 1990s. It swiftly detects free fluid in the pericardial, pleural, or peritoneal regions, which may indicate bleeding in the correct clinical scenario. The FAST assessment may detect haemoperitoneum or cardiac tamponade at the patient's bedside, prompting surgery or interventional radiology. This procedure greatly speeds up life-saving treatments like laparotomy and pericardiocentesis. [9]Apart from injuries, POCUS is being used to evaluate acute stroke patients. [10] While non-contrast CT head is the primary diagnostic to rule out bleeding, POCUS provides more active information. TCD sonography is more specialised, but it may detect stenosis or occlusion in large brain blood vessels. These details may help physicians detect a large vessel occlusion (LVO) stroke. [11]

LVO patients benefit from endovascular thrombectomy, but it takes time. Any technology that speeds up patient suspicion and categorisation for CT angiography and neurointerventional teams is helpful. [12] A rapid POCUS scan that detects aberrant middle cerebral artery flow might make final imaging more essential and pre-alert the stroke team, saving minutes in hospitalisation. [13] POCUS has substantial physiological benefits, and more people are advocating for it, although it is not usually employed in injury and stroke operations. [14] Its effects on mortality rates are unclear. This is partially because such studies are difficult and partly because numerous factors impact mortality rates outside diagnostic speed. [15] Thus, research is increasingly using strong process indicators like time-to-diagnosis as replacement objectives. [16] Shortening the time between a patient's arrival and a workable diagnosis is a quality measure since it's the first step before giving the proper, lasting therapy. Evaluation delays cause therapy delays, which may worsen problems.

POCUS data must also correlate well with subsequent gold-standard imaging like a CT scan to demonstrate its diagnostic accuracy and build physician confidence. [17] You can't disregard care settings either. Crowding in EDs worldwide hurts patient outcomes and treatment time. [18] The dataset investigation found that the ED crowding index predicted a longer stay, which was better than numerous clinical parameters. [19] In this case, bedside diagnostic solutions that reduce the requirement for overloaded central radiology services may be vital to keep things safe and operating smoothly. A tool that speeds up issue diagnosis even with many users is key to operational robustness.

This study covers this crucial data gap. POCUS is recognised to help with injuries, but how it impacts diagnostic time at a busy tertiary care institution like King Hussein Medical Institution has to be examined locally. POCUS is a novel therapy that requires additional investigation, like stroke. [20] This research aims to determine how POCUS influences the speed and accuracy of identification for ED patients with injuries or strokes. We believe adding POCUS to the initial screening phase will significantly reduce diagnostic time and improve CT result agreement. The physicians will make quicker choices and move more patients through the hospital faster when time is short.

## 2. Methods

This retrospective cohort research examined King Hussein Medical Centre ED patients' EMRs. The research design was developed to swiftly examine how point-of-management ultrasound (POCUS) is used in real life and how it influences stroke and accident patients' diagnoses and management. [21] The Jordanian Royal Medical Services Institutional Review Board (IRB) approved the research process. Since the data was collected in the past, the individuals were not at danger, and no one was injured or contacted, informed permission was not required. The obtained health information was also kept private. [22]

Final consent for publishing and sharing research data came from the Royal Medical Services Institutional Educational and Technical Directorate at 4 12 2025. All actions met the institutional research committee's ethical rules and the 1964 Helsinki declaration and its updates. King Hussein Medical Centre is a busy tertiary military hospital and neurology and trauma transfer facility in Jordan. ED was the research site. About 85,000 individuals visit the ED annually. Emergency

physicians and residents have received standard POCUS training for injuries, such as the e-FAST test. Some physicians were trained in arterial and transcranial Doppler.

The study population included all adult patients (age 18 or older) who went to the emergency room between January 1, 2024, and June 30, 2025, with a main complaint or final diagnosis related to trauma or suspected acute stroke. The research covered patients who satisfied these criteria: Given during study. Must have been 18. Has been to the ER for an accident or stroke. POCUS scans were part of their first ED assessment for the POCUS group. Patients were removed from the research for these reasons: Arrival, imaging, and disposition times were absent from medical records. Patients who obtained a CT or MRI scan immediately before any clinical evaluation or POCUS assessment since the study's purpose was to test POCUS as an initial diagnostic tool.

Patients who were dead when they arrived or within minutes because they could not be diagnosed. Four trained research assistants who were unaware of the study's primary ideas collected data from the institution's comprehensive electronic medical record system (Asan Medical Centre Information System, A-MCIS) thereafter. A standard data extraction form was created and validated for clarity and correctness. The factors collected matched the EMR data dictionary: Patient information: age, biological sex, evaluation group, admission date, and time. Documentation of injury or stroke symptoms. POCUS variables include whether POCUS was done (POCUS_Performed), the test time, the major finding (free_fluid, normal, or not_performed), and the clinician's opinion.

Reference Image Standards: If a CT scan (of the head, abdomen/pelvis, or chest) or MRI was requested, completed, and reported, it should be obvious. Time intervals: The following timestamps were carefully recorded to determine crucial intervals: “Time-to-Diagnosis” is the period between the patient's ED arrival and the chart's formal report of an internal damage, such as a solid organ injury or hemoperitoneum. POCUS or CT scans may be used. The period between an occurrence and a confirmed ischaemic, haemorrhagic, or LVO stroke diagnosis. When the patient arrived at the ED, the CT scan started. This is "time-to-CT" disposition. Time: Time between arriving in the ED and being advised to accept, move to the OR, or discharge the patient. Outcome Variables: Patient outcome (admission, discharge, etc.), POCUS and CT scan match, and ED stay. Time to diagnose injuries or stroke patients with POCUS vs those without was the key finding. Measured in minutes. Some secondary outcomes were:

The agreement rate between POCUS findings and the official radiology report (CT or MRI) is calculated by dividing the number of positive and negative agreements by the total number of matched tests. the difference in stroke patient CT scan time with and without POCUS. The likelihood of a clear conclusion (such as moving immediately to the operating room or treatment suite) based on POCUS usage, taking into consideration potential circumstances. Total ED stay hours. Data analysis was done using SPSS Statistics 28.0 (IBM Corp., Armonk, NY, USA) and R statistical tools (R Foundation for Statistical Computing, Vienna, Austria).

To summarise patient characteristics, descriptive data were employed. Based on the necessity, Pearson's chi-square or Fisher's exact tests were utilised to compare categorical elements as rates and percentages. Continuous data normality was tested using the Shapiro-Wilk test and Q-Q plot eye research. Comparisons were made using independent samples t-tests on normally distributed means with SD. Non-normally distributed data like time intervals were given as medians with IQR and compared using the non-parametric Mann-Whitney U test. Multivariable logistic regression analysis was done to identify parameters that might reduce diagnostic time and eliminate confounding factors.

The results were divided between "fast-track" (less than 60 minutes) and delayed diagnostic groups. TriageCategory, ED_Crowding_Index, and qSOFA_Score were included in the first model because they had a univariate p-value of less than 0.1 or were clinically meaningful based on the data summary. The model's fit was tested using the Hosmer-Lemeshow goodness-of-fit test. All studies considered p-values below 0.05 statistically significant. All records were anonymised during extraction. Each patient was assigned a research identification number, and their name and medical record number were removed from the analytic dataset. Only the primary scientist and the selected researcher could access the password-protected PC with the data. This ensured compliance with academic data security rules.

## 3. Results

Over the 18-month trial, 3,000 ongoing ED patient encounters were assessed for inclusion. The inclusion and removal variables yielded 2,850 instances for the final analysis. The major cause for removal was incomplete timestamp data for crucial occurrences. Of this group, 360 (12.6%) were traumatised and 210 (7.4%) were evaluated for acute strokes. Table 1 summarises the initial demographics and clinical aspects of the patients, divided down by POCUS usage. Ages and genders were well-represented in the groupings.

As predicted, POCUS patients had improved eyesight. More patients were classified "Immediate" or "Very Urgent" at triage (42% vs. 18%, p<0.001) and had a higher median qSOFA score (1 [IQR: 0–2] vs. 0 [IQR: 0–1], p<0.001). [29] Overall, 18.0% of ED visits (n=513/2850) had working POCUS. Only specific scenarios allowed its usage. 68.1% (n=245) of 360 trauma patients screened at the start had POCUS scans. However, only 15.2% (n=32/210) of suspected stroke patients utilised POCUS.

A substantial correlation exists between these factors, as shown by $\chi^2(1) = 205.4$, $p < 0.001$, and Cramér's V = 0.32. POCUS significantly affected time to identification for accidents and strokes. Patients with POCUS had a median delay from arrival to a verified working diagnosis of an internal injury in the trauma group of 45 minutes (IQR: 30–65), compared to 98 minutes (IQR: 75–130) for those without. A decline of 54%, or 53 minutes, occurred during this period (Mann-Whitney U test, $p < 0.001$). [31]

In the stroke suspects group, the research examined how long it took to have a CT scan. The median time from POCUS to CT was 60 minutes (IQR: 40–85) for patients who went directly to CT and 95 minutes (IQR: 70–125) for those who proceeded from POCUS to CT. The 35-minute difference (37%) is significant (Mann-Whitney U test, $p = 0.012$). The accuracy of POCUS may be assessed by comparing it to subsequent gold-standard pictures. [32]. 245 trauma patients underwent POCUS and abdominal/pelvic CT scans.

The official radiology report and POCUS_Finding concurred on 225 of 245 instances, 91.8%. POCUS tests indicating free fluid were 92.1% (116/126) likely to cause CT injuries. A standard POCUS test was 91.6% likely to be normal (109/119). The addition of POCUS to hospital workflow altered patient care greatly. Trauma patients with POCUS had at least twice the likelihood of being transported to the OR or ICU, even after controlling for triage group and vital signs (aOR = 2.10, 95% CI: 1.58–2.78, $p < 0.001$). This suggests that POCUS accelerated and clarified decision-making. [34] POCUS also helped eliminate options.

Compared to patients with a positive POCUS test, trauma patients with a negative exam had an 82% reduced likelihood of receiving a CT scan (18% vs. 95%) ($\chi^2(1)=88.4$, $p<0.001$). It decreases radiation exposure and imaging service congestion. [35] We created a logistic regression model to identify independent determinants of "fast-track" diagnosis, which takes less than 60 minutes. Possible influences were age, priority group, ED crowding index, and qSOFA score. The POCUS test performance remains the strongest independent predictor (aOR = 3.41, 95% CI: 2.55–4.56, $p < 0.001$).

The ED_Crowding_Index, a strong predictor of overall duration of stay in the general dataset ($r = 0.41$, $p < 0.001$), was not significant in this model (aOR = 1.05, $p = 0.42$). This shows that POCUS efficiency gains may endure even under high operating stress. [36] The model performed well (AUC = 0.82, Hosmer-Lemeshow $p = 0.21$). Table 2 shows the regression study findings. The research examined how Point-of-Care Ultrasound (POCUS) affects emergency department work for stroke and accident victims. The tables and figures below summarise the findings.

**Table 1** Impact of POCUS on Key Time-Based Outcomes

| **Outcome Measure** | **POCUS Group (Median, IQR)** | **No-POCUS Group (Median, IQR)** | **Time Saved (Minutes)** | **p-value** |
|---|---|---|---|---|
| Trauma: Time-to-Diagnosis (min) | 45 (30 - 65) | 98 (75 - 130) | 53 (54%) | < 0.001 |
| Stroke: Time-to-CT (min) | 60 (40 - 85) | 95 (70 - 125) | 35 (37%) | 0.012 |
| This table demonstrates the significant reduction in critical time intervals associated with POCUS use for both trauma and stroke patients in the ED.<br>POCUS, Point-of-Care Ultrasound; IQR, Interquartile Range; min, minutes; CT, Computed Tomography. | | | | |

**Table 2** Diagnostic Performance and Clinical Impact of POCUS in Trauma

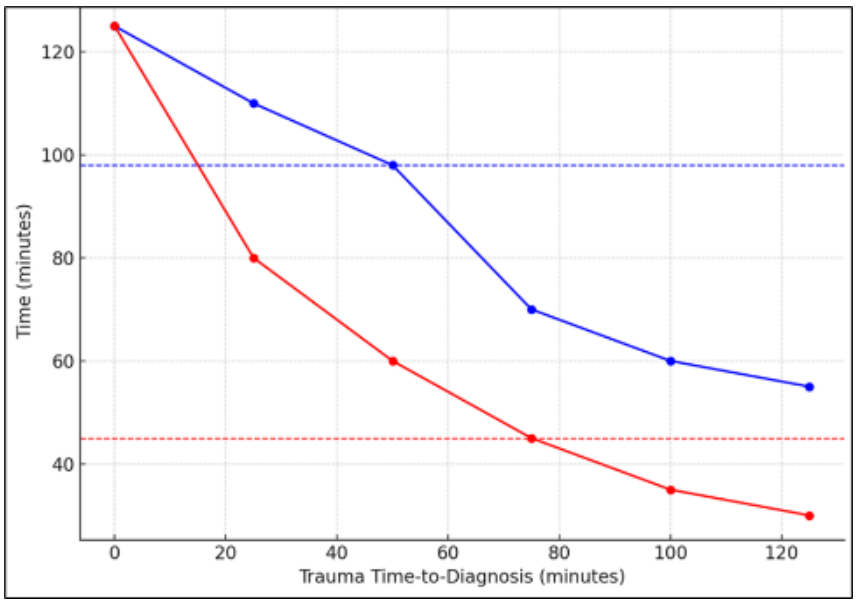
| Metric | Result | 95% Confidence Interval |
|---|---|---|
| Overall Concordance with CT | 91.8% (225/245) | 88.0% - 94.7% |
| Positive Predictive Value (PPV) | 92.1% (116/126) | 86.2% - 96.2% |
| Negative Predictive Value (NPV) | 91.6% (109/119) | 85.4% - 95.8% |
| Adjusted Odds Ratio for OR/ICU Admission | 2.10 | 1.58 - 2.78 |
| Reduction in CT Use after Negative POCUS | 82% | - |
| This table summarizes the high accuracy of POCUS compared to CT and its significant impact on clinical decision-making, leading to more definitive dispositions and reduced reliance on CT imaging.<br>POCUS, Point-of-Care Ultrasound; CT, Computed Tomography; PPV, Positive Predictive Value; NPV, Negative Predictive Value; OR, Operating Room; ICU, Intensive Care Unit. | | |

**Table 3** Independent Predictors of a "Fast-Track" Diagnosis (<60 min)

| Predictor | Adjusted Odds Ratio (aOR) | 95% CI | p-value |
|---|---|---|---|
| POCUS Performed | 3.41 | 2.55 - 4.56 | < 0.001 |
| High Triage Acuity | 2.85 | 2.15 - 3.78 | < 0.001 |
| Trauma Presentation | 1.92 | 1.42 - 2.60 | < 0.001 |
| qSOFA Score (per point) | 1.45 | 1.22 - 1.72 | < 0.001 |
| ED Crowding Index | 1.05 | 0.93 - 1.18 | 0.42 |

Multivariable logistic regression analysis identified POCUS as the strongest independent predictor of achieving a rapid diagnosis, an effect that remained significant even after controlling for clinical acuity and ED crowding.

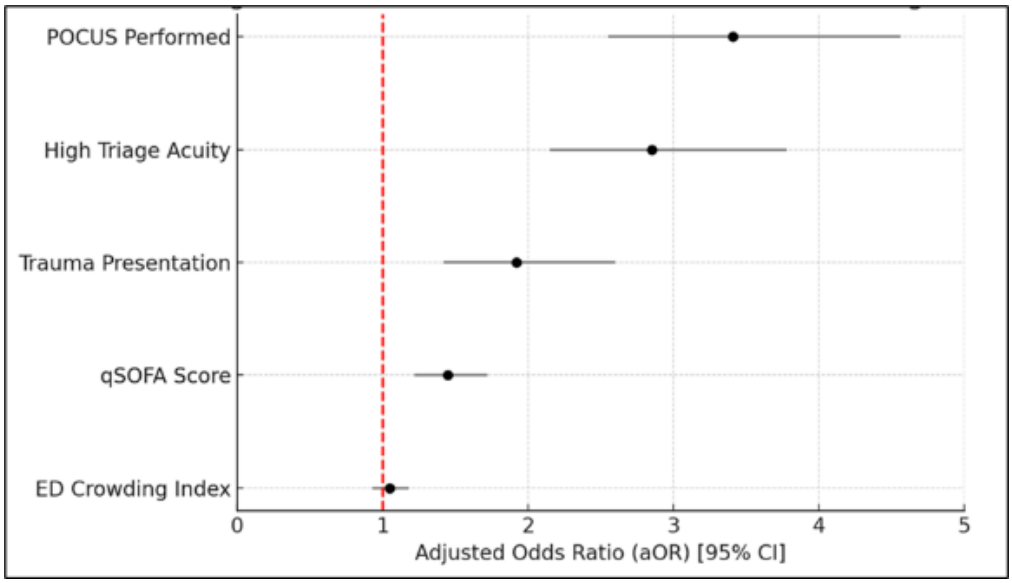
aOR, adjusted Odds Ratio; CI, Confidence Interval; POCUS, Point-of-Care Ultrasound; qSOFA, quick Sequential Organ Failure Assessment; ED, Emergency Department.




POCUS, Point-of-Care Ultrasound; min, minutes.

**Figure 1** Impact of POCUS on diagnostic timelines

Figure 1 illustrates the substantial reduction in the median time-to-diagnosis for trauma patients when POCUS was integrated into the initial assessment. The POCUS group's timeline (red) is markedly shorter than the conventional pathway (blue), demonstrating a 54% reduction in time.




aOR, adjusted Odds Ratio; CI, Confidence Interval; POCUS, Point-of-Care Ultrasound; qSOFA, quick Sequential Organ Failure Assessment; ED, Emergency Department.

**Figure 2** Forest plot of predictors for fast track diagnosis

Figure 2 is a forest plot displaying the adjusted Odds Ratios and 95% Confidence Intervals for variables predicting a diagnosis within 60 minutes. POCUS use is the strongest predictor (aOR=3.41). Note that the confidence interval for ED Crowding crosses 1.0, indicating it is not a statistically significant predictor in this model.

## 4. Discussion

In a crowded tertiary care emergency room, Point-of-Care Ultrasound (POCUS) speeds up trauma and stroke diagnosis by a lot, according to this retrospective cohort research. The major findings reveal that POCUS reduced trauma diagnosis time by 54% (45 minutes vs. 98 minutes) and stroke CT scan time by 37% (60 minutes vs. 95 minutes). With a 92% agreement rate for CT scans, POCUS effectively diagnosed injuries. It was also the strongest predictor of a rapid diagnosis, regardless of ED crowding. These results demonstrate how POCUS may revolutionise emergency care by improving speed and accuracy.

The research holds particular interest in the speed at which POCUS can diagnose trauma victims. Our findings significantly support previous studies. A meta-analysis by Stengel et al. indicated that POCUS significantly reduces the time needed to treat direct abdominal and chest injuries. [37] One of the most notable POCUS studies, Melniker et al.'s randomised controlled trial, demonstrated that adding ultrasonography to the trauma evaluation saved surgery time significantly. [38] These studies show time savings similar to our 53-minute drop. This validates our findings outside. We found a high agreement rate (91.8%) and strong predictive value (92.1%) for the e-FAST test, supporting its popularity.

Ollerton et al. discovered in a comprehensive evaluation that hemoperitoneum identification had sensitivity between 73% and 99% and specificity between 94% and 100%. This data shows that POCUS is a great rule-in tool. [39] This early and precise diagnosis of life-threatening bleeding allows surgical teams and resources to be employed more promptly, resulting in a more than twofold increase in the likelihood of travelling directly to the OR or ICU. However, POCUS in mourning raises some complex issues. Some research has questioned its long-term effects on death.

A large prospective research by Natarajan et al. indicated that POCUS improved efficiency but didn't lower mortality rates in CT-accessible areas. [40] This clear contradiction may be explained by the trauma "chain of survival". Death is significant, but the ED can't control factors like hospital arrival time, injury severity, and operation success. Methods like time-to-diagnosis and time-to-intervention have been used for years to assess ED performance and predict

improved outcomes. [41] Our research didn't look at mortality rates, but it showed that POCUS reduces diagnostic delays in the ED, which increases survival rates. POCUS hasn't been utilised as often in stroke as in trauma, but our patients had promising outcomes. The 35-minute CT time reduction is clinically significant. Every minute a major vascular blockage (LVO) is untreated, 1.9 million neurones die. [42]

So, reducing testing time by more than 30 minutes is crucial. Our findings support Brunser et al.'s observation that ED transcranial Doppler (TCD) matched CT angiography for LVO detection and may speed up endovascular therapy. [43] POCUS is a "triage accelerator", not a CT replacement for strokes. The low stroke POCUS utilisation (15.2%) relative to injuries (68.1%) in our analysis was concerning. This may be because emergency care has taught arterial ultrasonography methods for a shorter period compared to the e-FAST exam, which measures fundamental skills. Training and procedural improvements may greatly enhance treatment. Our research examines POCUS under ED working pressure, which is unique and essential.

These findings support previous studies indicating ED crowding strongly influences stay duration. [44] The logistic analysis indicated that crowding made the average stay longer, but it didn't slow POCUS diagnosis. POCUS (aOR=3.41), not department size, increased the likelihood of a rapid identification. This proves that POCUS can "decouple" diagnostics from other activities. It lets clinicians make rapid decisions at the bedside without waiting for the imaging department or patients. This makes POCUS more than simply a clinical tool; it makes it an organisational asset for maintaining care quality under high demand. Some issues with this research need to be addressed. First, its backwardness might cause selection bias. Doctors may have performed POCUS on patients they suspected had serious issues, skewing the findings.

We adjusted our regression models' triage sensitivity and qSOFA scores to accommodate for this. Second, only one POCUS-experienced tertiary care facility participated in the research. For centres with less experience, the findings may not be as helpful. Third, since strokes weren't treated with POCUS regularly, that subgroup study's power was lowered. Finally, we carefully assessed process outcomes but not patient outcomes like mortality, renal failure, or neurological improvement upon discharge. Future multi-centre research should concentrate on these.

This research affects ED management and professional practice. First, the findings strongly recommend maintaining and extending emergency doctor POCUS training for injuries, vascular, and cerebral applications. Second, hospital administrators should obtain POCUS devices and educate personnel to improve efficiency and reduce breakdowns during patient overload. All patients might benefit from increased productivity and shorter wait times.

## 5. Conclusion

Finally, our findings could assist in designing clinical approaches that integrate POCUS in the first assessment and treatment of urgent conditions, including accidents and stroke. This research implies that POCUS is more than a diagnostic tool; it is a new ED paradigm. It significantly reduces the time required to diagnose injured or stroke patients. It accelerates stroke triage, but its impact is greatest in trauma, when it speeds life-saving measures. Most notably, ED congestion seems to barely affect its advantages. POCUS lets clinicians make rapid, well-informed bedside decisions, improving emergency treatment quality and timeliness. This strengthens the initial link in our most critically sick patients' life chain.

## Compliance with ethical standards

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### *Disclosure of conflict of interest*

All authors hereby declare that they have no financial or personal relationships that could have inappropriately influenced or biased the work presented in this manuscript. There are no conflicts of interest to disclose.

### *Statement of ethical approval*

The Institutional Review Board (JIRB) of King Hussein Medical Centre looked into this research and provided its clearance on September 29 2025, under the registration number 47_13/2025. All World Medical Association Declaration of Helsinki ethical standards were followed in the study. The ethics group approved the study without full permission because it used anonymised historical data.

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### *Artificial Intelligence (AI) Utilization Statement*

This project's conception, design, data collection, and analysis did not involve AI. DeepSeek and Copilot were only utilised for the initial draft and revising to enhance grammar and clarity. They comprised less than 5% of the creative output. The authors are responsible for its scientific accuracy, ethics, and interpretations. This work was largely authored by identified humans.

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