TPM Vol. 32, No. S7, 2025
ISSN: 1972-6325
https://www.tpmap.org/

DIAGNOSTIC ACCURACY OF DECISION INSTRUMENT NEXUS CHEST FOR THE IDENTIFICATION OF THORACIC INJURY TAKING CHEST IMAGING AS GOLD STANDARD AT TERTIARY CARE HOSPITAL, KARACHI

DR SAIMA SIDDIQUI
POSTGRADUATE RESIDENT EMERGENCY MEDICINE, JPMC, KARACHI , EMAIL: saima.smc77@gmail.com
ORCID:0009-0001-3777-9447

DR MUNAWWAR KHURSHEED
MBBS, FCPS, INCHARGE EMERGENCY MEDICINE DEPARTMENT, NICVD KARACHI, EMAIL: munawar.md@outlook.com, ORCID:0009-0003-1077-4405

DR MARVI
POSTGRDADUATE RESIDENT EMERGENCY MEDICINE, JPMC, KARACHI , EMAIL: marviali66@gmail.com
ORCID ID: 0009-0004-3829-1058

DR SANOBER SIKANDAR
MBBS, FCPS, CONSULTANT EMERGENCY MEDICINE JPMC, KARACHI , EMAIL: drsanoberjpmc@gmail.com
ORCID: 0009-0003-1909-6938

DR NOSHEEN RAUF
MBBS, MPH/INCHARGE EMERGENCY MEDICINE, JPMC, KARACHI, EMAIL: nausheenrauf@jpmc.edu.pk
ORCID: 0009-0007-4598-0611

ABSTRACT

Background: Prompt recognition of thoracic injuries in patients with blunt trauma remains critical for guiding imaging and treatment. The National Emergency X-Radiography Utilization Study (NEXUS) Chest decision instrument was designed to identify patients at low risk for significant thoracic injury and reduce unnecessary imaging. We aimed to determine its diagnostic accuracy against chest imaging as the gold standard in a tertiary care hospital.

Methods: We carried out a cross-sectional study of 134 blunt trauma patients who underwent both NEXUS Chest assessment and chest imaging. We calculated sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy, using chest imaging as the reference standard.

Results: The NEXUS Chest instrument correctly classified 82 patients as true positives and 25 as true negatives, with 10 false positives and 17 false negatives. It achieved a sensitivity of 73.9%, specificity of 71.4%, PPV of 89.1%, NPV of 59.5%, and an overall diagnostic accuracy of 79.8%. The tool reliably confirmed injury when present but showed limited ability to rule out injury when negative.

Conclusion: NEXUS Chest provides good diagnostic accuracy for detecting thoracic injuries in blunt trauma, particularly when confirming injury. Clinicians should interpret negative results cautiously, especially in high-risk patients. Combining NEXUS Chest with adjunctive modalities such as extended focused assessment with sonography for trauma (E-FAST) may enhance diagnostic precision and support safe, efficient imaging decisions in tertiary care settings.

Keywords: Thoracic injury; NEXUS Chest; Blunt chest trauma; Trauma assessment; Diagnostic accuracy; Chest imaging; E-FAST; Specificity; Sensitivity

INTRODUCTION

Although chest imaging—such as chest X-ray (CXR) and chest computed tomography (CT)—yields clinically significant findings in only a small proportion of patients, it remains the most commonly used radiographic assessment in blunt trauma evaluations and is recommended for nearly all such patients under current Advanced Trauma Life Support (ATLS) guidelines.[1-2] The routine use of chest radiography, particularly CT

scans, in trauma cases unnecessarily exposes a predominantly young patient population to harmful ionizing radiation, which may substantially increase their risk of developing cancer. [3-4] The use of intravenous contrast in trauma protocol chest CT can also result in additional iatrogenic complications. Moreover, the financial burden and the time required by healthcare providers to process and interpret non-contributory studies place added strain on trauma centers already facing limited resources. [5-6]

The NEXUS Chest decision tool, developed from data on 2,628 patients across three trauma centers, is a seven-criteria scoring system used to predict thoracic trauma. The factors include: age over 60 years, high-energy deceleration injury (such as a fall from more than 20 feet or a motor vehicle collision at speeds exceeding 40 mph), presence of chest pain, intoxication, altered mental status, distracting painful injury, and tenderness upon palpation of the chest wall. [7-8]

Chest injuries, a major predictor of early mortality, occur in roughly one-third of all injury-related hospital admissions and account for approximately 25% to 50% of deaths resulting from trauma. [9-10] Chest trauma can be either penetrating or blunt and may involve conditions such as pneumothorax, hemothorax, hemopneumothorax, flail chest, injury to major blood vessels, or diaphragmatic damage. Early and accurate diagnosis plays a crucial role in determining patient outcomes. [11] While chest radiographs are useful for assessing breathing issues and verifying tube placement, their diagnostic accuracy heavily depends on the interpreter□s expertise. Additionally, they expose radiosensitive organs, such as the thyroid, to radiation. These limitations have led to recommendations for more precise diagnostic tools, such as computed tomography (CT) and ultrasonography. [12-13] Given the time-intensive process and ongoing debate over the optimal imaging method, it is recommended that clinicians stratify patients into low- and high-risk categories. This approach helps identify those needing immediate intervention and guides the selection of the most appropriate imaging modality for each patient. [14] Such a decision can both save the lives of patients who need urgent intervention and minimize the frequency of unnecessary chest X-rays. [15]

Thoracic injuries, including rib fractures, pneumothorax, hemothorax, and pulmonary contusions, are common in trauma patients and can have life-threatening consequences if not promptly identified and managed. Routine imaging for all trauma patients may lead to unnecessary radiation exposure, increased healthcare costs, and prolonged emergency department (ED) stay. The NEXUS tool uses specific clinical criteria, such as chest wall tenderness and abnormal breathing sounds, to stratify risk and guide imaging decisions. Despite its potential benefits, the diagnostic accuracy of the NEXUS Chest decision instrument in identifying thoracic injuries remains a topic of ongoing investigation. Understanding its sensitivity, specificity, and overall performance in diverse clinical settings is crucial to ensuring patient safety while minimizing unnecessary imaging. The results could help refine clinical decision-making, optimize imaging utilization, and improve patient outcomes in trauma care.

MATERIALS AND METHODS

This cross-sectional validation study was conducted in the Department of Emergency Medicine at Jinnah Postgraduate Medical Centre (JPMC), Karachi, from April 2025 to August 2025. A total of 134 patients were enrolled, determined through a sample size calculation using a 95% confidence level, 9% prevalence of blunt trauma, 97.8% sensitivity, 51.8% specificity, and a 6% desired precision. Patients were selected using a non-probability consecutive sampling technique.

Eligible participants included individuals aged between 20 and 70 years of either gender who were clinically suspected of sustaining blunt trauma. Patients were excluded if they were unstable due to blunt abdominal trauma, had a history of chest surgery, or were known cases of stroke, chronic renal failure, chronic obstructive pulmonary disease (COPD), asthma, congestive heart failure, or myocardial infarction.

Following approval from the College of Physicians and Surgeons Pakistan and the institutional ethics review board, written informed consent was obtained from all participants. Patients presenting to the emergency department and meeting the study criteria were assessed. Demographic information, including age and gender, was collected at the time of admission. Chest imaging, including either a chest X-ray or CT scan, was performed as required by the attending emergency physician, and results were classified as positive or negative based on predefined thoracic injury criteria. At the same time, the NEXUS Chest decision instrument was applied at presentation, and patients were categorized according to the presence or absence of any listed criteria. All collected data were entered into a predesigned proforma. Decision Instrument Nexus Chest: (1) older than 60 years, (2) rapid deceleration mechanism (defined as a fall >20 ft [>6.0 m] or motor vehicle crash >40 mph [>64 km/h]), (3) chest pain, (4) intoxication, (5) abnormal alertness/mental status, (6) distracting painful injury, and (7) tenderness to chest wall palpation. Presence of any one or more will be used to label thoracic injury. Thoracic Injury Seen On Chest Imaging: It will be defined as thoracic injury seen on chest imaging (TICI) as pneumothorax, hemothorax, aortic or great vessel injury, 2 or more rib fractures, ruptured diaphragm, sternal fracture, and pulmonary contusion or laceration seen on radiographs. Presence of any one or more will be used to label thoracic injury.

True positive result = presence of 1 or more DI criteria and having injury.
True-negative result = absence of all DI criteria and not having injury;
False positive result = presence of 1 or more DI criteria and not having injury;

False-negative result = absence of all DI criteria and having injury.
Data analysis was carried out using SPSS version 22. For quantitative variables such as age, the mean and standard deviation were calculated for normally distributed data (as assessed by the Kolmogorov Smirnov test), while non-normally distributed variables were reported using the median and interquartile range (IQR). Categorical variables such as gender, NEXUS Chest outcome (positive/negative), and chest imaging results (positive/negative) were summarized as frequencies and percentages.
The sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy of the NEXUS Chest decision instrument were computed using a 2x2 contingency table, with chest imaging serving as the gold standard. Stratification was performed by age and gender to assess their impact on the diagnostic performance. Post-stratification calculations for sensitivity, specificity, predictive values, and accuracy were conducted using stratified 2x2 tables.

RESULTS

A total of 134 patients with blunt thoracic trauma participated in the study. Most patients (59.7%, n = 80) were between 20 and 45 years of age, while 40.3% (n = 54) were between 46 and 70 years. Males accounted for 61.2% (n = 82) of the sample, and females comprised 38.8% (n = 52). The NEXUS Chest decision instrument classified 73.9% (n = 99) of participants as positive for thoracic injury risk and 26.1% (n = 35) as negative. Chest imaging confirmed thoracic injury in 68.7% (n = 92) of cases, while 31.3% (n = 42) showed no evidence of injury.

TABLE 1: CHARACTERISTICS OF PATIENTS

DEMOGRAPHY		NUMBER	PERCENTAGE
AGE	20-45 YEARS	80	59.7%
	46-70 YEARS	54	40.3%
GENDER	MALE	82	61.2%
	FEMALE	52	38.8%
THORACIC INJURY ON NEXUS CHEST DECISION INSTRUMENT	POSITIVE	99	73.9%
	NEGATIVE	35	26.1%
THORACIC INJURY ON CHEST IMAGING	POSITIVE	92	68.7%
	NEGATIVE	42	31.3%

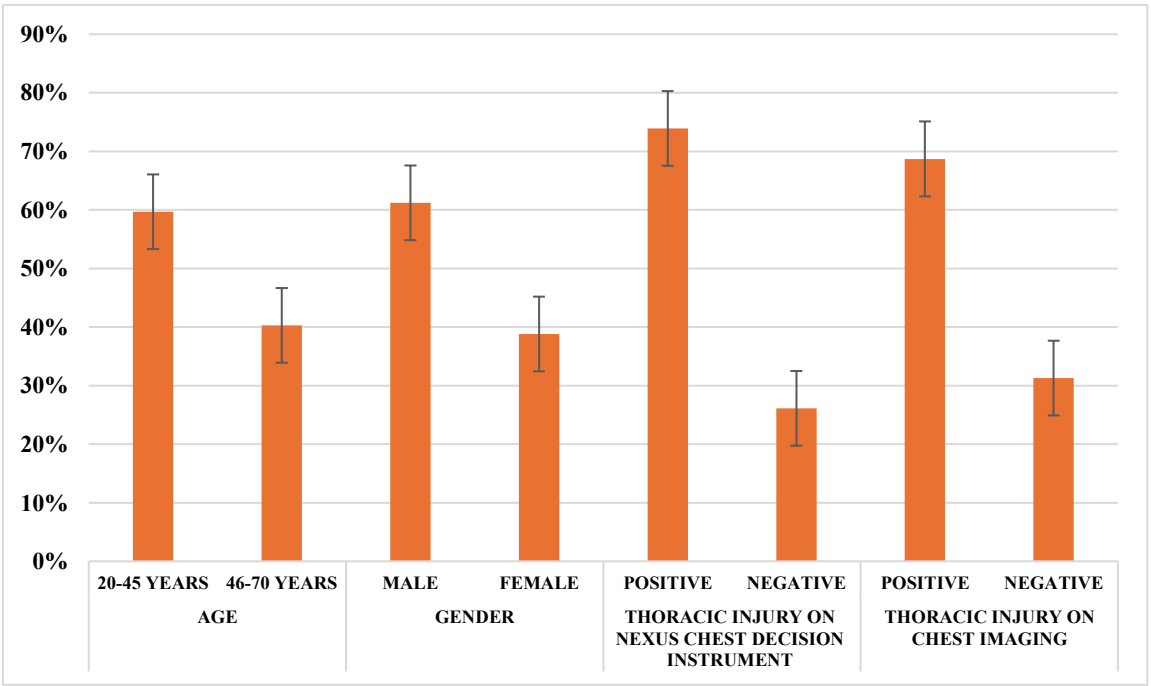

Figure 1: Demographic features of all the patients included in this study

Comparing the NEXUS Chest findings with chest imaging revealed that 82 patients were true positives, receiving both a positive NEXUS result and confirmation of injury on imaging. Ten patients had false positive results, testing positive on NEXUS but showing no injury on imaging. Seventeen patients were false negatives, scoring negative on NEXUS despite having injuries confirmed radiologically, and 25 patients were true negatives. These findings show that the decision instrument correctly identified most patients with thoracic injury but failed to detect a notable number of cases.

TABLE 2: DECISION INSTRUMENT NEXUS CHEST FOR THE IDENTIFICATION OF THORACIC INJURY TAKING CHEST IMAGING AS GOLD STANDARD

VARIABLE		THORACIC INJURY ON CHEST IMAGING		TOTAL
		POSITIVE	NEGATIVE	
THORACIC INJURY ON NEXUS CHEST DECISION INSTRUMENT	POSITIVE	82(TP)	10(FP)	92
	NEGATIVE	17(FN)	25(TN)	42
TOTAL		99	35	134

The NEXUS Chest decision instrument demonstrated a sensitivity of 73.9% and a specificity of 71.4% when chest imaging served as the reference standard. The positive predictive value reached 89.1%, indicating that most patients with a positive NEXUS result indeed had thoracic injury. The negative predictive value was lower at 59.5%, reflecting a reduced ability to rule out injury in patients with a negative score.

TABLE 3: SENSITIVITY, SPECIFICITY, POSITIVE AND NEGATIVE PREDICTIVE VALUES AND DIAGNOSTIC ACCURACY OF DECISION INSTRUMENT NEXUS CHEST FOR THE IDENTIFICATION OF THORACIC INJURY TAKING CHEST IMAGING AS GOLD STANDARD

VARIABLE	SENSITIVITY	SPECIFICITY	POSITIVE PREDICTIVE VALUE	NEGATIVE PREDICTIVE VALUE	DIAGNOSTIC ACCURACY
Thoracic injury on nexus chest decision instrument	73.9%	71.4%	89.1%	59.5%	79.8%

DISCUSSION

We assessed the diagnostic accuracy of the NEXUS Chest decision instrument for detecting thoracic injuries in 134 patients with blunt trauma, using chest imaging as the reference standard. The tool correctly identified 82 true positives and 25 true negatives, while producing 10 false positives and 17 false negatives. These results correspond to a sensitivity of 73.9%, a specificity of 71.4%, a positive predictive value (PPV) of 89.1%, a negative predictive value (NPV) of 59.5%, and an overall diagnostic accuracy of 79.8%. The high PPV shows that the instrument performs well in confirming thoracic injury when the result is positive. However, the moderate NPV indicates that a negative finding does not reliably exclude injury, underscoring the need for cautious interpretation, particularly in patients at higher risk.

Our results align with the validation study by Rodriguez et al[17] which demonstrated that NEXUS Chest offers high sensitivity for clinically significant injuries. Thus enabling clinicians to safely limit unnecessary imaging

in low-risk cases. Similarly, Safari et al[18] reported high sensitivity for both NEXUS Chest and the Thoracic Injury Rule Out Criteria (TIRC), with TIRC showing slightly greater specificity while maintaining low false-negative rates. Ahmadzadeh et al. [19] reinforced these findings in a systematic review and meta-analysis, highlighting NEXUS Chest as a useful adjunct to thorough clinical assessment rather than a stand-alone test. The sensitivity and specificity we observed are slightly lower than the highest values reported but remain within the range documented in multi-centre evaluations, supporting its applicability in varied emergency settings.

Comparisons with studies incorporating extended focused assessment with sonography for trauma (E-FAST) illustrate important trade-offs between sensitivity and specificity. Rageh et al. [20] found that for pneumothorax, NEXUS Chest achieved 100% sensitivity but only 10% specificity, whereas E-FAST yielded 87% sensitivity and 98% specificity. For hemothorax, NEXUS again showed 100% sensitivity but 11% specificity, compared with E-FAST□s 80% sensitivity and 100% specificity. These findings suggest that while NEXUS Chest effectively captures all potential injuries, its low specificity may lead to higher false-positive rates and increased imaging. Integrating bedside ultrasound into the diagnostic process could mitigate this limitation. In addition, Vazirizadeh-Mahabadi et al. [21] demonstrated that machine learning algorithms can predict thoracic injuries with higher accuracy than conventional decision rules, pointing towards future opportunities to combine structured clinical tools with advanced computational models.

Taken together, our findings support incorporating NEXUS Chest into trauma assessment protocols at tertiary care hospitals, particularly when used alongside adjunctive modalities such as E-FAST. This integrated approach could provide rapid, accurate, and cost-efficient diagnosis while maintaining patient safety. Further research should refine combined algorithms to enhance NPV and reduce false negatives, ensuring optimal care for patients with suspected thoracic injury.

LIMITATIONS

We conducted this study at a single tertiary care hospital. This limits the extent to which these findings apply to other settings with different patient populations or resource availability. The modest sample size and use of chest imaging as the only reference standard may have introduced selection bias. In addition, hence it would have failed to capture some clinically important injuries.

CONCLUSION

This study shows that the NEXUS Chest decision instrument provides good diagnostic accuracy for detecting thoracic injuries in patients with blunt trauma. Thus, performing particularly well when confirming the presence of injury. However, its moderate negative predictive value means clinicians should interpret negative results cautiously. This is especially relevant in higher-risk patients. Using NEXUS Chest alongside complementary tools such as E-FAST can strengthen trauma assessment protocols in tertiary care settings, enabling faster, more accurate, and efficient clinical decision-making. Future multi-centre research should refine integrated diagnostic strategies to improve sensitivity, specificity, and overall patient outcomes.

CONFLICT OF INTEREST: This study has no conflict of interest to declare by any author.

REFERENCES

1. Wisbach GG, Sise MJ, Sack DI, et al. What is the role of chest X-ray in the initial assessment of stable trauma patients? J Trauma. 2007;62(1):74-79.
2. Smith-Bindman R, Lipson J, Marcus R, et al. Radiation dose associated with common computed tomography examinations and the associated lifetime attributable risk of cancer. Arch Intern Med. 2009;169(22):2078-2086.
3. Berrington de González A, Mahesh M, Kim KP, et al. Projected cancer risks from computed tomographic scans performed in the United States in 2007. Arch Intern Med. 2009;169(22):2071-2077.
4. Brenner DJ, Hall EJ. Computed tomography□an increasing source of radiation exposure. N Engl J Med. 2007;357(22):2277-2284.
5. Fazel R, Krumholz HM,Wang Y, et al. Exposure to low-dose ionizing radiation from medical imaging procedures. N Engl J Med. 2009;361(9):849-857.
6. Amis ES Jr, Butler PF, Applegate KE, et al; American College of Radiology. American College of Radiology white paper on radiation dose in medicine. J AmColl Radiol. 2007;4(5):272-284.
7. Korley FK, Pham JC, Kirsch TD. Use of advanced radiology during visits to US emergency departments for injury-related conditions, 1998-2007. JAMA. 2010;304(13):1465-1471.
8. Rodriguez RM, Anglin D, Langdorf MI, Baumann BM, Hendey GW, Bradley RN, Medak AJ, Raja AS, Juhn P, Fortman J, Mulkerin W. NEXUS chest: validation of a decision instrument for selective chest imaging in blunt trauma. JAMA surgery. 2013 Oct 1;148(10):940-6.
9. Ekpe EE, Eyo C. Determinants of mortality in chest trauma patients. Niger J Surg. 2014;20(1):30□4.
10. Farooq U, Raza W, Zia N, Hanif M, Khan MM. Classification and man agement of chest trauma. J Coll Physicians Surg Pak. 2006;16(2):101□3.

11. Demirhan R, Onan B, Oz K, Halezeroglu S. Comprehensive analysis of 4205 patients with chest trauma: A 10-year experience. Interact Cardiovasc Thorac Surg. 2009;9(3):450□3.
12. Kool DR, Blickman JG. Advanced Trauma Life Support®. ABCDE from a radiological point of view. Emerg Radiol. 2007;14(3):135□41.
13. Safari S, Baratloo A, Negida AS, Sanei Taheri M, Hashemi B, Hosseini Selkisari S. Comparing the interpretation of traumatic chest X-ray by emergency medicine specialists and radiologists. Arch Trauma Res. 2014;3(4). e22189.
14. Scaglione M, Pinto A, Pedrosa I, Sparano A, Romano L. Multi-detector row computed tomography and blunt chest trauma. Eur J Ra diol. 2008;65(3):377□88.
15. Kaewlai R, Avery LL, Asrani AV, Novelline RA. Multidetector CT of blunt thoracic trauma. Radiographics. 2008;28(6):1555□70.
16. Norouzi N, Amini A, Hatamabadi H. Comparison of diagnostic accuracy of Nexus chest and thoracic injury rule-out criteria in patients with blunt trauma; a cross-sectional study. Trauma Monthly. 2019 May 1;24(3):1-6.
17. Rodriguez RM, Anglin D, Langdorf MI, Baumann BM, Hendey GW, Bradley RN, Medak AJ, Raja AS, Juhn P, Fortman J, Mulkerin W. NEXUS chest: validation of a decision instrument for selective chest imaging in blunt trauma. JAMA Surgery. 2013 Oct 1;148(10):940-6.
18. Safari S, Radfar F, Baratloo A. Thoracic injury rule out criteria and NEXUS chest in predicting the risk of traumatic intra-thoracic injuries: A diagnostic accuracy study. Injury. 2018 May 1;49(5):959-62.
19. Ahmadzadeh K, Abbasi M, Yousefifard M, Safari S. Value of NEXUS chest rules in assessment of traumatic chest injuries; a systematic review and a meta-analysis. The American Journal of Emergency Medicine. 2023 Mar 1;65:53-8.
20. Rageh TM, Eldeen AM, Abd Elaziz ME, Hegazy EM. Comparative Study of National Emergency X-Radiography Utilization Study (NEXUS) Chest Algorithm and Extended Focused Assessment with Sonography for Trauma (E-FAST) Performed by Emergency Physicians in the Early Detection of Blunt Chest Injuries. The Egyptian Journal of Hospital Medicine. July 2025;100:3138-3144.
21. Vazirizadeh-Mahabadi M, Jolfayi AG, Hosseini M, Yarahmadi M, Zarei H, Masoodi M, Sarveazad A, Yousefifard M. Predicting the Presence of Traumatic Chest Injuries Using Machine Learning Algorithm. Archives of Academic Emergency Medicine. 2025 Mar 17;13(1):e41.