Original Investigation

NEXUS Chest
Validation of a Decision Instrument for Selective Chest Imaging in Blunt Trauma

Robert M. Rodriguez, MD; Deirdre Anglin, MD, MPH; Mark I. Langdorf, MD; Brigitte M. Baumann, MD, MSCE; Gregory W. Hendey, MD; Richard N. Bradley, MD; Anthony J. Medak, MD; Ali S. Raja, MD, MPH; Paul Juhn, MD; Jonathan Fortman; William Mulkerin; William R. Mower, MD, PhD

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IMPORTANCE Chest radiography (chest x-ray [CXR] and chest computed tomography [CT]) is the most common imaging in blunt trauma evaluation. Unnecessary trauma imaging leads to greater costs, emergency department time, and patient exposure to ionizing radiation.

OBJECTIVE To validate our previously derived decision instrument (NEXUS Chest) for identification of blunt trauma patients with very low risk of thoracic injury seen on chest imaging (TICI). We hypothesized that NEXUS Chest would have high sensitivity (>98%) for the prediction of TICI and TICI with major clinical significance.

DESIGN, SETTING, AND PARTICIPANTS From December 2009 to January 2012, we enrolled blunt trauma patients older than 14 years who received chest radiography in this prospective, observational, diagnostic decision instrument study at 9 US level I trauma centers. Prior to viewing radiographic results, physicians recorded the presence or absence of the NEXUS Chest 7 clinical criteria (age >60 years, rapid deceleration mechanism, chest pain, intoxication, abnormal alertness/mental status, distracting painful injury, and tenderness to chest wall palpation).

MAIN OUTCOMES AND MEASURES Thoracic injury seen on chest imaging was defined 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. An expert panel generated an a priori classification of clinically major, minor, and insignificant TICIs according to associated management changes.

RESULTS Of 9905 enrolled patients, 43.1% had a single CXR, 42.0% had CXR and chest CT, 6.7% had CXR and abdominal CT (without chest CT), 5.5% had multiple CXRs without CT, and 2.6% had chest CT alone in the emergency department. The most common trauma mechanisms were motorized vehicle crash (43.9%), fall (27.5%), pedestrian struck by motorized vehicle (10.7%), bicycle crash (6.3%), and struck by blunt object, fists, or kicked (5.8%). Thoracic injury seen on chest imaging was seen in 1478 (14.9%) patients with 363 (24.6%) of these having major clinical significance, 1079 (73.0%) minor clinical significance, and 36 (2.4%) no clinical significance. NEXUS Chest had a sensitivity of 98.8% (95% CI, 98.1%-99.3%), a negative predictive value of 98.5% (95% CI, 97.6%.6-99.1%), and a specificity of 13.3% (95% CI, 12.6%-14.1%) for TICI. The sensitivity and negative predictive value for TICI with clinically major injury were 99.7% (95% CI, 98.2%-100.0%) and 99.9% (95% CI, 99.4%-100.0%), respectively.

CONCLUSIONS AND RELEVANCE We have validated the NEXUS Chest decision instrument, which may safely reduce the need for chest imaging in blunt trauma patients older than 14 years.

JAMA Surg. 2013;148(10):940-946. doi:10.1001/jamasurg.2013.2757
Published online August 7, 2013.

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Robert M. Rodriguez, MD, Department of Emergency Medicine, University of California San Francisco School of Medicine, San Francisco General Hospital, San Francisco, CA 94110 (robert.rodriguez@emergency.ucsf.edu).

Despite revealing clinically important findings in a minority of patients, chest imaging (chest x-ray [CXR] and chest computed tomography [CT]) is the most frequently performed radiography during blunt trauma patient evaluation and is recommended for almost all blunt trauma victims by current Advanced Trauma Life Support (ATLS) guidelines.[1,2] This indiscriminate chest radiography, especially CT, exposes disproportionately young trauma patients to harmful ionizing radiation, potentially inducing cancer at a significant rate.[3-7] Intravenous contrast from trauma protocol chest CT may also lead to other iatrogenic complications. Furthermore, the cost and health care providers' time necessary to process and interpret uninformative studies strain increasingly resource-limited trauma centers.[8]

Much of the excessive radiography may arise from indiscriminate blunt trauma imaging protocols. Prior versions of ATLS guidelines recommended routine chest, pelvis, and cervical spine imaging.[2,9,10] However, well-validated clinical decision rules, such as the NEXUS and Canadian cervical spine rules, have demonstrated that selective cervical spine imaging can be implemented in blunt trauma patients without compromising safety.[11,12] This has led to the removal of routine cervical spine imaging recommendations from the most recent ATLS guidelines and widespread adoption of selective cervical spine imaging practice.[1] Despite ubiquitous ordering of CXRs and chest CTs in blunt trauma evaluation, no similar decision rules have been developed for selective chest imaging.

The goal of this research is to reduce unnecessary chest imaging in blunt trauma. Previously, we derived a decision instrument (DI) consisting of 7 clinical criteria (NEXUS Chest) that predicted intrathoracic injury with high sensitivity and excluded injury with high negative predictive value (NPV).[13,14] In a separate cohort, we sought to prospectively validate NEXUS Chest, testing the hypothesis that this DI has high sensitivity (>98%) for the prediction of intrathoracic injury and clinically significant intrathoracic injury in blunt trauma patients older than 14 years.

Methods

We have described the derivation and interrater reliability assessment of our selective chest imaging DI.[13,14] We conducted this multicenter, prospective cohort validation study at 9 US level I trauma centers from December 2009 to January 2012. We enrolled patients using the following inclusion criteria: (1) older than 14 years, (2) blunt trauma occurring within 24 hours of emergency department (ED) presentation, and (3) receiving chest imaging (CXR or chest CT) in the ED as part of blunt trauma evaluation.

Because of study personnel availability limitations, we used a daytime (7 AM to 11 PM) systematic sampling method. Study personnel collected data regarding patient characteristics and trauma mechanism. We provided no guidance for chest imaging, leaving radiography ordering decisions to the treating physicians' discretion. After CXR or chest CT was ordered in the ED and prior to the viewing of images or receiving imaging reports, we gave the primary physicians caring for study patients (emergency medicine or trauma surgery attending and resident physicians) a 1-page sheet on which they indicated the presence or absence of the NEXUS Chest DI criteria: (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. If physicians responded that the patient had abnormal alertness/mental status, they could answer "unknown" to other criteria questions. See eAppendix in the Supplement for criteria definitions made available during physician assessments.

Outcome Determination

Prior to our derivation study, we convened an attending emergency and trauma physician expert panel, who defined 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.[14] We did not consider pericardial tamponade and cardiac contusion TICI because they are not primarily diagnosed by CXR or chest CT.

We used official radiologic interpretations by board-certified radiologists, who were blind to patient enrollment, to determine the presence or absence of TICI. We classified patients undergoing more than 1 CXR or CT as positive for injury if TICI was noted on any ED imaging study. In patients who had CXR and chest CT, we designated the CT results as the TICI outcome reference standard. If a patient did not have chest CT but had an abdominal CT demonstrating thoracic injury not seen on CXR, for example, a pneumothorax on upper abdominal CT images, then we considered TICI present. When radiology readings were ambiguous for the presence of TICI findings, for example, possible pulmonary contusion, we deemed TICI to be present.

In reviews of other selective imaging DIs, investigators have debated the clinical significance of missed injuries, for example, small, nonsurgical traumatic brain hemorrhages.[15] To address this issue of radiologic diagnosis compared with clinical significance, we convened an expert trauma panel of 10 associate professor level or higher trauma surgeons and emergency medicine physicians (R.M.R., M.I.L., B.M.B., G.W.H., A.J.M., and W.R.M.) to classify thoracic injuries according to the associated clinical interventions. We generated an inclusive list of TICI paired with management changes, interventions, or both, for example, pneumothorax with chest tube placement. Panel members independently reviewed this list and assigned values to each injury-intervention pair: 0 indicated no clinical significance; 1, minor clinical significance; and 2, major clinical significance. We calculated the means for these injury-intervention pairs, rounding to the second decimal place and designated mean scores of 0-0.49, 0.50-1.49, and 1.50-2 to represent injuries with no, minor, and major clinical significance, respectively (**Box**).

Blind to patient DI criteria assessment and following medical record abstraction principles described by Gilbert et al,[16] we determined TICI and clinical outcomes independently. We used standard quality-assurance methods, including double

Box. Trauma Expert Panel Determination of Clinical Significance of Injuries Seen on Chest Imaging

Major Clinical Significance

Aortic or great vessel injury (all are considered major)

Ruptured diaphragm (all are considered major)

Pneumothorax: Received evacuation procedure (chest tube or other procedure)

Hemothorax: Received drainage procedure (chest tube or other procedure)

Sternal fracture: Received surgical intervention

Multiple rib fracture: Received surgical intervention or epidural nerve block

Pulmonary contusion: Received mechanical ventilatory assistance (including noninvasive ventilation) of any type for management

Minor Clinical Significance

Pneumothorax: No evacuation procedure but observed as inpatient >24 hours

Hemothorax: No drainage procedure but observed as inpatient for >24 hours

Sternal fracture: No surgery but had in-hospital pain management or observed as inpatient >24 hours

Sternal fracture: No surgical intervention, no inpatient observation (pain managed on an outpatient basis)

Multiple rib fracture: Received in-hospital pain management or observation >24 hours

Multiple rib fracture: No surgical intervention, no inpatient observation (pain managed on an outpatient basis)

Pulmonary contusion or laceration: No mechanical ventilatory assistance but observed >24 hours

No Clinical Significance

Hemothorax: No surgical intervention, no inpatient observation (managed on an outpatient basis)

Pneumothorax: No surgical intervention, no inpatient observation (managed on an outpatient basis)

Pneumomediastinum without pneumothorax: No inpatient observation (managed on an outpatient basis)

Pulmonary contusion or laceration: No mechanical ventilatory assistance, no surgical intervention, no inpatient observation (managed on an outpatient basis)

data entry checking, random audits, abstractor consistency assessments, quarterly investigator conference calls, and site-monitoring visits. We categorized patients with more than 1 TICI according to their highest clinically significant injury. Primary investigators (all authors) resolved conflicting outcome assessments (<0.01% of total assessments) by consensus.

Workup Bias

To address the potential for workup bias related to missed injuries in trauma patients who did not receive chest radiography, we obtained written consent for telephone follow-up of nonimaged blunt trauma patients discharged from 1 of the EDs. We contacted these patients between 2 weeks and 3 months of ED discharge and asked them whether they had seen a health care provider for chest injuries and, if so, what imaging tests and diagnoses they had received. We also followed up the hospital course of a consecutive sample of admitted blunt trauma patients who had not undergone ED chest radiography to determine whether they were subsequently diagnosed with TICI. With the intent to feasibly arrive at an accurate estimate of missed injuries, we set, a priori, this workup bias sample size at 200 patients. If none of these patients were later found to have TICI, the estimated undetected injury rate would be low enough (95% CI <2%) to be deemed negligible.

We used a similar method and predetermined sample size of 200 patients to address potential missed injuries in patients who were imaged but had negative (no TICI) ED results. We obtained written consent and contacted TICI-negative patients who were discharged from 1 ED and followed up the hospital course of TICI-negative patients admitted to that hospital.

We deidentified and recorded data in a manner precluding individual patient identification. Institutional review board approval with waiver of informed consent was issued at all sites.

Statistical Analysis

Our previous trauma DI research has demonstrated that the sample size calculation for this study is driven by the need to validate the DI with very high sensitivity (instead of NPV) and a narrow CI around the sensitivity point estimate.[11,15] Assuming rule performance (sensitivity of approximately 99%) and injury frequency similar to those of our derivation study, we estimated that we would need 9718 patients to validate the DI within a 0.5% CI. Additionally, given its lethality, we agreed a priori that if any aortic or great vessel injury was missed, the DI would be considered unreliable. Missing and ambiguous data (<0.02% DI criteria responses) were analyzed as if criteria were present.

We managed data using Research Electronic Data Capture (RedCAP) tools hosted by the University of California, San Francisco.[17] We performed statistical tests using STATA, version 9.0 (StataCorp PL). We summarized demographic data in aggregate form and calculated screening performance characteristics (sensitivity, specificity, positive predictive value and NPV, and negative likelihood ratio) using standard formulas with the following definitions: 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.

Results

Of 9905 enrolled patients, 43.1% had 1 CXR, 42.0% had CXR and chest CT, 6.7% had CXR and abdominal CT (without chest CT), 5.5% had multiple CXRs without CT, and 2.6% had chest CT without CXR in the ED. Their mean age was 46 years (interquartile range, 29-60 years) and 62.8% were male. The most common trauma mechanisms were motorized vehicle crash (43.9%), fall (27.5%), pedestrian struck by motorized vehicle

(10.7%), bicycle crash (6.3%), and struck by blunt object, fists, or kicked (5.8%). Of the 5173 (52.2%) admitted patients, 4877 (94.3%) survived to hospital discharge.

Thoracic injury seen on chest imaging was seen in 1478 (14.9%) patients with 363 (24.6%) of these having major clinical significance, 1079 (73.0%) minor clinical significance, and 36 (2.4%) no clinical significance. The most common diagnoses were multiple rib fractures, pulmonary contusion or laceration, and pneumothorax seen in 67.4%, 39.9%, and 35.7% of patients with TICI, respectively. **Table 1** summarizes all TICI diagnoses.

Evaluating for workup bias, we obtained follow-up on 212 blunt trauma patients with negative ED chest imaging and 221 blunt trauma patients who did not receive ED chest imaging. None of these patients were diagnosed with injuries that would have been considered TICI.

Table 1. Thoracic Injuries Seen on Chest Imaging: 2553 Injuries Seen in 9905 Enrolled Patients

Thoracic Injuries on Chest Imaging	All Enrolled Patients Diagnosed With This Injury, No. (%)
Multiple (≥2) rib fractures	996 (10.1)
Pulmonary contusion or laceration	590 (6.0)
Pneumothorax	527 (5.3)
Sternal fracture	212 (2.1)
Hemothorax	207 (2.1)
Aortic or great vessel injury	15 (0.2)
Ruptured diaphragm	6 (0.1)

The NEXUS Chest DI had a sensitivity of 98.8% (95% CI, 98.1%-99.3%), an NPV of 98.5% (95% CI, 97.6%-99.1%), and a specificity of 13.3% (95% CI, 12.6%-14.1%) for the prediction of TICI. Of the 17 missed (false-negative) TICI patients, 1 had clinically major injury (hemopneumothorax with chest tube placement), 14 had clinically minor injury, and 2 had no clinically significant injury (**Table 2**). The sensitivity and NPV for clinically major TICI were 99.7% (95% CI, 98.2%-100.0%) and 99.9% (95% CI, 99.4%-100.0%), respectively, and the sensitivity and NPV for clinically major or minor TICI were 99.0% (95% CI, 98.2%-99.4%) and 98.7% (95% CI, 98.1%-99.3%), respectively. **Table 3** summarizes NEXUS Chest screening performance characteristics.

Thirteen of the 17 missed TICI occurred at 1 site. The sensitivity for TICI at this site was 97.1%, while the sensitivity at the other 8 sites was 99.6%.

Discussion

Noting costs and risks of increasing imaging use without corresponding increases in diagnosed disease, investigators have called for the development of guidelines to direct ED imaging.[7,8] To achieve widespread acceptance in trauma settings, such guidelines must have near-perfect sensitivity for clinically significant injury. Following the highest level of decision rule development evidence-based methods, we have prospectively validated a simple DI consisting of readily available clinical cri-

Table 2. Injuries Missed by NEXUS Chest DI (False-Negative Results)

TICI Injuries	Intervention/ Management Change	Clinical Significance Classification[a]	Other Significant Injuries
Multiple rib fracture, pneumothorax, hemothorax, pulmonary contusion	Admitted, pain medications, chest tube inserted	Major	Iliac fracture, pelvis hematoma
Multiple rib fracture	Admitted, pain medications	Minor	Liver laceration, multiple lumbar spine fractures
Pneumothorax	Admitted	Minor	None
Multiple rib fracture, pulmonary contusion	Admitted, pain medications	Minor	Subarachnoid hemorrhage, thoracic spine fracture
Multiple rib fracture	Admitted, pain medications	Minor	Subarachnoid hemorrhage, nasal fracture, complex facial laceration, acromioclavicular separation
Pulmonary contusion	Admitted	Minor	Complex shoulder laceration
Pneumothorax	Admitted	Minor	Subdural hematoma, nasal fracture, orbit fractures, complex facial laceration
Pulmonary contusion	Admitted	Minor	Lumbar spine fracture
Pulmonary contusion	Admitted	Minor	Subarachnoid hemorrhage
Pulmonary contusion	Admitted	Minor	Intracranial hemorrhage, lumbar spine fracture
Multiple rib fracture	Admitted, pain medications	Minor	None
Multiple rib fracture, pneumothorax	Admitted, pain medications	Minor	Multiple lumbar spine fractures
Multiple rib fracture, pulmonary contusion	Admitted, pain medications	Minor	Scapula fracture, ligamentous knee injury
Multiple rib fracture	Admitted, pain medications	Minor	Splenic rupture, tibia fracture, iliac fracture, radius fracture
Multiple rib fracture	Discharged from ED	Minor	Tibia-fibula fracture
Pulmonary contusion	Discharged from ED	No significance	Cervical spinous process fracture
Pulmonary contusion	Discharged from ED	No significance	None

Abbreviations: DI, decision instrument; ED, emergency department; TICI, thoracic injury seen on chest imaging.

[a] Clinical significance classification defined according to trauma expert panel.

Table 3. Screening Performance Characteristics of NEXUS Chest DI

Variable (No.)	% (95% CI) Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Negative Likelihood Ratio
Thoracic Injury Seen on Chest Imaging					
TP (1461) TN (1123) FP (7304) FN (17)	98.8 (98.1-99.3)	13.3 (12.6-14.1)	16.7 (15.9-17.5)	98.5 (97.6-99.1)	0.09 (0.05-0.14)
TICI With Major Clinical Significance					
TP (362) TN (1142) FP (8400) FN (1)	99.7 (98.2-100.0)	12.0 (11.3-12.6)	4.1 (3.7-4.6)	99.9 (99.4-100.0)	0.02 (0.00-0.16)
TICI With Major or Minor Clinical Significance					
TP (1427) TN (1124) FP (7339) FN (15)	99.0 (98.2-99.4)	13.3 (12.6-14.0)	16.3 (15.6-17.1)	98.7 (97.8-99.2)	0.08 (0.05-0.13)

Abbreviations: DI, decision instrument; FN, false-negative result: absence of all DI criteria and having injury; FP, false-positive result: presence of 1 or more DI criteria and not having injury; TICI, thoracic injury chest imaging; TN, true-negative result: absence of all DI criteria and not having injury; TP, true-positive result: presence of 1 or more DI criteria and having injury.

teria that demonstrates high sensitivity for TICI and clinically significant injury to safely guide selective chest imaging in blunt trauma.[18]

Although other blunt trauma DIs for the head, cervical spine, knee, and ankle are widely used, little has been published regarding selective blunt trauma chest imaging beyond our pilot and derivation work.[11,12,19-21] Sears et al[22] reported that senior trauma surgeon judgment had 95.1% sensitivity for the need for chest imaging. Brink et al[23] proposed a rule to direct selective chest CT use, but this instrument mandates other imaging and incorporates criteria that may not be readily available during initial patient assessment (thoracic spine radiography, pelvis radiography, and base deficit). Advocating for selective chest CT in blunt trauma evaluation, Pinette et al[24] have suggested that algorithms incorporating CXR and abdominal CT are sufficient to identify most significant thoracic injuries. Ungar et al[25] reported a decision rule with 86% sensitivity to rule out traumatic aortic injury. Our DI addresses the full spectrum of injuries diagnosed by chest radiography, uses simple criteria practical for application by clinicians beyond senior surgeons, and, most importantly, has the very high sensitivity necessary for widespread acceptance.

Authorities have noted that to be widely implemented, DIs must be easy to use and remember with unambiguous criteria.[18,26] In acute trauma evaluations, it is unlikely that physicians would embrace a rule that requires extra steps or complex algorithms. Our DI builds on the widely used NEXUS Cervical Spine criteria (3 criteria are identical) and, therefore, may be readily used in tandem for cervical spine and chest imaging decision support. The other 4 criteria (age, chest pain, rapid deceleration mechanism, and chest wall tenderness) are simple and part of standard trauma assessment, essentially adding no time or burden on clinicians and patients.

Although we used convenience sampling, we surveyed the demographics of potential participants from nonenrollment hours and found them to be similar to those of enrolled patients; it is unlikely that consecutive sampling would have changed our findings. We conducted this study at academic, US level I trauma centers; it is possible that use of the DI at dissimilar hospitals might produce different screening performance. We only included patients older than 14 years; this DI should not direct imaging in younger patients. Although we attempted to address the most important aspects of workup bias, other spectrum bias may exist (as with all similar studies).

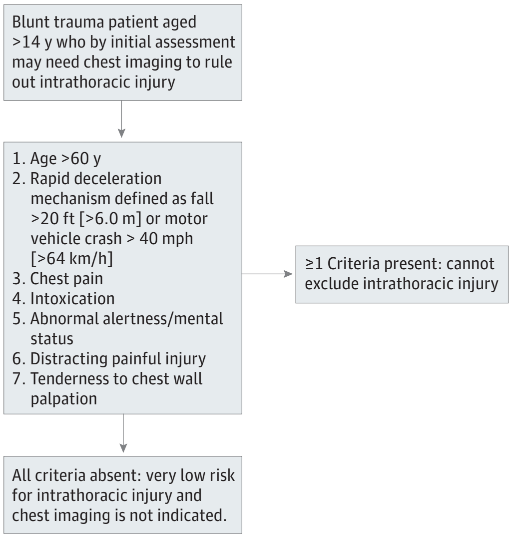
Considering the limited diagnostic sensitivity of CXR, the fact that less than half the patients received chest CT may raise concerns that we missed many TICI outcomes (injuries). While not completely eliminating this possible verification bias, our follow-up of patients with negative ED imaging results argues that it is very limited in scope. Furthermore, our goal was to develop a rule that may safely decrease the current, real-world practice of ubiquitous chest imaging in blunt trauma, *not* to test the sensitivity of chest imaging modalities. We did not seek a rule that would diagnose all injuries—even those injuries that are missed by current imaging practice itself.

Readers may disagree with our definitions of clinically major, minor, and insignificant injury. There are no accepted definitions or scales of the clinical significance of chest injury, and marked interspecialty differences of opinion regarding clinical meaning of traumatic injuries have been noted.[27] Nevertheless, we have presented broad analyses allowing for interpretation by clinicians of disparate viewpoints. Even if physicians believe that it is important to diagnose all injuries, our DI retains sufficient sensitivity to guide selective imaging.

Some authorities and practitioners may not be willing to accept anything but perfect screening diagnostics. However, beyond resource, cost, and time considerations, unselective imaging poses real health threats for iatrogenic cancer and intravenous contrast-induced nephropathy from chest CT that must be weighed against this quest for a zero-missed injury rate. Additionally, missed injuries do not necessarily entail compromised outcomes. Minor missed injuries may have healed without intervention and more significant missed injuries requiring intervention may have become apparent with observation, return instructions, and follow-up. We demonstrated 100% sensitivity for aortic and great vessel injury.

The reasons for one site's lower sensitivity are unclear. Seven missed injuries at this site were isolated pulmonary con-

Figure. NEXUS Chest Decision Instrument Implementation



Intrathoracic injury is defined as pneumothorax, hemothorax, aortic or great vessel injury; multiple rib fractures; ruptured diaphragm; sternal fracture; and pulmonary contusion or laceration. Intoxication, abnormal alertness, and distracting injury are defined in the same manner as in the NEXUS Cervical Spine Rule.[11]

tusion or minute pneumothorax seen on chest CT only; these *occult* findings did not have associated interventions. Computed tomographic use was high at this site and radiology reports of pulmonary contusion on CT were at times equivocal, with atelectasis and aspiration also included as possibilities. To avoid overestimation of the rule's sensitivity and NPV, we included these ambiguous readings as false-negative results. Misapplication of DI criteria in some cases is also possible. As seen in Table 2, several subjects with missed injuries had tibia, pelvis, and spinal fractures that should have fulfilled the DI criterion of distracting injury. Given the consistent high sensitivity at the other 8 sites, however, true rule failure is unlikely.

We designed our study to validate a DI that would effectively *rule out* clinically significant injury, meaning that absence of DI criteria tells the practitioner when it is safe *not* to order chest imaging. Having DI criteria does not mandate chest radiography in patients who would otherwise not be considered for chest imaging. For example, a 61-year-old patient with minor blunt trauma, who was otherwise not going to receive CXR or chest CT, should not have chest imaging merely because of age. Misuse of the DI in this manner could paradoxically lead to unnecessary radiography, as has been seen with other guidelines.[28] We recommend that clinicians first decide whether chest imaging is indicated per their usual practice and then use the rule to determine whether imaging can be safely omitted as illustrated in the **Figure**.

With low specificity, implementation of NEXUS Chest DI will likely spare a low percentage of patients from imaging. Nevertheless, given the frequency of chest imaging overall and the common use of advanced and repeated imaging (more than half of patients had chest CT or repeat CXR), this low percentage may translate into substantial resource savings and decreased radiation exposure in absolute numbers. Additionally, CT and repeat x-rays have been shown to increase ED length of stay; by eliminating the need for chest imaging upfront, our DI may improve trauma care efficiency.[8] Our DI may also prevent the costly propagation of testing and workup of incidental findings, such as lung nodules, attendant with imaging overuse. As with all decision rules, this DI is not intended to entirely replace clinical judgment or negate other indicators for chest imaging.

We have validated a clinical DI that may safely guide selective chest imaging in blunt trauma victims older than 14 years. Broad implementation of this rule may conserve resources and decrease radiation and intravenous contrast-medium exposure in this population.

ARTICLE INFORMATION

Accepted for Publication: February 4, 2013.

Published Online: August 7, 2013. doi:10.1001/jamasurg.2013.2757.

Author Affiliations: Department of Emergency Medicine, The University of California San Francisco School of Medicine, San Francisco General Hospital (Rodriguez, Fortman); Department of Emergency Medicine, Keck School of Medicine of University of Southern California, Los Angeles (Anglin, Juhn, Mulkerin); Department of Emergency Medicine, University of California, Irvine (Langdorf and Mulkerin); Department of Emergency Medicine, Cooper Medical School of Rowan University, Camden, New Jersey (Baumann); Department of Emergency Medicine, University of California, San Francisco, Fresno Medical Education Program (Hendey); Department of Emergency Medicine, The University of Texas Health Science Center at Houston (Bradley); Department of Emergency Medicine, University of California, San Diego School of Medicine (Medak); Department of Emergency Medicine, Brigham and Women's Hospital/Harvard Medical School, Boston, Massachusetts (Raja); Department of Emergency Medicine, University of California, Los Angeles (Mower).

Author Contributions: *Study concept and design:* Rodriguez, Anglin, Langdorf, Baumann, Hendey, Bradley, Mower.
Acquisition of data: Rodriguez, Anglin, Langdorf, Baumann, Hendey, Medak, Raja, Jhun, Fortman, Mulkerin, Mower.
Analysis and interpretation of data: Rodriguez, Hendey, Raja, Mower.
Drafting of the manuscript: Rodriguez, Langdorf, Baumann, Hendey, Raja, Mower.
Critical revision of the manuscript for important intellectual content: Rodriguez, Langdorf, Baumann, Hendey, Raja, Mower.
Statistical analysis: Rodriguez, Raja.
Obtained funding: Rodriguez, Hendey, Mower.
Administrative, technical, and material support: Jhun, Fortman, Mulkerin.
Study supervision: Rodriguez, Hendey, Mower.

Funding/Support: This study was funded by grant RO-1 1 RO1/CE001589-01 from the Centers for Disease Control and Prevention (Dr Rodriguez).

Role of the Sponsor: The Centers for Disease Control and Prevention had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Correction: This article was corrected online October 28, 2013, for an error in an author affiliation.

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