

Screening Cervical Spine CT in the Emergency Department: A Collaborative Multi-phase Approach to Improving Imaging Over-Utilization

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Background

- Blunt trauma with potential cervical spine injury (CSI) is a frequent reason for presentation to emergency departments in the US.
 - More than 1 million patients treated annually.
- Delay or failure to diagnose injuries has disastrous consequences.
- As a result, emergency physicians often have a low threshold for ordering cervical spine imaging, which leads to high numbers of negative C-spine CT scans.
- Potential to both improve **cost-effectiveness** and decrease **radiation exposure** through the use of **strict clinical criteria**.



Background

- In 2000, the **National Emergency X-Radiography Utilization Study (NEXUS) Low-Risk Criteria (NLC)** were established to identify patients with a low probability of cervical spine injury.
- One of the standard practices for determining the need for cervical spine imaging in trauma patients.
- Used as part of the **ACR Appropriateness Criteria** (along with **Canadian Cervical Spine Rule CCR**).
- Despite the presence of screening tools for cervical spine imaging, many patients continue to be imaged without meeting these criteria.

NEXUS Criteria

- **No tenderness at the posterior midline of the cervical spine.**
- **No focal neurologic deficit.**
- **Normal level of alertness.**
- **No evidence of intoxication.**
- **No clinically apparent, painful injury that might distract the patient from the pain of a cervical spine injury.**



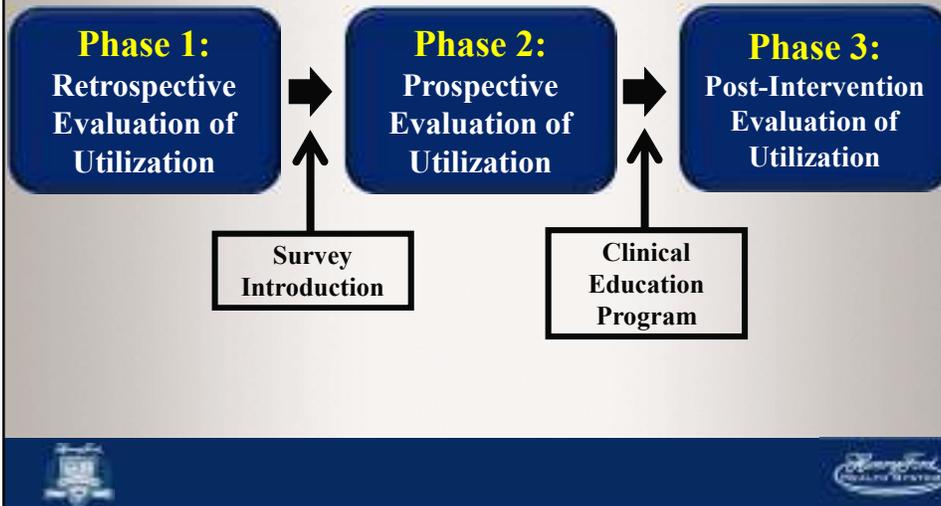
Purpose

- The **purpose** of this multi-phase study was to:
 - Analyze the use of screening cervical spine CT performed following blunt trauma in order to establish the number of **potentially avoidable studies** when strict criteria (NEXUS criteria) are applied.
 - Determine the **indications** for ordering studies in the **absence of guideline criteria**.
 - Assess whether introduction of a **clinical education program** could improve utilization rates.

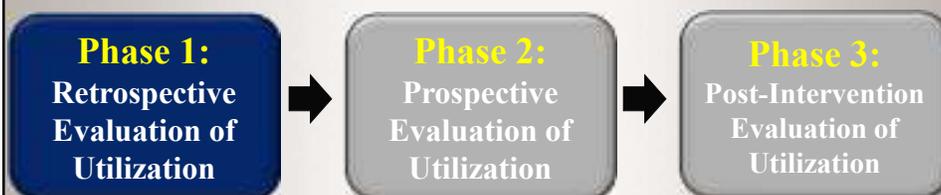


Project Design

- Project broken into 3 phases:

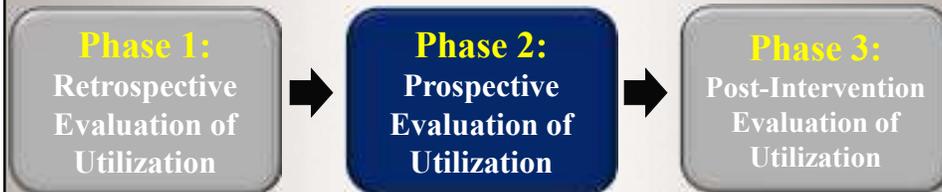


Project Design



- Retrospectively assess use of **screening cervical spine CT** for blunt trauma and whether **strict application of NEXUS criteria** could have reduced the number of unnecessary studies.

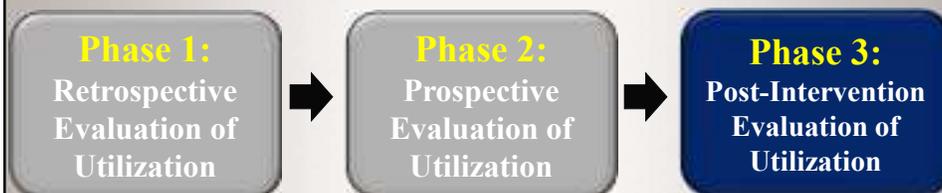
Project Design



- Prospectively establish the number of **potentially avoidable cervical spine CT studies** based on proper application of established clinical guidelines.
- Determine **indications** used for ordering studies in the **absence of guideline criteria**.
- Establish a **baseline** to assess improvement following intervention.



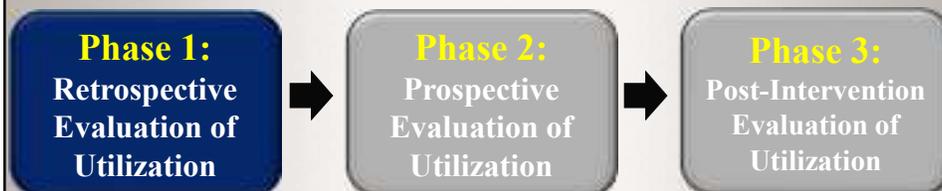
Project Design



- Institute a **clinical education program** for clinicians in the Emergency Department regarding **appropriate use of CT** in the setting of blunt trauma.
- Assess **improvement in utilization** of cervical spine CT studies based on proper application of established clinical guidelines.



Phase 1: Retrospective Evaluation of Utilization



Phase 1: Purpose

- Retrospectively assess use of **screening cervical spine CT** for blunt trauma and whether **strict application of NEXUS criteria** could have reduced the number of unnecessary studies.



Screening Cervical Spine CT
in a Level I Trauma Center:
Overutilization?

Griffith et al. *AJR* 2011; 197(2):463-7



Phase 1: Materials and Methods

- All cervical spine CT studies performed within the Henry Ford Health System on patients over 18 years of age were assessed for:
 - Presence of cervical spine **fracture, dislocation or subluxation**.
 - Presence of the **5 NEXUS criteria**.

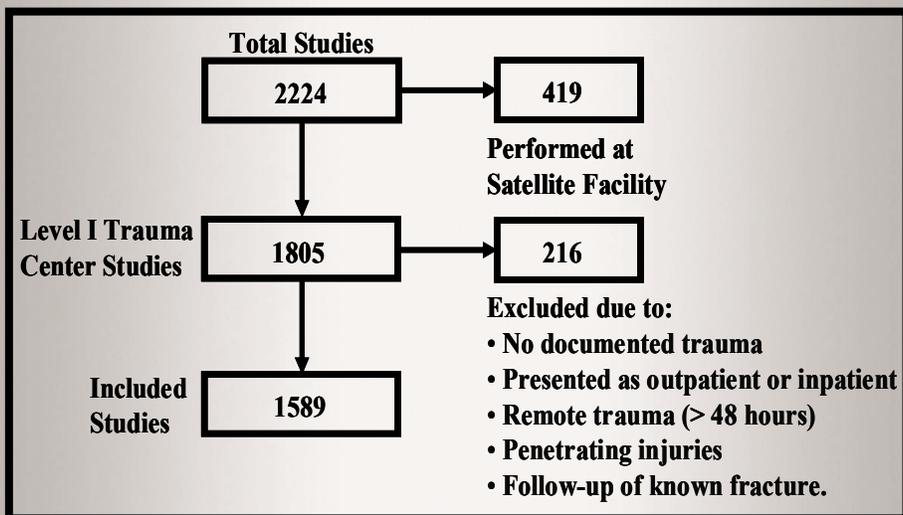


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Phase 1: Materials and Methods

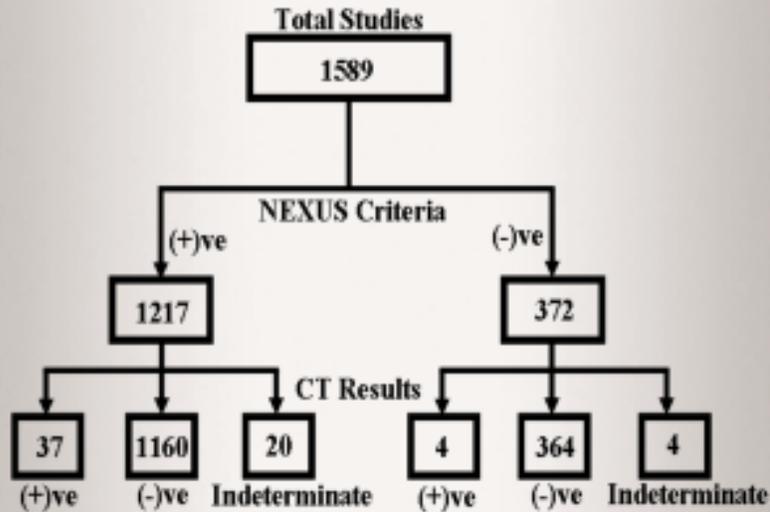


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Phase 1: Results



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Phase 1: Results

	Total	No Acute Cervical Spine Injury	Positive Cervical Spine Injury	Indeterminate initial study (negative on follow-up)
All studies	1589	1524 (95.9%)	41 (2.6%)	24 (1.5%)
Positive NEXUS	1217	1160 (95.3%)	37 (3.0%)	20 (1.6%)
Positive Liberalized NEXUS	1273	1216 (95.5%)	37 (2.9%)	20 (1.6%)
No NEXUS Documented	372	364 (97.8%)	4 (1.1%)	4 (1.1%)
No Liberalized NEXUS Documented	316	308 (97.5%)	4 (1.3%)	4 (1.3%)

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Phase 1: Conclusions

- **Strict application of NEXUS criteria** prior to cervical spine imaging would have decreased the number of negative studies by **23.9%** (364 fewer studies).
- In this study, 4 patients with cervical spine injury had no documented NEXUS or “liberalized” NEXUS criteria in their charts. However, no potentially missed fractures were unstable or required surgical intervention.
- Despite its retrospective nature, the evidence suggests that despite the presence of clinical screening tools, **many patients continue to be imaged despite having no NEXUS criteria.**

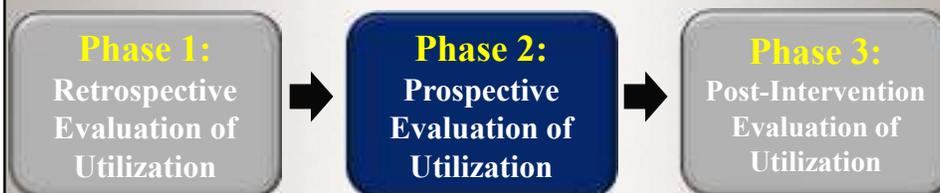


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Phase 2: Prospective Evaluation of Utilization



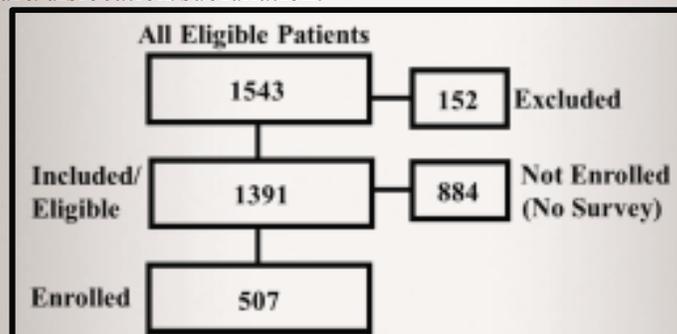
Phase 2: Purpose

- Given the limitations of a retrospective study, a collaborative prospective study between the departments of radiology and emergency medicine was undertaken.
- The purpose of this study was to:
 - Prospectively establish the number of **potentially avoidable cervical spine CT studies** based on proper application of established clinical guidelines.
 - Determine **indications** used for ordering studies in the **absence of guideline criteria**.
 - Establish a **baseline** to assess improvement following intervention.



Phase 2: Material and Methods

- All patients presenting in the setting of blunt trauma who underwent screening CT of the cervical spine were eligible for the study.
- **Exclusion criteria** included: <18 yrs of age; penetrating trauma; transfer patient; remote injury (>48 hours); known cervical spine fracture/dislocation/subluxation.



Screening Cervical Spine CT in the Emergency Department, Phase Two: A Prospective Assessment of Use

Griffith et al. *AJNR* originally published online on October 4, 2012, 10.3174/ajnr.A3306



Phase 2: Material and Methods

- Ordering clinicians completed survey documenting:
 - Mechanism of Injury
 - Indication for ordering study
 - Clinical suspicion for cervical spine injury
- CT interpreted by board-certified radiologist blinded to survey information.

CERVICAL SPINE CT PROSPECTIVE STUDY

Evaluator (please circle): Staff / Resident / PA / Other _____
 Date: _____
 Patient/MRN: _____

Exclusion Criteria: (Circle all that apply; if "yes" to any, do not complete remaining question)

- Age < 18 yrs
- Penetrating injury
- Known C-spine fracture or dislocation/subluxation
- Transfer patient
- Remote injury (> 48 hrs)

Mechanism of Injury (please circle):
 Fall / MVA / Assault / Pedestrian/Motor vehicle / Other (specify): _____

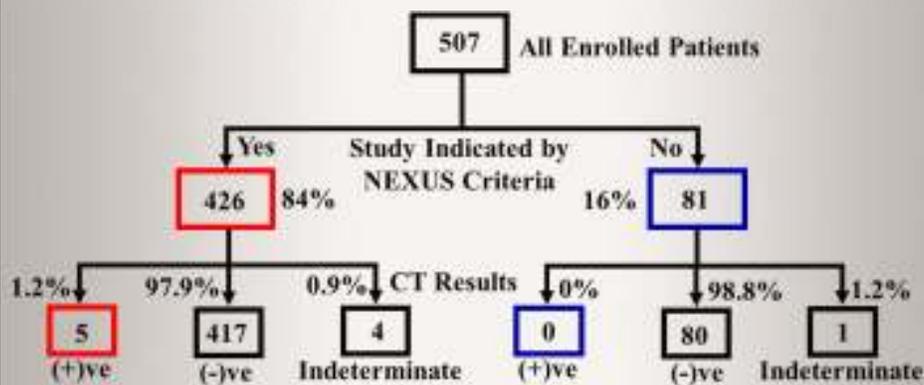
Reason for Study (please circle number of all that apply):

- Posterior midline cervical spine tenderness
- Suspected intoxication
- Altered level of consciousness/alertness
- Focal neurologic deficit
- Distraction injury
- Dangerous mechanism by Canadian Cervical Spine Rule (Includes: Fall from height > 3 ft or 5 stairs; Axial load to head; MVA at speed > 100 km/hr or 62 mph or with rollover or ejection; Collisions involving motorized recreational vehicle, or Bicycle injury)
- Dangerous Mechanism (Other: _____)
- Age > 65 yrs
- Breastheisia in extremities
- Inability to actively rotate neck (limited or painful range of motion)
- Paravertebral tenderness
- Suspicious C-spine radiographs
- Intracranial injury on Head CT
- Complaints of neck pain
- Study requested by consulting service (Name of Service: _____)
- Other (please specify): _____

Clinical Suspicion for Cervical Spine Injury (1 - very unlikely; 5 - very likely)
 1 2 3 4 5

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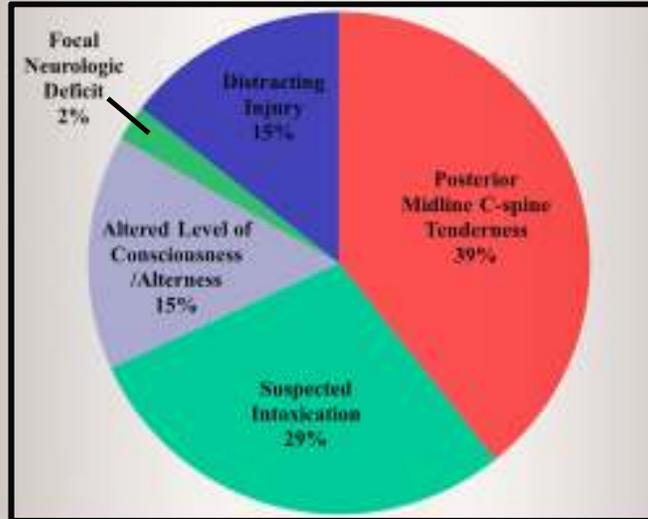
Phase 2: Results



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Phase 2: Results

Study Indications (NEXUS criteria present)



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Phase 2: Results

Indication for Study (in absence of NEXUS)	81 total patients
Dangerous mechanism - Canadian CSR	24 (29.6%)
Dangerous mechanism - other	15 (18.5%)
Age >65 yrs	11 (13.6%)
Paresthesias in extremities	5 (6.2%%)
Inability to actively rotate neck	5 (6.2%%)
Paravertebral tenderness	8 (9.9%)
Suspicious radiographs	0
Intracranial injury on Head CT	1 (1.2%)
Complains of neck pain	33 (40.7%)
Consulting service requested	7 (8.6%)
Other	4 (4.9%)

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Phase 2: Results

Evaluator	All	Studies Indicated by NEXUS (426)	Studies Not Indicated by NEXUS (81 total)
Staff	115 (22.7%)	104 (90.4%)	11 (9.6%)
Resident	301 (59.4%)	250 (83.1%)	51 (16.9%)
PA	45 (8.9%)	36 (80%)	9 (20%)
NA	46 (9.1%)	36 (78.3%)	10 (21.7%)



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Phase 2: Conclusions

- **Strict application of NEXUS criteria** prior to imaging would have decreased the number of negative studies by **16.3% (81 fewer studies)**. This is decreased from the **23.9%** observed in the retrospective study.
- In addition, further analysis found that strict application of either the NEXUS criteria or an abbreviated Canadian Cervical Spine Rule (CCR)*, would have still decreased the number of negative studies by **7.6%**.
- **All patients (5) with injury were detected by application of the NEXUS criteria.**

*Abbreviated CCR: Dangerous mechanism, Age > 65 yrs, Paresthesias in extremities, Inability to actively rotate neck



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Phase 2: Conclusions

- While Phase 2 confirmed frequent imaging of patients **meeting the NEXUS criteria for non-imaging**, the findings suggest potential **decrease in over-utilization** (23.9% to 16.3%) by institution of a simple survey, perhaps acting as a “reminder” for ordering clinicians.
- Staff physicians demonstrate **stricter application of clinical criteria** (9.6% overutilization vs. 16.9% for residents and 20% for PAs)
 - Further education, especially of residents and mid-level providers, may decrease over-utilization.



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Phase 3: Post-Intervention Evaluation of Utilization



Phase 3: Purpose

- The purpose of the final phase was to assess improvement in cervical spine CT utilization in the setting of blunt trauma following implementation of a clinical education program.

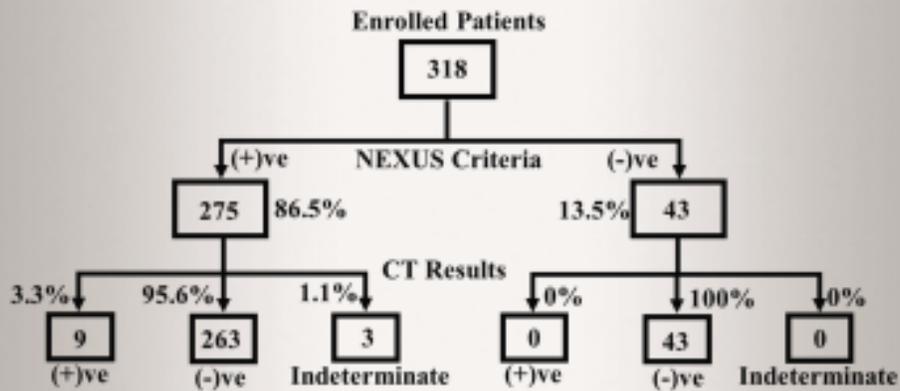


Phase 3: Material and Methods

- A **clinical education program** was used to educate clinicians responsible for ordering studies in the emergency department regarding:
 - Findings of the prior retrospective and prospective studies.
 - Current clinical guidelines for ordering cervical spine imaging in the setting of blunt trauma with specific emphasis on the ACR appropriateness criteria (CCR and NEXUS).

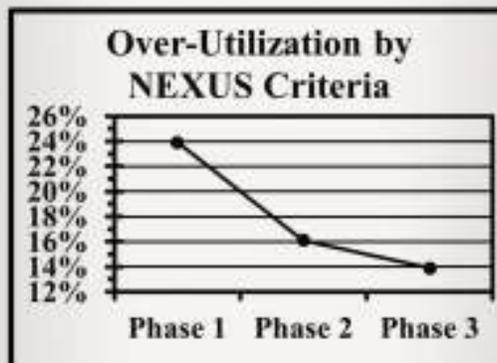


Phase 3: Results



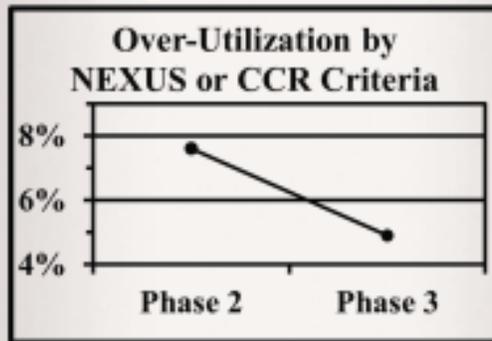
Phase 3: Conclusions

- **Strict application of NEXUS criteria** would have decreased the number of negative studies by **13.9%**. This is decreased from the **16.1%** observed in Phase 2 and **23.9%** in Phase 1.



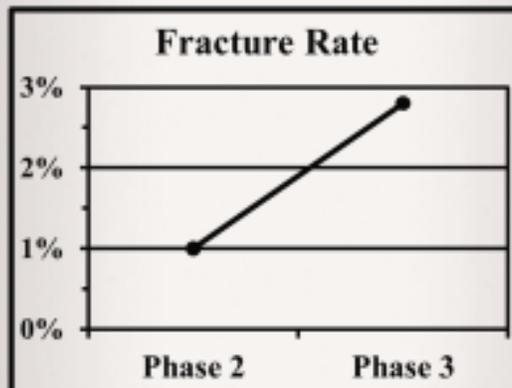
Phase 3: Conclusions

- When allowing for application of either the NEXUS or abbreviated CCR criteria, the number of negative studies would have decreased by only **4.9%**. This is improved from the **7.6%** in Phase 2 ($p = 0.128$).



Phase 3: Conclusions

- By applying criteria more strictly, the cervical spine injury rate amongst imaged patients increased from **1%** to **2.8%** ($p = 0.045$).



Teaching Points

- Even with wide acceptance of clinical screening tools for cervical spine injury, **many patients continue to be imaged despite failing to meet appropriate criteria.**
- Following initiation of a **clinical education program**, the rate of over-utilization decreased from 7.6% to 4.9%.
- **By applying criteria more strictly**, the cervical spine injury rate amongst imaged patients increased from 1% to 2.8%.
- No patients imaged in the absence of appropriate clinical criteria in Phase 2 or Phase 3 were found to have injury of the cervical spine.



Teaching Points

- **Educating clinicians** with regards to **ACR appropriateness criteria** was effective in improving patient care in the setting of blunt trauma by decreasing the number of unnecessary studies performed.
- Applying a similar approach to other imaging studies has the potential to **decrease** imaging **“over-utilization”** and significantly improve patient care.



Teaching Points

- Recent shifts towards quality-based reimbursement, as well as changes to the **maintenance of certification (MOC)** process have placed increased emphasis on **practice quality improvement (PQI)**.
- Documenting **impact** on **quality of care** is essential to maintaining radiology's integral role in healthcare delivery.
- Through projects such as this, radiologists can work to **improve imaging utilization** through practice quality improvement – thereby satisfying an MOC requirement while ensuring patients continue to receive appropriate and effective imaging.

For additional information, please see Exhibit LL-HPE4578 "*A Guide to Improving Imaging (Over-)Utilization Through Practice Quality Improvement*"



THANK YOU!

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