Avoidable Imaging Wave II

Head Trauma (Clinical Topic)
Presenters

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Head CT after Trauma: How to improve care and decrease imaging for adults

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American College of Emergency Physicians  
E-QUAL Network Presentation
Conflicts of Interest & Disclosures

• We have no conflicts of interest to report
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• The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality.
Overview

• Background
• Overuse
• Implementation challenges
• Understanding Overuse
• CDS role, other implementation strategies
• Patient-centered CDS
Is it a problem?

Figure 4. As shown, the testing threshold demonstrates an asymptotic increase around a willingness-to-pay of $20,000 per quality-adjusted life-year (QALY).

Figure 5. The incremental cost-effectiveness ratio (ICER) represents the cost in dollars necessary to increase the quality-adjusted life-year (QALY) by 1. The graph demonstrates an exponential increase in the ICER for very low pretest probabilities, therefore indicating a significant reduction in cost-effectiveness as pretest probability diminishes.

Is it a problem?

• Variation in CT ordering in ED patients with minor head injury
  • 4-100% imaging rates in 311 EPs treating 20,797 patients across 11 EDs in Alberta

Grigat et al. CJEM 2016. Abstract
Avoid computed tomography (CT) scans of the head in emergency department patients with minor head injury who are at low risk based on validated decision rules.

Minor head injury is a common reason for visiting an emergency department. The majority of minor head injuries do not lead to injuries such as skull fractures or bleeding in the brain that need to be diagnosed by a CT scan. As CT scans expose patients to ionizing radiation, increasing patients’ lifetime risk of cancer, they should only be performed on patients at risk for significant injuries. Physicians can safely identify patients with minor head injury in whom it is safe to not perform an immediate head CT by performing a thorough history and physical examination following evidence-based guidelines. This approach has been proven safe and effective at reducing the use of CT scans in large clinical trials. In children, clinical observation in the emergency department is recommended for some patients with minor head injury prior to deciding whether to perform a CT scan.

Avoid placing indwelling urinary catheters in the emergency department for either urine output monitoring in stable patients who can void, or for patient or staff convenience.

Indwelling urinary catheters are placed in patients in the emergency department to assist when patients cannot urinate, to monitor urine output or for patient comfort. Cather-associated urinary tract infection (CAUTI) is the most common hospital-acquired infection in the U.S., and it can be prevented by avoiding the use of indwelling urinary catheters. Emergency physicians and nurse practitioners discuss the need for a urinary catheter with a patient and/or their caregivers, as sometimes such catheters can be avoided. Emergency physicians can reduce the use of indwelling urinary catheters by following the Centers for Disease Control and Prevention’s evidence-based guidelines for the use of urinary catheters. Indications for a catheter may include: urgent monitoring for critically ill patients, relief of urinary obstruction, at the time of surgery and end-of-life care. When possible, alternatives to indwelling urinary catheters should be used.

Don’t delay engaging available palliative and hospice care services in the emergency department for patients likely to benefit.

Palliative care is medical care that provides comfort and relief of symptoms for patients who have chronic and/or incurable diseases. Hospice care is palliative care for those patients in the final two months of life. Emergency physicians refer patients to the hospice department when appropriate, especially when patients or their families express an interest in hospice care. Early referral from the emergency department to hospice and palliative care services can benefit select patients resulting in both improved quality and quantity of life.

Avoid antibiotics and wound cultures in emergency department patients with uncomplicated skin and soft tissue abscesses after successful incision and drainage and with adequate medical follow-up.

Skin and soft tissue infections are a frequent reason for visiting an emergency department. Some infections, called abscesses, become walled off and form pus under the skin. Opening and draining an abscess is the appropriate treatment; antibiotics offer no benefit. Even in abscesses caused by Methicillin-resistant Staphylococcus aureus (MRSA), appropriately selected antibiotics offer no benefit if the abscess has been adequately drained and the patient has a well-functioning immune system. Additionally, culture of the drainage is not needed as the result will not routinely change treatment.

Avoid instituting intravenous (IV) fluids before doing a trial of oral rehydration therapy in uncomplicated emergency department cases of mild to moderate dehydration in children.

Many children who come to the emergency department with dehydration require fluid replacement. To avoid the pain and potential complications of an IV catheter, it is preferable to give these fluids by mouth. Giving a medication for nausea may allow patients with nausea and vomiting to accept fluid replacement easily. This strategy can eliminate the need for an IV. It is best to give these medications early during the ED visit, rather than later, in order to allow time for them to work optimally.
### Which Rule?

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Age &gt; 60</td>
<td>Age &gt; 65</td>
<td>Age ≥ 65yr</td>
</tr>
<tr>
<td>Vomiting</td>
<td>Vomiting &gt; 2 times</td>
<td>Recurrent or forceful vomiting</td>
</tr>
<tr>
<td>Visible trauma above the clavicles</td>
<td>Suspected Skull Fracture</td>
<td>Evidence of significant skull fracture</td>
</tr>
<tr>
<td>Drug or Alcohol Intoxication</td>
<td>Signs of basal skull fracture</td>
<td>Scalp hematoma</td>
</tr>
<tr>
<td>Persistent anterograde amnesia</td>
<td>GCS &lt; 15 2 hrs after</td>
<td>Neurologic deficit</td>
</tr>
<tr>
<td>Headache</td>
<td>Amnesia before impact</td>
<td>Altered Alertness (GCS &lt; 15)</td>
</tr>
<tr>
<td>Seizure</td>
<td>&gt; 30 min</td>
<td>Abnormal behavior</td>
</tr>
<tr>
<td></td>
<td>Dangerous mechanism</td>
<td>Coagulopathy</td>
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</table>

ACEP Clinical Policy

• Level A: LOC or amnesia and ≥ 1 of the following:
  • **Headache**, vomiting, age greater than 60 years, drug or alcohol intoxication, deficits in short-term memory, **physical evidence of trauma above the clavicle**, posttraumatic seizure, GCS score less than 15, focal neurologic deficit, or coagulopathy.

• Level B: No LOC or amnesia and ≥ 1 of the following:
  • Focal neurologic deficit, vomiting, severe headache, age 65 years or greater, physical signs of a basilar skull fracture, GCS score less than 15, coagulopathy, or a dangerous mechanism of injury.*

https://www.acep.org/Clinical-Practice-Management/ACEP-Current-Clinical-Policies/
Which Rule?

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Percentage Compliance</th>
<th>Expected Change in CT Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCHR</td>
<td>64.7%</td>
<td></td>
</tr>
<tr>
<td>ACEP</td>
<td>74.3%</td>
<td></td>
</tr>
<tr>
<td>NICE</td>
<td>96.7%</td>
<td>Expect decrease in head CT use</td>
</tr>
<tr>
<td>NOC</td>
<td>90.5%</td>
<td>Expect increase in head CT use</td>
</tr>
</tbody>
</table>

2008 ACEP CDS
Expect **no change** in CT use

New Orleans CDS
Expect **increase** in head CT use

Canadian CDS
Expect **decrease** in head CT use

---

No surgical injuries missed

Head CT Scans
11,432 encounters

Random sample of 100 encounters
- 12 charts concordant with CCHR
  3 GCS < 15
  6 Vomiting ≥ 2
  1 open skull fracture
  2 INR > normal range
- 2 found to be not trauma

Chart Review:
Found 87.8% of Head CTs Discordant w/ CCHR
(95% CI 81.2 - 94.4%)
Estimated 10,037 avoidable CTs

Total Discordance:
10,037/27,240 = 36.8% (95% CI 34.1 - 39.6%)

Study conclusion:
- No surgical injuries missed
- Study results:
  - 10,037 avoidable CTs
  - 36.8% discordance
  - 95% CI 34.1 - 39.6%

Study methodology:
- Random sample of 100 encounters
- Chart review
- Discordance analysis
- CCHR (Canadian CT Head Rule)

Study findings:
- 87.8% of Head CTs Discordant w/ CCHR
- 10,037 avoidable CTs
- 36.8% discordance
- 95% CI 34.1 - 39.6%

Study implications:
- Potential for reduced unnecessary CTs
- Improvement in CT utilization
- Enhanced patient safety
# Medical-Imaging Stewardship in the Accountable Care Era

Daniel J. Durand, M.D., Jonathan S. Lewin, M.D., and Scott A. Berkowitz, M.D., M.B.A.

## Lessons for Imaging Stewardship from the Centers for Disease Control and Prevention (CDC) Antimicrobial Stewardship Framework.

<table>
<thead>
<tr>
<th>Element of CDC Antimicrobial Stewardship Framework</th>
<th>Imaging Stewardship Analogue</th>
<th>Implementation Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership commitment: dedicating necessary resources</td>
<td>Making necessary investments and committing publicly to a cultural shift toward appropriateness and away from easy access to imaging</td>
<td>Endorse Choosing Wisely list items related to imaging; allocate budget for investments in information technology and nonclinical time</td>
</tr>
<tr>
<td>Accountability: appointing a single leader responsible for program outcomes</td>
<td>Appointing a single leader within each imaging specialty; establishing joint accountability among the multiple relevant specialties</td>
<td>Shift compensation away from volume-based metrics to include measures of imaging appropriateness</td>
</tr>
<tr>
<td>Drug expertise: appointing a single pharmacist leader for improving antibiotic use</td>
<td>Making imaging specialists responsible for executing appropriateness interventions</td>
<td>Designate stewardship champions (with formal roles and partial salary support) within each imaging department</td>
</tr>
<tr>
<td>Action: implementing recommended actions, such as systemic evaluation of ongoing treatment need after a set period of initial treatment</td>
<td>Implementing interventions to ensure systematic evaluation of appropriateness at the time of ordering and encouraging dialogue between referring physicians and imaging experts</td>
<td>Change the imaging-order workflow, through CDS, consultation with imaging specialists, or both</td>
</tr>
<tr>
<td>Tracking: monitoring antibiotic prescribing and resistance patterns</td>
<td>Monitoring imaging utilization and appropriateness scores for providers and tracking per-capita costs and radiation doses</td>
<td>Gather, and share with providers, data on ordering appropriateness for commonly overused exams</td>
</tr>
<tr>
<td>Reporting: regularly reporting information on antibiotic use and resistance to doctors, nurses, and relevant staff</td>
<td>Informing referring physicians about their imaging utilization rates and the best available measures of imaging appropriateness</td>
<td>Generate quarterly reports for physicians showing their ordering performance relative to that of their peers</td>
</tr>
<tr>
<td>Education: educating clinicians about resistance and optimal prescribing</td>
<td>Identifying key knowledge gaps on imaging appropriateness and educating referring physicians on relevant evidence-based guidelines</td>
<td>Request or require that ordering physicians review consensus guidelines on imaging relevant to their practice</td>
</tr>
</tbody>
</table>

# Implementation Imaging Rates

<table>
<thead>
<tr>
<th>Decision Rule</th>
<th>N</th>
<th>Pre-implementation</th>
<th>Post-implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Spine</td>
<td>11,824</td>
<td>62%</td>
<td>53%</td>
</tr>
<tr>
<td>Head</td>
<td>4,531</td>
<td>63-68%</td>
<td>74-76%</td>
</tr>
</tbody>
</table>

Integrated Decision Support

• Required answering multiple questions to allow a recommendation
• Combination of Canadian, New Orleans and CT in Head Injury Patients Prediction Rule
• Academic Trauma Center decreased head CTs
  • Relative reduction of 13.4% (absolute 7.8%, 58.1% vs 50.3%) post intervention.
• Cohort 1,988 (686 pre and 1302 post)
Implementation of the CCHR

- KP Southern California
  - Integrated health system
  - 4 Million members
- 13 Community EDs
  - Volume ranges from 25k – 90k/year
  - 80% of ED visits are for health plan members
  - ED leaders supported one standard of the CCHR
Canadian CT Head Rule Implementation

Adult Head Trauma: Who Needs a CT? Podcast

Estimated time to complete: 30 minutes/50 CME
ED Trauma Encounters with GCS score 1/1/14 – 12/31/15
N=65,303

Exclusions:
- Non-members (N=8,005)
- <16 (N=7,320)
- Resident, non-physician or out of network provider (N=7,096)

Study Cohort
N=44,947

Pre-intervention
N=26,751
- Skull fractures (N=33, 0.3%)
- Head bleeds (N=340, 3.5%)
- Neuro procedures (N=24, 0.3%)

Post-intervention
N=16,196
- Skull fractures (N=65, 1.3%)
- Head bleeds (N=233, 4.8%)
- Neuro procedures (N=15, 0.3%)

Received Head CT
N=9,758

Meeting any high risk criteria (N=9,120, 69.8%)*
- 265 (N=5,938, 88%)
- GCS <15 (N=1,602, 24%)
- Anticoagulants (N=1,662, 24%)
- Vomiting (N=526, 8%)
- Alcohol intoxication (N=283, 4%)

Received Head CT
N=4,875

Meeting any high risk criteria (N=3,438, 70.5%)*
- 265 (N=3,059, 89%)
- GCS <15 (N=849, 23%)
- Anticoagulants (N=873, 25%)
- Vomiting (N=221, 6%)
- Alcohol intoxication (N=116, 3%)

*not mutually exclusive
Implementation of the CCHR
Overall Results

• 15.8% relative reduction & 5.3% absolute reduction
• Adjusted odds of CT use decreased each month ($\approx 2%/mo$)
• 12 of 13 EDs decreased CT use (One ED 0.3% increase)
• 60.5% relative improvement & 2.3% absolute increase in the diagnostic yield of head CTs post intervention
Failure to Obtain Computed Tomography Imaging in Head Trauma: A Review of Relevant Case Law

Rachel A. Lindor, MD, JD, Eric T. Boie, MD, Ronna L. Calandruccio, MD, Erik P. Hess, MD, MSc, and Annie T. Sadosty, MD

Abstract

Objectives: The objectives were to identify and study the most providers for failing to order head computed tomography (CT) in cases of head trauma to determine the potential effects of available clinical decision rules (CDRs) on patients.

Methods: The authors reviewed a sample of medical malpractice settlements, and court opinions regarding alleged malpractice for failure to order head imaging for cases of head trauma from 1972 through February 2014 from an online legal research database (WestLaw). Data were abstracted onto a standardized data form. The performance of the CDR was evaluated.

Results: Sixty legal cases were identified (52 adult, eight children). Of 48 cases with known outcomes, providers were identified as negligent in 10 cases (six adult, four pediatric), settled in 11 cases (nine adult, two pediatric), and CDR was applicable in 27 cases. In all 10 cases in which providers were found negligent, evidence reviewed would have indicated the need for head CT. In all eight cases involving non-applicable CDR would have suggested the need for head CT or observation.

Review of legal cases reported in a major online legal research system revealed 60 providers were sued for failing to order head CTs in cases of head trauma. In all cases providers were found negligent, CT imaging or observation would have been indicated by applicable CDR.

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Decision to order a Head CT?

Understanding Overuse Of CT For Minor Head Injury In The ED:

A Triangulated Qualitative Study

Methods

Setting
- Urban Level I trauma center ED
- Satellite community ED

4 groups
22 subjects

Design

Patient Focus Groups

Provider focus groups

Cognitive task analysis: 4 SMEs

Provider Quote

“Every patient has a different stomach for uncertainty. Right? What I would love is a way to screen... If I could just figure out who can tolerate ambiguity and who cannot tolerate ambiguity and uncertainty and then have a tailored way to explain it to them, that would be ideal. But you can’t.”
Patient Quote

“To cover his ass. Before this, years ago, before Sonny Bono died and hit his head and there was a Kennedy who hit his head. These were celebrities. Now they just run them through. They are so paranoid. CAT ‘em. CAT ‘em. CAT ‘em. CAT ‘em. CAT ‘em.”
“For me personally, you could have the head of the medical school come and tell me that there’s no risk in terms of waiting on the CAT scan, and I would just say, ‘Look it’s not your daughter.’ ... I would just say ‘No, let’s risk it.’ Because it’s a short-term risk that she’s not going to wake up ... A long-term risk of cancer just doesn’t do it... I have a very consumer-driven approach to medicine—that I am buying a product.”
"Is a picture worth 1000 words?"

"Give it the time it needs to make me feel better"

Moore J. Br J Gen Pract. 2008;58(548):210-3
GATHER INFORMATION
- Evidence synthesis
- Analysis of usual practice

Develop Initial Prototype

Modify
- Designers
- Study team
- Informaticists
- Patients
- Clinicians
- Stakeholders

Feedback

1. Usability Test
2. Field Test
3. Beta-Test

Finalize Patient-Centered Decision Support

Evaluate (trial)
CONCUSSION OR BRAIN BLEED?

INJURY EVALUATOR

RISK VISUALIZATION
- HIGH RISK
- MEDIUM RISK
- LOW RISK

RISK DISCUSSION
- Evidence DOES support getting a CT
- "You can't see concussion on CT?"

CONSIDERATIONS
- CLAUSTROPHOBIA
- RADIATION
- TIME
- COST
- SYMPTOMS
- DANGER
- DURATION
- HOW TO HEAL
- FOLLOW-UP

Email or text handout to patient
Review decision and prepare EHR note
Concussion or Brain Bleed?
Let’s talk about how we tell the difference

This decision tool is designed for use with people who...
• DO NOT have a bleeding disorder
• DO NOT use a prescription strength blood thinner like coumadin
• DID NOT have a seizure after their injury
How serious is the injury?
Based on the Canadian CT Head Rule*

The patient had...

- GCS < 15 at 2 hours post-injury
- Suspected open or depressed skull fracture
- Any sign of basilar skull fracture (Hemotympanum, raccoon eyes, Battle’s sign, CSF oto-/ rhinorrhea)
- ≥ 2 episodes of vomiting
- Age ≥ 65

- Retrograde amnesia ≥ 30 minutes
- Injury involved a “dangerous” mechanism, e.g.
  - pedestrian struck by motor vehicle
  - Occupant ejected from motor vehicle
  - Fall from > 3 feet or > 5 stairs

- an absence of medium or high risk criteria

*This rule has been studied in over 11,000 patients and found to be 100% sensitive for predicting need for surgery.
YOUR INJURY IS LOW RISK.

This means that the current risk of finding a brain bleed on CT scan for 100 people like you is...

- 97 people will not have a finding of brain bleed on CT scan
- 3 people will have a brain injury seen on CT scan which may or may not be a brain bleed
  - 1 person would have their care plan changed (e.g. staying in the hospital longer)
  - 0 people will have a finding that requires surgery or some other invasive procedure
Studies show that people with **LOW RISK** injuries do not need a CT scan.

You may have a concussion.

A concussion can happen when the brain moves around in the skull.

**A concussion is not a brain bleed.**

Concussion do **not** show up on CT.

**LET’S TALK ABOUT YOUR CONCERNS...**

Did you know that you can’t see a concussion on a CT scan?

How comfortable do you feel not getting a CT scan?
What to expect after leaving the Emergency Department

SYMPTOMS OF CONCUSSION

DANGER SIGNS OF BRAIN BLEED (come back to the ED)

DURATION

LET THE BRAIN HEAL

FOLLOW-UP
What to expect after leaving the Emergency Department

SYMPTOMS OF CONCUSSION

- “Not feeling right” or feeling dazed
- Headache
- Nausea
- Balance problems or dizziness
- Blurry vision
- Confusion, concentration or memory problems

DANGER SIGNS OF BRAIN BLEED (come back to the ED)

DURATION

LET THE BRAIN HEAL

FOLLOW-UP

Email or text handout to patient

Review decision and prepare EHR note
Thank you
Questions? Contact the E-QUAL team at equal@acep.org