

# 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



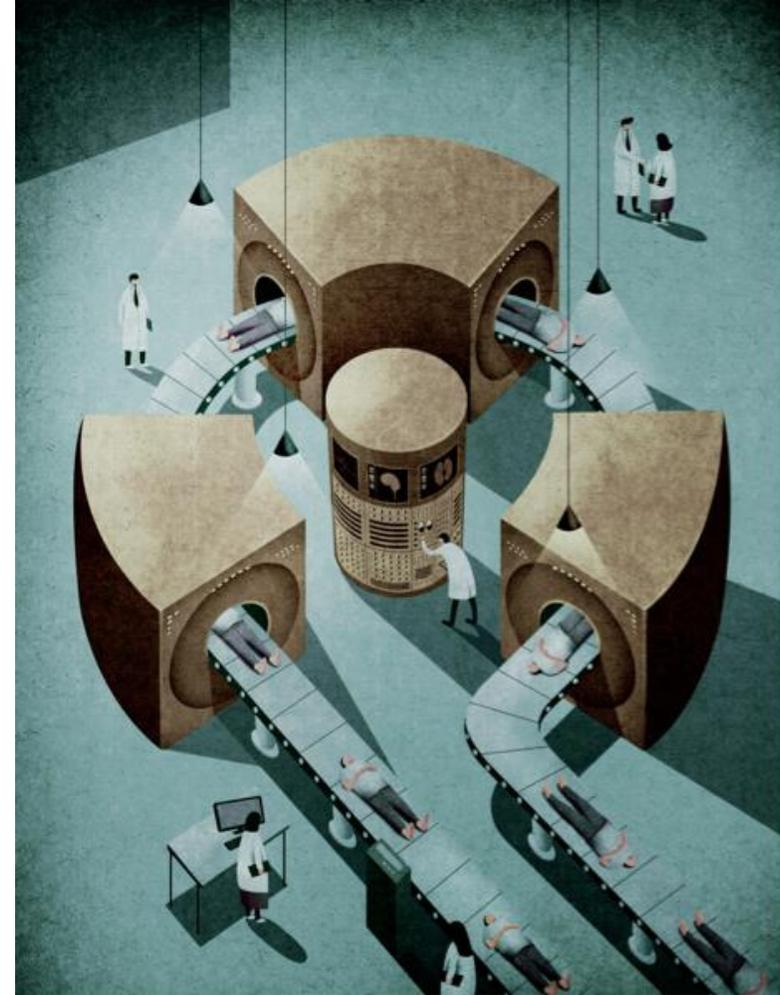
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# Conflicts of Interest & Disclosures

- 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.

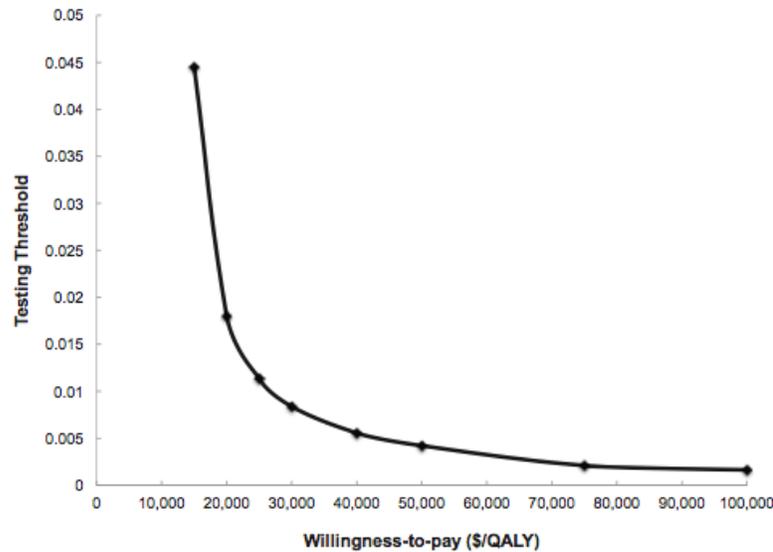
# Overview

- Background
- Overuse
- Implementation challenges
- Understanding Overuse
- CDS role, other implementation strategies
- Patient-centered CDS



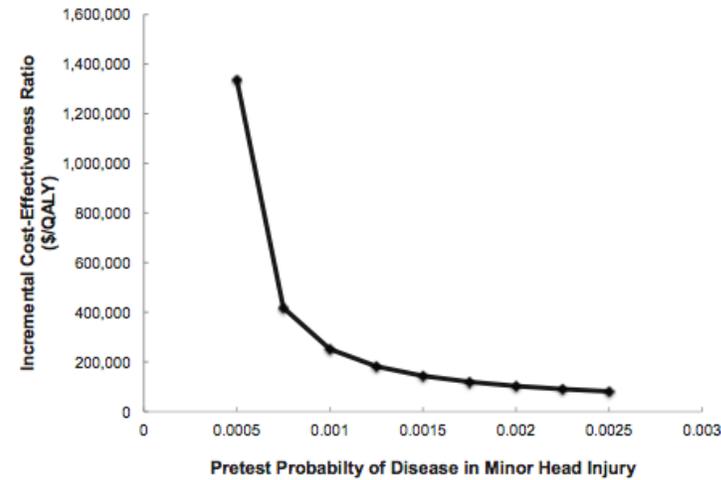
# Is it a problem?

**Testing Threshold as a Function of Willingness-to-Pay (WTP)**



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

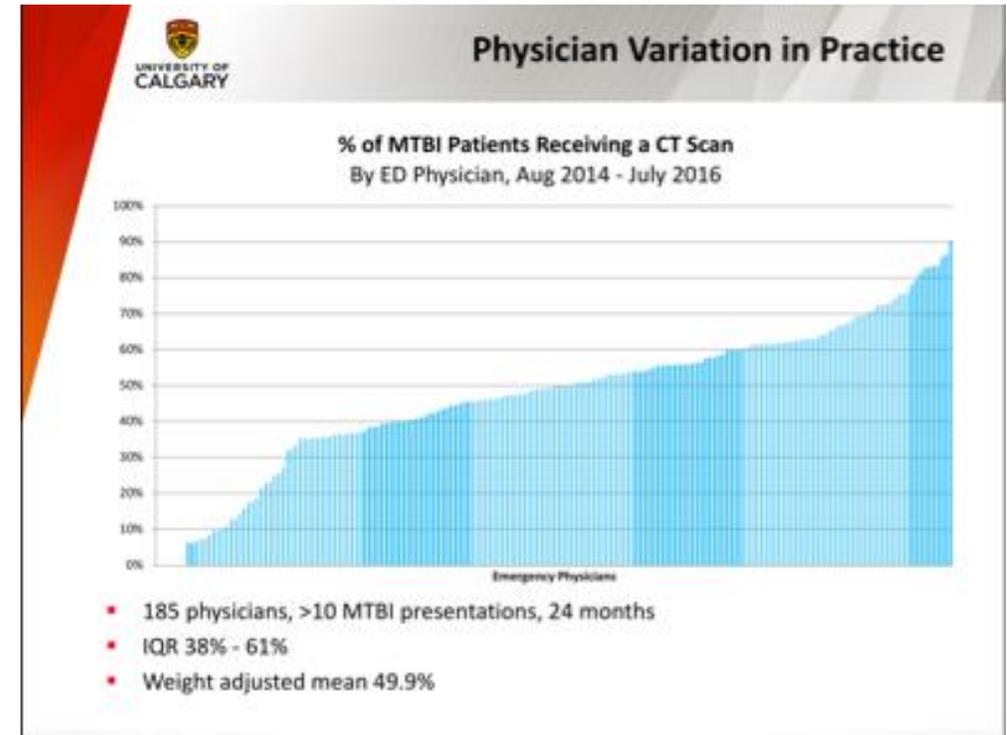
**Effect of Pretest Probability Risk Estimate of Diseases on Cost**



**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



## **1 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.

## **2 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. Catheter-associated urinary tract infection (CAUTI) is the most common hospital-acquired infection in the U.S., and can be prevented by reducing the use of indwelling urinary catheters. Emergency physicians and nurses should 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: output 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.

## **3 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 few months of life. Emergency physicians should engage patients who present to the emergency department with chronic or terminal illnesses, and their families, in conversations about palliative care and hospice services. 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.

## **4 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.

## **5 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 replenishment orally. 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?

New Orleans (2000) <sup>1</sup>	Canadian (2001) <sup>2</sup>	NEXUS II (2002) <sup>3</sup>
Age > 60	Age >65	Age ≥ 65yr
Vomiting	Vomiting >2 times	Recurrent or forceful vomiting
Visible trauma above the clavicles	Suspected Skull Fracture	Evidence of significant skull fracture
Drug or Alcohol Intoxication	Signs of basal skull fracture	Scalp hematoma
Persistent anterograde amnesia	GCS <15 2 hrs after	Neurologic deficit
Headache	Amnesia before impact >30min	Altered Alertness (GCS < 15)
Seizure	Dangerous mechanism	Abnormal behavior
		Coagulopathy

1. Haydel MJ, et al. *N Engl J Med*. 2000;343(2):100-5.

2. Stiell IG, et al. *Lancet*. 2001;357(9266):1391-96.

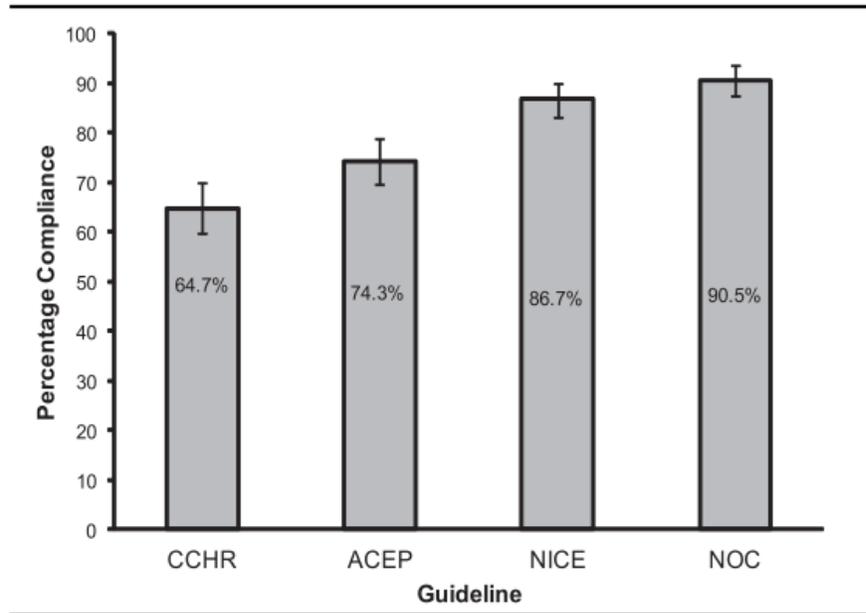
3. Mower WR, et al. *Ann Emerg Med*. 2002;40(5):505-514.

# ACEP Clinical Policy

- Level A: LOC or amnesia and  $\geq 1$  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  $\geq 1$  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.\*

# Which Rule?

## Percentage Compliance with the Four Guideline Recommendations (CCHR, ACEP, NICE, and NOC)



**Figure 2.** The proportion of 346 cases meeting criteria for computed tomography (CT) for the four guidelines varied from 64.7% to 90.5%. CCHR, Canadian CT Head Rule; ACEP, American College of Emergency Physicians; NICE, National Institute for Health and Clinical Excellence; NOC, New Orleans Criteria.

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



ORIGINAL RESEARCH CONTRIBUTION

Agreement Between Routine Emergency Department Care and Clinical Decision Support Recommended Care in Patients Evaluated for Mild Traumatic Brain Injury

Frederick K. Korley, MD, Melinda J. Morton, MD, MPH, Peter M. Hill, MD, MS, Tichaendepi Mundangepufu, MD, Tingting Zhou, Amir M. Mohareb, and Richard E. Rothman, MD, PhD

1. Melnick ER, et al. *Jt Comm J Qual Patient Saf.* 2012;38;483-9.
2. Korly FK, et al. *Acad Emerg Med.* 2013;20:463-9.

ED Adult (age 16+) Trauma Encounters receiving a head CT with GCS Documented at Triage

27,240 encounters

Use of CT consistent with CCHR and current recommendations:

- $\geq 65$  (14,558 enc)
- GCS  $\leq 15$  (3,882 enc)

# 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  $\geq 2$   
1 open skull fracture  
2 INR  $>$  normal range
- 2 found to not be 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%)

## ORIGINAL CONTRIBUTION

### Computed Tomography Use for Adults With Head Injury: Describing Likely Avoidable Emergency Department Imaging Based on the Canadian CT Head Rule

Adam L. Sharp, MD, MS, Ganesh Nagaraj, MD, Ellen J. Rippberger, MPH, Ernest Shen, PhD, Clifford J. Swap, MD, Matthew A. Silver, MD, Taylor McCormick, MD, David R. ...

encounters receiving a head CT from 2008 to 2013. The primary outcome was discordance with the Canadian CT Head Rule (CCHR) high-risk criteria; the secondary outcome was use of a neurosurgical intervention in the discordant cohort. We queried systemwide EHRs to identify CCHR discordance using criteria identifiable in discrete data fields. Explicit chart review of a subset of discordant CTs provided estimates of misclassification bias and assessed the low-risk cases who actually received an intervention.

**Results:** Among 27,240 adult trauma head CTs, EHR data classified 11,432 (42.0%) discordant with CCHR recommendation. Subsequent chart review showed that the designation of discordance based on the EHR was inaccurate in 12.2% (95% confidence interval [CI] = 5.6% to 18.8%). Inter-rater reliability for attributing CCHR concordance was 95% ( $\kappa = 0.86$ ). Thus, we estimate that 36.8% of trauma head CTs were truly likely avoidable (95% CI = 34.1% to 39.6%). Among the likely avoidable CT group identified by EHR, only 0.1% ( $n = 13$ ) received a neurosurgical intervention. Chart review showed none of these were actually "missed" by the CCHR, as all 13 were misclassified.

**Conclusion:** About one-third of head CTs currently performed on adults with head injury may be avoidable by applying the CCHR. Avoidance of CT in such patients is unlikely to miss any important injuries.

From the Department of Research and Evaluation, Kaiser Permanente Southern California (ALS, EJR, ES), Pasadena, CA; the Department of Emergency Medicine, Los Angeles Medical Center, Kaiser Permanente Southern California (ALS), Los Angeles, CA; the Department of Emergency Medicine, San Diego Medical Center, Kaiser Permanente Southern California (GN, CJS, MAS), San Diego, CA; the Department of Emergency Medicine, Harbor-UCLA Medical Center (TM), Torrance, CA; the Department of Emergency Medicine, Kaiser Permanente Sacramento Medical Center (DRV), Sacramento, CA; The Permanente Medical Group and Kaiser Permanente Division of Research (DRV), Oakland, CA; and the Department of Emergency Medicine, University of California (JRH), Los Angeles, CA.

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Address for correspondence and reprints: Adam L. Sharp, MD, MS; e-mail: adam.lsharp@kp.org. ACADEMIC EMERGENCY MEDICINE 2017;24:22-30.

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

# Implementation Imaging Rates

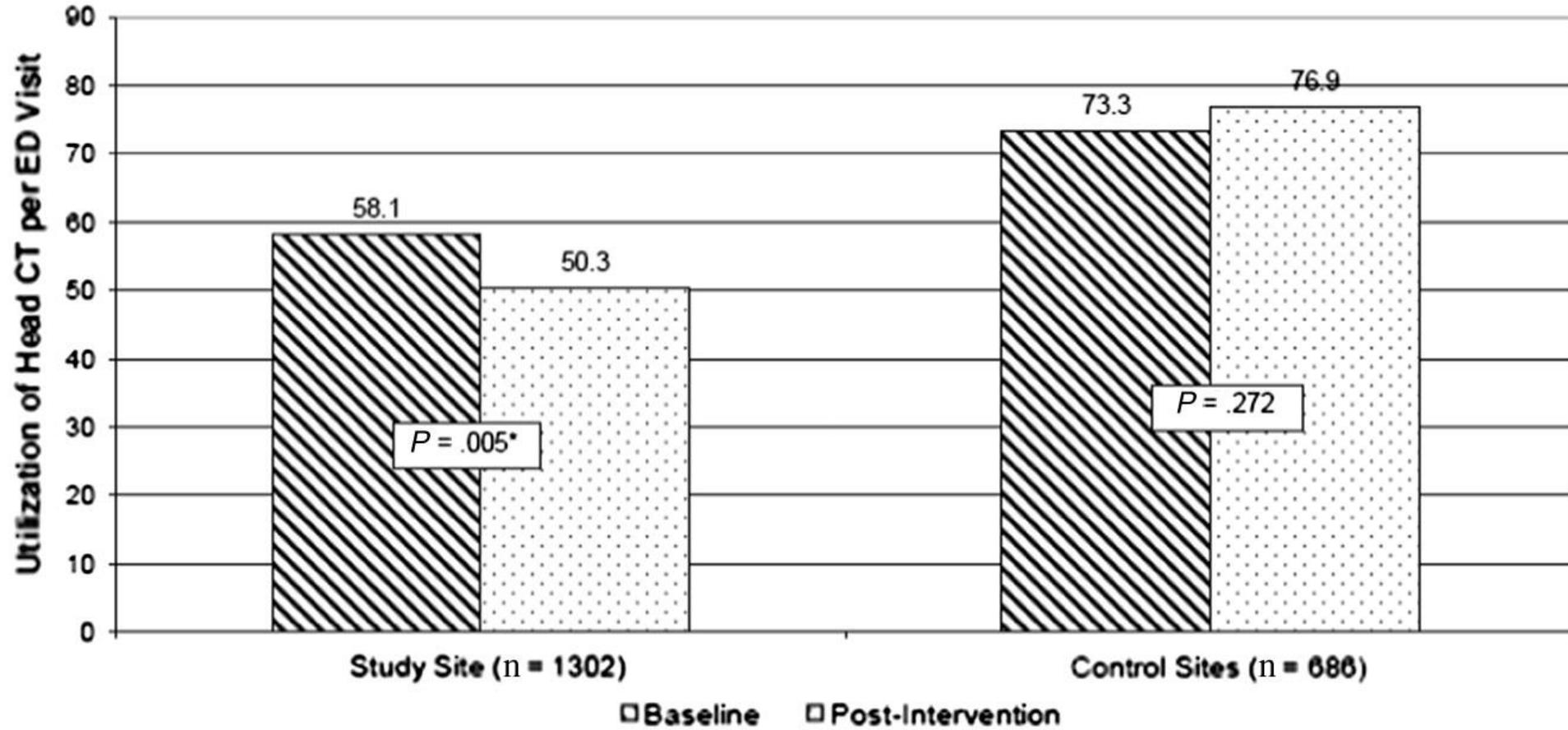
<b>Decision Rule</b>	<b>N</b>	<b>Pre-implementation</b>	<b>Post-implementation</b>
<b>C-Spine</b>	<b>11,824</b>	<b>62%</b>	<b>53%</b>
<b>Head</b>	<b>4,531</b>	<b>63-68%</b>	<b>74-76%</b>

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1. *BMJ* 2009;339.

2. *CMAJ* 2010;182:1527-32.

Utilization of Head CT in Mild Traumatic Brain Injury Related ED Visits (2009-2010)



# 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)

American Journal of Emergency Medicine 33 (2015) 320–325



Original Contribution

Impact of clinical decision support on head computed tomography use in patients with mild traumatic brain injury in the ED



Ivan K. Ip, MD, MPH <sup>a,b,c,e,\*</sup>, Ali S. Raja, MD, MPH, MBA <sup>a,b,d,e</sup>, Anurag Gupta, MD, MBA, MMSc <sup>a,b,d,e</sup>, James Andruchow, MD <sup>a,b,d,e</sup>, Aaron Sodickson, MD, PhD <sup>a,b,e</sup>, Ramin Khorasani, MD, MPH <sup>a,b,e</sup>

# 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



BestPractice Advisory - Inp-Qts-Ml-Erhmpc\_lhwqrrnrmxqngihjp

**PREVENTION REMINDER:** It is NOT recommended this patient receive a head CT (based on the Canadian CT Head Rule/KPSC Recommendations) unless patient meets one of the following Acknowledge Reasons below. Click on appropriate button.

[Click link to Canadian CT Head Rule](#)

Acknowledge reason:

Glasgow Coma Scale (GCS) <15    Open or depressed skull fracture  
Hemotympanum, "raccoon" eyes, CS...    Coagulopathy    Seizures    Vomiting >1  
Other action taken (explain)

Accept    Cancel



Adam L. Sharp, MD, MS  
Emergency Physician  
Research Investigator

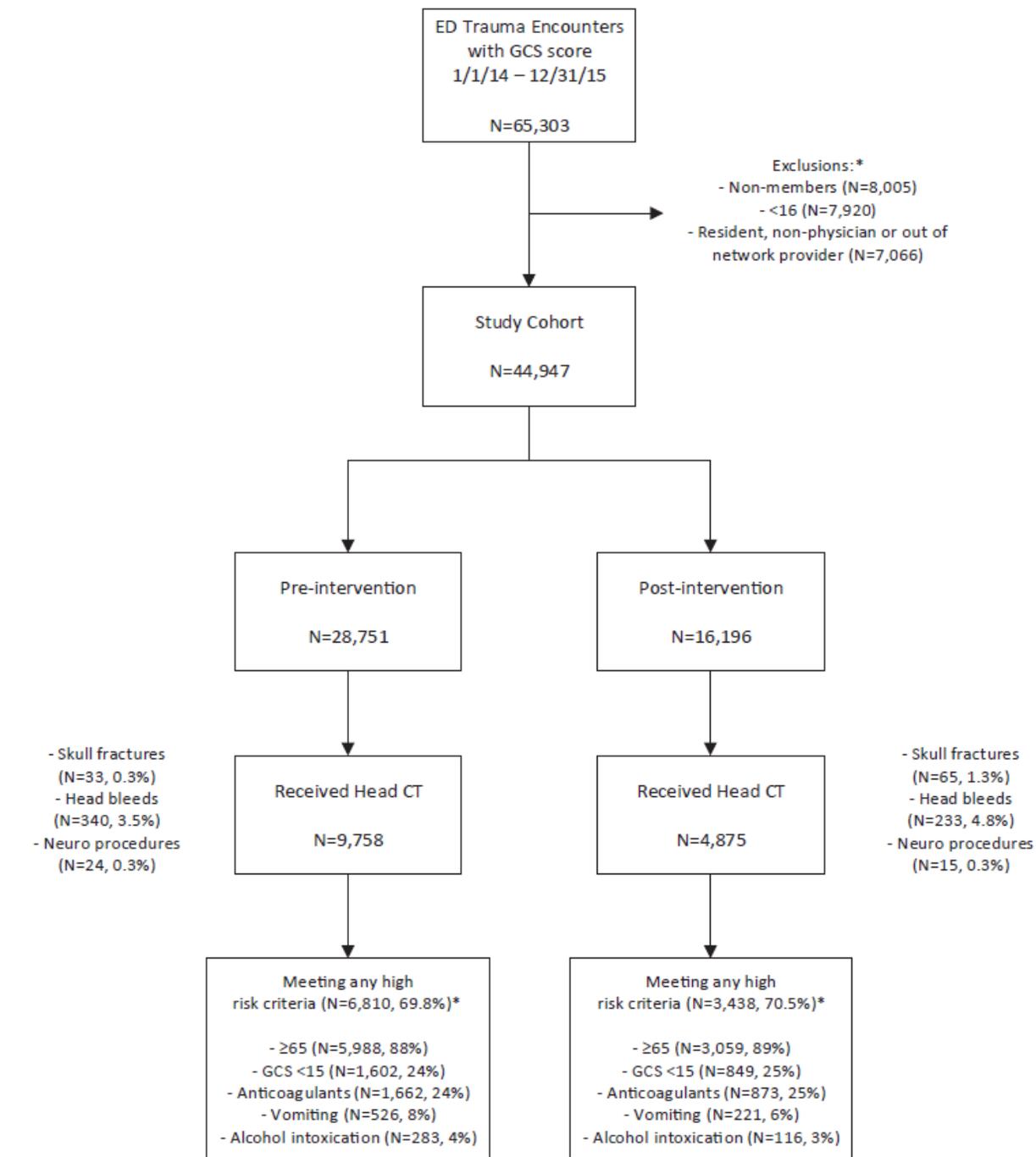


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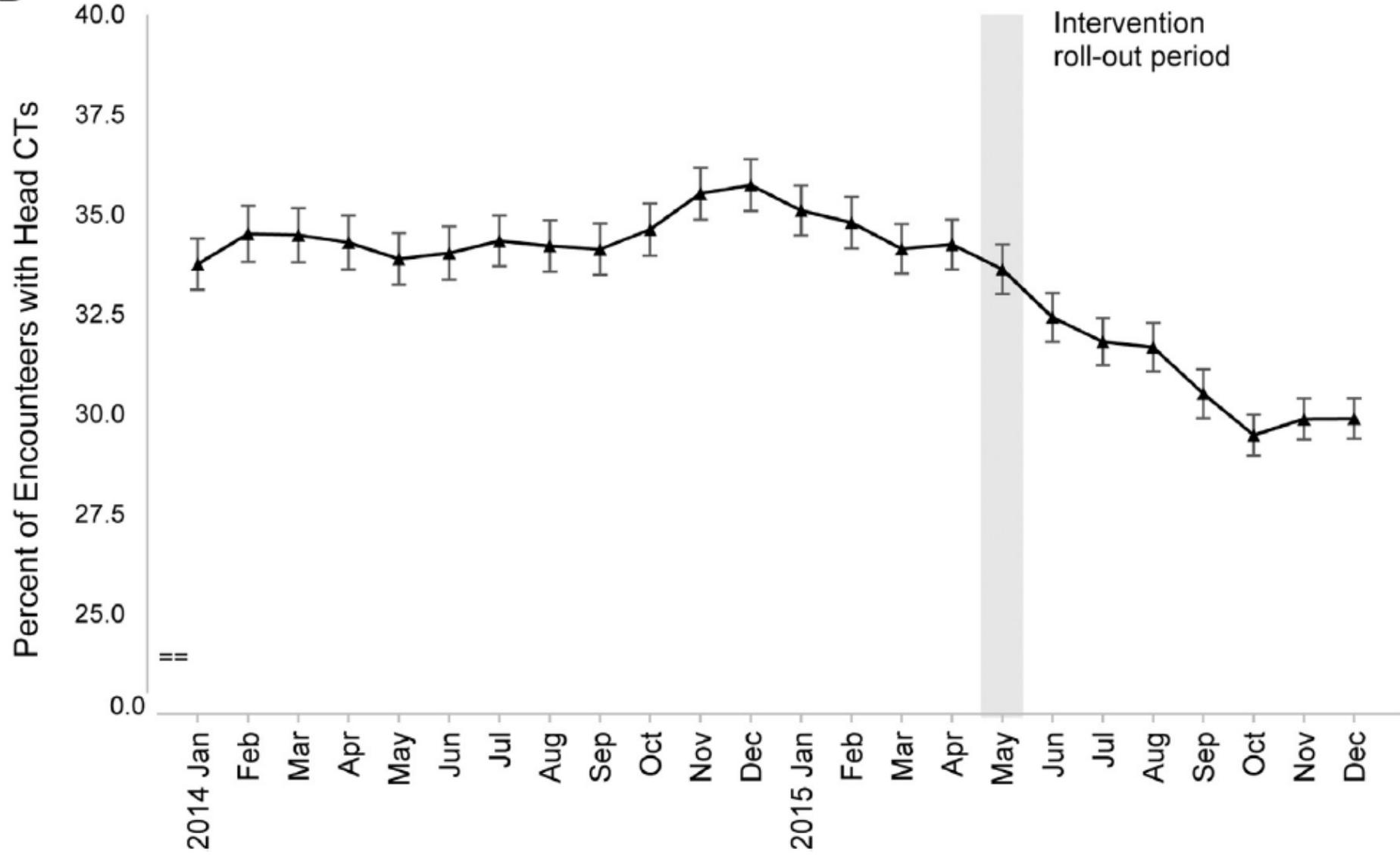
commercial relationships or conflicts of interests to declare. Further, this program did not receive any commercial support from an outside entity.

**Estimated time to complete:**  
30 minutes/.50 CME

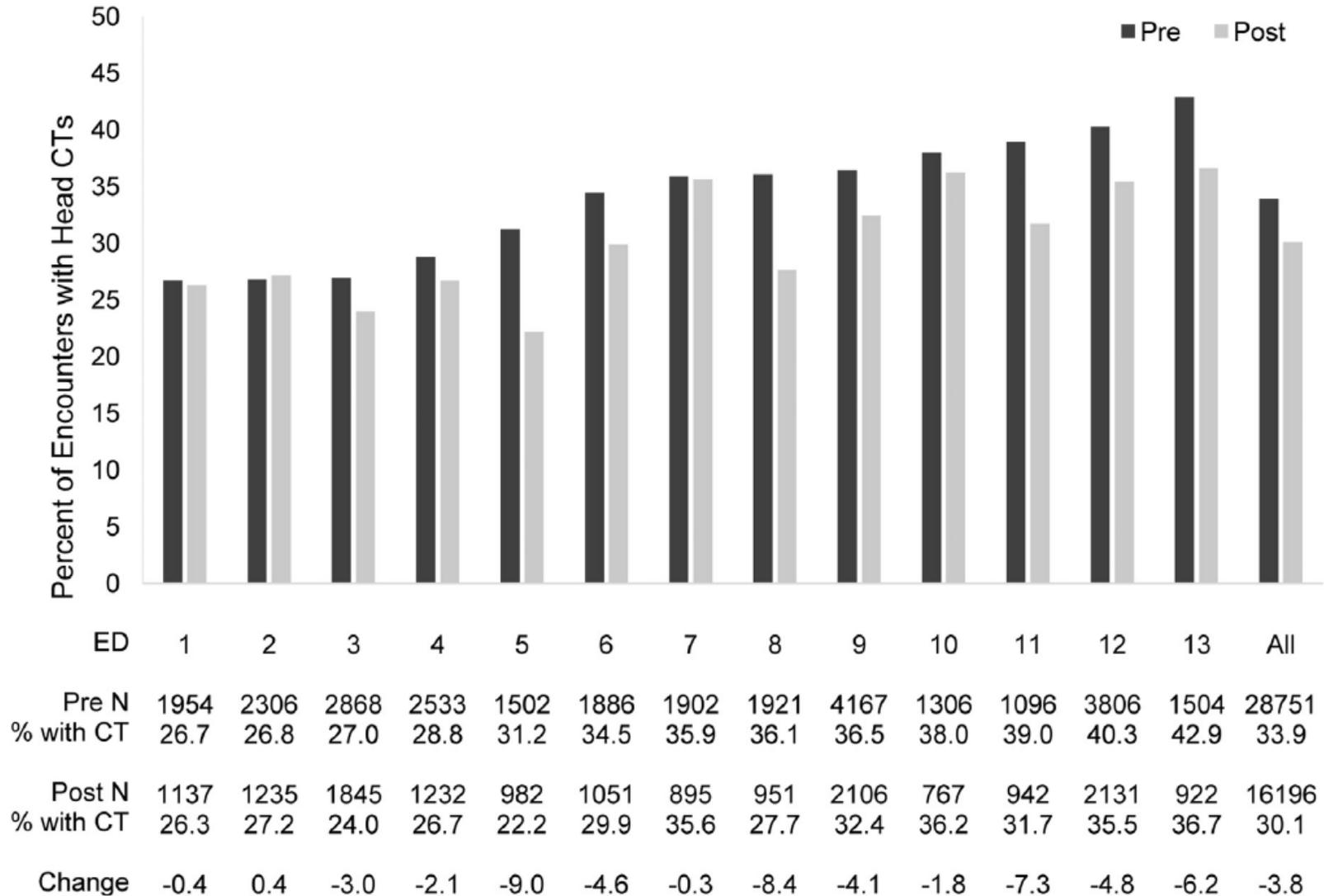




\*not mutually exclusive

**B**

# 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

## ORIGINAL CONTRIBUTION

# 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. C... Erik P. Hess, MD, MSc, and Annie T. Sadosty, MD

## Abstract

**Objectives:** The objectives were to determine the potential effects of available clinical decision rules (CDRs) on malpractice claims against providers for failing to order head computed tomography (CT) in cases of head trauma.

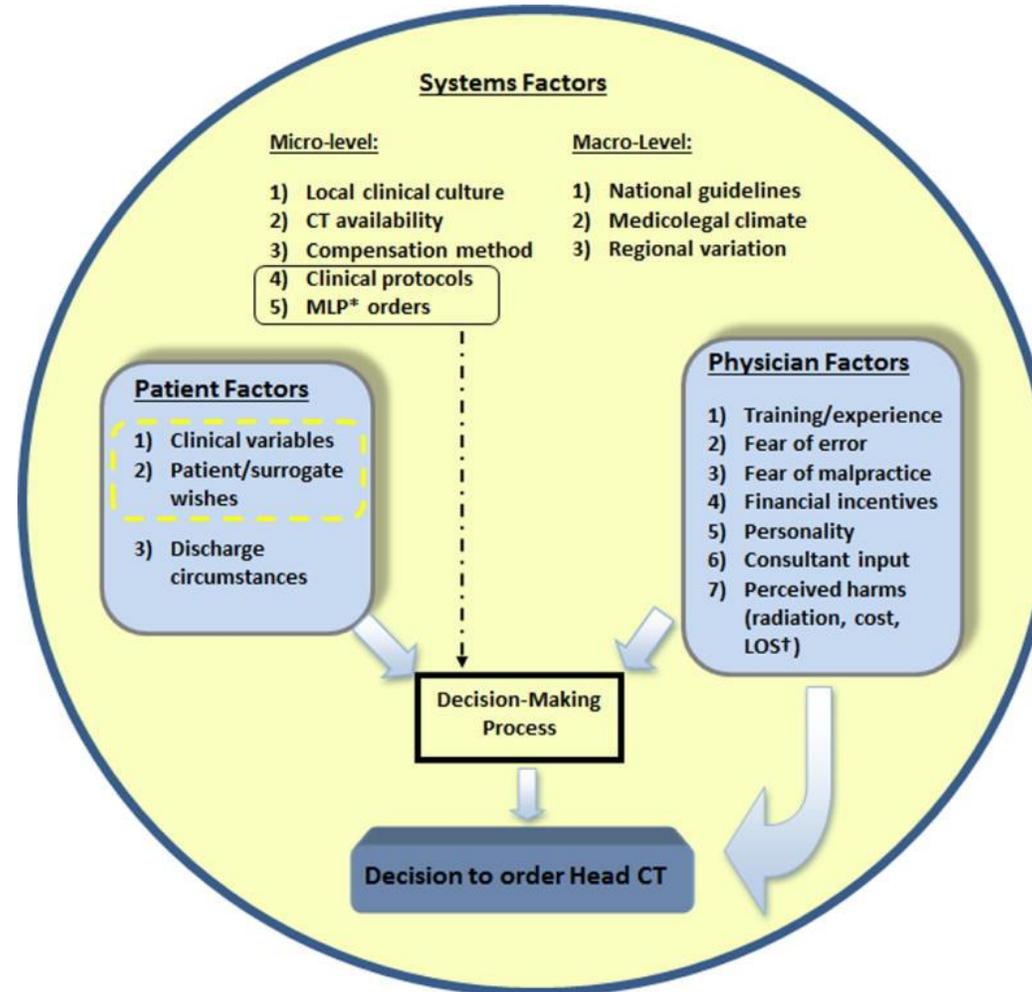
**Methods:** The authors conducted a review of malpractice settlements, and court opinions regarding alleged malpractice for failure to order head CT in cases of head trauma from an online legal research system (WestlawNext) from 1972 through February 2014 (text). Data were abstracted onto a standardized data form. The performance of the CDRs was compared to the outcomes of the cases.

**Results:** Sixty cases were identified (52 adult, eight children). Of 48 cases with known outcomes, 10 cases (six adult, four pediatric) were settled in 11 cases (nine adult, two pediatric). Available in 27 cases. In all 10 cases in which providers were found negligent, even if the CDR would have indicated the need for head CT. In all eight cases involving head trauma, the CDR would have suggested the need for head CT or observation.

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

Don't worry about being sued!

# Decision to order a Head CT?



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



A Triangulated Qualitative Study



Moore J. *Br J Gen Pract.* 2008;58(548):210-3.



# Methods

## Setting

- Urban Level I trauma center ED
- Satellite community ED

4 groups  
22 subjects

**Patient  
Focus  
Groups**

**Provider  
focus  
groups**

## Design

**Cognitive task  
analysis: 4 SMEs**

1. Curry LA, et al. *Circulation*. 2009;119(10):1442-1452.
2. *Bio Instrum Technol*. 1998;32(5):535-540 .

# 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.”



# Patient Quote

“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?

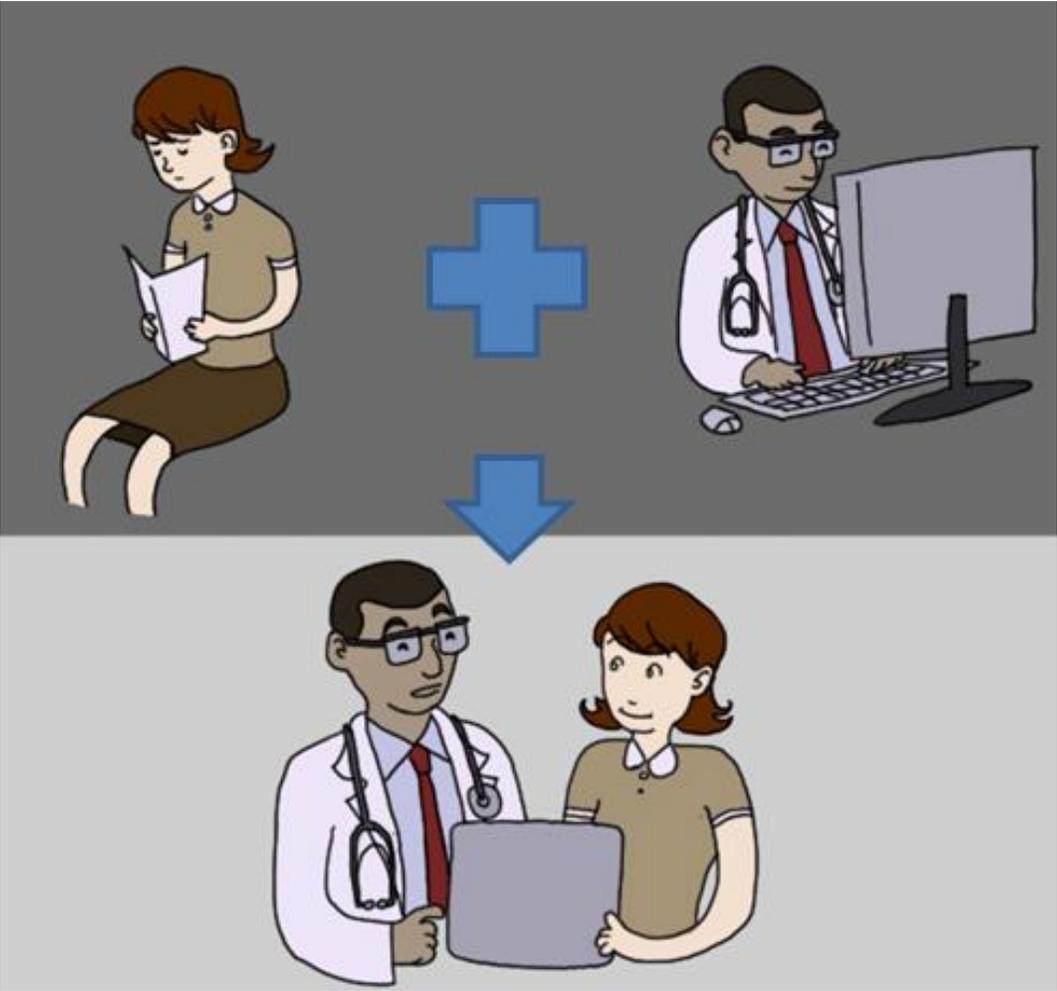


“Give it the time it needs to make me feel better”





JAMA 2012;307:2497.



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May 19, 2017

**Patient-Centered Decision Support:  
Formative Usability Evaluation of  
Integrated Clinical Decision Support  
With a Patient Decision Aid for Minor  
Head Injury...**

J Med Internet Res 2017;19(5):e174



**GATHER INFORMATION**

- Evidence synthesis
- Analysis of usual practice



**Develop Initial Prototype**

**Modify**



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

**Feedback**

**Finalize Patient-Centered Decision Support**



**EVALUATE (trial)**





# Concussion or Brain Bleed?

Let's talk about how we tell the difference



## IMPORTANT NOTE

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, racoon eyes, Battle's sign, CSF oto-/rhinorrhea)
- $\geq 2$  episodes of vomiting
- Age  $\geq 65$

**HIGH RISK** →

- Retrograde amnesia  $\geq 30$  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

**MEDIUM RISK** →

- an absence of medium or high risk criteria

**LOW RISK** →

\*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



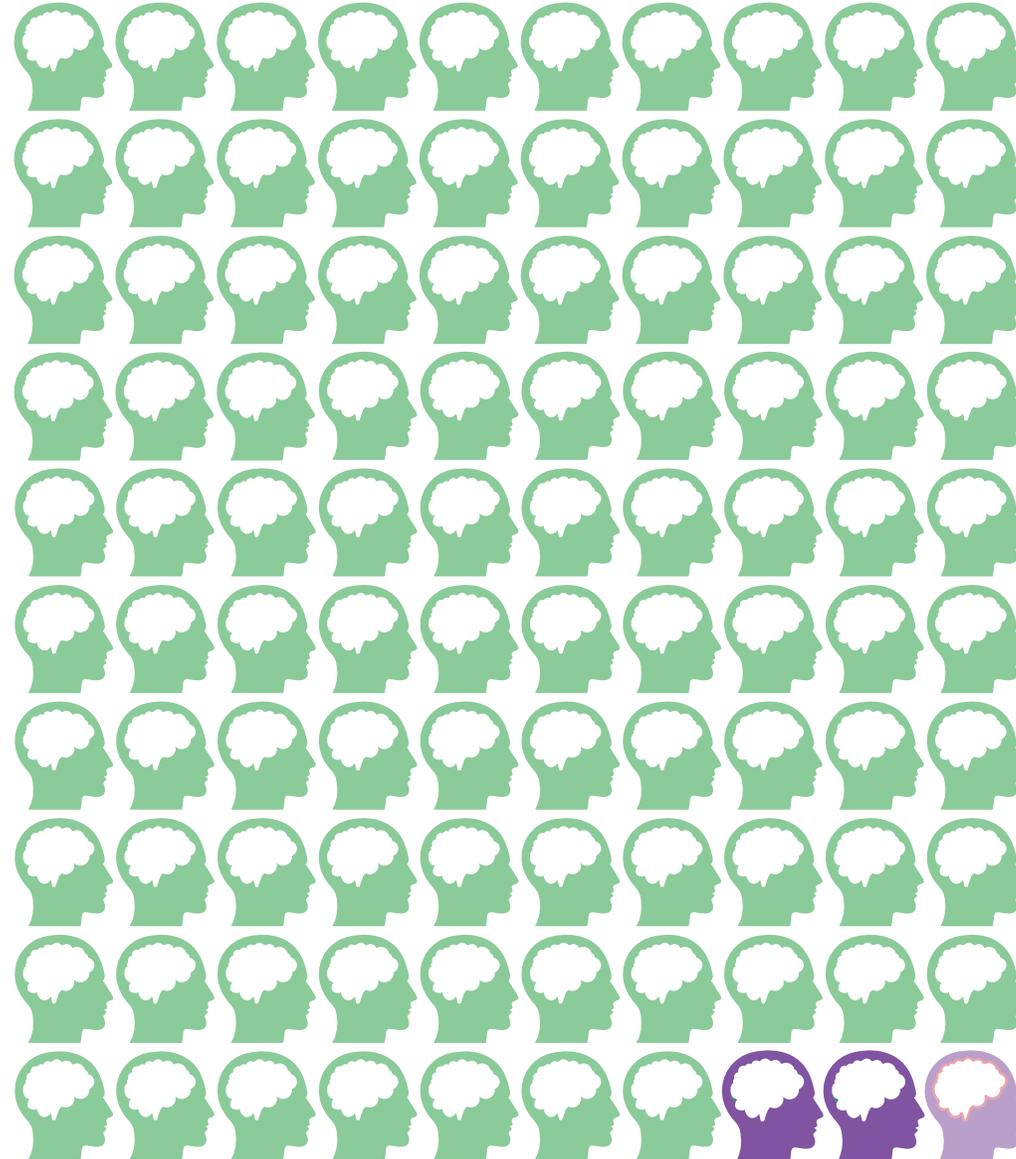
**3** people will have a brain injury seen on CT scan which may or may not be a brain bleed



**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** 



*Email or text  
handout to patient*



*Review decision and  
prepare EHR note*

## 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*



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