

Pediatric Readiness Program Education Session

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Glow in the Dark or Miss an Injury:

Indications for Cross-Sectional Imaging in Pediatric Trauma

Oregon and SW Washington Pediatric Readiness Program

May 22, 2025

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Disclosures

- None of the planners and faculty for this educational activity have relevant financial relationship(s) to disclose with ineligible companies whose primary business is producing, marketing, selling, reselling, or distributing healthcare products used by or on patients.
- Funding Sources:
 - Health Resources and Services Administration – Emergency Medical Services for Children
 - Health Resources and Services Administration – Pediatric Pandemic Network



Objectives

By the end of this session, the learned should be able to:

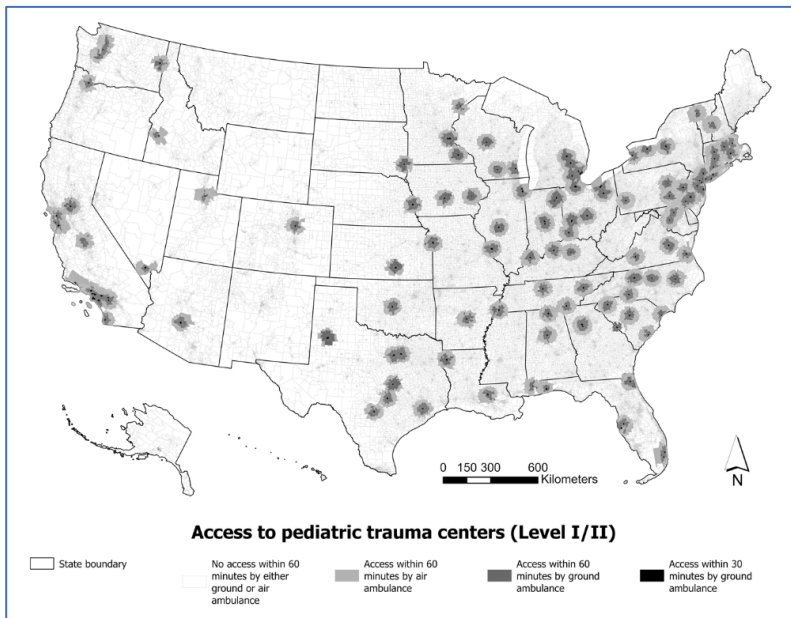
- Describe the indications of brain imaging after pediatric blunt trauma.
- Describe indications for cervical spine imaging after pediatric blunt trauma.
- Describe indications for chest, abdomen, and pelvis imaging after pediatric blunt trauma.

I'm a little biased...are you ready for these two?

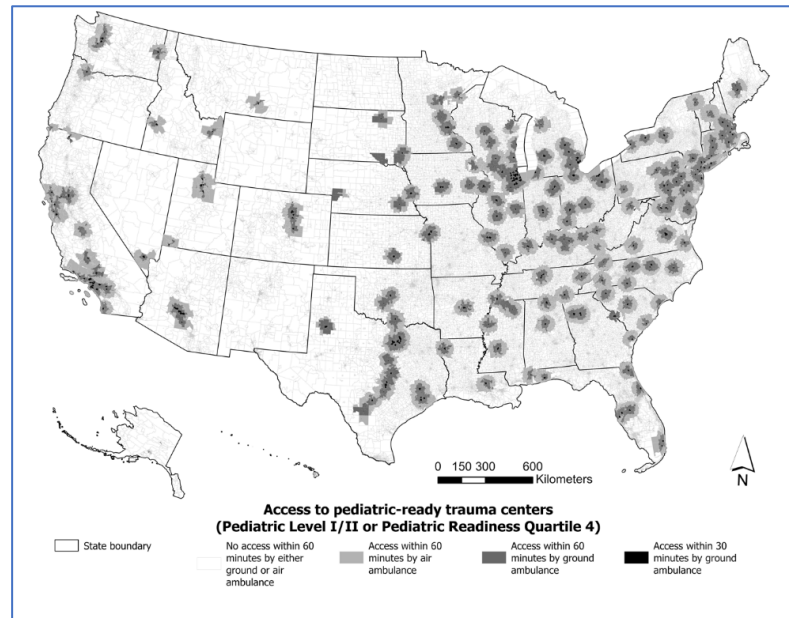


Trauma Center Access within 60 Minutes for Kids

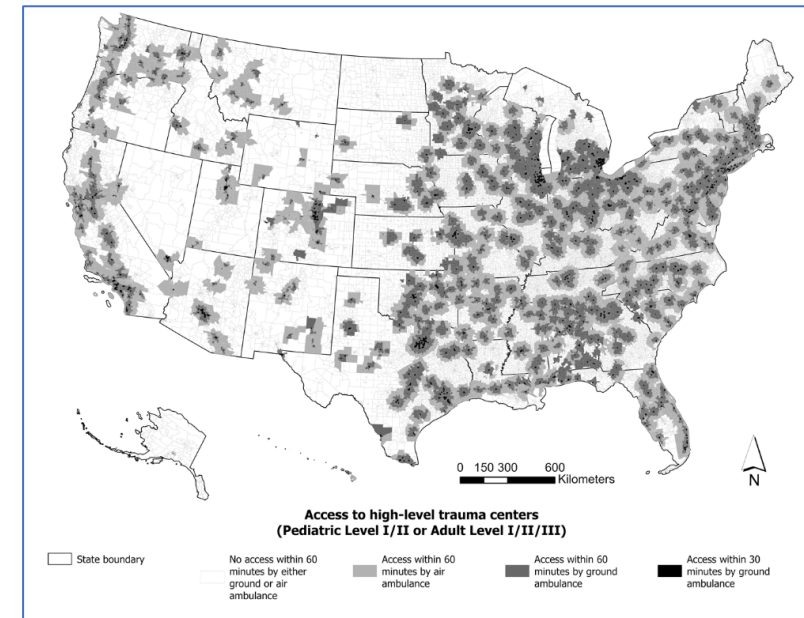
Pediatric Trauma Center
Ground 51% / Air 65%



'Peds Ready' Trauma Center
61% Ground / 73% Air



Any L1-L3 Trauma Center
81 % Ground / 92% Air



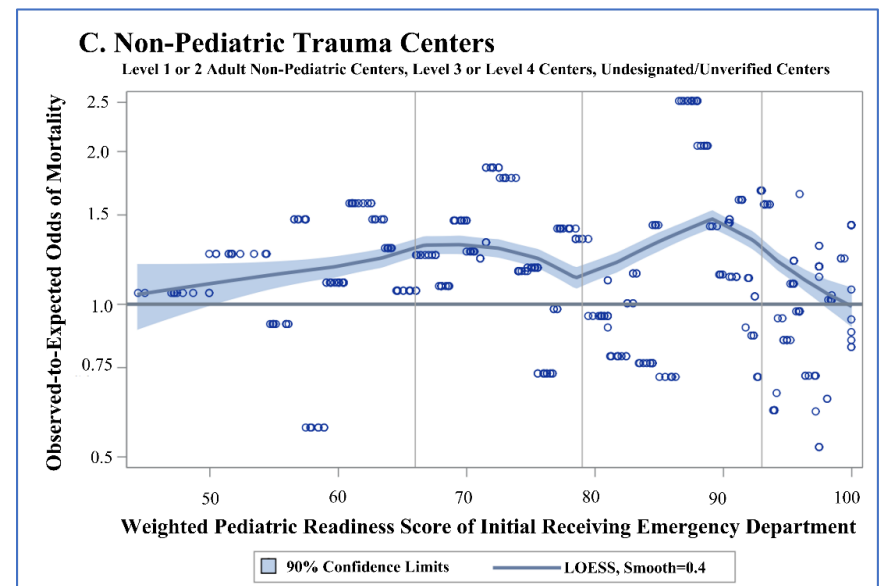
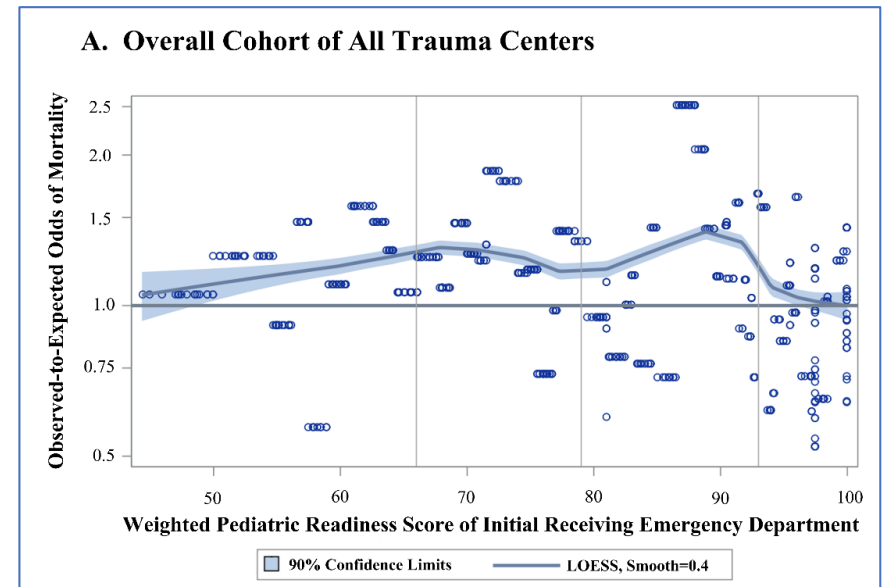
JAMA Pediatrics | [Original Investigation](#)

Pediatric Readiness and Trauma Center Access for Children

Caroline Melhado, MD, MS; Canaan Hancock, MD; Haoyu Wang, MSc; Maya M. Eldin, MD, MPH;
Nicholas George, MD; Jennifer A. Miller, PhD; Katherine E. Remick, MD; Bhavin Patel, MPH; Brian K. Yorkgitis, DO;
Lisa Gray, MHA, BSN, RN, CPN, TCRN; Michael W. Dingeldein, MD; Hilary A. Hewes, MD;
Katie W. Russell, MD; Michael L. Nance, MD; Aaron R. Jensen, MD, MEd, MS

Trauma Center Access within 60 Minutes for Kids

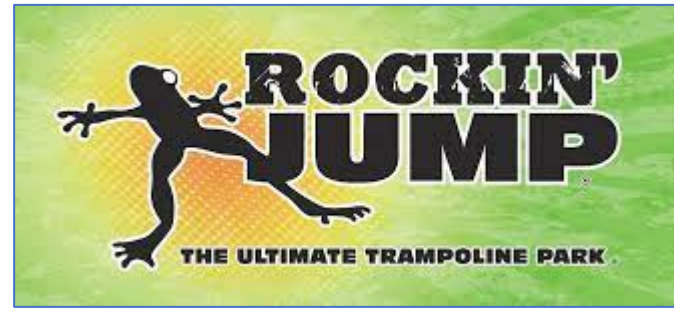
- NPRP 2021 assessment / NTDB data (2019-2021).
- 66,588 children (0-15y) meeting TQIP inclusion criteria from 630 trauma centers
 - Center-specific mortality (O:E odds ratios) by wPRS
- Adjusted mortality in top quartile centers (wPRS>93) significantly (17-27%) better than Q1, Q2, or Q3
- LOESS plots suggest improved mortality above wPRS ~88
- Presence of **pediatric-specific quality improvement plan** is independent driver of mortality benefit



The Association Between Pediatric Readiness and Mortality for Injured Children Treated at US Trauma Centers

Caroline Melhado, MD, MS,*† Katherine Remick, MD,‡ Amy Miskovic, MS,§
 Bhavin Patel, MPH,§ Hilary A. Hewes, MD,|| Craig D. Newgard, MD, MPH,¶
 Avery B. Nathens, MD, MPH, PhD,§# Charles Macias, MD, MPH,**
 Lisa Gray, MHA, BSN, RN, CPN, TCRN,†† Brian K. Yorkgitis, DO,‡‡
 Michael W. Dingeldein, MD,§§ and Aaron R. Jensen, MD, MEd, MS*†

Case Example



Discussion Case

- 3y healthy female w/unwitnessed fall from about **20 feet** at a Rockin' Jump play place.
- Fell from behind the trampoline setup, through the safety netting onto floor.
- Dad jumped down after her and is concerned he landed on her. (-) LOC.



Illustrative Case



Initial assessment

VS: HR 138 (crying) RR 16 BP 112/77 96%RA Temp 37.2 GCS 15

Head - **bruising swelling to head & face, head boggiess & tenderness**; abrasions.

Neck - C-collar in place- no tenderness, no step-offs.

Chest- atraumatic, nontender.

Abdomen- **small abrasion at R costal margin**, non-tender, soft, non-distended.

Pelvis - stable/non-tender.

Extremities – no deformity, tenderness or bruising

Next Steps??? *What do we expect to happen?*

Mechanism: 3yo 20-foot fall, dad fell on her, no LOC

Vitals: Normal except tachycardia (crying)

Exam: Head boggy and tender, exam otherwise normal

What imaging should we obtain now?



Case : What Actually Happened

2125: Arrival to ED

2200: Transfer to Radiology for Pan Scan (no CXR or C-spine XR completed, labs still cooking)



Why might this be a good idea? Why not?

Screening in High-Mechanism Trauma

What is a high-energy blunt mechanism?

CDC-Defined Criteria

Falls

- >10 feet (2-3 x body height)

MVC

- Death in same compartment
- Partial or complete ejection
- Intrusion
 - >12" at patient site
 - >18" anyplace

Car vs ped/bike/ATV/Motorcycle

- >20 mph, thrown, run over



Benefits of Routine Whole Body CT

Compared to selective body region CT. Hint: There are two



Benefits of Routine Whole Body CT

Compared to selective body region CT. Hint: There are two



**Faster Time to
Diagnosis**



Fewer Missed Adult Injuries

Downside of Routine Whole Body CT

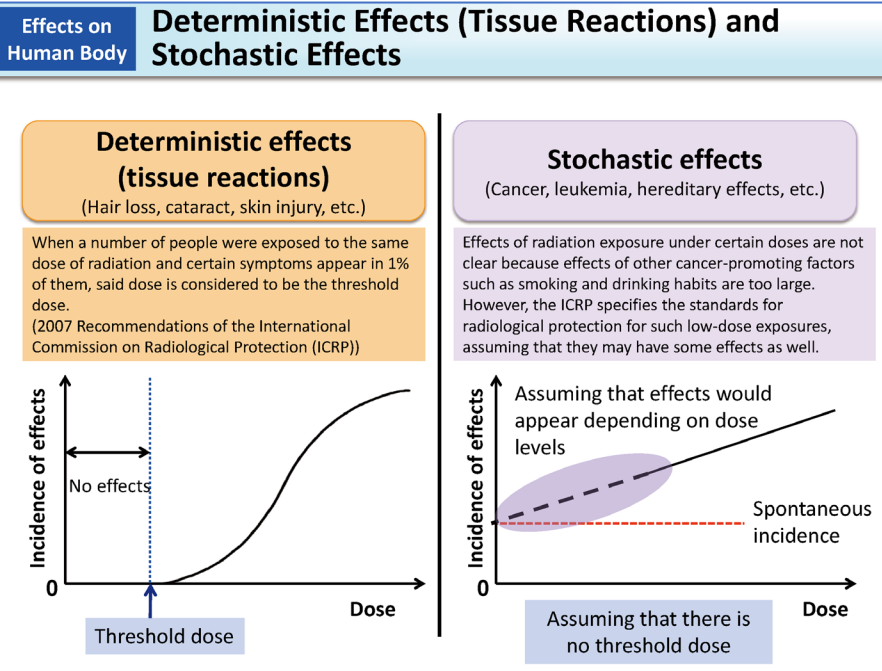


JAMA Surgery | Original Investigation

Risk of Hematologic Malignant Neoplasms From Abdominopelvic Computed Tomographic Radiation in Patients Who Underwent Appendectomy

Kyung Hee Lee, MD, PhD; Seungjae Lee, MS; Ji Hoon Park, MD, PhD; Sung Soo Lee, MS; Hae Young Kim, MD, PhD; Won Jin Lee, MD, PhD; Eun Shil Cha, PhD; Kwang Pyo Kim, PhD; Woojoo Lee, PhD; Ji Yun Lee, MD; Kyoung Ho Lee, MD, PhD

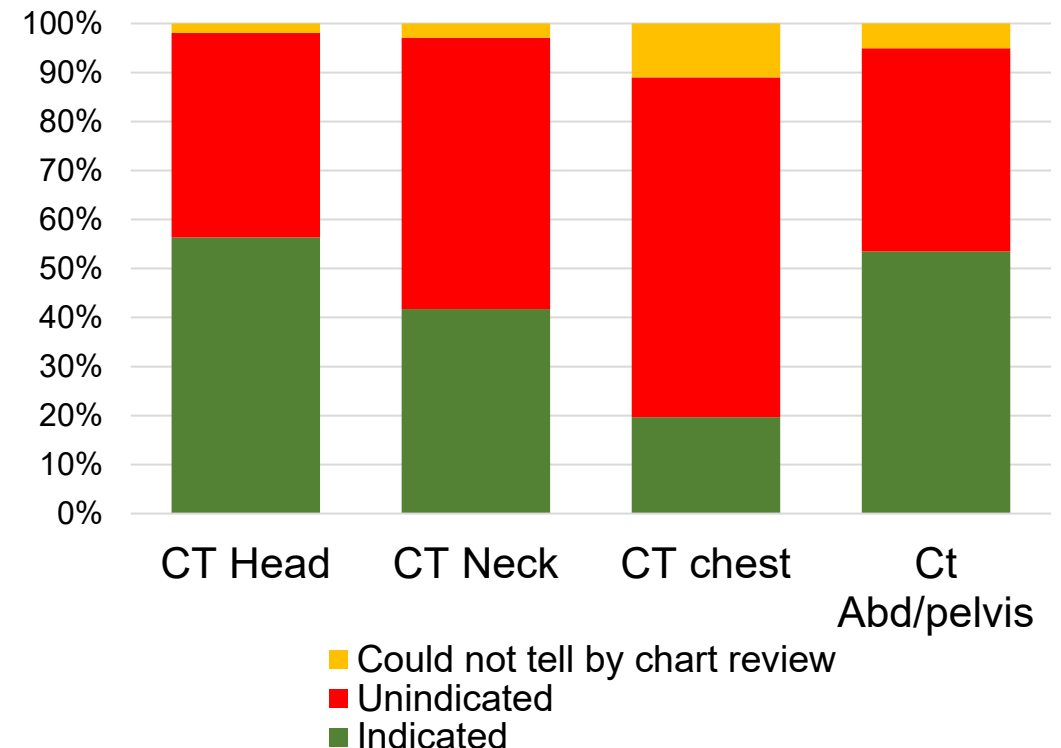
- 825,820 patients that underwent appendectomy
 - CT Exposed: 306,727
 - No CT: 519,093
- Median Age 28yo [IQR 15-41]
- Primary Outcome: Hematologic Malignancy within 2y of exposure
- Secondary Outcome: Abdominal/pelvic cancer within 5 years
- Incidence Rate Ratios (adjusted for person-years)
 - Hematologic Malignancy: 1.26 [1.09-1.45] in CT-exposed group
 - Abdominal Malignancy: 1.07 [1.00-1.15]



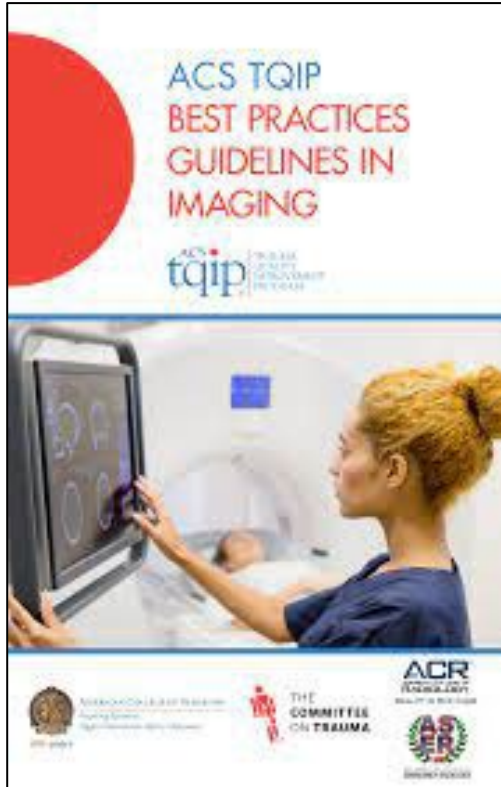
Northern CA Five-center Review of WBCT

- Children transferred to PTC after WBCT at initial center
- Cohort included 417 children (age 2 months-18 years)
 - 66% male
- Median ISS: 9 (IQR 4-18)
- 83% of WBCT were unindicated**
 - 867 body region CTs could have been avoided
- 75 children had no indication for a single body region CT (18%)**

Proportion of Single Body Region CT Scans Meeting Clinical Indications



What Kid Should get a Whole Body CT?

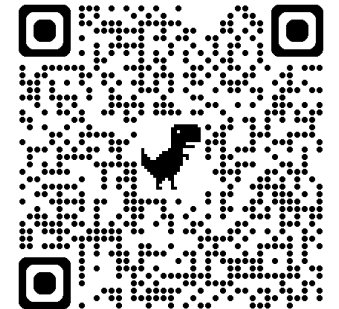
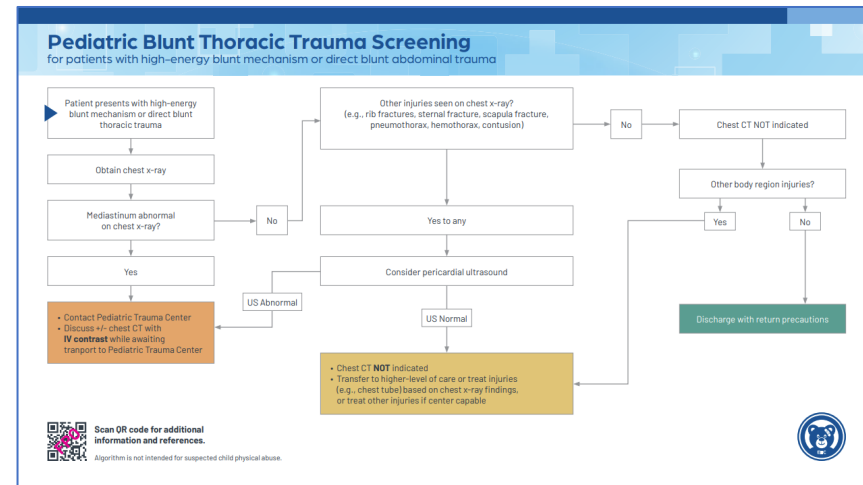
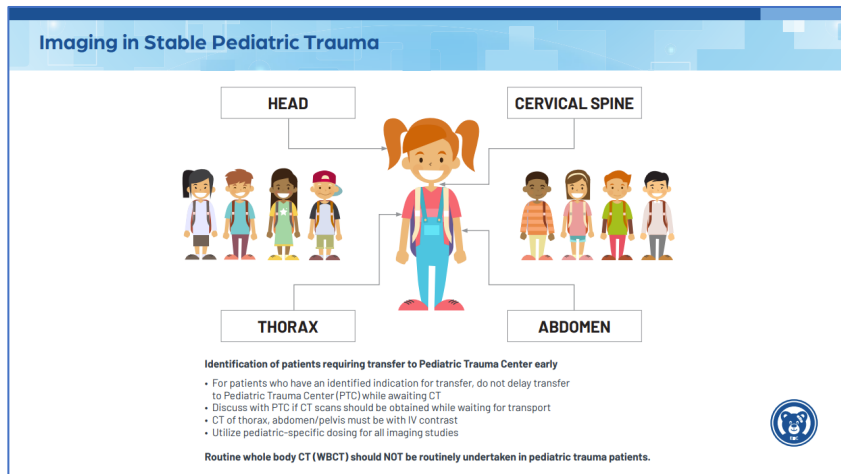
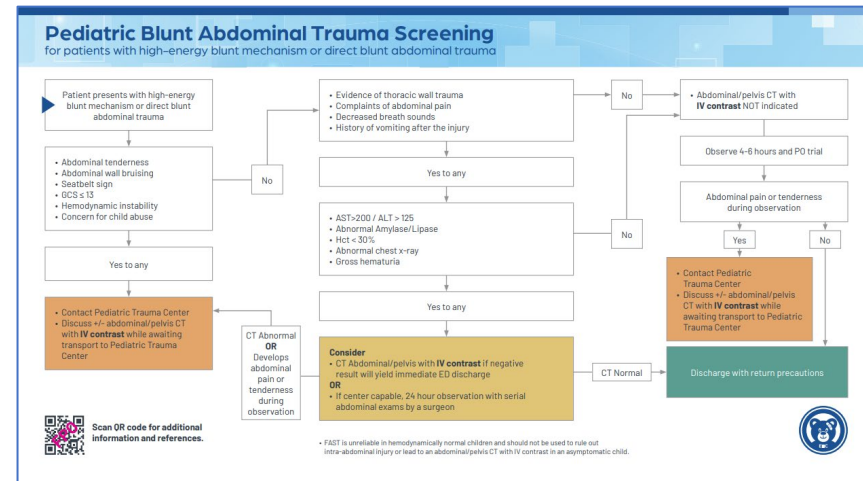


WBCT is generally used for **polytrauma** patients with **severe neurotrauma** that impairs the ability to obtain a **reliable physical examination**. It is **not used to screen asymptomatic children** with a high-energy mechanism.



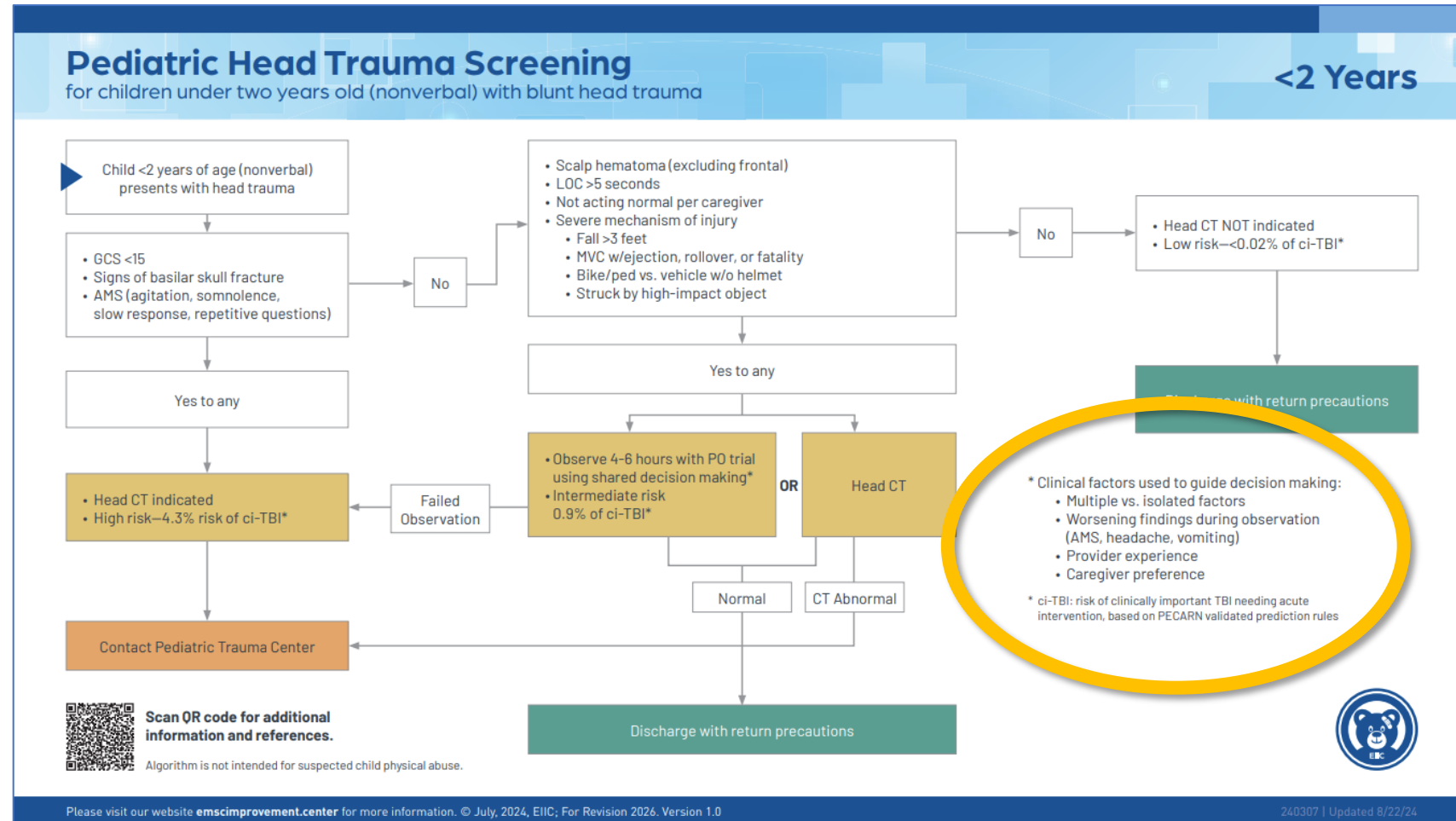
What about specific body region CTs?

Evidence-based Cross-Sectional Imaging Guidelines



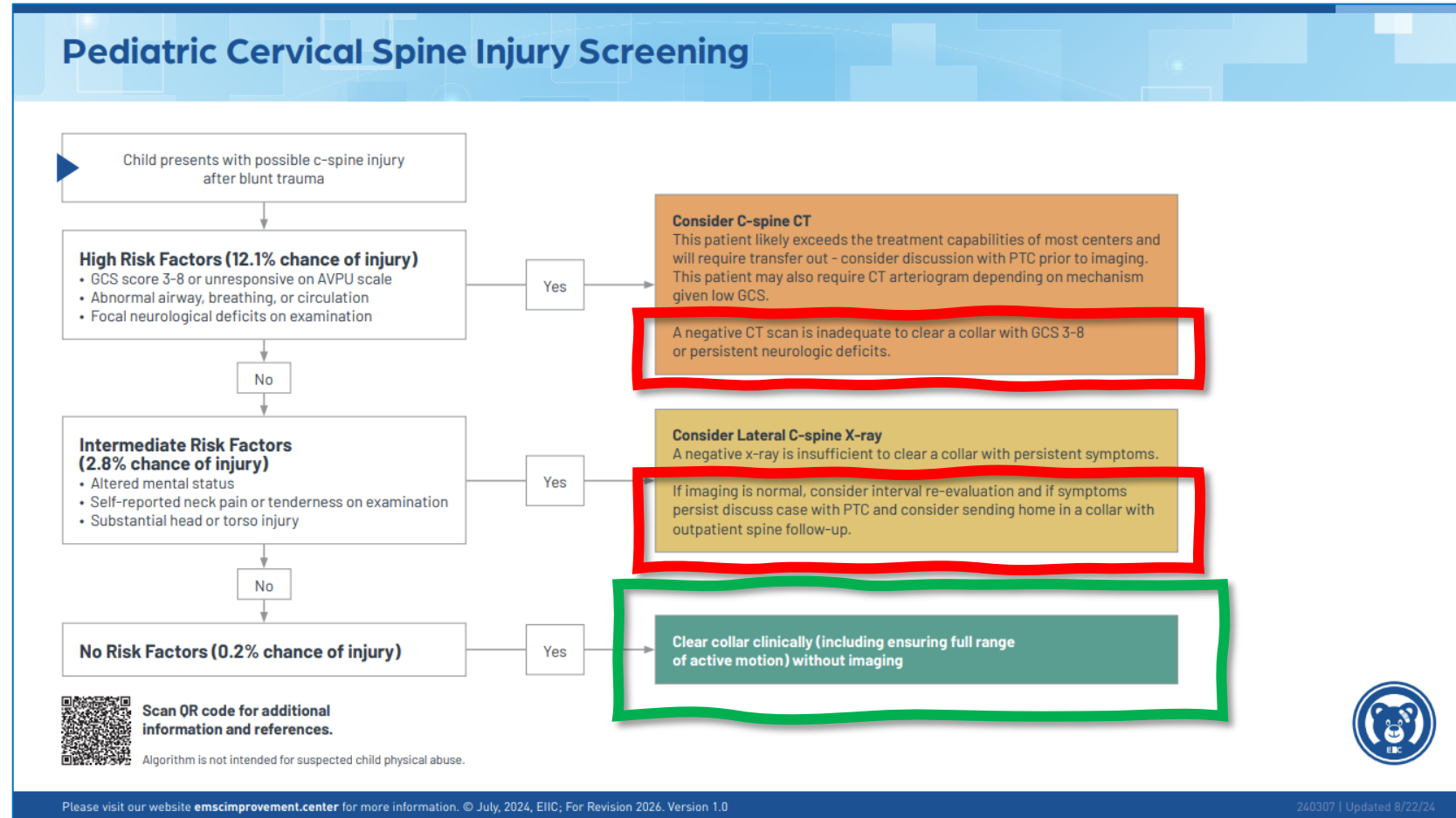
Head CT – PECARN Rules

- <2y (nonverbal) or 2y+ (verbal)
- Risk Stratified
 - High ~4%
 - Intermediate ~1%
 - Low <0.05%
- ‘Box 2’ factors are additive
 - Obs versus scan
 - No Zofran if no scan
 - No ibuprofen if no scan



C-Spine Imaging – PECARN Rules again

- Most useful if you get to the green box!
- More studies coming – kids under 3yo not specifically analyzed
- Requires a touch of common sense
- Consider CTA for high-risk group
- Normal CT still not considered 'good enough' to clear a pediatric spine
- No CT just for neck pain
- Home in a collar versus MRI



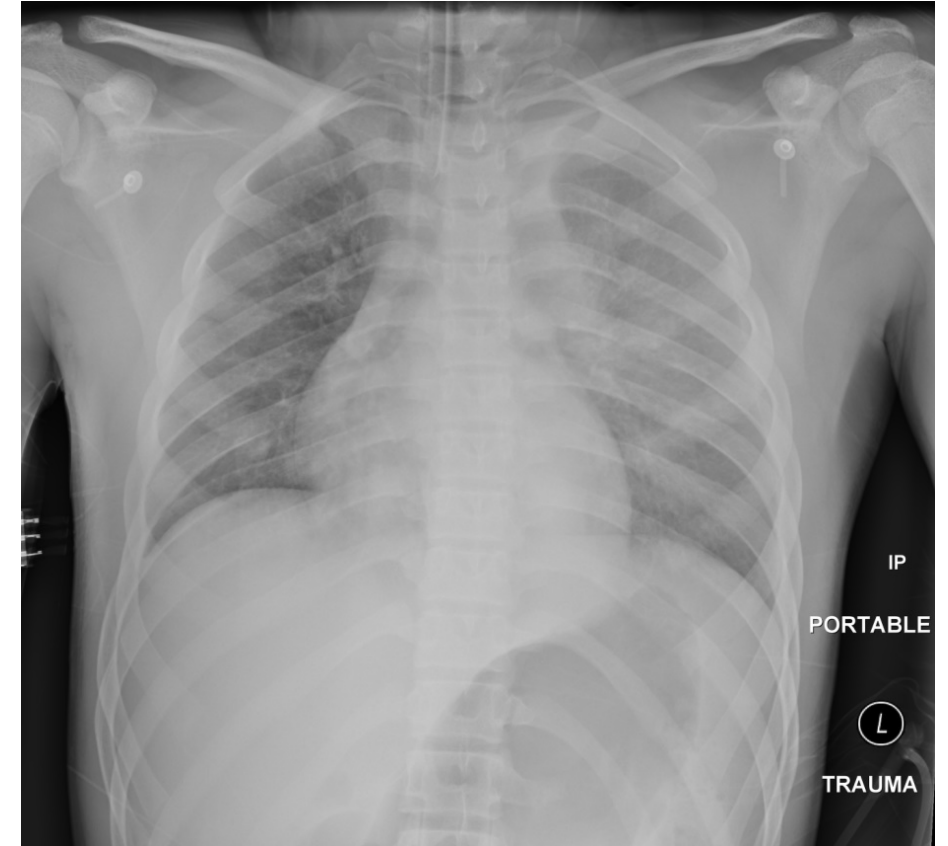
Chest CT – Illustrative Case

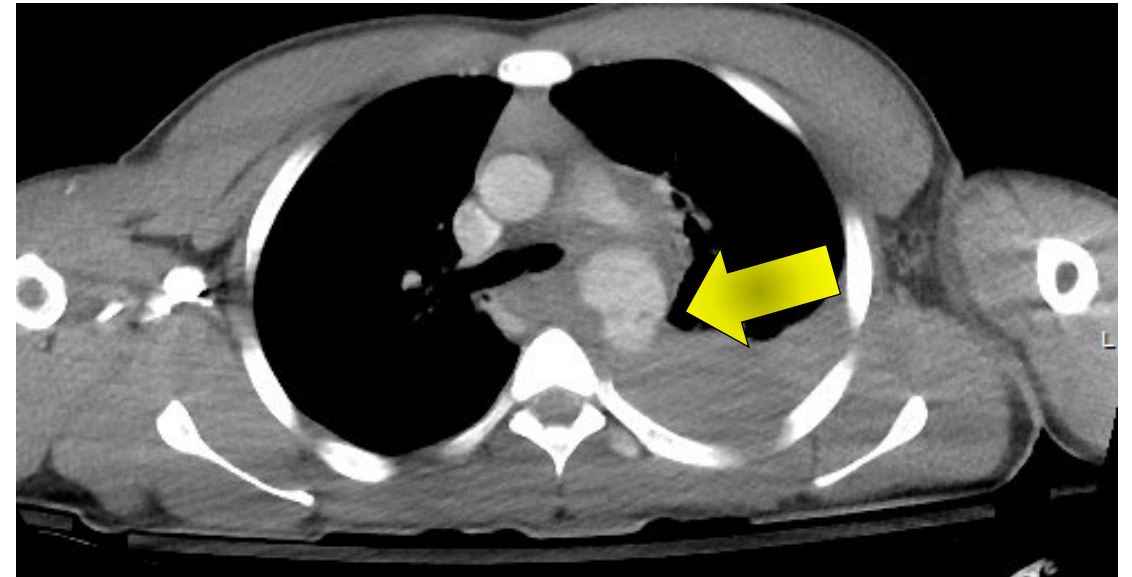
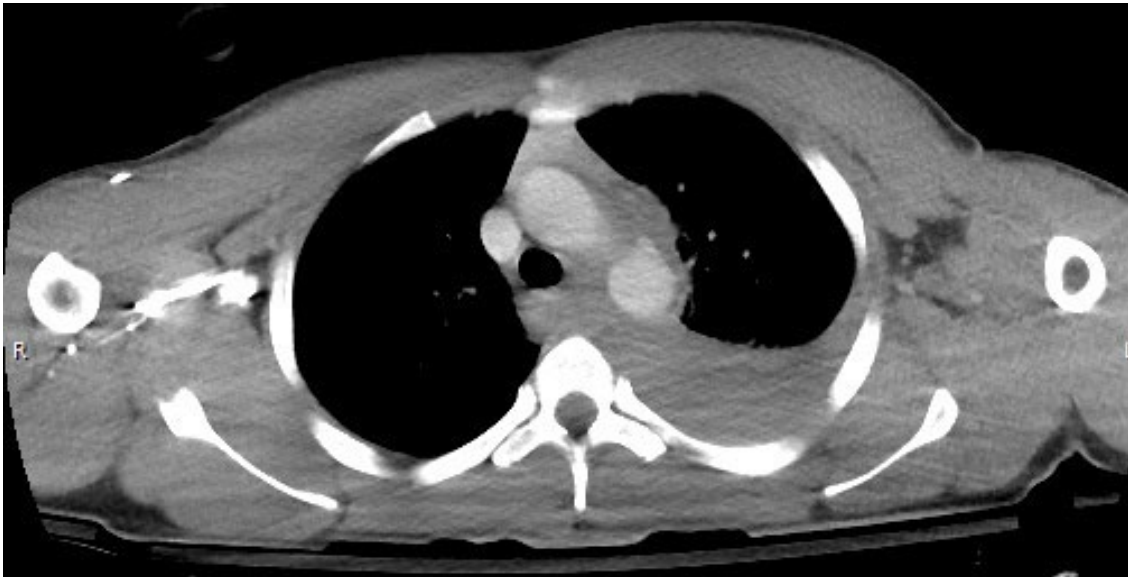
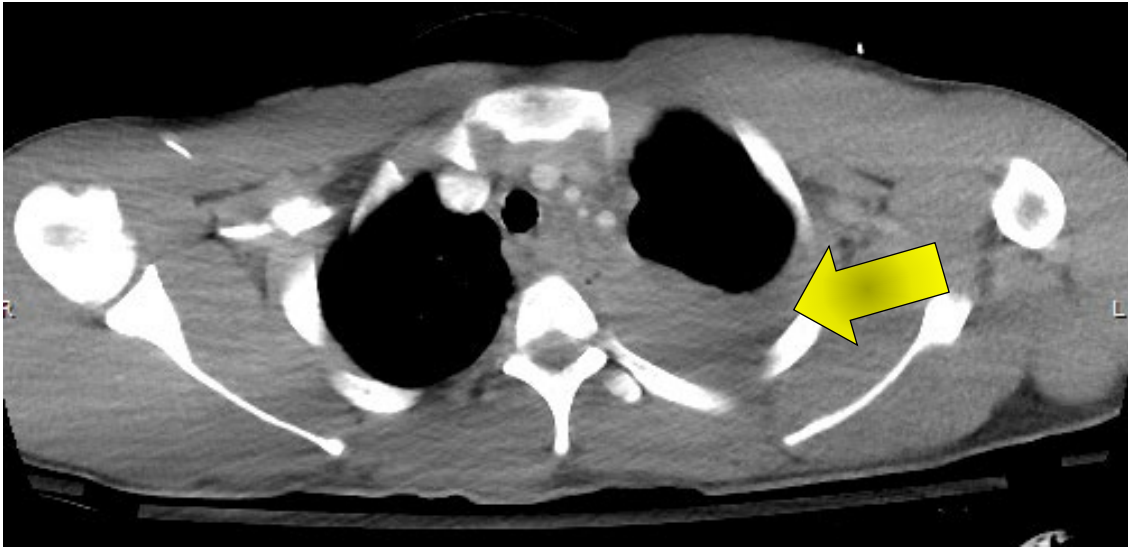
- 15yo back seat passenger
 - 80-100mph MVC
 - Unclear if restrained
 - Fatality at scene
 - Four other critical adults
 - GCS 11, 78/52, dyspnea, abdominal pain
- Direct air transport to freestanding pediatric center

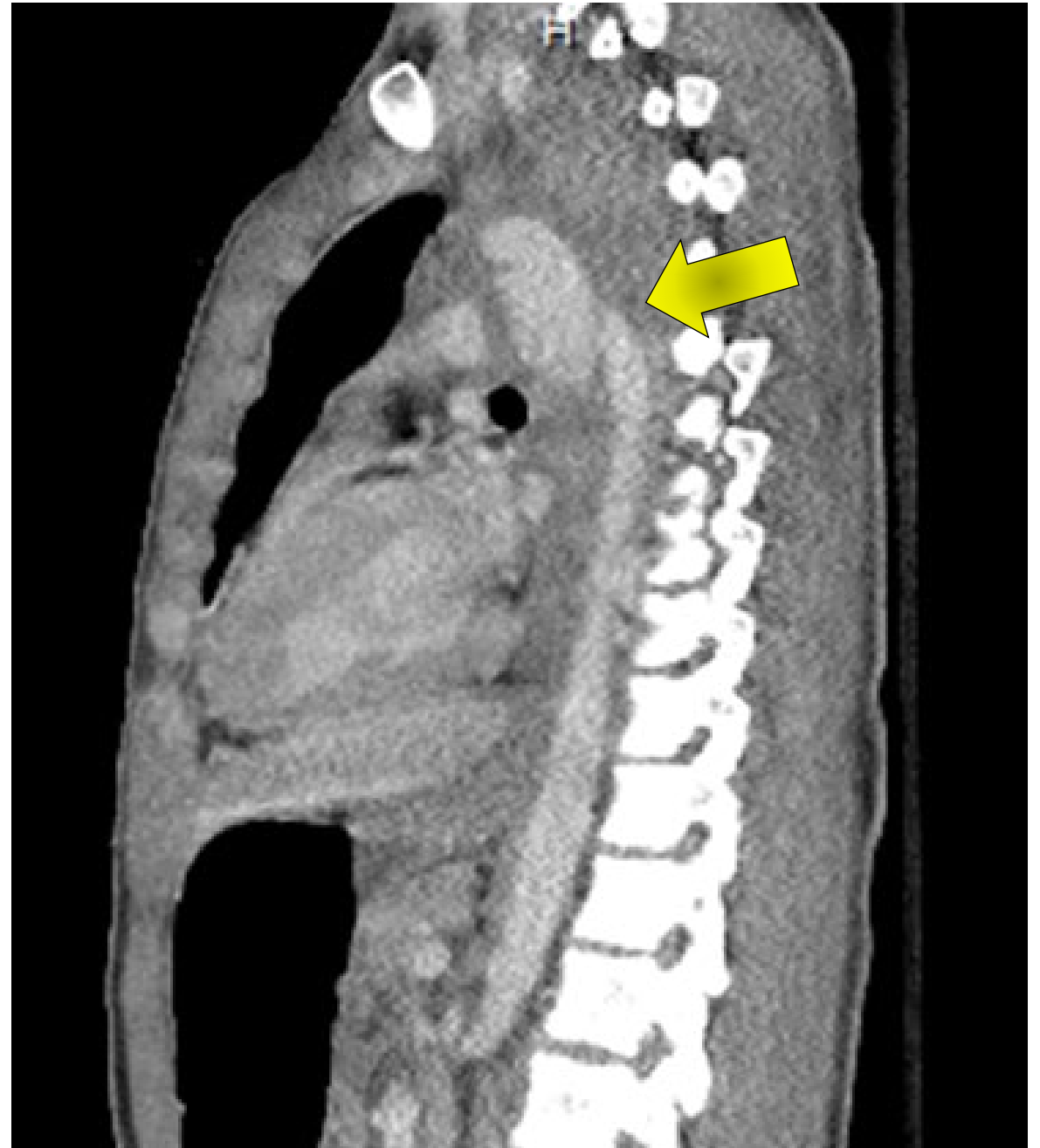
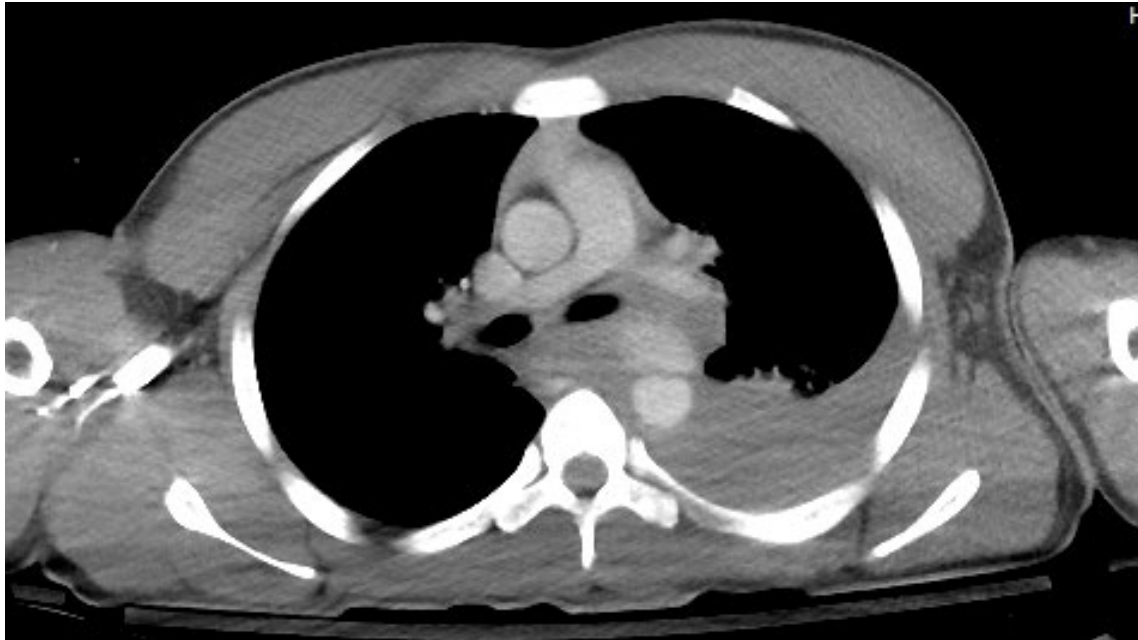
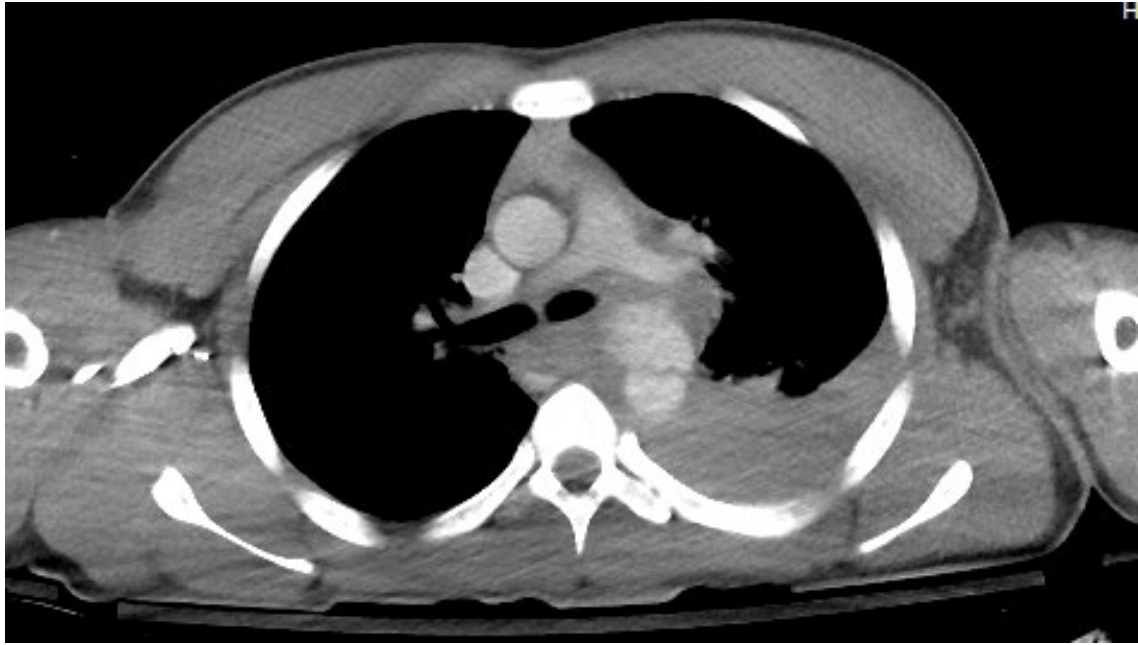


Chest CT – Illustrative Case

- Initial Assessment
 - GCS 13, Combative
 - 166/93, HR 94
 - Diminished left breath sounds
 - Abdomen tender/guarding
- Intubated
- CXR ->
- FAST – free fluid in RUQ and pelvis

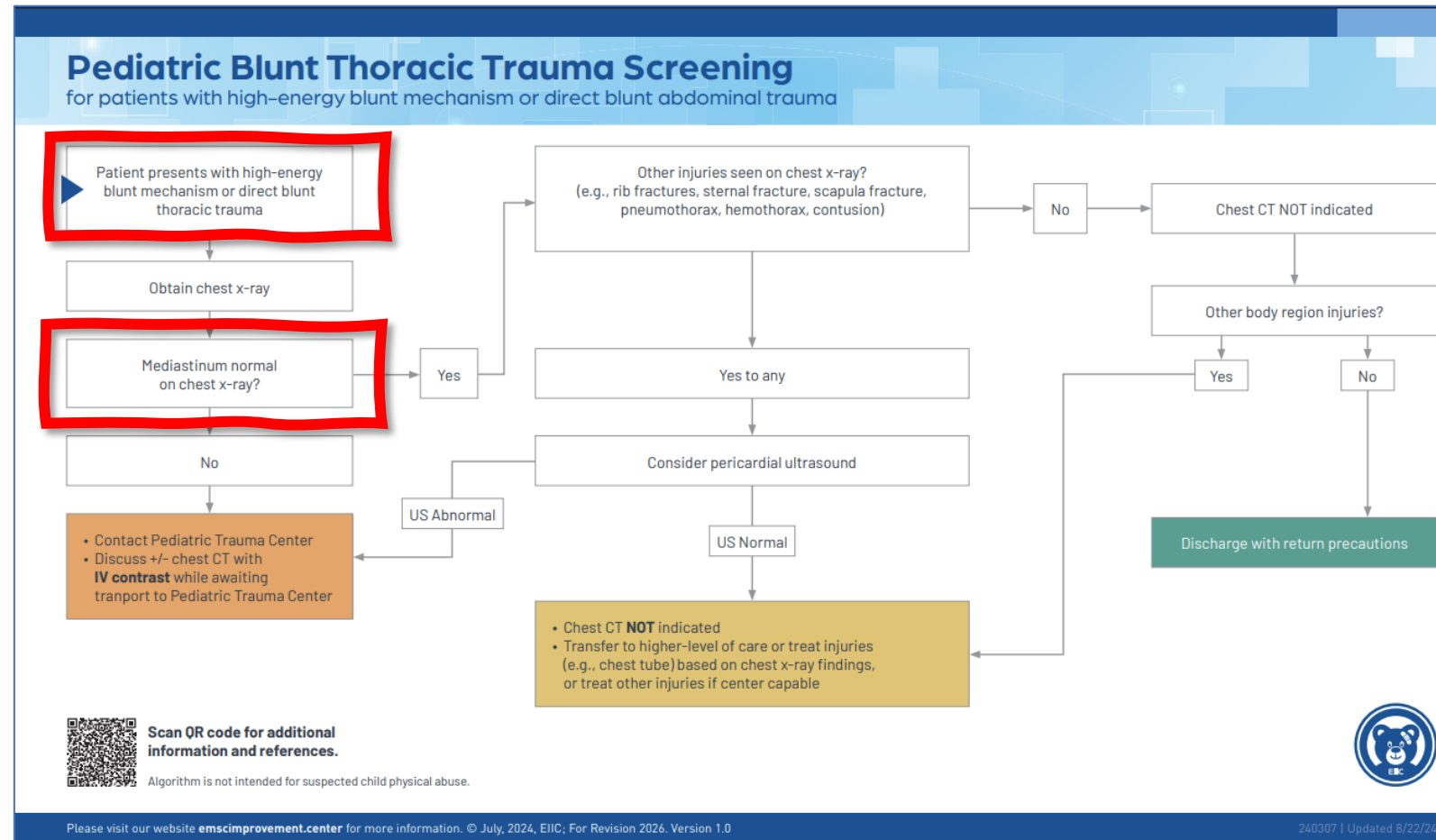






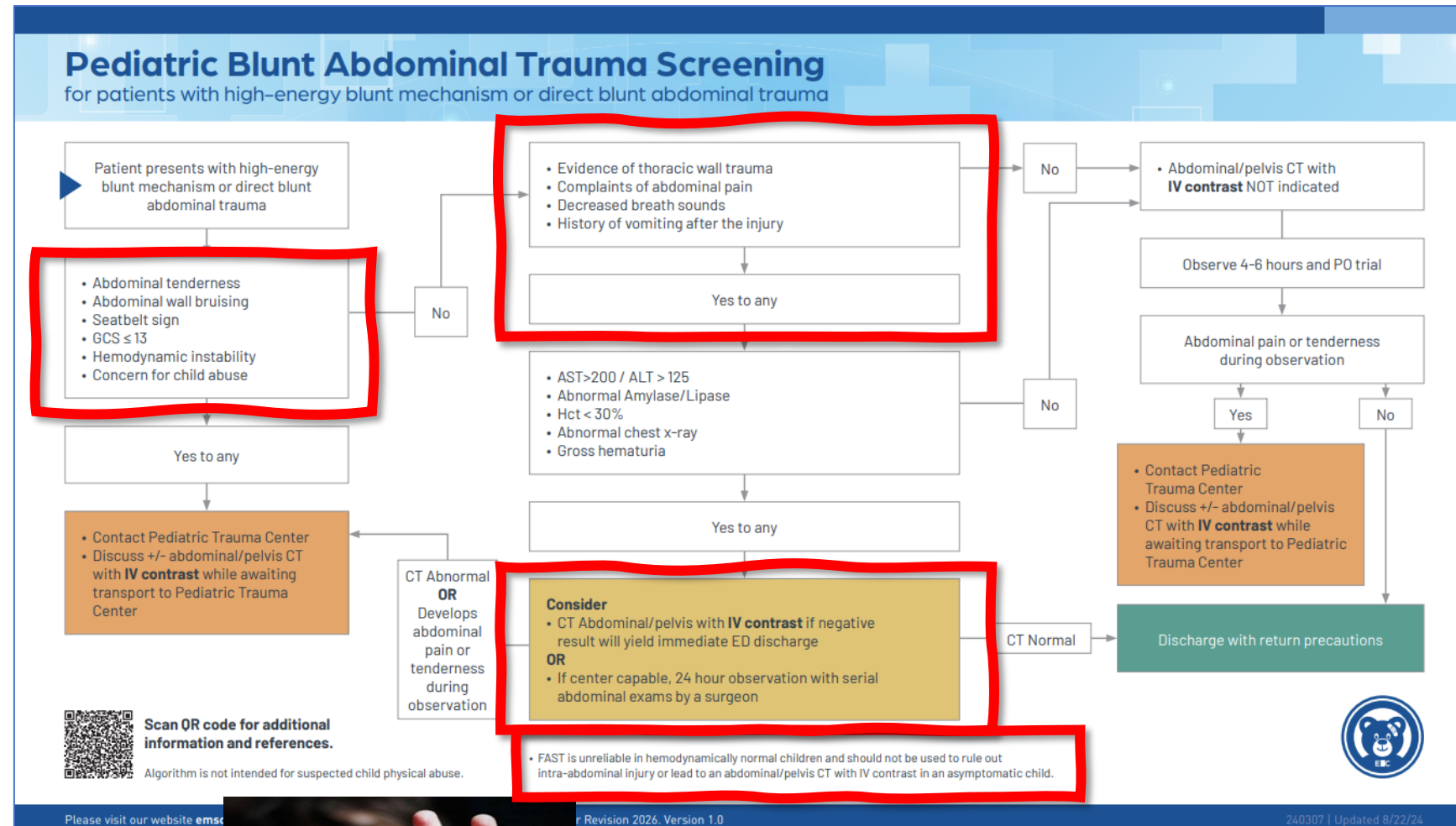
Chest CT – Almost Never *(unless WBCT indicated)*

- Most injuries seen on CT but not on CXR do not require treatment
- Indication for Chest CT is concern for mediastinal vascular injury **(needs contrast)**
- Normal mediastinum on CXR = no need for CT
- Abnormal mediastinum in a toddler and no significant deceleration mechanism = likely thymus



Abdomen/Pelvis CT – *Two algorithms integrated*

- Abdominal CT should not be obtained for mechanism alone!
- High-risk factors that prompt CT should prompt transfer to PTC. Don't delay.
- High-mechanism patients without complaints or signs of trauma can be observed.
 - Child abuse unique
- PECARN Rules probably too sensitive, but everyone doesn't need labs (PedSRC)
 - AST 200 / ALT 125 / Abnormal lipase
 - 80 / 80 if suspect abuse
- If abdominal CT obtained it **needs IV contrast**
- Do not CT simply for fluid on FAST



AST > 200 – Really???

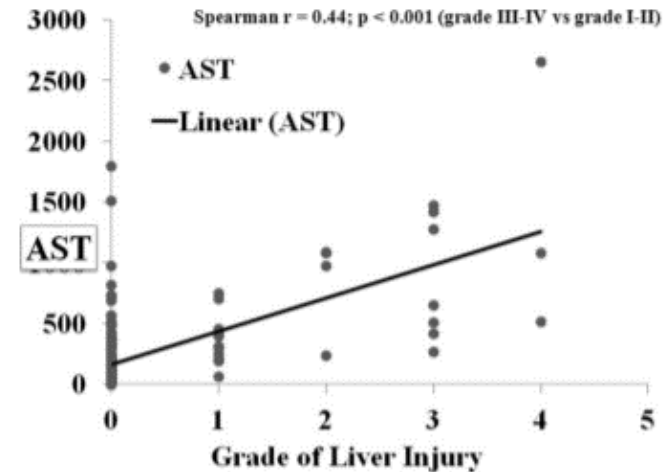
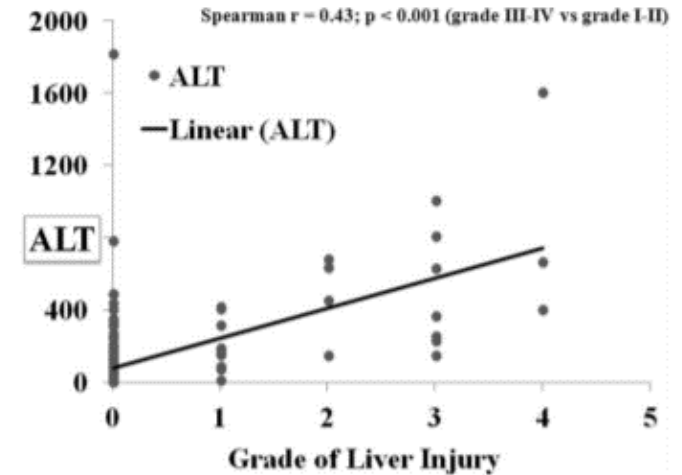
Re-evaluation of liver transaminase cutoff for CT after pediatric blunt abdominal trauma

Jessica A. Zagory¹ · Avafia Dossa¹ · Jamie Golden¹ · Aaron R. Jensen¹ · Catherine J. Goodhue¹ · Jeffrey S. Upperman¹ · Christopher P. Gayer¹

Level of AST/ALT correlates with injury grade

- 400/200 – 96% Sensitive for identification of Grade 3 and above injuries
- 250/200 will catch all the grade 2's

Is there a role for trending AST/ALT?



FAST – What is the Role?

Hemodynamically Normal Patients

460 randomized to FAST

- 19 patients had IAI
 - 5 positive FAST
 - 10 negative FAST
 - 4 indeterminate FAST
- 25 changes to CT ordering after FAST
 - 13 decided to not order CT
 - 12 decided to order CT – 1 injury (jejunal perforation)

465 randomized to standard care

- No missed IAIs

Effect of Abdominal Ultrasound on Clinical Care, Outcomes, and Resource Use Among Children With Blunt Torso Trauma A Randomized Clinical Trial

James F. Holmes, MD, MPH¹; Kenneth M. Kelley, MD¹; Sandra L. Wootton-Gorges, MD²; [et al](#)

[» Author Affiliations](#) | [Article Information](#)

JAMA. 2017;317(22):2290-2296. doi:10.1001/jama.2017.6322

Back to Our Case...

- Fall >2-3x Body Height
 - Needs screening
- Alert, examinable, normal GCS
 - Does NOT need WBCT
- PECARN Head Intermediate (~1% risk cTBI)
 - Non-frontal hematoma
 - High-risk mechanism
 - CT vs. Observation x 4 hours – I would CT
- PECARN C-spine low risk
 - Clinically clear neck
- Needs a CXR
 - Unlikely to have widened mediastinum with this mechanism
- Needs abdominal exam and labs
 - FAST not indicated with normal hemodynamics – should NOT prompt CT if fluid and no other symptoms
 - If labs and exam normal, can observe 4-6 hours, PO challenge, and consider discharge home with return precautions for abdominal pain



Summary

- Weigh risks of induced malignancy versus risks of missed injury
- Do not delay transfer in/out to obtain CT scans. Use CT (when indicated) or clinical prediction rules to facilitate safe discharge from community EDs.
- Whole body CT does have a role in high-mechanism neurotrauma
- Head CT rules are ubiquitous
- C-spine rules are new and will evolve
- Almost nobody needs a chest CT (unless abnormal mediastinum)
- Abdominal CT should not be performed for mechanism alone

Thank You!





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