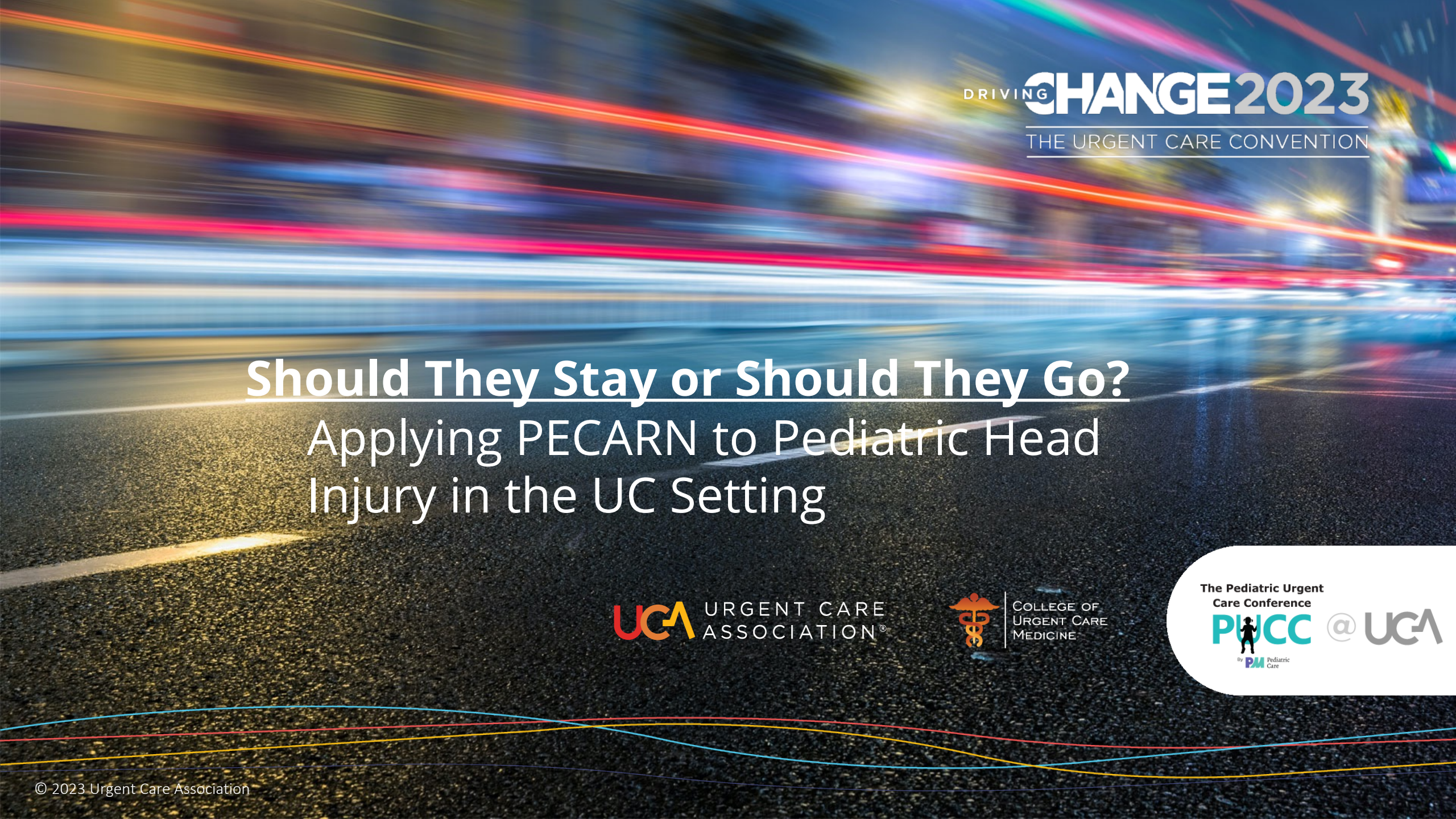

Financial Disclosures

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- I have no financial disclosures

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Objectives

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- Discuss minor head injury in different pediatric age groups
- Discuss the PECARN minor head injury decision rules
- Indications for transferring patients to the ED for potential CT scan of the brain in minor head injury

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This is NOT…

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- A talk on the chronic management of traumatic brain injury
- An absolute recommendation on the evaluation and treatment of minor or severe head injury
- An all-inclusive collection of the data that exists

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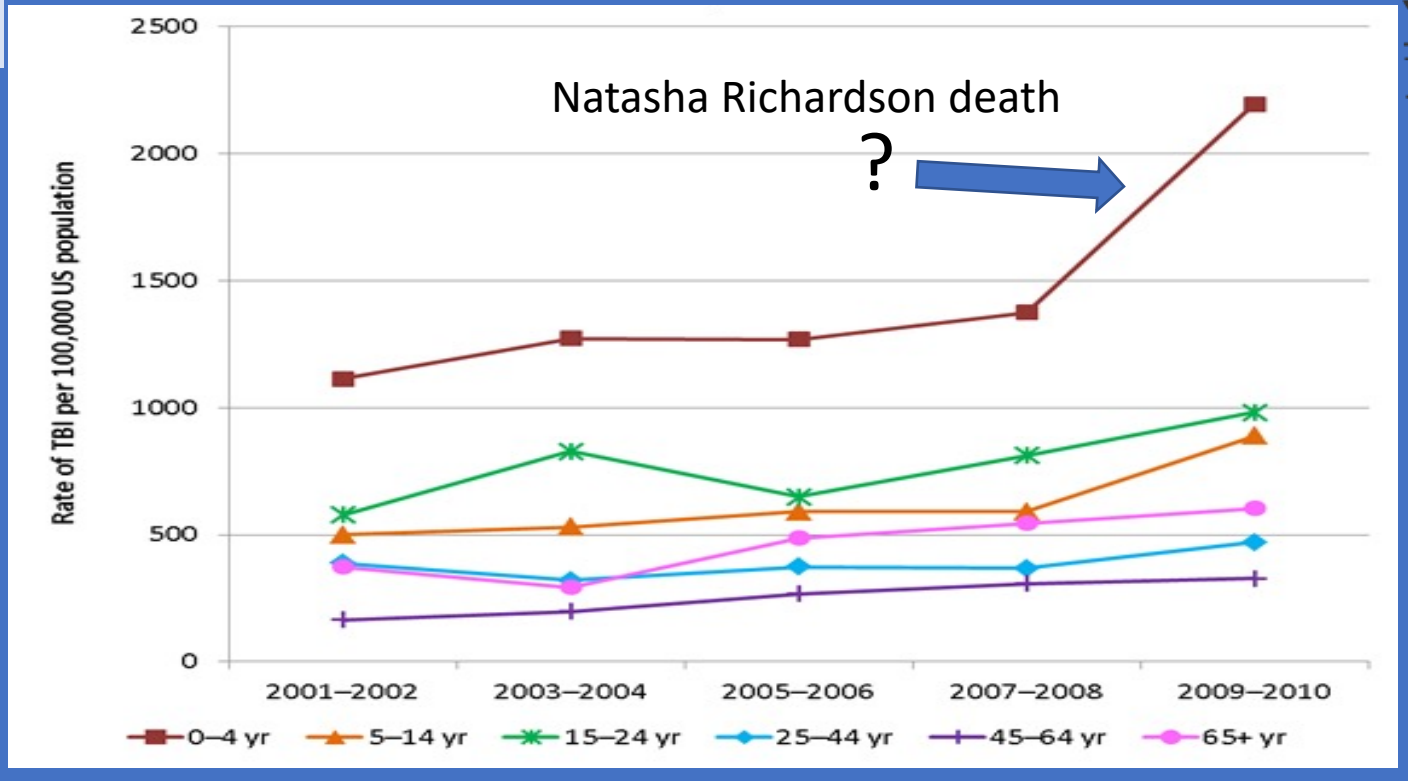
Background

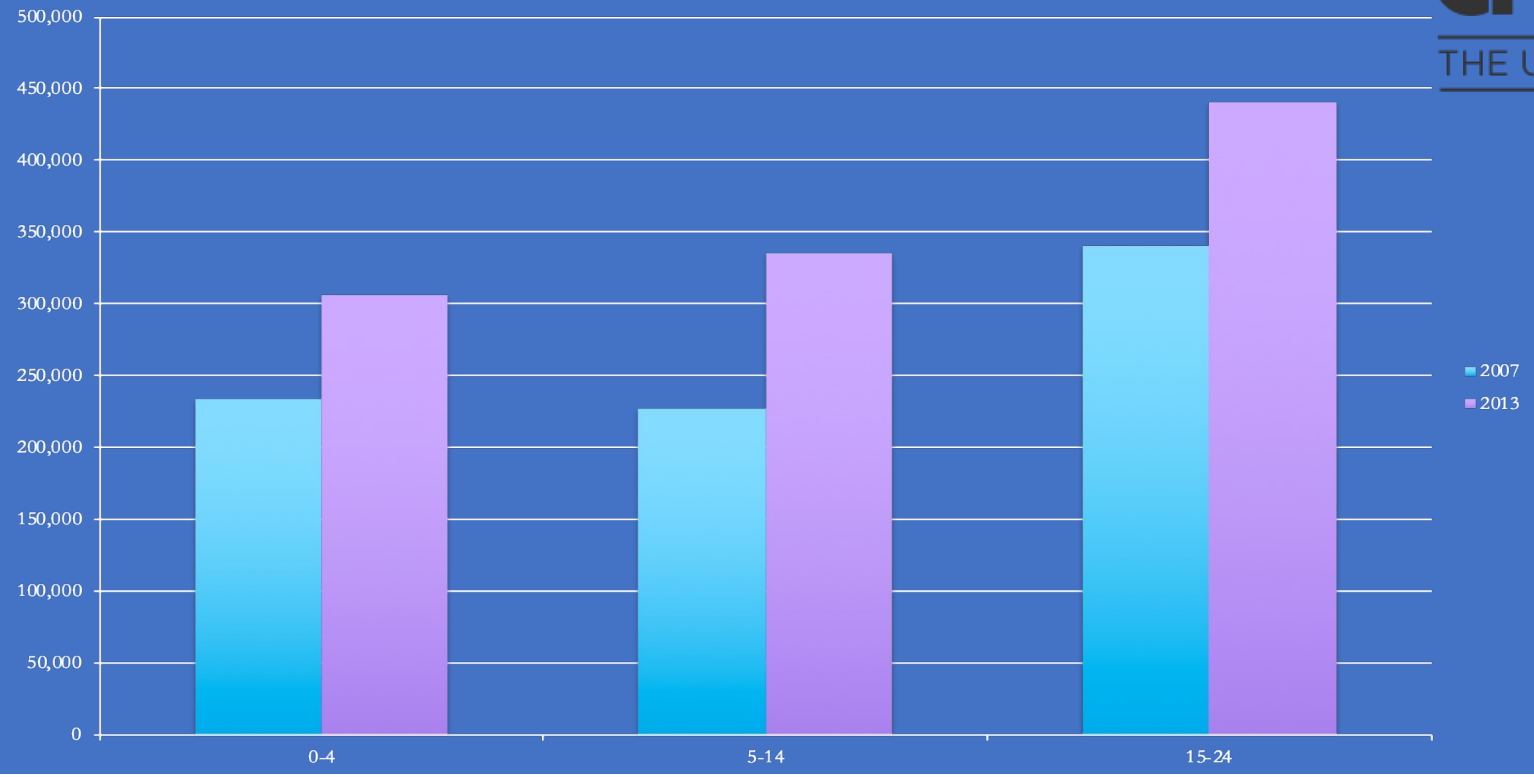
- >650,000 visits to emergency departments annually due to head injury
- Age >1 year: 3,000 deaths & 50,000 hospitalizations
- 90% of patients have minor head injury
- Most common mechanisms:
  - Falls (47%)
  - Being struck by or against an object (15%)
  - MVC (14%)

TBI ED Visit Rate by Age



https://www.cdc.gov/traumaticbraininjury/data/rates_ed_byage.html

ED VISITS



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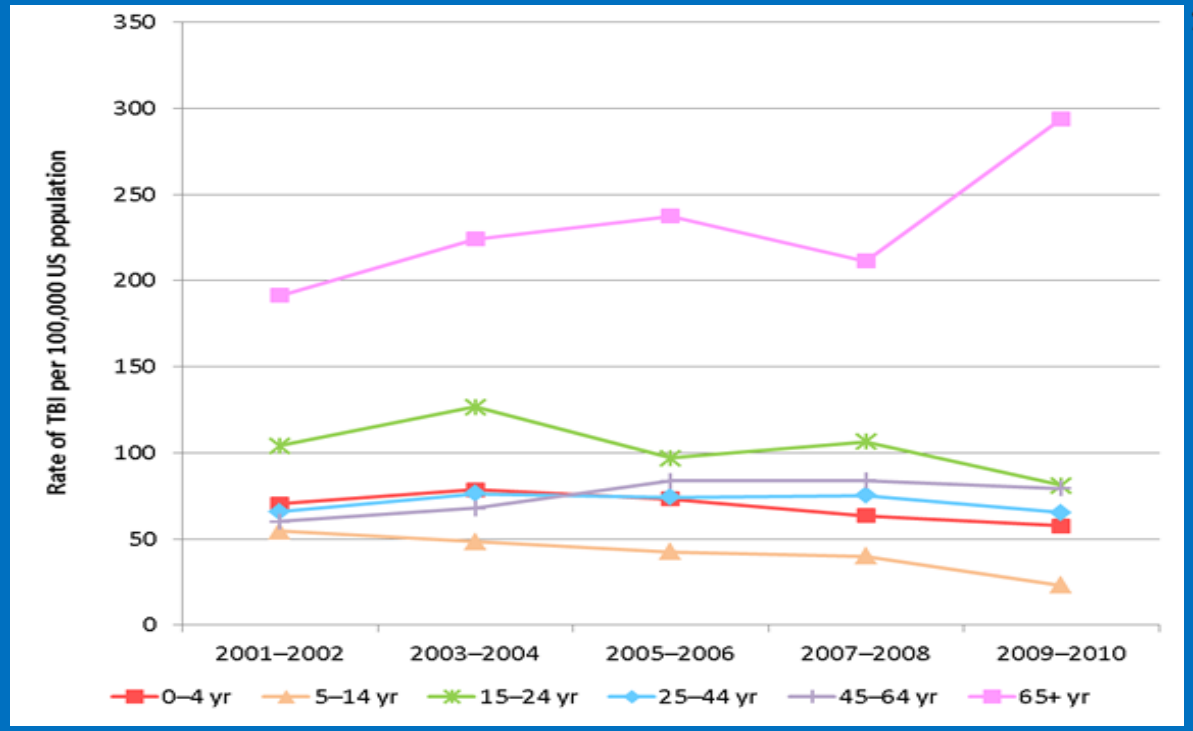
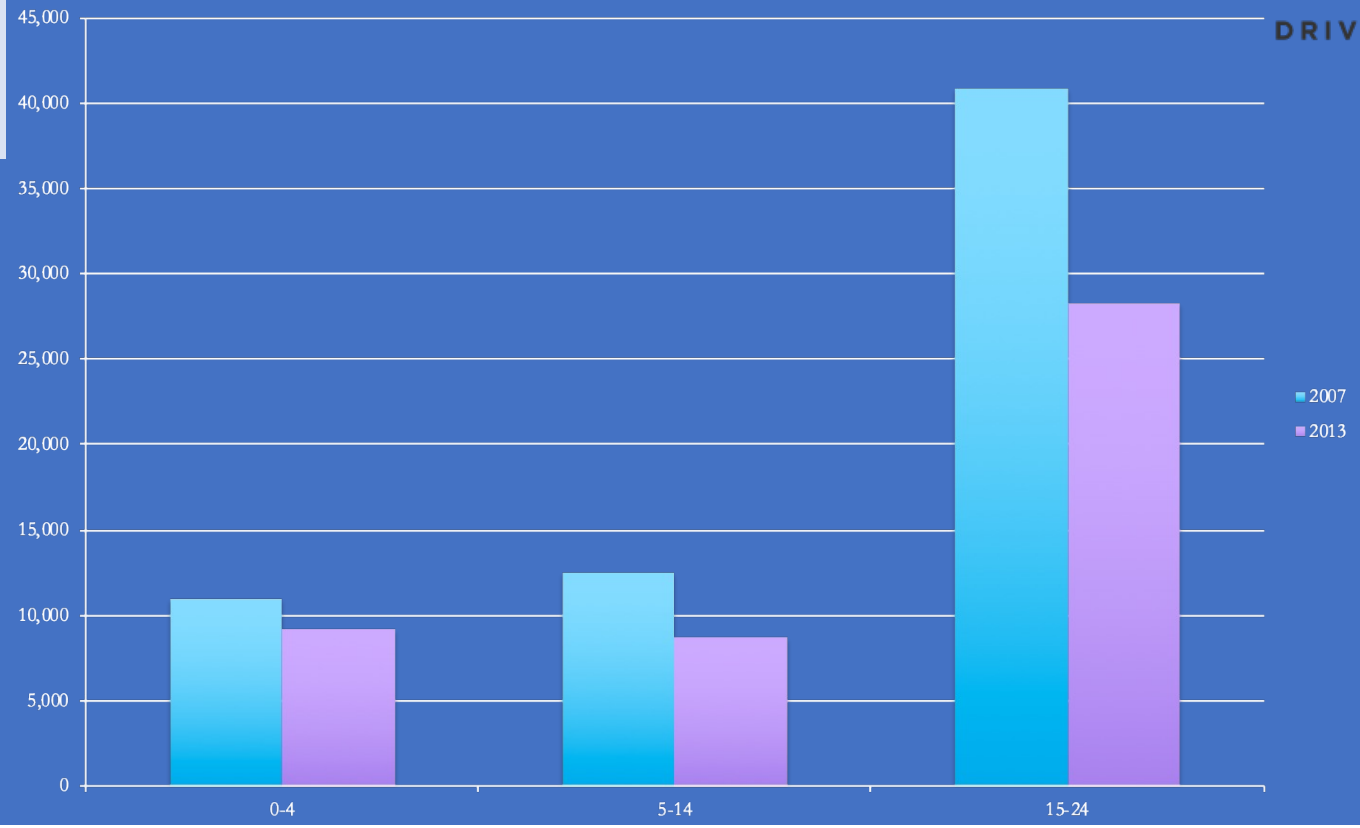
CDC Morbidity and Mortality Weekly Report, March 17, 2017. Vol. 66, No. 9.

TBI Hospitalization Rate by Age



https://www.cdc.gov/traumaticbraininjury/data/rates_hosp_byage.html

Hospitalization



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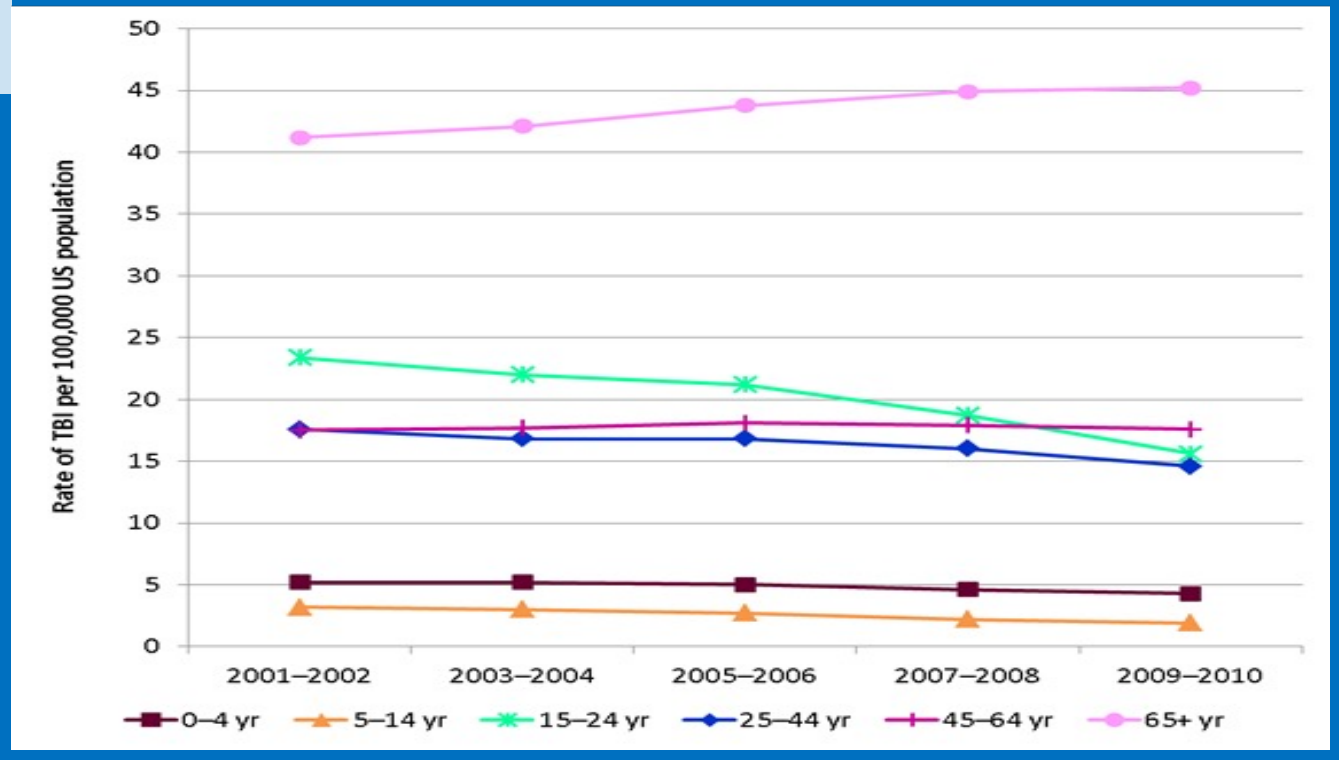
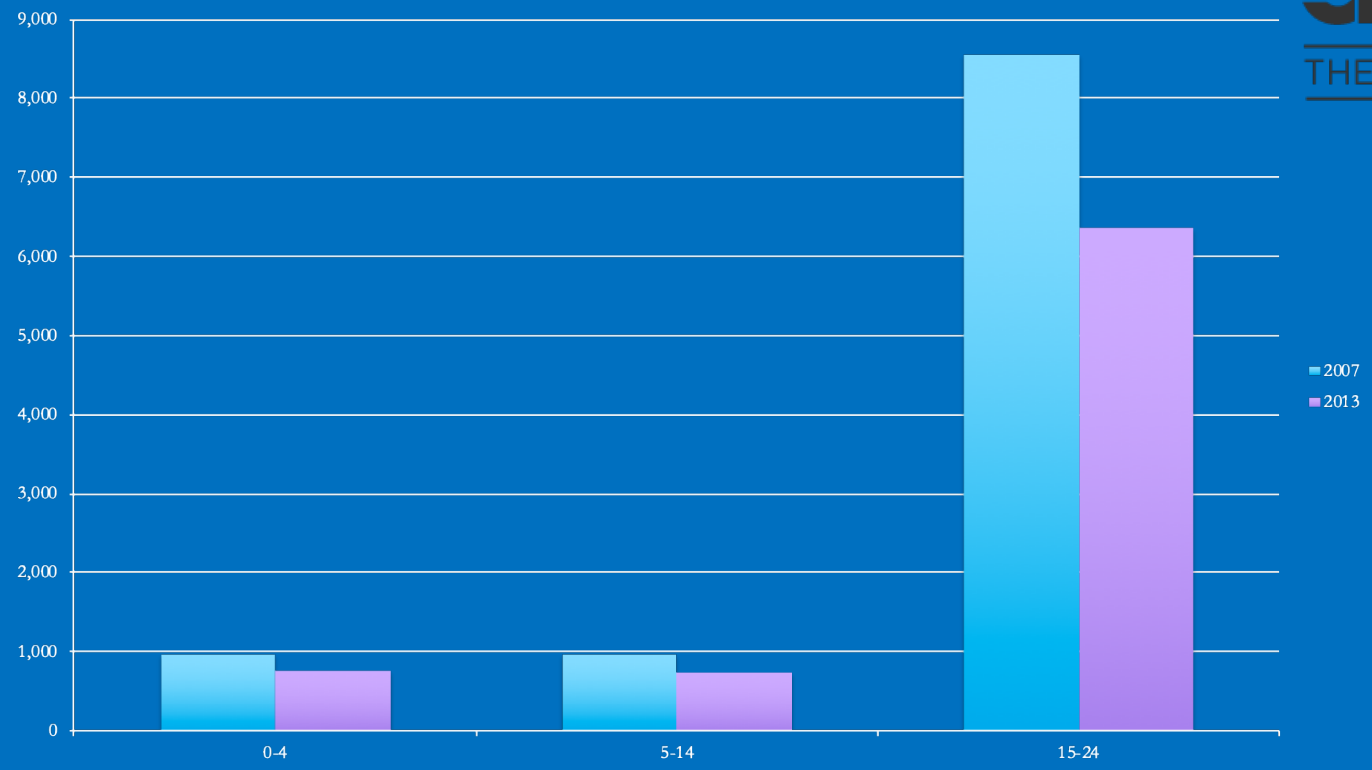
CDC Morbidity and Mortality Weekly Report, March 17, 2017. Vol. 66, No. 9.

TBI Death Rate by Age



https://www.cdc.gov/traumaticbraininjury/data/rates_deaths_byage.html

Deaths



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Approach to the head injured child in the UC setting

- Airway, Breathing, Circulation, Disability
  - Airway includes C-spine precautions in trauma
- Determine Glascow Coma Score

Glasgow Coma Scale (GCS)

Eye opening response (1-4)	Spontaneous	**4**
	To verbal stimuli	**3**
	To painful stimuli	**2**
	None	**1**
Verbal Response (1-5)	Oriented	**5**
	Confused	**4**
	Inappropriate words	**3**
	Nonspecific sounds or incomprehensible	**2**
	None	**1**
Motor Response (1-6)	Normal spontaneous movements	**6**
	Localizes painful stimuli	**5**
	Withdraws to painful stimuli	**4**
	Abnormal flexion (decorticate rigidity)	**3**
	Abnormal extension (decerebrate rigidity)	**2**
	None	**1**

Scores of 13-15 indicate MTBI

Modified GCS for Infants

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Eye opening response (1-4)	Spontaneous	**4**
	To verbal stimuli	**3**
	To painful stimuli	**2**
	None	**1**
Verbal Response (1-5)	Coos and /or babbles	**5**
	Irritable and continuous crying	**4**
	Cries to painful stimuli	**3**
	Moans to painful stimuli	**2**
	None	**1**
Motor Response (1-6)	Spontaneous purposeful movements	**6**
	Withdraws to touch	**5**
	Withdraws to painful stimuli	**4**
	Abnormal flexion (decorticate rigidity)	**3**
	Abnormal extension (decerebrate rigidity)	**2**
	None	**1**

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Approach to the head injured child in the UC setting

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- Airway, Breathing, Circulation, Disability
  - Airway includes C-spine precautions in trauma
- Determine Glascow Coma Score

Head Injury Are any of the following present?
- GCS≤14
- Altered mental status
- Palpable skull fracture/signs of basilar skull fx
- Focal neuro deficits

YES →

Activate EMS
Transfer to ED
immediately

  - Secondary survey – Head to Toe
    - Scalp, TMs, bruising behind ears, fundi, neuro exam, other injuries

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Case #

2023
CONVENTION

2023
CONVENTION

Scalp Hematomas
< 2 yrs

- Scalp hematomas strongly associated with intracranial injury in children < 2 y.o
  - 93% of ICI found on CT had a scalp hematoma
    - Palchak et al, ann emer med, 2003.

- Size, location and age are all important factors

Scalp Hematomas (SH) < 2 yrs

- More sensitive predictor of ICI than symptoms of brain injury
- 22/23 with SH and ICI also had a skull fx
- Only 1/265 asymptomatic with no SH had an ICI (small EDH with no intervention needed)

Skull X-Rays may be useful for <2yrs with SH to screen for those needing CT

Greenes, Pediatrics 1999;104:861-867

Scalp hematomas
Size

Hematoma location	Total n	No. with SF
Large	26	18 (69%)
Moderate	51	16 (31%)
Small	30	6 (20%)
No hematoma	65	5 (8%)

Greenes et al. Clinical significance of scalp abnormalities in asymptomatic head injured infants. *Ped Emer Care. 2001 17(2):88-92.*

Scalp hematomas
Location

Hematoma location	Total n	No. with SF
Parietal	46	35 (76%)
Temporal	7	4 (57%)
Occipital	17	3 (18%)
Frontal	45	2 (4%)
No Hematoma	65	5 (8%)

Greenes et al. Clinical significance of scalp abnormalities in asymptomatic head injured infants. *Ped Emer Care. 2001 17(2):88-92.*

Skull Fractures
Age

Age	Total n	No. diagnosed SF
0-2 months	42	12 (29%)
3-5 months	19	8 (42%)
6-11 months	64	17 (27%)
12-23 months	47	8 (17%)

Greenes et al. Clinical significance of scalp abnormalities in asymptomatic head injured infants. *Ped Emer Care. 2001 17(2):88-92.*

Scalp hematomas
Putting it all together

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Risk points	Patient age	Hematoma size	Hematoma location
0	≥ 12 months	None	Frontal
1	6-11 months	Small (barely palpable)	Occipital
2	3-5 months	Medium (easily palpable)	Temporal/Parietal
3	0-2 months	Large (boggy consitency)	

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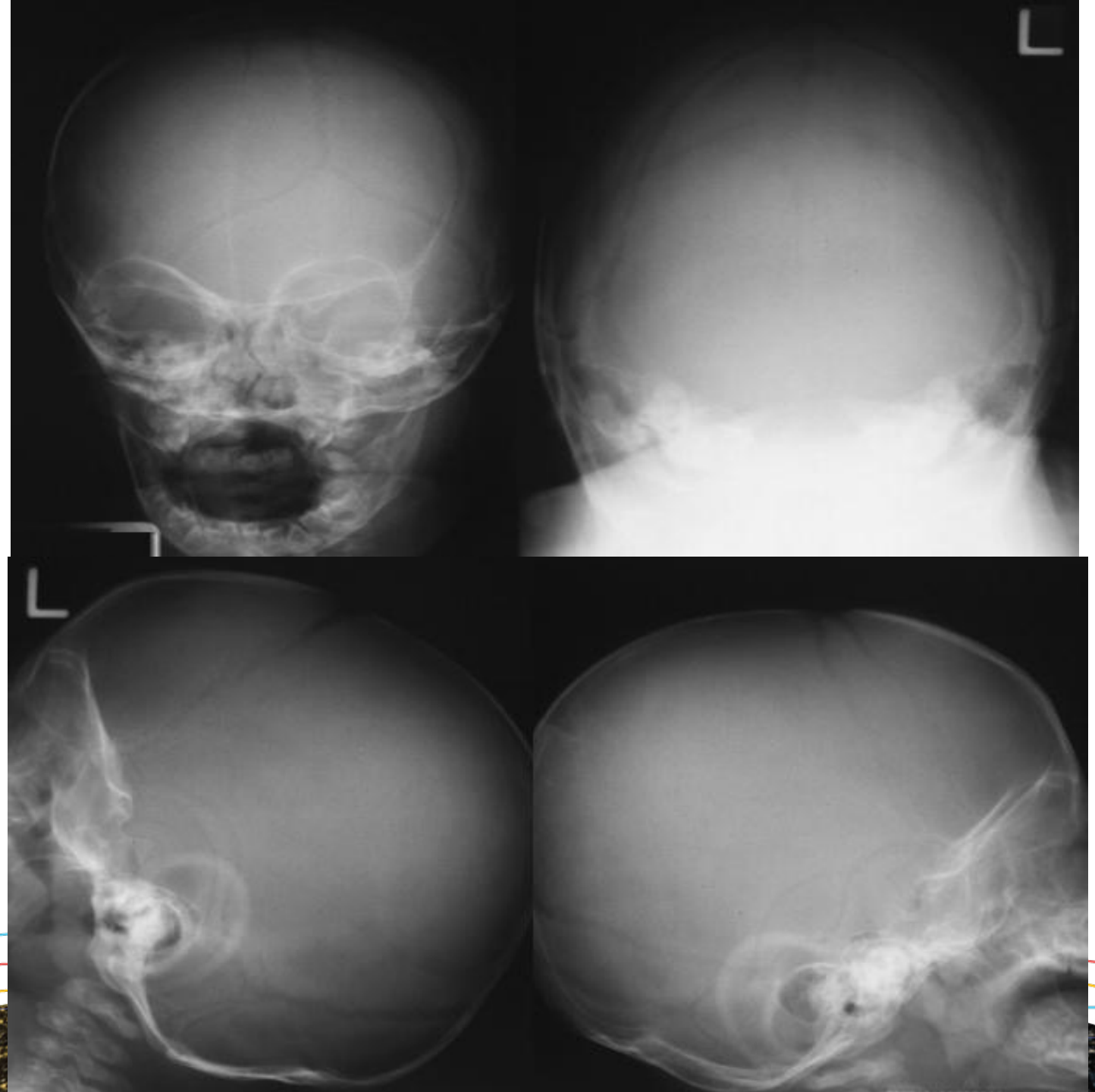
Greenes et al. Clinical significance of scalp abnormalities in asymptomatic head injured infants. *Ped Emer Care. 2001 17(2):88-92.*

Skull fractures

- One of the strongest predictors of ICI in children under 2 with mild head trauma
- 15-40% incidence of TBI if there is evidence of skull fracture
  - Sensitive but not specific
- Skull radiographs can be very user dependent (not currently recommended)
  - AP, Townes (flexed AP) and 2 laterals

Schutzman et al, Evaluation and management of children younger than two years Old with Apparently minor head trauma: proposed guidelines. Pediatrics, 2001; 107:983-993



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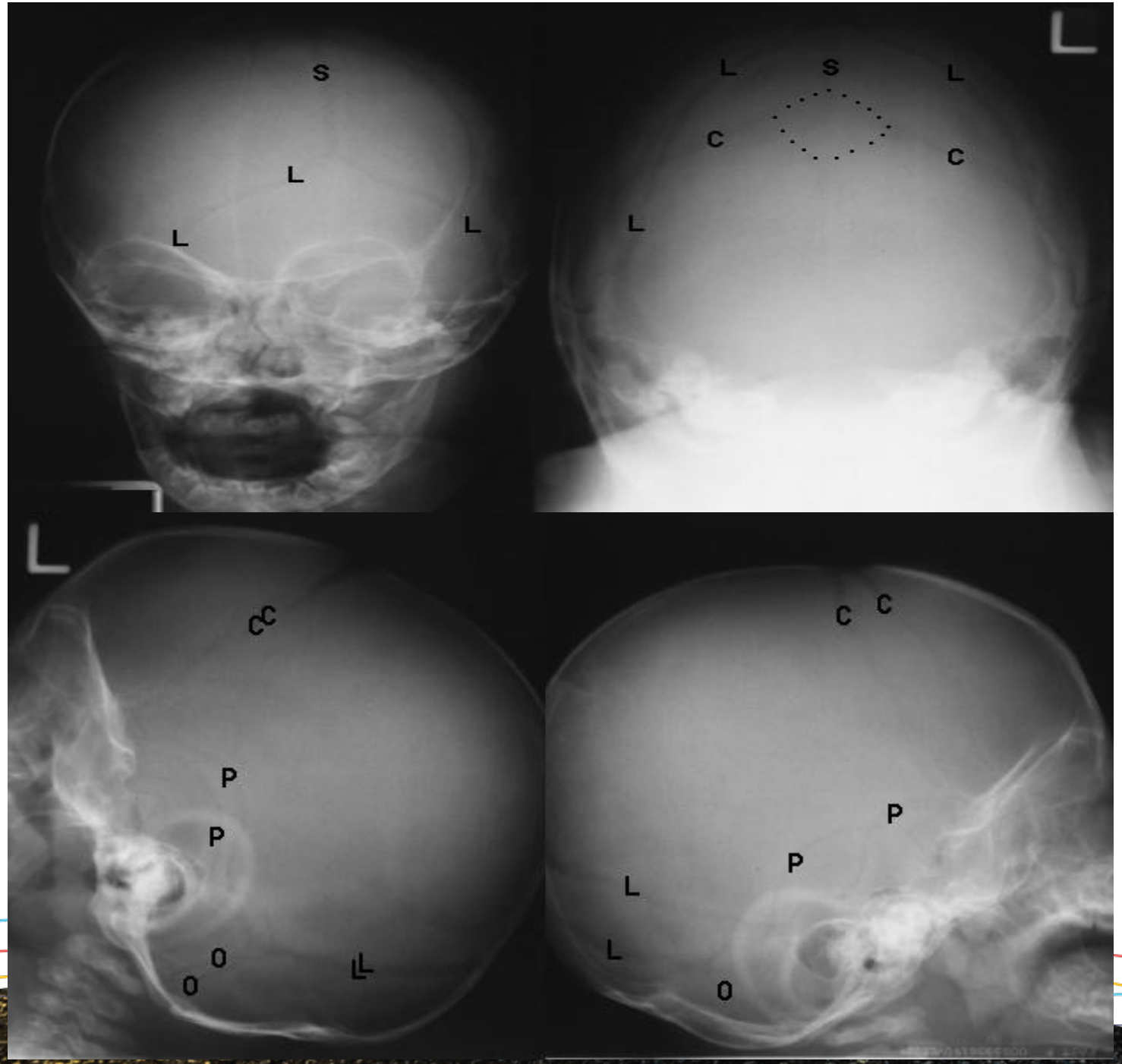

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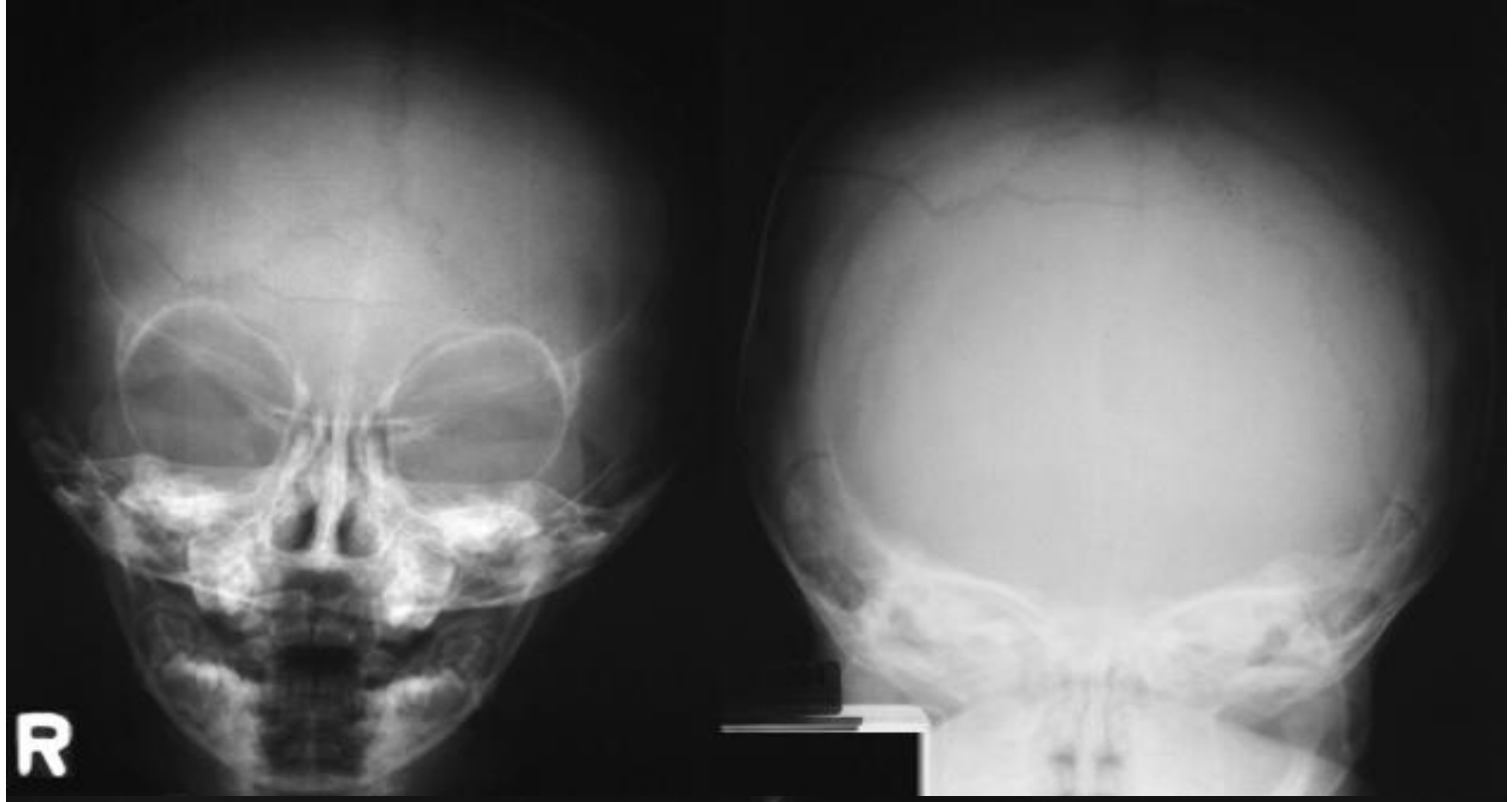

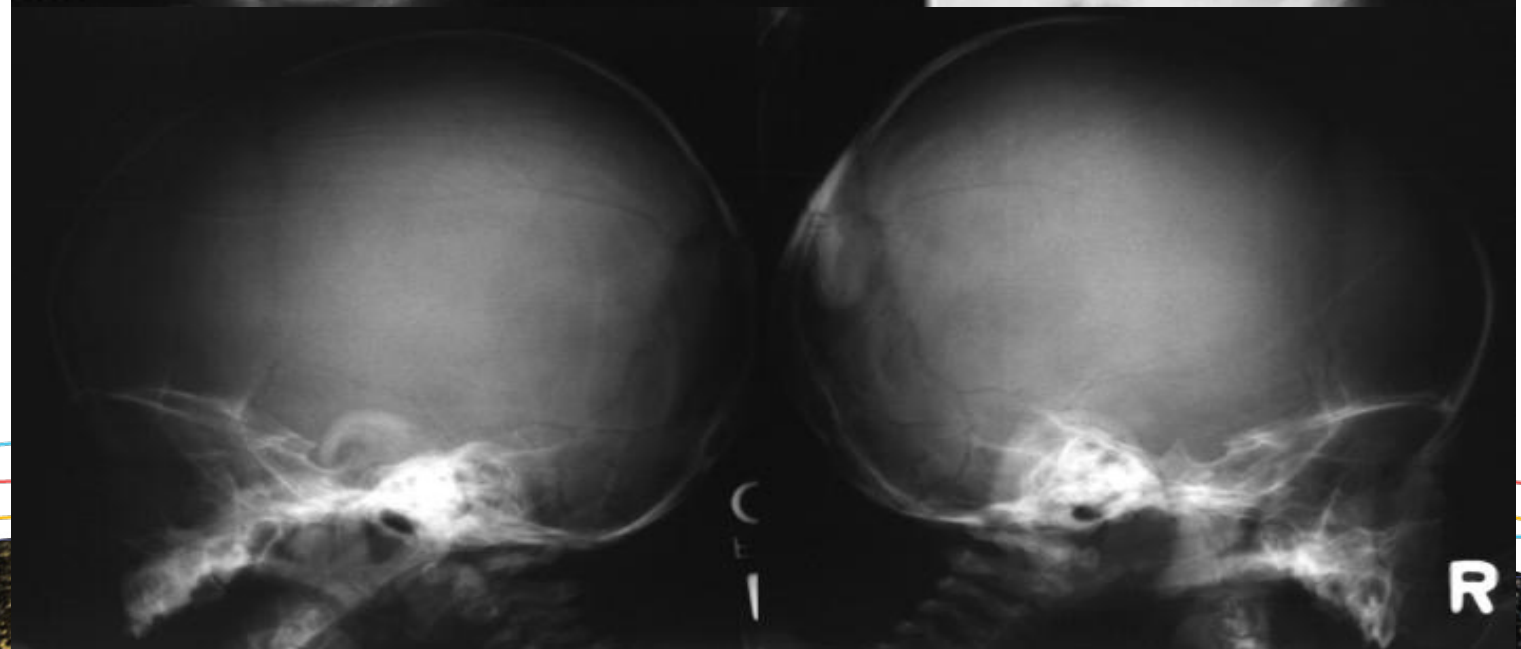

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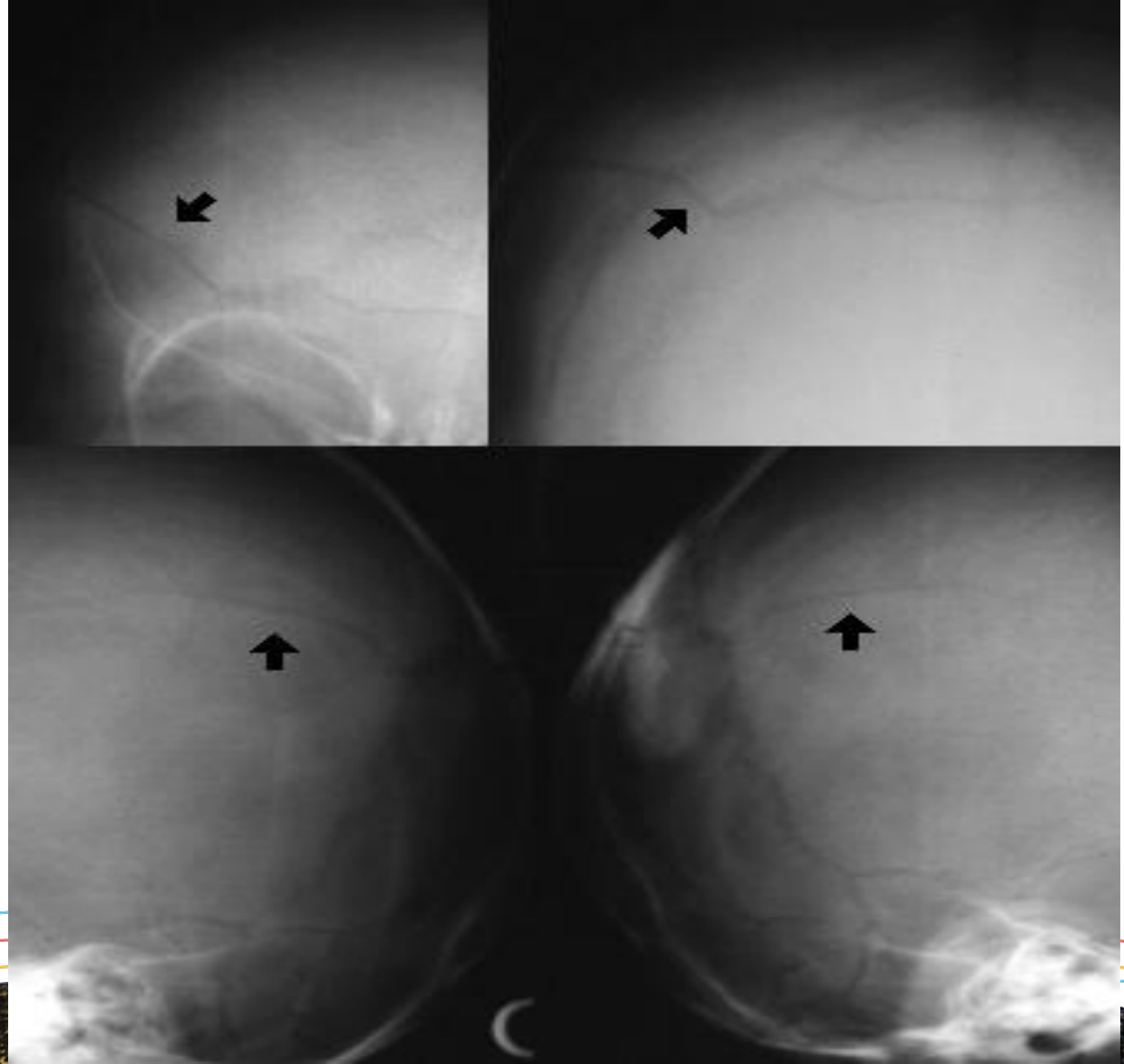

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Pre-PECARN Recommendations (< 2 y.o)

- Multidisciplinary panel comprised of 9 experts in pediatric head trauma
- Consensus based on review of the literature

Schutzman et al, Evaluation and management of children younger than two years Old with Apparently minor head trauma: proposed guidelines. Pediatrics, 2001; 107:983-993

Pre-PECARN Recommendations (< 2 y.o)

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High Risk

- Depressed mental status
- Focal neurologic findings
- Signs of depressed or basilar skull fracture
- Seizure
- Irritability
- Acute skull fracture
- Bulging fontanalle
- Vomiting ≥ 5 times or > 6 hours
- Loss of consciousness ≥ 1 minute

Intermediate Risk

- Vomiting 3-4 times
- Loss of consciousness < 1 minute
- History of lethargy or irritability that has resolved
- Caretaker concerned about childs behavior
- Nonacute skull fracture (> 24-48 hours old)

Low Risk

- Low energy mechanism (eg fall < 3 feet)
- No signs or symptoms
- More than 2 hours since injury
- Age > 12 months

Schutzman et al, Evaluation and management of children younger than two years Old with Apparently minor head trauma: proposed guidelines. Pediatrics, 2001; 107:983-993

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Minor Head Injury - < 2 years
Summary

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- Higher risk group for injury
- Difficult to assess
- Intracranial injury may occur with few or subtle signs in infants < 1 year.
- Scalp hematoma is a clinical predictor of ICI
- Scalp hematoma + skull fracture ≈ 30% risk of TBI

1) Shutzman et al., *Pediatrics*. May 2001 2) Greenes et al.,*Pediatrics*. Nov 1999 3) Quayle, et al. *Pediatrics*. 1997;99

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Guidelines (> 2 Y.O)

- Why the 2-year cut off?
  - Mental status is easier to assess
  - History and physical are easier to obtain
  - More reliable clinical judgment
- AAP 1999 proposed guidelines
  - Developed an algorithm based on history of LOC, presence of symptoms and inability to obtain proper history and exam (language barrier , ETOH, Drugs)

AAP. The management of minor closed head injuries in children. Pediatrics 1999;104:1407-1415

Why do we care?

Radiation Risks

PECARN Neuroimaging Decision Rules:

- Before recently, there was much variability regarding the care of head trauma for children in the ED.
- The Pediatric Emergency Care Applied Research Network (PECARN) has performed substantial research regarding the identification of patients after blunt head trauma.
- Analyzed over 42,000 children who had minor head injuries. They broke the kids up into 2 groups: those <2 years and those >2 years

Specific Aim:

To identify children at very low risk of clinically-important traumatic brain injuries (ciTBI) for whom CT might be unnecessary

3 risk categories

Risk category #1 (high risk!):

- Patients with altered mental status
- GCS<15
- Skull fracture (palpable <2 years, signs of basilar fx in >2 years)

If any YES —> high risk of ciTBI (>4% risk), therefore CT is recommended

Risk category #2 (intermediate risk!):

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- Children <2 years:
  - parietal/temporal/occipital scalp hematoma
  - LOC >5 sec
  - not acting normally as per parent
  - severe mechanism of injury*

- Children >2 years:
  - LOC
  - Vomiting*
  - Severe headache
  - Severe mechanism of injury*

Definition of severe mechanism of injury:

- MVC with patient ejection, death of another passenger, or rollover
- Pedestrian or bicyclist without helmet struck by a motorized vehicle
- Fall >3ft (<2yrs) or >5ft (≥2yrs)
- Head struck by a high-impact object

If any YES —>0.9% risk of ciTBI, therefore EITHER observation in a hospital setting or CT imaging, based on several factors:

-physician experience, multiple vs. isolated findings, worsening signs/symptoms after emergency department observation, parental preference, or age<3 months

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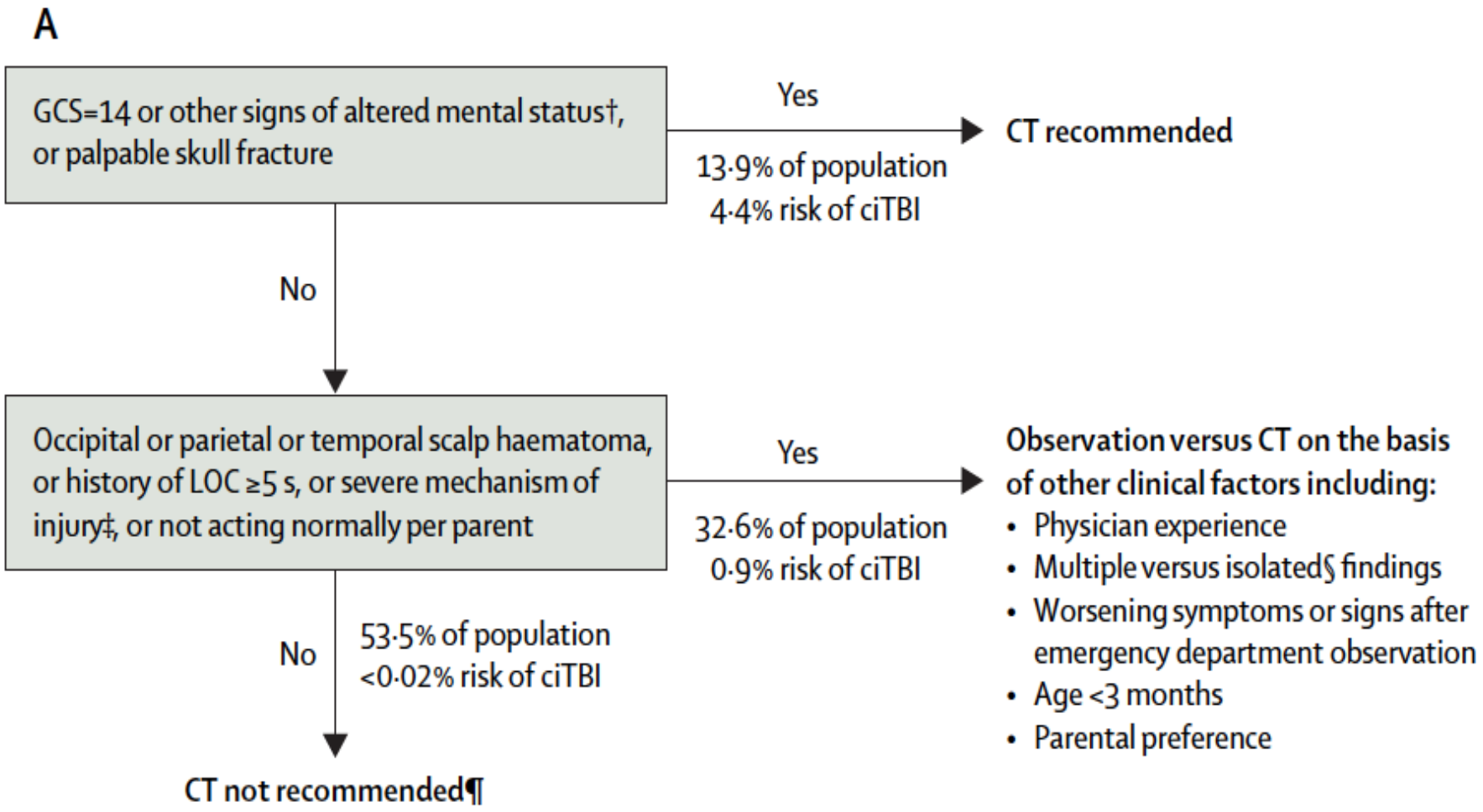
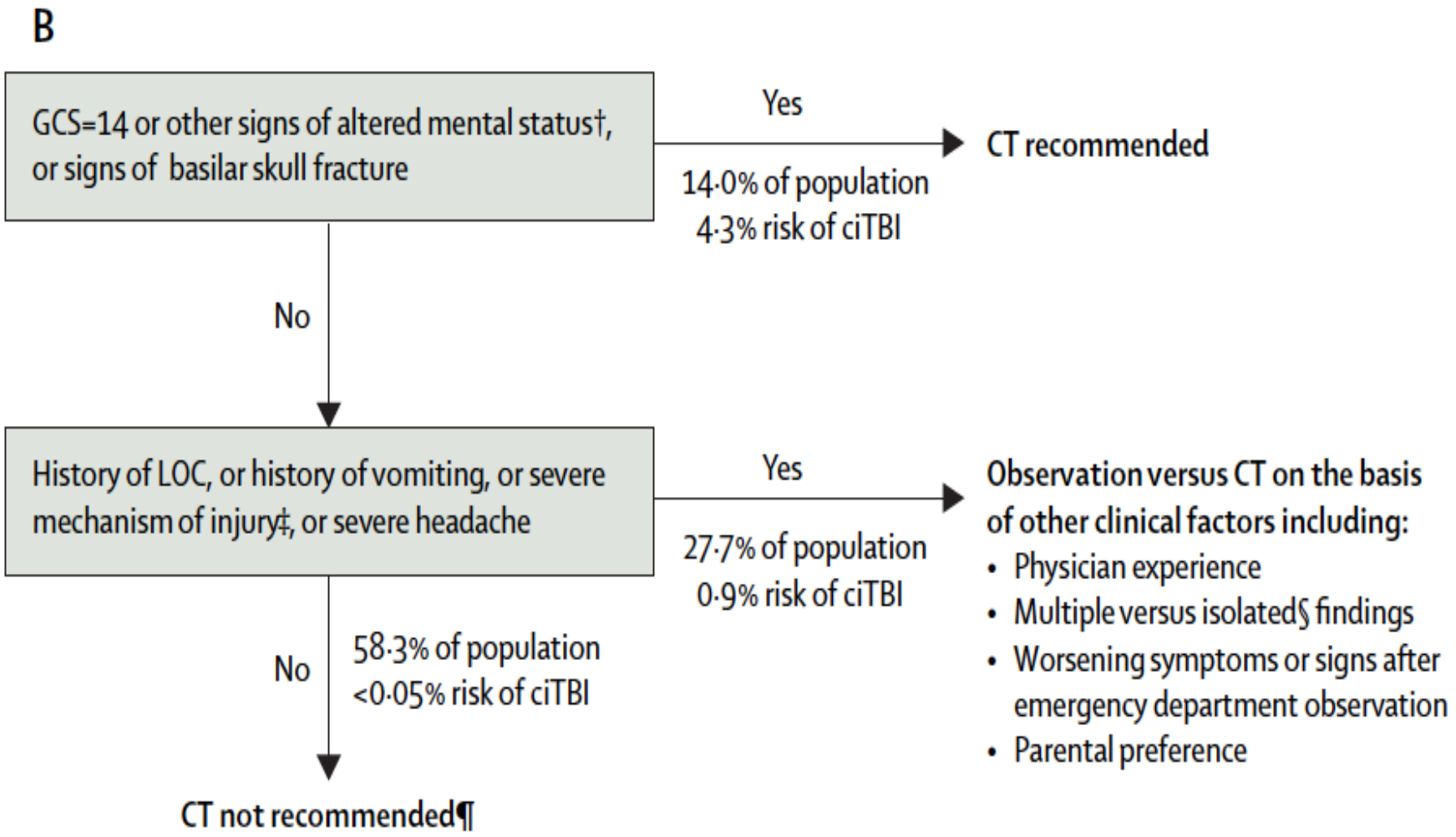
Risk category #3:
(extremely low risk!!)

- If none of the prior factors are met, then <0.05% risk of ciTBI (<0.02% in <2yrs), therefore CT is NOT recommended

Decision rules:
≤2 years old



Decision rules:
>2 years old



Transfer/CT, Obs or DC?

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Some crowd

- 9-month-old fall, forehead hematoma → *NO CT RECOMMENDED*
- 15-month-old fall, palpable skull fx → *CT RECOMMENDED, TRANSFER*
- 3 yr old fall, temporal scalp hematoma → *OBSERVATION VS TRANSFER FOR CT*
- 6 yr old bicyclist struck (with helmet), no LOC → *NO CT RECOMMENDED, D/C*
- 10 yr old fall off monkey bars, +vomiting → *OBSERVATION VS TRANSFER FOR CT*
- 15 yr old MVC w/rollover, asymptomatic → *OBSERVATION VS TRANSFER FOR CT*
- 16 yr old hit by baseball, signs of basilar skull fx → *CT RECOMMENDED, TRANSFER*

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Session Evaluation

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- Your feedback is valuable, take a moment to complete the survey for this session.
- To claim CME, you must complete a separate survey available after the convention.