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uma

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Faculty Disclosure

Danny Thimann, MD, faculty for this educational event, has no relevant financial relationships with any ineligible companies to disclose.

Objectives

- Review head injuries
- Review different rules that can be applied to head injuries
- Quick word on concussions
- Scan or not scan

ED Case

- A 5 yo female presents with a history of headache. She states the headache started after she struck a tree while riding her bicycle. She had brief loss of consciousness, vomiting and slow response to questions
- Do we:
  - CT her head
  - Discharge
  - Observe
  - Obtain more history

Head Trauma: Epidemiology

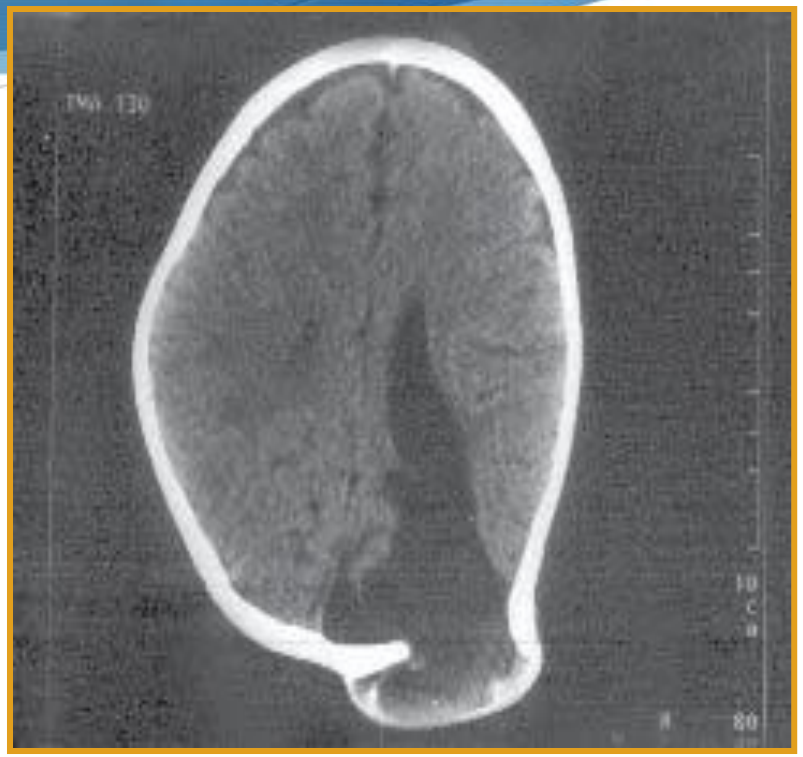
- Trauma is the leading cause of death among children
- Covid and Flu are not

Case 2

5 yo male fell from 3 feet onto tile 4 months ago. Mother reports that the area seems to be more swollen. You touch it and it feels boggy, what do you do next?

Growing Fractures

- Rare delayed complication
- Present as mass in scalp
- Underlying dural tear
- Meningeal herniation into fracture site
- Require surgical repair



Case 3

6 yo female fell from the third story window. EMS reports LOC for 3 minutes, she is now posturing. You noticed a large occipital boggy area. What do you do next?

Case 4

Mother reports that the 2 month old rolled out of bed. You notice a contusion on the temporal side of his head. You also wonder why does the child have a bite mark on his left arm. Are there zombies out there? The child is happy, interactive on exam. Pt also has a circular scab on his forehead. Is that impetigo?

What do you do next?

Case 5

3 yo is running around with his sister when he hits his head against the coffee table. Pt has had no LOC, he is smiling in the room with a small frontal contusion. Mother reports he threw up at home. What is next?

Case 6

13 yo male, during the kick return, has head to head contact with another player. Pt immediately falls to the ground. reports he is unable to move his arms or legs. Arrives to your ED on a backboard and col[illegible] awake and breathing well.

What do you do next?

Mild Head Injury
Who should we CT?

- Risk of Malignancy is 1/1000 to 1/5000
- Pediatric Emergency Care Research Network
- Goal: To derive a clinical decision rule to accurately identify children at high risk and near zero risk of traumatic brain injury
- The PECARN clinical decision rule aims to determine which children are at very low risk

  of important brain injury and who therefore do not require a CT scan of the head.
- Studied <18 years of age
- GCS 14-15
- Studied >40000 patients

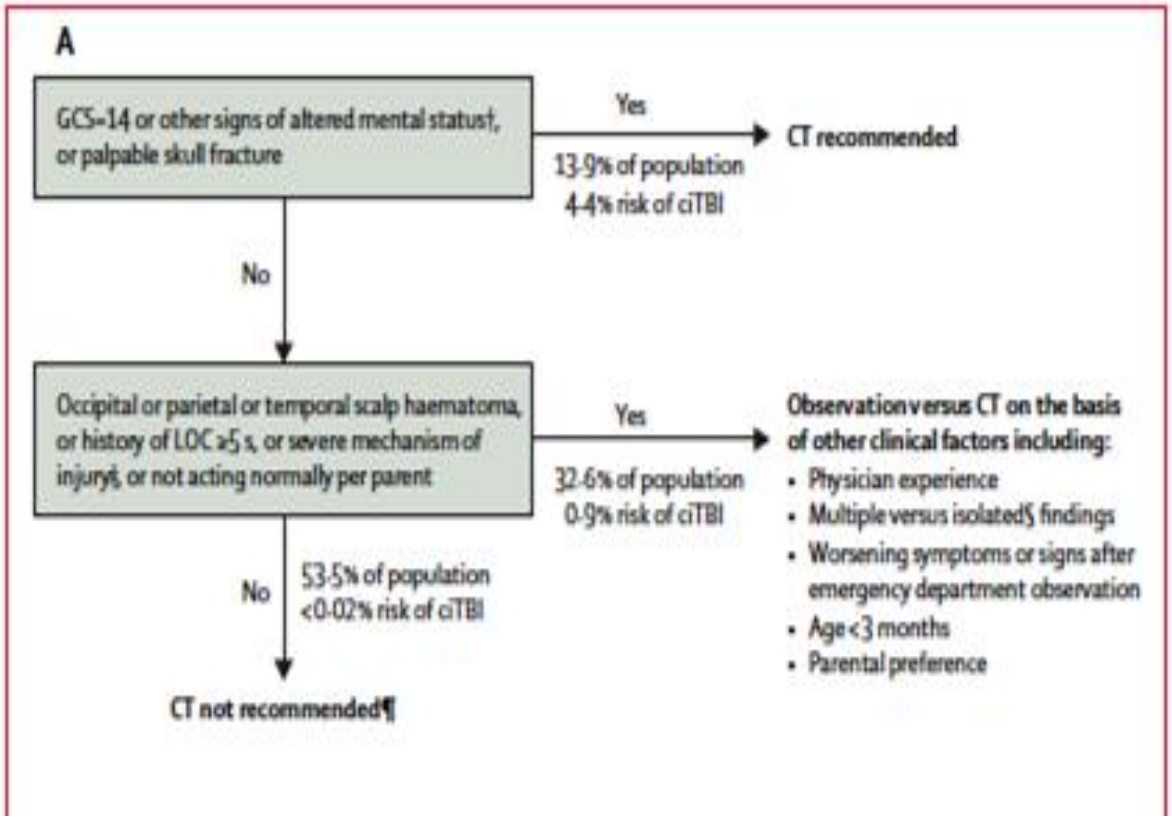
<2 years

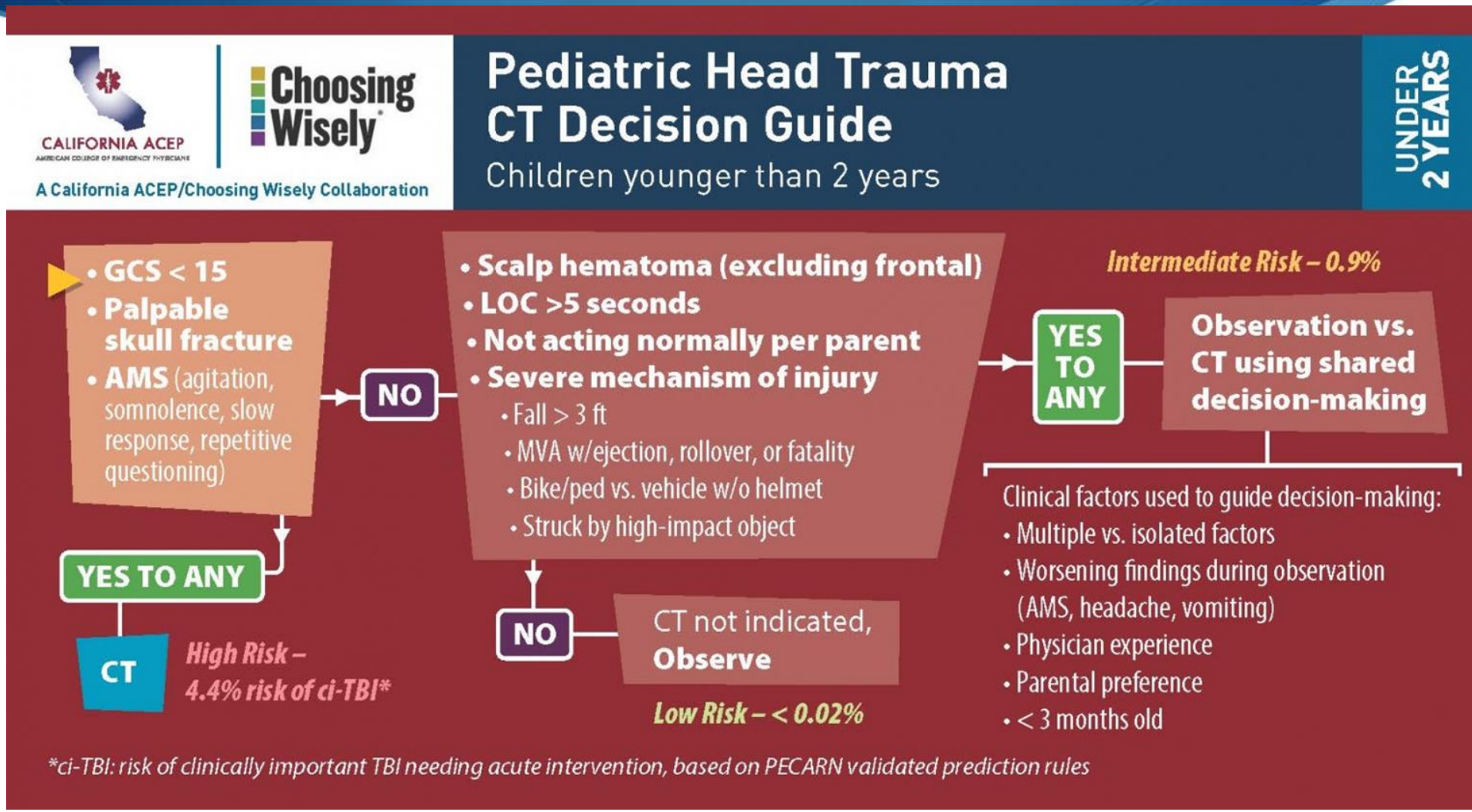
- Altered mental status:

  Agitation, somnolence, repetitive questioning, slow to response

- Severe mechanism of injury:

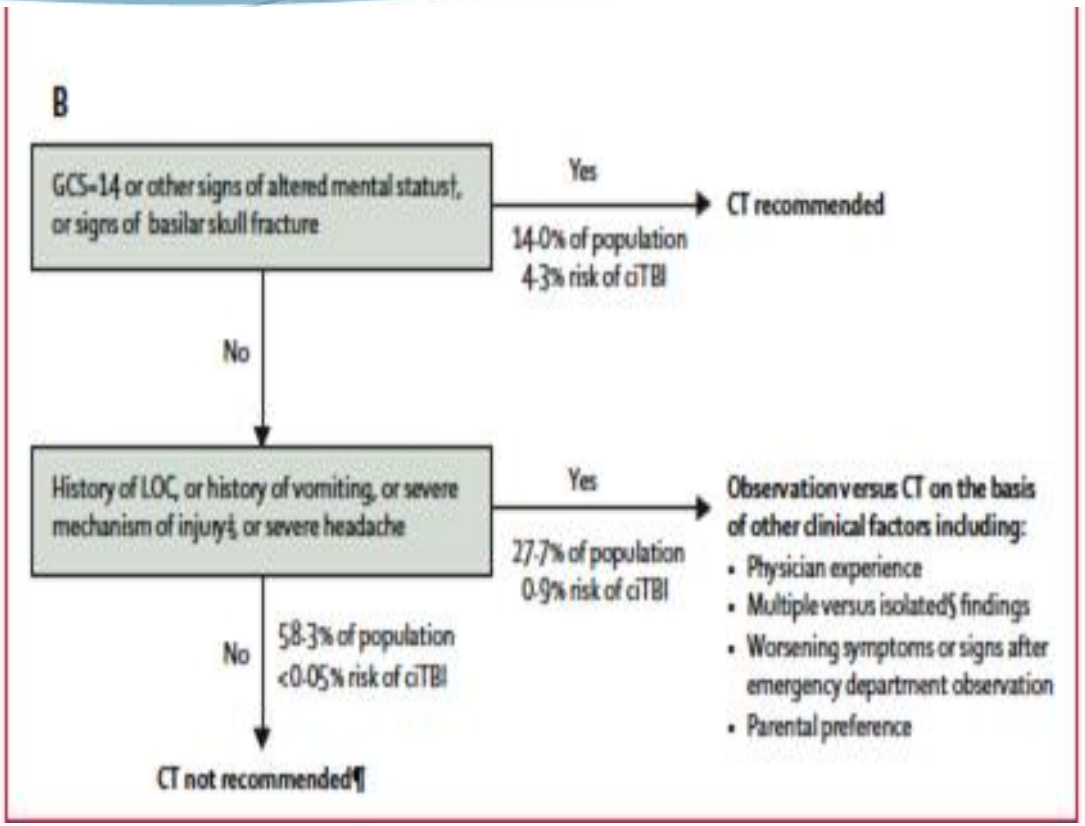
  >3 feet, MVC rollover/ejection/death, pedestrian or bicyclist without helmet, high impact

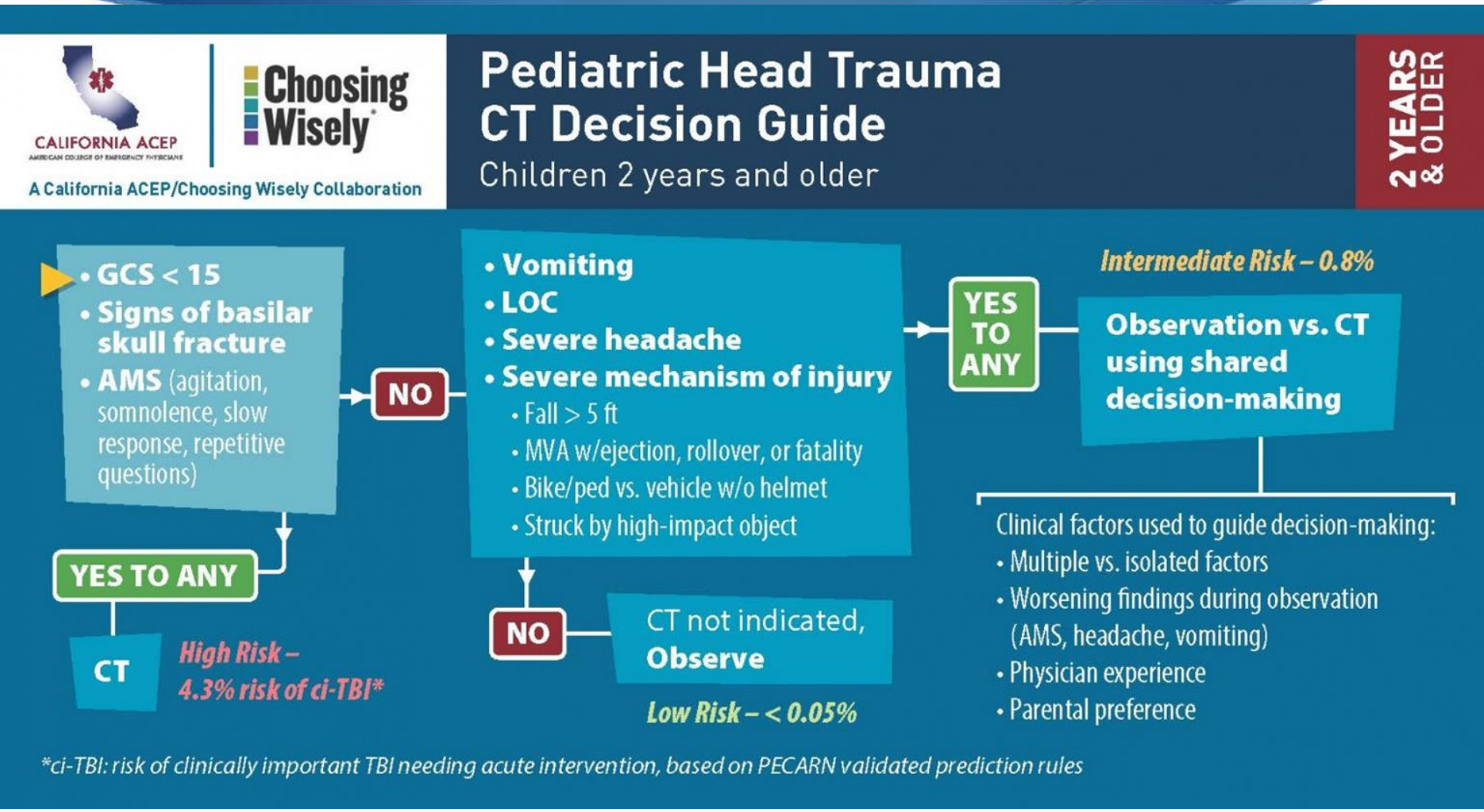



CALIFORNIA ACEP
AMERICAN COLLEGE OF EMERGENCY PHYSICIANS
Choosing Wisely
A California ACEP/Choosing Wisely Collaboration
Pediatric Head Trauma
CT Decision Guide
Children younger than 2 years
UNDER 2 YEARS
• GCS < 15
• Palpable skull fracture
• AMS (agitation, somnolence, slow response, repetitive questioning)
NO
YES TO ANY
CT
High Risk – 4.4% risk of ci-TBI*
• Scalp hematoma (excluding frontal)
• LOC >5 seconds
• Not acting normally per parent
• Severe mechanism of injury
• Fall > 3 ft
• MVA w/ejection, rollover, or fatality
• Bike/ped vs. vehicle w/o helmet
• Struck by high-impact object
NO
CT not indicated, Observe
Low Risk – < 0.02%
Intermediate Risk – 0.9%
YES TO ANY
Observation vs. CT using shared decision-making
Clinical factors used to guide decision-making:
• Multiple vs. isolated factors
• Worsening findings during observation (AMS, headache, vomiting)
• Physician experience
• Parental preference
• < 3 months old
*ci-TBI: risk of clinically important TBI needing acute intervention, based on PECARN validated prediction rules

>2 years

- The only difference if fall >5 feet




CALIFORNIA ACEP
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Choosing Wisely
A California ACEP/Choosing Wisely Collaboration
Pediatric Head Trauma
CT Decision Guide
Children 2 years and older
2 YEARS & OLDER
• GCS < 15
• Signs of basilar skull fracture
• AMS (agitation, somnolence, slow response, repetitive questions)
NO
• Vomiting
• LOC
• Severe headache
• Severe mechanism of injury
• Fall > 5 ft
• MVA w/ejection, rollover, or fatality
• Bike/ped vs. vehicle w/o helmet
• Struck by high-impact object
YES TO ANY
Intermediate Risk – 0.8%
Observation vs. CT using shared decision-making
Clinical factors used to guide decision-making:
• Multiple vs. isolated factors
• Worsening findings during observation (AMS, headache, vomiting)
• Physician experience
• Parental preference
YES TO ANY
CT
High Risk – 4.3% risk of ci-TBI*
NO
CT not indicated, Observe
Low Risk – < 0.05%
*ci-TBI: risk of clinically important TBI needing acute intervention, based on PECARN validated prediction rules

Bottom line

Findings We enrolled and analysed 42 412 children (derivation and validation populations: 8502 and 2216 younger than 2 years, and 25 283 and 6411 aged 2 years and older). We obtained CT scans on 14 969 (35·3%); ciTBIs occurred in 376 (0·9%), and 60 (0·1%) underwent neurosurgery. In the validation population, the prediction rule for children younger than 2 years (normal mental status, no scalp haematoma except frontal, no loss of consciousness or loss of consciousness for less than 5 s, non-severe injury mechanism, no palpable skull fracture, and acting normally according to the parents) had a negative predictive value for ciTBI of 1176/1176 (100·0%, 95% CI 99·7–100·0) and sensitivity of 25/25 (100%, 86·3–100·0). 167 (24·1%) of 694 CT-imaged patients younger than 2 years were in this low-risk group. The prediction rule for children aged 2 years and older (normal mental status, no loss of consciousness, no vomiting, non-severe injury mechanism, no signs of basilar skull fracture, and no severe headache) had a negative predictive value of 3798/3800 (99·95%, 99·81–99·99) and sensitivity of 61/63 (96·8%, 89·0–99·6). 446 (20·1%) of 2223 CT-imaged patients aged 2 years and older were in this low-risk group. Neither rule missed neurosurgery in validation populations.

- With a GCS <14, the risk of TBI is >20%

Children's Head Injury algorithm for the Prediction of Important Clinical Events (CHALICE)

- The CHALICE clinical decision rule aims to determine which children with head injuries of any severity require a CT scan of the head.

The children's head injury algorithm for the prediction of important clinical events rule

A computed tomography scan is required if any of the following criteria are present.

- **History**
  - Witnessed loss of consciousness of >5 min duration.
  - History of amnesia (either antegrade or retrograde) of >5 min duration.
  - Abnormal drowsiness (defined as drowsiness in excess of that expected by the examining doctor).
  - ≥3 vomits after head injury (a vomit is defined as a single discrete episode of vomiting).
  - Suspicion of non-accidental injury (NAI, defined as any suspicion of NAI by the examining doctor).
  - Seizure after head injury in a patient who has no history of epilepsy.
- **Examination**
  - Glasgow Coma Score (GCS) <14, or GCS<15 if <1 year old.
  - Suspicion of penetrating or depressed skull injury or tense fontanelle.
  - Signs of a basal skull fracture (defined as evidence of blood or cerebrospinal fluid from ear or nose, panda eyes, Battles sign, haemotympanum, facial crepitus or serious facial injury).
  - Positive focal neurology (defined as any focal neurology, including motor, sensory, coordination or reflex abnormality).
  - Presence of bruise, swelling or laceration >5 cm if <1 year old.
- **Mechanism**
  - High-speed road traffic accident (defined as accident with speed >40 m/h) either as pedestrian, cyclist or occupant.
  - Fall of >3 m in height.
  - High-speed injury from a projectile or an object.

If none of the above variables are present, patient is at low risk of intracranial pathology.

Canadian Assessment of Tomography for Childhood Head Injury (CATCH)

- The CATCH clinical decision rule aims to determine which children with mild head injuries require a CT scan of the head
- The application of the CATCH rule requires two steps.
  - First, it assesses if a patient has a mild head injury defined as GCS of 13-15, witnessed loss of consciousness, definite amnesia, witnessed disorientation, more than one vomit or persistent irritability (in a child under 2 years of age).
  - If a patient has such a head injury, the CATCH rule can be applied.

Canadian Assessment of Tomography for Childhood Head injury: the CATCH Rule

CT of the head is required only for children with minor head injury* and any one of the following findings:

High risk (need for neurosurgical intervention)

1. Glasgow Coma Scale score <15 at two hours after injury.
2. Suspected open or depressed skull fracture.
3. History of worsening headache.
4. Irritability on examination.

Medium risk (brain injury on CT scan)

5. Any sign of basal skull fracture (e.g., haemotympanum, "raccoon" eyes, otorrhea or rhinorrhea of the cerebrospinal fluid, Battle's sign).
6. Large, boggy haematoma of the scalp.
7. Dangerous mechanism of injury (e.g., motor vehicle crash, fall from elevation ≥3 ft [≥91 cm] or 5 stairs, fall from bicycle with no helmet).

Note:

CT = computed tomography.

*Minor head injury is defined as injury within the past 24 hours associated with witnessed loss of consciousness, definite amnesia, witnessed disorientation, persistent vomiting (more than one episode) or persistent irritability (in a child under two years of age) in a patient with a Glasgow Coma Scale score of 13-15.

TABLE 2 - CATCH ALGORITHM[10]

Mild Head Injury

- Otherwise known as a Concussion; is defined as a head injury with any alteration in mental status. Usually a GCS of 13-15
- Symptoms: LOC, amnesia, confusion, headache, nausea, vomiting, dizziness and decrease in balance
- Diagnosis: May use the SCAT, there is an app for that.
- Treatment:
    1. Rest for 24-48 hrs of school
    2. Activity as Tolerated

Alvarado scoring system

Parameter	Score
Anorexia	1
Nausea/ emesis	1
Fever	1
Migration of pain	1
Tenderness in right lower quadrant	2
Cough/ percussion/ hop tenderness	2
Leucocytosis	1
Neutrophilia	1
Total	10

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- Migration of pain: It refers to the migration of pain from the umbilicus to the right lower quadrant.[2]
- Cough tenderness: Coughing causes increased pain (Dunphy's sign).[4]
- Neutrophilia and Leukocytosis was defined, depending on the age of the child.[5]

Any Questions?

References

1. Osmond MH, Klassen TP, Wells GA, et al. CATCH: a clinical decision rule for the use of computed tomography in children with minor head injury. *CMAJ*. 2010;182(4):341-348. doi:10.1503/cmaj.091421
2. Kuppermann N, Holmes JF, Dayan PS, et al. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study [published correction appears in Lancet. 2014 Jan 25;383(9914):308]. *Lancet*. 2009;374(9696):1160-1170. doi:10.1016/S0140-6736(09)61558-0
3. Lyttle MD, Crowe L, Oakley E, Dunning J, Babl FE. Comparing CATCH, CHALICE and PECARN clinical decision rules for paediatric head injuries. *Emerg Med J*. 2012;29(10):785-794. doi:10.1136/emermed-2011-20022
4. Dunning J, Daly JP, Lomas JP, et al. Derivation of the children's head injury algorithm for the prediction of important clinical events decision rule for head injury in children. *Arch Dis Child*. 2006;91(11):885-891. doi:10.1136/adc.2005.083980
5. Lumba-Brown A, Yeates KO, Sarmiento K, et al. Centers for Disease Control and Prevention Guideline on the Diagnosis and Management of Mild Traumatic Brain Injury Among Children [published correction appears in JAMA Pediatr. 2018 Nov 1;172(11):1104]. *JAMA Pediatr*. 2018;172(11):e182853. doi:10.1001/jamapediatrics.2018.2853
6. Samuel M. Pediatric appendicitis score. *J Pediatr Surg*. 2002;37(6):877-881. doi:10.1053/jpsu.2002.32893