ASSESSMENT OF

Minor Head Trauma in Pediatric Patients

2019 Update

This care process model (CPM) was developed by the Intermountain Pediatrics and Childhood Health Minor Head Trauma Development Team. It serves as a guide to providers in assessing the risk of clinically important traumatic brain injury (ciTBI)—trauma resulting in an adverse outcome or requiring significant intervention—after minor head trauma (MHT). These recommendations apply to patients younger than 18 years with acute, isolated, uncomplicated, MHT that has occurred within 24 hours of patient presentation. Recommendations are based on available scientific evidence, particularly the landmark 'PECARN' study.[KUP]

Why Focus ON MINOR HEAD TRAUMA IN CHILDREN?

- **It's common.** Head trauma is a common reason parents seek medical care for their children.
- **Presentation can be misleading.** While most instances of pediatric head trauma are minor, some children presenting with apparent MHT have ciTBI and require intervention.
- **Accurate assessment is complex.** Assessment requires consideration of many factors, as no single factor accurately identifies patients at very low risk of ciTBI.
- **CT use is variable and often overutilized.** Implementing a guideline is likely to reduce unnecessary CT scans and attendant risk of CT-induced malignancy.

WHAT'S INSIDE?

Key Points

This CPM is evidence-based and functions as a practical guide to assessment of MHT. The information and algorithms:

- Are based on a robust, landmark trial which identified patients at very low risk of ciTBI.[KUP] The model also incorporates findings from other important studies (see references).
- Stratify patients into risk groups and provide management recommendations.
- Contain a separate algorithm for assessing children < 2 years of age to help manage the complexity of evaluating very young children.
- Give guidance for appropriate decisions regarding neuroimaging because:
  - CT is highly accurate in identifying intracranial injuries.
  - The use of CT is highly variable and generally increasing.
  - It is important to avoid unnecessary CT scans given the increased risk of malignancy associated with ionizing radiation. Malignancy rates associated with pediatric head CT are estimated at 1/1000 to 1/5000, with increasing risk associated with younger age.[BRE1, BRE2]
- Help identify cases where observation is appropriate.
- Provide recommendations regarding duration of observation and discharge criteria.

MEASUREMENT & GOALS

The goal of this CPM is to decrease CT use in mild head trauma patients without increasing rates of missed ciTBI.

For continuous improvement, we will monitor and report:

- CT rate in children presenting to the ED with MHT
- 48-hour admission rate in children with MHT that were initially discharged from the ED

Indicates an Intermountain measure

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(a) Severe mechanism of injury

- Motor vehicle crash with patient ejection, death of another passenger, or rollover
- Pedestrian/bicyclist without helmet, struck by motor vehicle
- Fall > 3 feet
- Head struck by high-impact object

(b) High-risk hematoma

Risk of ciTBI increases for non-frontal hematomas as more of the following are present.

- Size > 3 cm
- Boggy (soft) consistency
- Patient < 9 months of age

(c) Risk table (< 2 years old)

Isolated risk factor	Risk of ciTBI
Loss of consciousness (> 5 sec)[LEE]	0.5 %
Hematoma[DAY2]	0.4 %
Severe mechanism of injury[NIG]	0.3 %

(d) Factors favoring CT use in intermediate risk category

- Multiple risk factors present
- Symptoms are severe or worsening
- Age < 3 months
- High-risk hematoma **(b)**
- Provider inexperience
- Patient lives long distance from CT facility or facility is very far from trauma center

(e) Observation

If observation is determined for patients in intermediate risk category, consider:

- Observation for 3–4 hours after injury
- Neurochecks every 2 hours
- Administration of clear fluids
- Need for CT if symptoms worsen or are persistent and significant

(f) Discharge

Consider discharge if patient meets the following criteria:

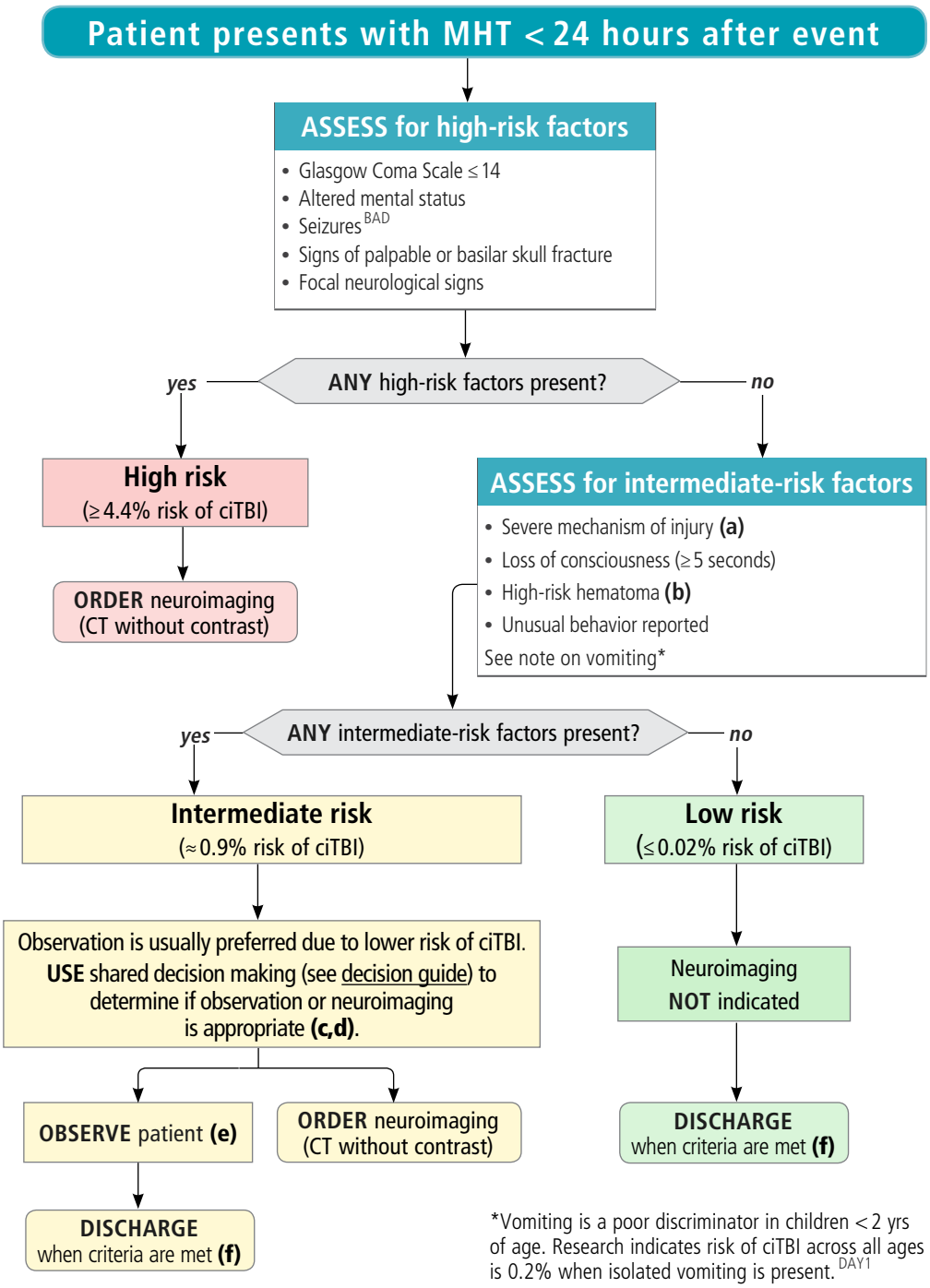
- Normal mental status
- Resolving or minor symptoms
- Tolerating oral intake
- Dependable social support

MINOR HEAD TRAUMA IN PATIENTS < 2 YEARS OLD

The algorithm below and risk estimates of clinically important traumatic brain injury (ciTBI)* are based primarily on the PECARN study and should be used to approach acute, isolated, minor head trauma (MHT) without complicating factors. **Do not use algorithm if:** Moderate or severe head injury, multisystem trauma, penetrating injury, structural brain disease, VP shunts, or bleeding disorder is present; if abuse is suspected; or more than 24 hours have elapsed since time of injury.

*ciTBI is injury resulting in: Death, neurosurgery, intubation > 24 hours, or admission to hospital ≥ 2 nights.

ALGORITHM: ASSESSMENT OF MHT IN PATIENTS < 2 YEARS OF AGE



*Vomiting is a poor discriminator in children < 2 yrs of age. Research indicates risk of ciTBI across all ages is 0.2% when isolated vomiting is present.[DAY1]

(a) Severe mechanism of injury

- Motor vehicle crash with patient ejection, death of another passenger, or rollover
- Pedestrian / bicyclist without helmet, struck by motor vehicle
- Fall > 5 feet
- Head struck by high-impact object

(b) Risk table (≥ 2 years old)

Isolated risk factor	Risk of ciTBI
Loss of consciousness (>5 sec)[LEE]	0.5 %
Vomiting[DAY1]	0.7%
Severe mechanism of injury[NIG]	0.5%

(c) Factors favoring CT use in intermediate risk category

- Multiple risk factors
- Symptoms are severe or worsening
- Provider inexperience
- Patient lives long distance from CT facility or facility is very far from trauma center

(d) Observation

If observation is determined for patients in intermediate risk category, consider:

- Observation for 3–4 hours after injury
- Neurochecks every 2 hours
- Administration of clear fluids
- Need for CT if symptoms worsen or are persistent and significant

(e) Discharge

Consider discharge if patient meets the following criteria:

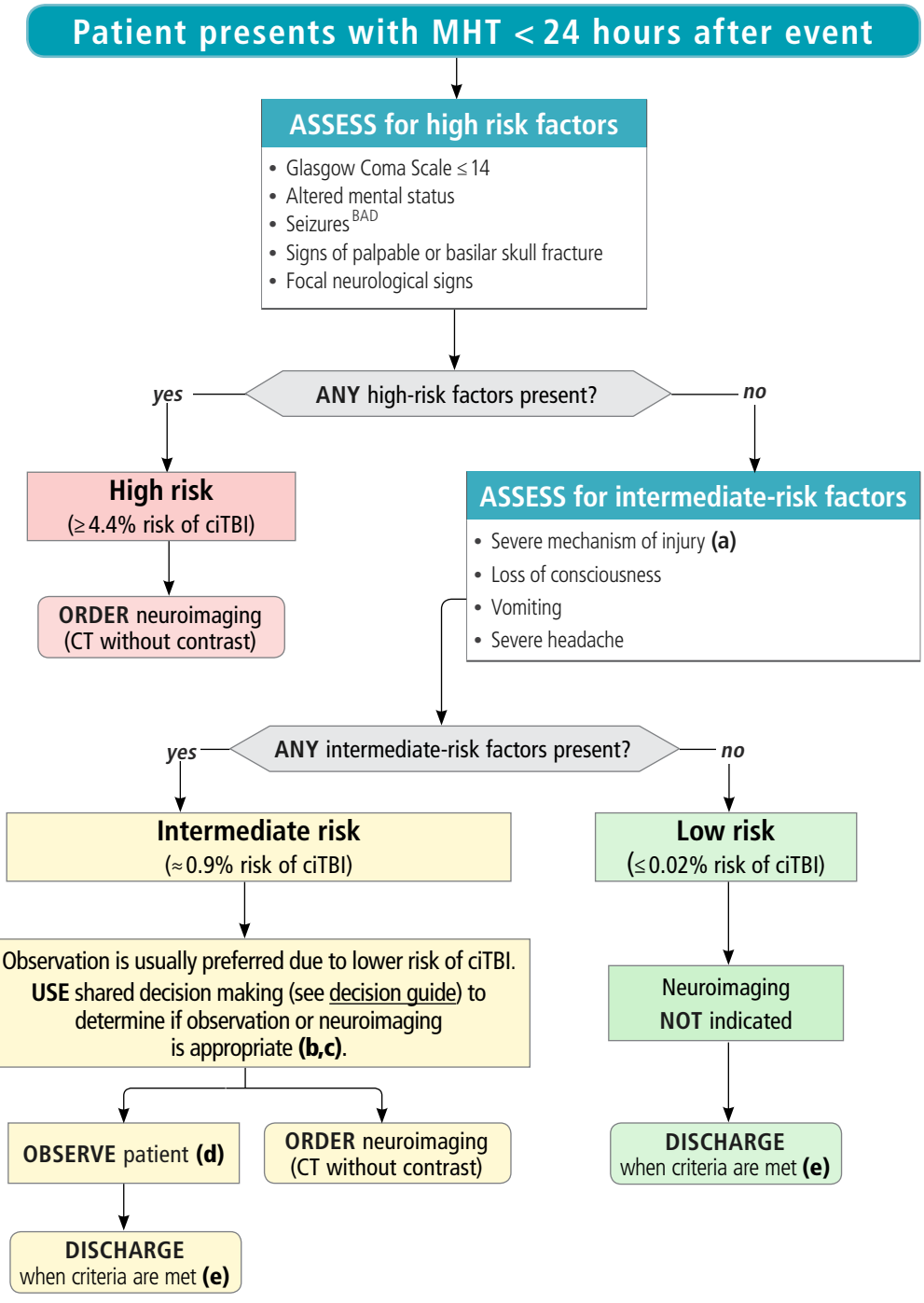
- Normal mental status
- Resolving or minor symptoms
- Tolerating oral intake
- Dependable social support

MINOR HEAD TRAUMA IN PATIENTS ≥ 2 YEARS OLD

The algorithm below and risk estimates of clinically important traumatic brain injury (ciTBI)* are based primarily on the PECARN study and should be used to approach acute, isolated, minor head trauma (MHT) without complicating factors. **Do not use algorithm if:** Moderate or severe head injury, multisystem trauma, penetrating injury, structural brain disease, VP shunts, or bleeding disorder is present; if abuse is suspected; or more than 24 hours have elapsed since time of injury.

*ciTBI is injury resulting in: Death, neurosurgery, intubation > 24 hours, or admission to hospital ≥ 2 nights.

ALGORITHM: ASSESSMENT OF MHT IN PATIENTS ≥ 2 YEARS OF AGE



CPM
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RESOURCES

To support shared decision-making and education on this topic, access the patient and provider resources listed below.

Patient resources

You can find a searchable list of all patient handouts at Intermountainhealthcare.org

Clinicians can order Intermountain patient education booklets, fact sheets, and trackers for their patients from **Print It**, Intermountain's Design and Print Center for one-stop access and ordering of Intermountain-approved education.

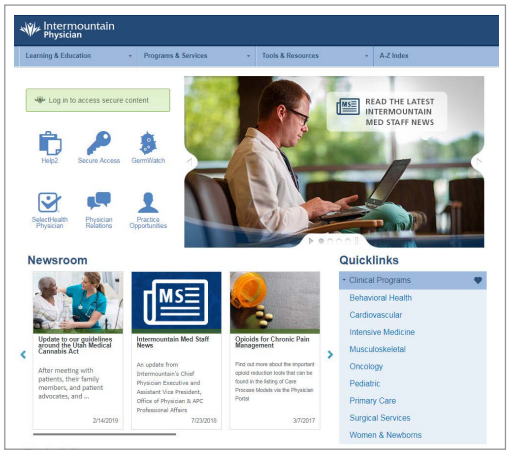
Patient Information:

An array of booklets, trackers, and fact sheets to help, including:

- *Head Injury decision guide: is a CT scan right for my child? (English) / (Spanish)*
- *Mild Traumatic Brain Injury (English) / (Spanish)*
- *Brain Injury: creating a healing environment (English) / (Spanish)*
- *Brain injury: Keeping your child safe after head injury (English) / (Spanish)*
- *Sleep after a brain injury (English) / (Spanish)*
- *Brain Injury Severity and Measurements (English) / (Spanish)*
- *Brain Injuries: a guide for teachers (English) / (Spanish)*

Provider resources

To find this CPM, clinicians can go to intermountainphysician.org. This CPM also has abbreviated algorithms for point-of-care use in the form of best practice flash cards. These can be accessed from the menu on the left-hand side of the CPM page or in mobile format using the Intermountainphysician app.



REFERENCES

BAD Badaway MK, Dayan PS, Tunik MG, et al. Prevalence of brain injuries and recurrence of seizures in children with posttraumatic seizures. *Acad Emerg Med.* 2017; 24(5):595-605.

BRE1 Brenner DJ. Estimating cancer risks from pediatric CT: Going from the qualitative to the quantitative. *Pediatr Radiol.* 2002;32(4):228-231.

BRE2 Brenner DJ, Hall EJ. Computed tomography – An increasing source of radiation exposure. *N Engl J Med.* 2007;357(22):2277-2284.

DAY1 Dayan PS, Holmes JF, Atabaki S, Hoyle J Jr, Tunik MG, Lichenstein R, Alpern E, Miskin M, Kuppermann N; Traumatic Brain Injury Study Group of the Pediatric Emergency Care Applied Research Network (PECARN). Association of traumatic brain injuries with vomiting in children with blunt head trauma. *Ann Emerg Med.* 2014 Jun;63(6):657-665.

DAY2 Dayan PS, Holmes JF, Schunk J, et al. Risk of traumatic brain injuries in children younger than 24 months with isolated scalp hematomas. *Ann Emerg Med.* 2014; 64(2):153-162.

KUP Kuppermann N, Holmes JF, Dayan PS, et al; Pediatric Emergency Care Applied Research Network (PECARN). Identification of children at very low risk of clinically-important brain injuries after head trauma: A prospective cohort study. *Lancet.* 2009; 374(9696):1160-1170.

LEE Lee LK, Monroe D, Bachman D, et al. Isolated loss of consciousness in children with minor blunt head trauma. *JAMA Ped.* 2014;168(9):837-843.

NIG Nigrovic LE, Lee LK, Hoyle J, et al. Prevalence of clinically important traumatic brain injuries in children with minor blunt head trauma and isolated severe injury mechanisms. *Arch Pediatr Adolesc Med.* 2012;166(4):356-361.

OTHER TEXTS CONSULTED

ATA Atabaki SM, Stiell IG, Bazarian JJ, et al. A clinical decision rule for cranial computed tomography in minor pediatric head trauma. *Arch Pediatr Adolesc Med.* 2008;162(5):439–445.

DAD Da Dalt L, Marchi AG, Laudizi L, et al. Predictors of intracranial injuries in children after blunt head trauma. *Eur J Pediatr.* 2006;165(3):142–148.

DUN Dunning J, Daly JP, Lomas JP, Batchelor J, Mackway-Jones K: Children's head injury algorithm for the prediction of important clinical events study group. 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.

GRE Greenes DS, Schutzman SA. Clinical significance of scalp abnormalities in asymptomatic head-injured infants. *Pediatr Emerg Care.* 2001;17(2):88–92.

HAM Hamilton M, Mrazik M, Johnson DW. Incidence of delayed intracranial hemorrhage in children after uncomplicated minor head injuries. *Pediatrics.* 2010;126(1):e33-e39.

HAY Haydel MJ, Shembekar AD. Prediction of intracranial injury in children aged five years and older with loss of consciousness after minor head injury due to nontrivial mechanisms. *Ann Emerg Med.* 2003;42(4):507–514.

HOL Holmes JF, Borgialli DA, Nadel FM, et al; TBI Study Group for the Pediatric Emergency Care Applied Research Network. Do children with blunt head trauma and normal cranial computed tomography scan results require hospitalization. *Ann Emerg Med.* 2011;58(4):315-322.

LAN Langlois JA, Rutlan-Brown W, Thomas KE. Traumatic brain injury in the United States: Emergency department visits, hospitalizations, and deaths. Atlanta, GA: Centers for Disease Control and Preventions, National Center For Injury Prevention and Control, 2004. http://stacks.cdc.gov/view/cdc/12294. Published 2006. Accessed November 1, 2013.

MAG Maguire JL, Boutis K, Uleryk EM, et al. Should a head-injured child receive a head CT scan? A systematic review of clinical prediction rules. *Pediatrics.* 2009;124(1):e145-e154.

MAN Mannix R, Meehan W, Monuteaux M, et al. Computed tomography for minor head injury: Variation and trends in major United States pediatric emergency departments. *J Pediatr.* 2012;160(1):136-139.

MAN Mannix R, Bourgeois F, Schutzman S, et al. Neuroimaging for pediatric head trauma: Do patient and hospital characteristics influence who gets imaged? *Acad Emerg Med.* 2010;17(7):694-700.

NAT National Center for Injury Prevention and Control. Traumatic brain injury in the United States: Assessing outcomes in children. http://stacks.cdc.gov/view/cdc/13378. Published 2000. Accessed November 1, 2013.

OMA Oman JA, Cooper RJ, Holmes JF, et al; NEXUS II Investigators. Performance of a decision rule to predict need for computed tomography among children with blunt head trauma. *Pediatrics.* 2006;117(2):e238-e246.

PAL Palchak MJ, Holmes JF, Vance CW, et al. A decision rule for identifying children at low risk for brain injuries after blunt head trauma. *Ann Emerg Med.* 2003;42(4):492–506.

SUN Sun BC, Hoffman JR, Mower WR. Evaluation of a modified prediction instrument to identify significant pediatric intracranial injury after blunt head trauma. *Ann Emerg Med.* 2007;49(3):325–332.

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This CPM presents a model of best care based on the best available scientific evidence at the time of publication. It is not a prescription for every physician or every patient, nor does it replace clinical judgment. All statements, protocols, and recommendations herein are viewed as transitory and iterative. Although physicians are encouraged to follow the CPM to help focus on and measure quality, deviations are a means for discovering improvements in patient care and expanding the knowledge base. Send feedback to Jeff Schunk MD, Intermountain Healthcare, Jeff.Schunk@hsc.utah.edu.