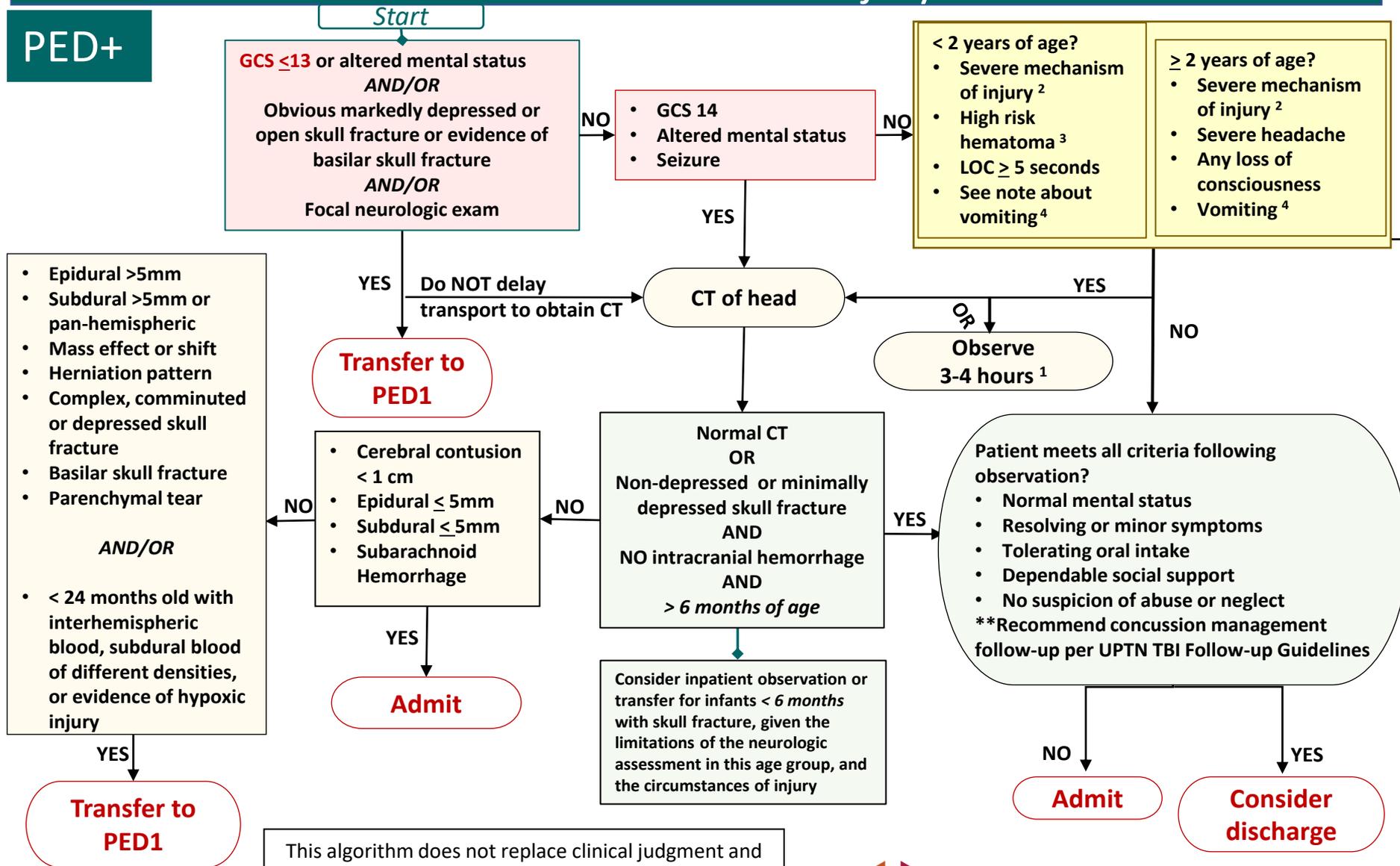


2023 Pediatric Traumatic Brain Injury (TBI) Clinical Guideline

Isolated Blunt Head Injury*

PED+



This algorithm does not replace clinical judgment and is not intended to be prescriptive for all patients.

Pediatric Traumatic Brain Injury (TBI) Clinical Guideline

Isolated Blunt Head Injury*

*Isolated Blunt Head Injury

- No multi-system trauma
- No suspicion of abuse
- No structural brain disease
- No **VP** shunts
- No bleeding disorders
- No other conditions that may complicate assessment

1 Observation

Observation for 3-4 hours can be considered in lieu of CT scanning.

Depending on comfort level of clinician, distance to definitive care or presence of multiple factors, CT scanning may be favored.

2 Severe mechanism of injury

- Motor vehicle with ejection, death of another passenger or rollover
- Pedestrian/bicyclist struck by motor vehicle
- Fall > 3 feet (age < 2 years) or > 5 feet
- Head struck by high-impact object

Modified Glasgow Coma Scale for Infants and Children

| | Child | Infant | Score |
|----------------------|-------------------------------|--------------------------------------|-------|
| Eye opening | Spontaneous | Spontaneous | 4 |
| | To speech | To speech | 3 |
| | To pain only | To pain only | 2 |
| | No response | No response | 1 |
| Best verbal response | Oriented, appropriate | Coos and babbles | 5 |
| | Confused | Irritable cries | 4 |
| | Inappropriate words | Cries to pain | 3 |
| | Incomprehensible sounds | Moans to pain | 2 |
| | No response | No response | 1 |
| Best motor response* | Obeys commands | Moves spontaneously and purposefully | 6 |
| | Localizes painful stimulus | Withdraws to touch | 5 |
| | Withdraws in response to pain | Withdraws to response in pain | 4 |
| | Flexion in response to pain | Abnormal flexion posture to pain | 3 |
| | Extension in response to pain | Abnormal extension posture to pain | 2 |
| | No response | No response | 1 |

3 High risk scalp hematoma

- Large, > 3cm
- Boggy
- Non-frontal
- Age < 6-12 months

4 Vomiting

Vomiting is so common in younger children that it is generally a poor discriminator of serious injury risk. This is especially true when vomiting occurs in isolation.

*If patient is intubated, unconscious, or preverbal, the most important part of this scale is motor response. Motor response should be carefully evaluated.

Pediatric Traumatic Brain Injury (TBI) Clinical Guideline

Isolated Blunt Head Injury*

Pediatric Head Trauma < 2 years

Derived from Intermountain CMP (2019, not published) and PECARN study 2009 (N = 42, 412) with subsequent substudies based on patients < 24 hours from head injury

| Risk Stratification | Risk of ci TBI* |
|---|-----------------|
| High Risk | 4.4% |
| -Any of the following: | |
| GCS ≤ 14 or altered mental status | |
| Palpable skull fracture | |
| Signs of basilar skull fracture | |
| Focal neurologic exam | |
| Seizure | |
| Medium Risk | 0.9% |
| -Not high risk and any of the following: | |
| Severe mechanism of injury | |
| High risk hematoma | |
| LOC ≥ 5 seconds | |
| Not acting normally per parents | |
| Comments regarding vomiting | |
| Low Risk | < 0.02% |
| -All others (NOT High Risk and NOT Medium Risk) | |

*ciTBI: clinically important brain injury is defined as death, neurosurgery, intubation > 24 hours, admission ≥ 2 nights

Pediatric Head Trauma ≥ 2 years

Derived from Intermountain CMP (2019, not published) and PECARN study 2009 (N = 42, 412) with subsequent substudies based on patients < 24 hours from head injury

| Risk Stratification | Risk of ci TBI* |
|---|-----------------|
| High Risk | 4.3% |
| -Any of the following: | |
| GCS ≤ 14 or altered mental status | |
| Signs of basilar skull fracture | |
| Focal neurologic exam | |
| Seizure | |
| Medium Risk | 0.9% |
| -Not high risk and any of the following: | |
| Severe mechanism of injury | |
| History of LOC | |
| Severe headache | |
| Vomiting | |
| Low Risk | < 0.05% |
| -All others (NOT High Risk and NOT Medium Risk) | |

*ciTBI: clinically important brain injury is defined as death, neurosurgery, intubation > 24 hours, admission ≥ 2 nights

Pediatric Traumatic Brain Injury (TBI) Clinical Guideline

Isolated Blunt Head Injury*

ADDITIONAL INFORMATION (< 2 years)

Focal neurologic exam: Focal findings are extremely uncommon after pediatric head trauma and are generally recognized as necessitating a CT scan.

Seizure: Seizure was not included in the original derivation of the PECARN study because many of these patients presented with other risk factors (e.g. altered mental status). Subsequent focused analysis indicates risk of Intracranial Injury (ICI) on CT scan significant enough to warrant scanning. Impact seizures have the lowest risk, 8.6% (95% ci 5.1%-13.5%) of ICI on CT while seizures occurring more than 30 minutes after trauma had the highest TBI risk of 20.0% (95% ci 10.4% – 33.0%). Clinicians should not scan for typical breath holding spells following minor head trauma.

Signs of basilar skull fracture: Uncommon in young children, includes CSF rhinorrhea / otorrhea, hemotympanum, racoon eyes, Battle's sign.

Severe mechanism of injury: MVC with ejection, death or rollover, pedestrian or bicyclist without helmet struck by a vehicle, fall > 3 feet if < 2 years and > 5 feet if > 2 years, head struck by high impact object. For isolated severe mechanism (no other signs / symptoms) in children < 2 years, a subsequent study noted a risk of ciTBI of 4/1330, 0.3% (95% ci 0.1%-0.8%) while for children ≥ 2 years, 12/2300, 0.5% (95% ci 0.3%-0.9%) had a ciTBI.

High risk hematoma: young age (especially < 6 months), size (especially > 3 cm), boggy and non-frontal location increases risk of ICI (intracranial injury) on CT. Frontal hematomas are NOT considered high risk. Re-evaluation for high risk hematoma during period of observation is recommended in infants.

Vomiting: Vomiting in the younger child was a poor discriminator because it is so common. In the original 2009 PECARN study vomiting was NOT an independent risk factor. In a follow-up sub study: for < 2 years olds with *isolated* vomiting there was an intracranial injury rate of 1% (95% ci 0.1%, 3.8%), while 0/567 had ciTBI.

Pediatric Traumatic Brain Injury (TBI) Clinical Guideline

Isolated Blunt Head Injury*

ADDITIONAL INFORMATION (≥ 2 years)

Focal neurologic exam: Focal findings are extremely uncommon after pediatric head trauma. And are generally recognized as necessitating a CT scan.

Seizure: Seizure was not included in the original derivation of the PECARN study because many of these patients presented with other risk factors (e.g. altered mental status). Subsequent focused analysis indicates risk of Intracranial Injury (ICI) on CT scan significant enough to warrant scanning. Impact seizures have the lowest risk, 8.6% (95% ci 5.1%-13.5%) of ICI on CT while seizures occurring more than 30 minutes after trauma had the highest TBI risk of 20.0% (95% ci 10.4% – 33.0%). Clinicians should not scan for typical breath holding spells following minor head trauma.

Signs of basilar skull fracture: Uncommon in young children, includes CSF rhinorrhea / otorrhea, hemotympanum, racoon eyes, Battle's sign.

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Vomiting: In the original 2009 PECARN study vomiting was NOT included as a moderate risk factor for younger children but it was included for older children. In a follow-up sub study: for **≥ 2 years olds** with isolated vomiting there was an intracranial injury rate of 3.2% (95% ci 2.1%-4.7%), while 10/1501 (0.7%) had ciTBI.

2023 Pediatric Traumatic Brain Injury (TBI) Option for Follow-up Care

****We recommend follow-up for TBI of all severity. For higher severity, the following clinic is available:**

The best way to make a Telehealth referral to the Concussion Clinic is to get the caregiver's e-mail address and send demographics to Angel.waddoups@utah.edu with a request for an appointment. Angel will then send a link to be opened on the day of the appointment. Consider providing the following information (discharge paperwork) in case of a missed e-mail

“You will receive a call to set a follow-up appointment in the **Concussion Management Program at University Orthopaedic Center** with Brain Injury Specialist Dr. Colby Hansen or Lara Haynes NP, **801-587-7109**. If you do not hear from them in one week, please call. The Orthopedic Center is located at 590 Wakara Way (on the corner of Wakara Way and Foothill). For an in-person visit plan on arriving early to fill out paperwork. Check-in at the south desk. Bring an Insurance card, picture ID, medications, and copay if required. Appointment may take as long as 2 hours.”

Dr Hansen can see all insurance companies in network with Primary Children's (**pretty much all insurance companies**).

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2023 Pediatric Traumatic Brain Injury (TBI) Severity Categories and Return to Play and Follow up Guidelines

| TBI Severity | Glasgow Coma Scale (GCS) | Loss of Consciousness (LOC) | Alteration of Consciousness (AOC) | Post Traumatic Amnesia (PTA) | CT of Head (or MRI) | Return to Play | Follow up |
|-------------------------|--------------------------|-----------------------------|-----------------------------------|------------------------------|---------------------|----------------|---|
| Very Mild** | 15 | None to < 1 minute | None | None to < 1 hour | Normal | 1 week | 1-2 weeks with PCP or concussion clinic as needed |
| Mild** | 13 to 15 | None to < 30 minutes | None to < 24 hours | None to < 24 hours | Normal | 2 weeks | |
| Complicated Mild | 13 to 15 | None to < 30 minutes | None to < 24 hours | None to < 24 hours | Abnormal* | 3 months | 1-3 weeks with concussion clinic |
| Moderate | 9 to 12 | > 30 minutes | > 24 hours | 1-7 days | Normal or Abnormal* | 6 months | 4 weeks with Rehabilitation Specialist |
| Severe | 3 to 8 | > 24 hours | > 24 hours | > 7 days | Normal or Abnormal* | 12 months | |

*Abnormal: Subarachnoid hemorrhage (SAH), Subdural hematoma (SDH, Fracture, Epidural Hematoma (EDH), Parenchymal contusion, Diffuse Axonal Injury/Shear (DAI)
 ** TBI Severity determination may also be based on other factors such as previous concussions

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2023 Pediatric Traumatic Brain Injury (TBI) Severity Categories and Return to Play and Follow up Guidelines

| TBI Symptoms |
|---|
| Headache or “pressure” in head |
| Nausea or vomiting |
| Balance problems/dizziness |
| Double or blurry vision |
| Sensitivity to light or noise |
| Feeling sluggish, hazy, foggy or groggy |
| Confusion, concentration or memory problems |
| Just not “feeling right” or “feeling down” |

<https://www.cdc.gov/headsup>

| Stepwise Return to Activity Modify for age-appropriateness |
|---|
| 1. Rest until symptoms improve |
| 2. Light activity once symptoms begin to resolve (age-appropriate) -modified school schedule - light aerobic exercise; walking, swimming |
| 3. Moderate activity once symptoms are mild and nearly gone -regular school schedule -moderate activity; jogging |
| 4. Regular activity once symptoms are gone -Heavy, noncontact activity such as sprinting/running, high-intensity stationary biking, regular weightlifting routine, non-contact-sport-specific drills |
| 5. Practice and full contact -Normal training activities |
| 6. Competition / Return to Play |

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