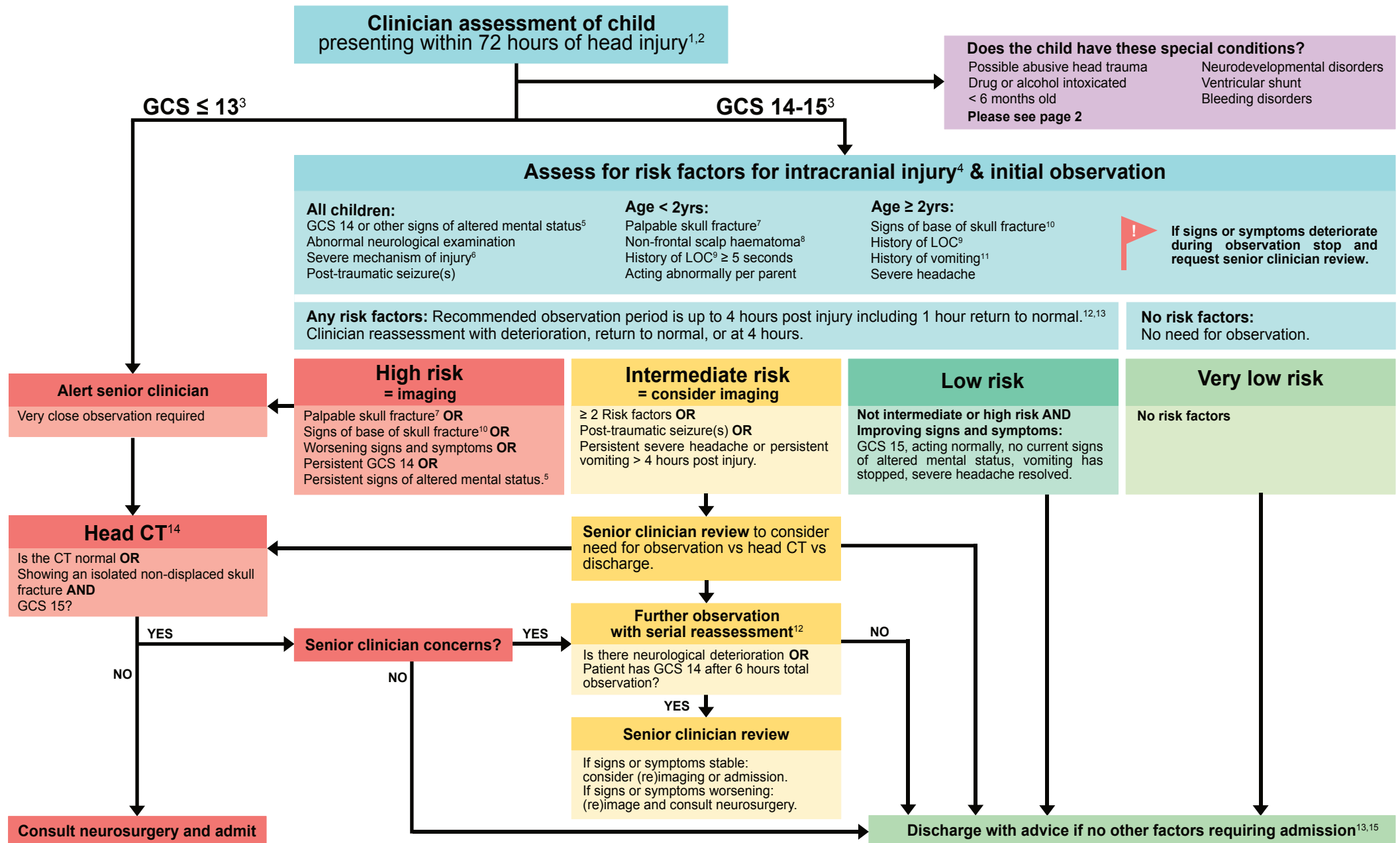




Algorithm: Imaging & Observation Decision-Making for Children with Head Injuries

Further details and footnotes are important to interpretation of the algorithm. Please see page 2.





Further details to aid algorithm interpretation

- ¹ Always consider possible cervical spine injuries and abusive head trauma in children presenting with head injuries.
- ² Children with delayed initial presentation (24-72 hrs post head injury) and GCS 15 should be risk stratified the same way as children presenting within 24 hours. They do not need to be assessed with a further 4 hrs of observation.
- ³ Remember to use an age-appropriate Glasgow Coma Scale (GCS).
- ⁴ Risk factors adapted from Kuppermann N et al. *Lancet* 2009;374(9696):1160-70.
- ⁵ Other signs of altered mental status: agitation, drowsiness, repetitive questioning, slow response to verbal communication.
- ⁶ Severe mechanism of injury: motor vehicle accident with patient ejection or rollover, death of another passenger, pedestrian or cyclist without helmet struck by motor vehicle, falls of $\geq 1\text{m}$ (< 2 yrs), fall > 1.5m ($\geq 2\text{yrs}$), head struck by high impact object.
- ⁷ Palpable skull fracture: on palpation or possible on the basis of swelling or distortion of the scalp.
- ⁸ Non-frontal scalp haematoma: occipital, parietal, or temporal.
- ⁹ Loss of consciousness.
- ¹⁰ Signs of base of skull fracture: haemotympanum, 'raccoon' eyes, cerebrospinal fluid (CSF) otorrhoea or CSF rhinorrhoea, Battle's signs.
- ¹¹ Isolated vomiting, without any other risk factors, is an uncommon presentation of clinically important traumatic brain injury (cTBI). Vomiting, regardless of the number or persistence of vomiting, in association with other risk factors, increases concern for cTBI.
- ¹² Observation to occur in an optimal environment based on local resources. Frequency of observation to be $\frac{1}{2}$ hourly for the first 2 hours, then 1-hourly until 4 hours post injury. After 4 hours, continue 2-hourly as long as the patient is in hospital. Observation duration may be modified based on patient and family variables. These include time elapsed since injury/symptoms and ability of child/parent to follow advice on when to return to hospital.
- ¹³ Shared decision-making between families and clinicians should be considered.
- ¹⁴ Do not use plain X-rays, or ultrasound of the skull, prior to or in lieu of CT scan, to diagnose or risk stratify a head injury for possible intracranial injuries.
- ¹⁵ Other factors warranting hospital admission may include other injuries or clinician concerns e.g. persistent vomiting, drug or alcohol intoxication, social factors, underlying medical conditions, possible abusive head trauma.



Special Conditions

Possible abusive head trauma



Follow local screening tools for abusive head trauma (AHT). CT should be used as initial diagnostic tool to evaluate possible intracranial injury and other injuries relevant for the evaluation of AHT e.g. skull fractures. The extent of the assessment of a child with possible AHT should be co-ordinated with the involvement of an expert in the evaluation of non-accidental injury.

Drug or alcohol intoxicated



Treat as if the neurological findings are due to the head injury. Decision to CT scan or observe should be informed by risk factors for intracranial injury rather than the child being intoxicated.

< 6 months of age



Consider at higher risk of intracranial injury with a lower threshold for observation or imaging. Discuss with a senior clinician.

Neurodevelopmental disorders



It is unclear whether these children have a different background risk for intracranial injury. As these children may be difficult to assess, consider structured observation or head CT scan and include the paediatric team that knows the child (parents, caregivers, and clinicians) in shared decision-making.

Ventricular shunt (e.g. ventriculo-peritoneal shunt)



Consider structured observation over immediate CT scan if there are no risk factors of intracranial injury. If there are local signs of shunt disconnection/shunt fracture (such as palpable disruption or swelling) or signs of shunt malfunction, consider obtaining a shunt series based on consultation with a neurosurgical service.

Bleeding disorders or anti-coagulant or anti-platelet therapy



Urgently seek advice from the treating haematology team around risk of bleeding and management of coagulopathy. Consider structured observation over immediate CT scan if there are no risk factors for intracranial injury. If there is a risk factor for intracranial injury a head CT should be performed. If there is a deterioration in neurological status, perform urgent head CT scan.

Coagulation factor deficiency

CT scan or decision to observe must not delay the urgent administration of replacement factor.

Immune thrombocytopaenias (ITP)

Check a platelet count in all patients and blood group in all symptomatic patients if not already available. For ITP with platelet counts $< 20 \times 10^9/\text{L}$, consider empirical treatment after discussion with the treating haematology team.

On warfarin therapy or other newer anticoagulants (e.g. direct oral-anticoagulant) or anti-platelet therapy

Consider CT regardless of the presence or absence of risk factors for intracranial injury. Seek senior clinician review to inform timing of the CT and discuss the patient with the team managing the anticoagulation regarding early consideration of reversal agents. For children on anticoagulation therapy, if available, check the appropriate anticoagulant measure (e.g. International normalised ratio).

Citation: Babl FE, Tavender E, Dalziel S. On behalf of the Guideline Working Group for the Paediatric Research in Emergency Departments International Collaborative (PREDICT). Australian and New Zealand Guideline for Mild to Moderate Head injuries in Children – Algorithm (2021). PREDICT, Melbourne, Australia.