

New National Paediatric Head Injury Guidelines: What GPs need to know?

Associate Professor Elizabeth Cotterell

School of Rural Medicine, UNE

Clinical Director of Paediatrics, Armidale Rural Referral hospital

Member PREDICT Head Injury Guideline Steering Committee and Working Group



Learning outcomes

TRIAGE AND REFERRAL

- Which child with a head injury should be referred to ED?

EXPECTATIONS OF E.D ASSESSMENT

- Which children when they are assessed in ED can be observed rather than require CT Brain?
- Which child with a head injury can be safely managed at home?

EXPECTATIONS POST DISCHARGE

- What follow-up is required for a child with concussion?
- What follow-up is required for a child < 5 years with a simple linear skull fracture?

Factors affecting decision making for head injury in children

WHAT IS YOUR RISK TOLERANCE?

- Difficulty assessing infant's and young children neurological status
- Risk of missing clinical significant acute brain injury – uncommon high risk events
- Risk of CT scanning and radiation associated brain tumour or leukaemia
- Risk of missing significant brain injury in delayed presentation – is there a difference > 24 hours
- Risk of poor concussion management – long term effects

RADIATION RISK OF HEAD CT SCAN

What you need to know about CT scans for children

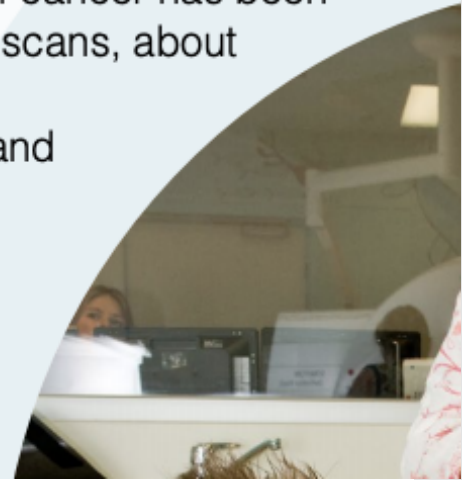
A resource for
parents and carers

- Use of CT scans in children has been linked to a slight increase in the chance of developing cancer later in life. One extra case of cancer has been estimated for every 1800 CT scans, about 10 years after exposure.¹ For comparison, 1 in 2 men and 1 in 3 women will develop cancer in their lifetimes.² Further information is available at nps.org.au/radiation-risks-in-children.

AUSTRALIAN COMMISSION
ON SAFETY AND QUALITY IN HEALTH CARE

 **NPS
MEDICINEWISE**

 **ACHC**
association for the wellbeing
of children in healthcare



It was just a
roll off the
bed....

Head injury that killed baby Adrian Ware likely not a result of fall from bed, court told

By [Ellie Sibson](#)

Posted Tue 30 Jul 2019 at 2:48pm, updated Thu 23 Jul 2020 at 2:25pm



Adrian Joshua Ware had suffered a head injury, but it's not known whether it was it was deliberate or accidental. (Facebook: Kozan Ware)

<https://www.abc.net.au/news/2019-07-30/baby-killer-committal-hearing/11366216>

Every parent's
nightmare....

My toddler fell off a 50cm stool. What happened next is every parent's nightmare

By Marion Ives

Posted Mon 1 Feb 2021 at 5:00am



When Mina fell and hit her head, I never imagined her life could be in imminent danger. *(Supplied: Marion Ives)*

<https://www.abc.net.au/news/2021-02-01/my-toddler-fell-off-stool-what-happened-next-parent-nightmare/13099030>

Serious head injuries from low risk mechanisms

'Is she normally like this?'

When we arrived at Emergency, the triage nurse asked a list of routine COVID questions before she looked at Mina. She was resting her head on my husband's shoulder, eyes shut.

"Is she normally like this?" the nurse asked. At that moment her head flopped forwards and the nurse snatched Mina from her father's arms and ran, yelling "RESUS!"

Suddenly, there were more than a dozen people in gowns, ripping off her clothes and connecting her to machines. My adrenalin started pumping and I had a gut-wrenching feeling of helplessness. My husband sat in the chair beside me, tears streaming down his face.

Mina had suffered what's called an extradural haemorrhage. When the side of her head hit the floor, the impact ruptured an artery. After a few hours, a large collection of blood shifted her brain, causing her to lose consciousness.

One of the surgeons said that such a serious head trauma was more typical in a car accident or football injury — rarely in a fall from such a low height. There was no time for consent forms or discussions with doctors. Mina was taken straight for a CT scan and into surgery.

Had we put her to bed that night, she would never have woken up.



After her surgery, Mina was completely unrecognisable. (Supplied: Marion Ives)

Parental recognition of concussion

Researchers find most parents unaware of proper concussion treatments for children

Posted Tue 26 Nov 2013 at 7:43am



Concussed children are at an increased risk of further injury on the sports field.

Share



<https://www.abc.net.au/news/2013-11-26/parents-failing-to-treat-concussed-children-properly/5116410>

Even the
experts don't
know.....

Concussion in children is little understood and requires more research, experts say

PM / By Nick Grimm

Posted Thu 1 Jun 2017 at 7:26pm



Adults recover from concussion faster than children do. (Supplied: Ch.9)

Share



New international guidelines have been developed to tackle the problem of sports-related concussion (SRC) in children and adolescents, but medical researchers admit they do not know enough about the long-term damage it may do to young people.

<https://www.abc.net.au/news/2017-06-01/concussion-in-children-requires-more-research-experts-say/8581078>

CLINICAL DECISION RULES for Paediatric head injury

CHALICE

- Dunning et al *Arch Dis Child* 2006
- Tells when to CT scan depending on History, examination and Mechanism

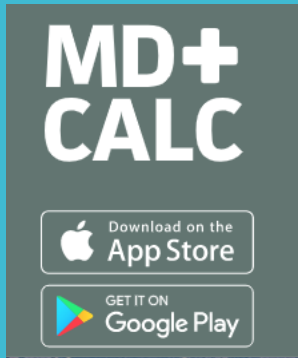
CATCH

- Osmond et al *CMAJ* 2010, 2018
- Original 7 items, when to CT scan

PECARN

- Kupperman et al, *Lancet* 2009
- 42,412 derivation and validation study
- CT scan rate 35%, ciTBI 0.9%
- Separated < 2 year and > 2 years
- Identified children at very low risk for whom CT scan can be obviated.

CHALICE



CHALICE (Children's Head injury Algorithm for the prediction of Important Clinical Events) Rule ☆

Predicts death, need for neurosurgical intervention or CT abnormality in children with head trauma.

History		
Witnessed LOC >5 min	☒ No	☐ Yes
Amnesia >5 min Antegrade or retrograde	☒ No	☐ Yes
Abnormal drowsiness Abnormal = in excess of drowsiness expected by the examining doctor	☒ No	☐ Yes
≥3 vomits after head injury 1 vomit = single discrete episode of vomiting	☒ No	☐ Yes
Suspicion of non-accidental injury (NAI) Any suspicion of NAI by the examining doctor	☒ No	☐ Yes
Seizure after head injury (and no previous history of epilepsy)	☒ No	☐ Yes
Examination		
GCS <14 (or GCS <15 if <1 year old)	☒ No	☐ Yes
Suspicion of penetrating or depressed skull injury, or tense fontanelle	☒ No	☐ Yes
Signs of basal skull fracture Blood or CSF from ear or nose, panda eyes, Battle's sign, hemotympanum, facial crepitus, or serious facial injury	☒ No	☐ Yes
Positive focal neurologic sign Any focal neurologic sign (motor, sensory, coordination, or reflex abnormality)	☒ No	☐ Yes
Bruise, swelling or laceration >5 cm (if <1 year old)	☒ No	☐ Yes
Mechanism		
High-speed road traffic accident as pedestrian, cyclist or occupant High-speed: >40 mph (64 km/h)	☒ No	☐ Yes
Fall of >3 m in height	☒ No	☐ Yes
High-speed injury from a projectile or an object	☒ No	☐ Yes

Low risk
CT not necessary.
98% sensitive (death, neurosurgical intervention, abnormal CT).
[Copy Results](#) [Next Steps](#)

CATCH

MD+
CALC

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App Store

GET IT ON
Google Play

CATCH (Canadian Assessment of Tomography for Childhood Head injury) Rule ☆

Predicts clinically significant head injuries in children.

INSTRUCTIONS

Use in patients up to 16 yrs with minor head injury and initial [GCS](#) at least 13, injury within 24 hrs, plus at least one of the following: blunt trauma with witnessed [LOC](#), amnesia, witnessed disorientation, vomiting 2+ times at least 15 mins apart, persistent irritability if under 2 years old. Do NOT use if: penetrating skull injury, depressed fx, focal neuro deficit, developmental delay, child abuse, re-eval after prior head injury, pregnant patient. Note: We recommend using [PECARN](#), as it is more widely validated.

When to Use ▾

Pearls/Pitfalls ▾

Why Use ▾

[GCS](#) <15 at 2 hrs after injury

No

Yes

Suspected open or depressed skull fracture

No

Yes

History of worsening headache

No

Yes

Irritability on exam

No

Yes

Any sign of basal skull fracture

Hemotympanum, raccoon eyes, [CSF](#) otorrhea or rhinorrhea, Battle's sign

No

Yes

Large boggy scalp hematoma

No

Yes

Dangerous mechanism of injury

[MVC](#), fall from ≥3 ft (91 cm) or 5 stairs, fall from bicycle with no helmet

No

Yes

Low risk

CT not necessary.

Copy Results 📄

Next Steps ➤➤➤

PECARN Algorithm

MD+
CALC

Download on the
App Store

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Google Play

PECARN Pediatric Head Injury/Trauma Algorithm ☆

Predicts need for brain imaging after pediatric head injury.

INSTRUCTIONS

Note: This only applies to children with **GCS** scores of 14 or greater.

When to Use ▼

Pearls/Pitfalls ▼

Why Use ▼

Age

<2 Years

≥2 Years

GCS ≤14, palpable skull fracture or signs of AMS

AMS: Agitation, somnolence, repetitive questioning, or slow response to verbal communication

No

Yes

Occipital, parietal or temporal scalp hematoma; history of LOC ≥5 sec; not acting normally per parent or severe mechanism of injury?

Severe mechanism: MVC with patient ejection, death of another passenger, rollover; pedestrian or bicyclist w/o helmet struck by motorized vehicle; fall from >0.9m or 3ft; head struck by high-impact object

No

Yes

PECARN recommends No CT; Risk of cTBI <0.02%, "Exceedingly Low, generally lower than risk of CT-induced malignancies."

Copy Results 📋

Next Steps >>>

Diagnostic Accuracy of Clinical Decision Rules and Physician Judgement

	Sensitivity (%)	Specificity (%)
Physician Estimation	95	68
Physician Practice	100	50
PECARN	100	62
CHALICE	84	85
CATCH	91	44

*Defined as death from traumatic brain injury, a need for neurosurgery, intubation lasting greater than 24 hours for traumatic brain injury, or hospital admission greater than 2 nights for traumatic brain injury.

- CDR sensitive, excellent negative predictive value
- Not specific - most children who have CT scan won't have a brain injury
- Senior clinician judgement almost as sensitive as PECARN
- Planned Observation leads to lower CT rates

REFERENCES:

Easter JS, Bakes K, Dhaliwal J, et al. Comparison of PECARN, CATCH, and CHALICE rules for children with minor head injury: a prospective cohort study. Ann Emerg Med 2014;64(2):145-52

This infographic was created by Anthony Rousseaux and edited by Alvin Chin

Gaps in Clinical Decision Rules for Paediatric head injury

- Delayed presentation up to 72 hours
- Child with a bleeding disorder
- Child with neurodevelopmental disorder
- Intoxicated child and a head injury

Risk of increasing CT scan rates if apply CDR uniformly across practice in Australia **given existing CT rates for mild to moderate head injury in 8.2 % at tertiary, 6.6% in metro, and 6.1 % in regional settings**

Wilson et al. Variation in Computed Tomography Use for Paediatric Head Injuries across different types of Emergency Departments in Australia and New Zealand. *Emerg Med J* 2020

PREDICT Head Injury Publications

- **APHIRST**

Babl et al. Accuracy of PECARN, CATCH, and CHALICE head injury decision rules in children: a prospective cohort study. *Lancet* 2017

- 20,000 presentations Aust and NZ in tertiary EDs
- Comparison of 3 CDR

- **APHIRST GAP**

Wilson et al. Variation in Computed Tomography Use for Paediatric Head Injuries across different types of Emergency Departments in Australia and New Zealand. *Emerg Med J* 2020

- CT scan rate across Australia
- Tertiary vs metro vs regional

- **HI guideline working group**

- ADOLPEMENT process – evidence based guideline
- 33 clinical questions
- 71 Recommendations – evidence base, consensus, practice points
- Published Feb 2021



PREDICT Head Injury Guideline development process

Guideline Working Group
comprised representation from
Australia and New Zealand

- Paediatric Emergency medical and nursing
- Emergency Medicine
- General Pediatricians
- Neurosurgery
- Intensive care
- Pre- hospital medicine
- Radiologists
- General Practice
- Implementation scientists

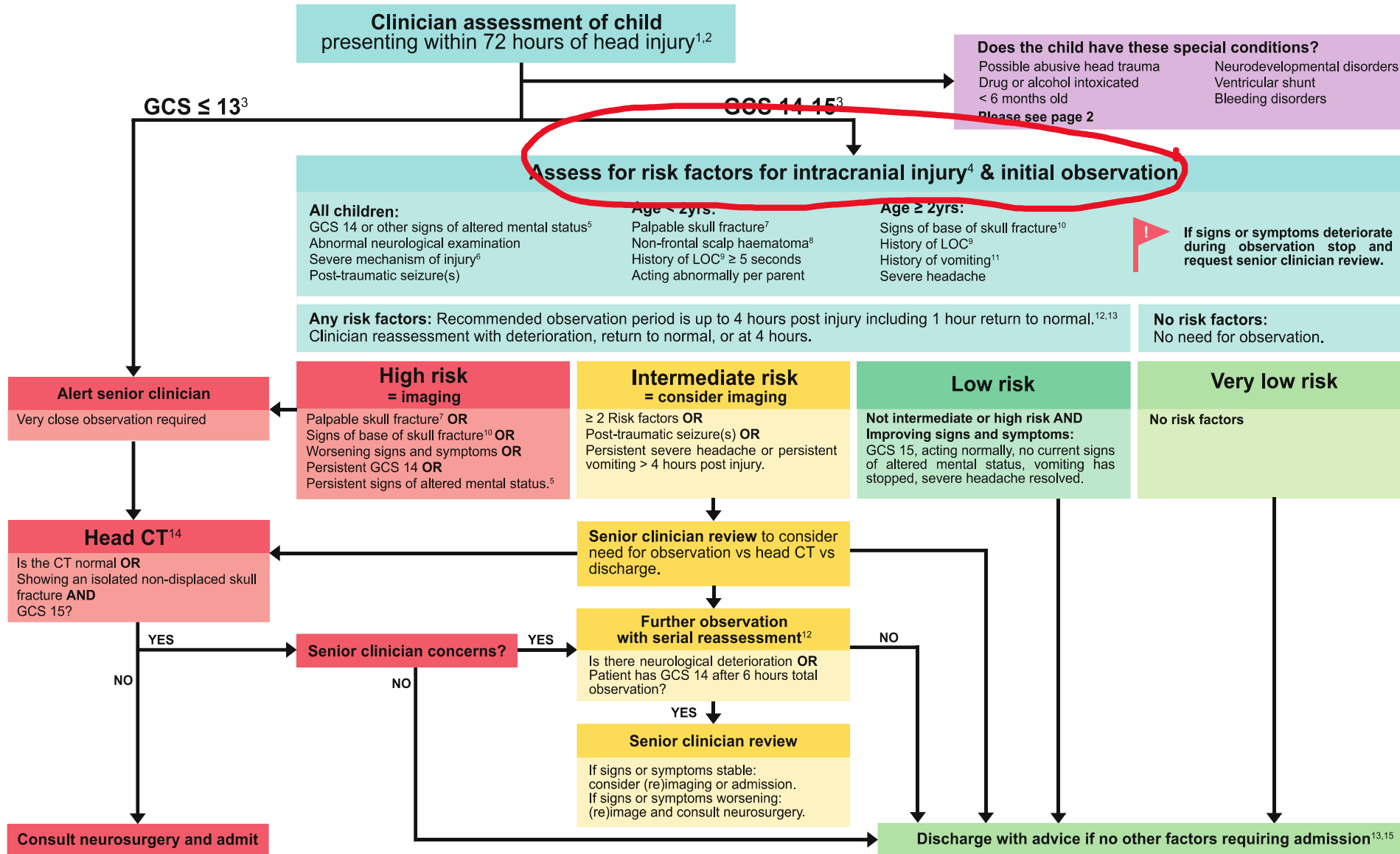
Formal feedback was received from:

Australasian College for Emergency Medicine; New Zealand Emergency Medicine Network; The Royal Australasian College of Physicians; Paediatric Society of New Zealand; Australasian College of Paramedicine; Council of Ambulance Authorities Inc.; Royal Australian and New Zealand College of Radiologists; Australian Society of Medical Imaging and Radiation Therapy; New Zealand Institute of Medical Radiation Technology; Neurosurgical Society of Australasia; Royal Australasian College of Surgeons; Sports Medicine Australia; Australian Haemophilia Centre Directors' Organisation; Royal Flying Doctor Service; College of Emergency Nurses New Zealand; Australian College of Nurse Practitioners; College of Emergency Nurses Australasia; Australian College of Nursing; Metro & Regional Paediatrics Network, Agency for Clinical Innovation New South Wales; Advanced Paediatric Life Support Australia; Advanced Paediatric Life Support New Zealand; The Royal Australian College of General Practitioners; Australian College of Rural and Remote Medicine; Victorian Department of Education.



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 $\geq 1\text{m}$ ($< 2\text{yrs}$), fall $> 1.5\text{m}$ ($\geq 2\text{yrs}$), 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 thrombocytopenias (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.

Triaging

Consensus based recommendations

Children with head injury should be **assessed in a hospital setting** if the mechanism of injury was severe¹ or if they develop the following signs or symptoms within 72 hours of injury:

- seizure or convulsion
- double vision, ataxia, clumsiness or gait abnormality
- loss of consciousness
- deteriorating level of consciousness
- weakness and tingling in arms or legs
- presumed skull fracture (palpable fracture, 'raccoon eyes' or Battle's signs)
- vomiting² (isolated vomiting unlikely TBI in absence or other risk factors)
- severe headache
- not acting normally, including abnormal drowsiness, increasing agitation, restlessness or combativeness (in children aged less than 2 years, not acting normally as deemed by a parent)
- occipital or parietal or temporal scalp haematoma (in children aged less than 2 years only).³

Consider Mechanism of Injury

Severe mechanism of injury

- motor vehicle accident with patient ejection, death of another passenger or rollover;
- pedestrian or bicyclist without helmet struck by motorised vehicle;
- falls of 1 m or more for children aged less than 2 years, and more than 1.5 m for children aged 2 years or older; or
- head struck by a high-impact object

Children with trivial head injury

- do not need to attend hospital for assessment; they can be safely managed at home

Trivial head injury includes

- ground-level falls
- walking or running into stationary objects,
- with no loss of consciousness,
- a GCS score of 15
- no signs or symptoms of head trauma other than abrasions.

Risk factors for Intracranial injury GCS 14-15

- **Risk factors for clinically-important traumatic brain injury:**
 - GCS score of 14 or other signs of altered mental status
 - Severe mechanism of injury
 - Post-traumatic seizure(s)
 - Abnormal neurological examination
- **Specific risk factors for children aged less than 2 years:**
 - Palpable skull fracture
 - Occipital or parietal or temporal scalp haematoma
 - History of LOC 5 seconds or more
 - Not acting normally per parent
- **Specific risk factors for children aged 2 years and older: –**
 - Signs of base of skull fracture
 - History of LOC
 - History of vomiting
 - Severe headache.

Special considerations

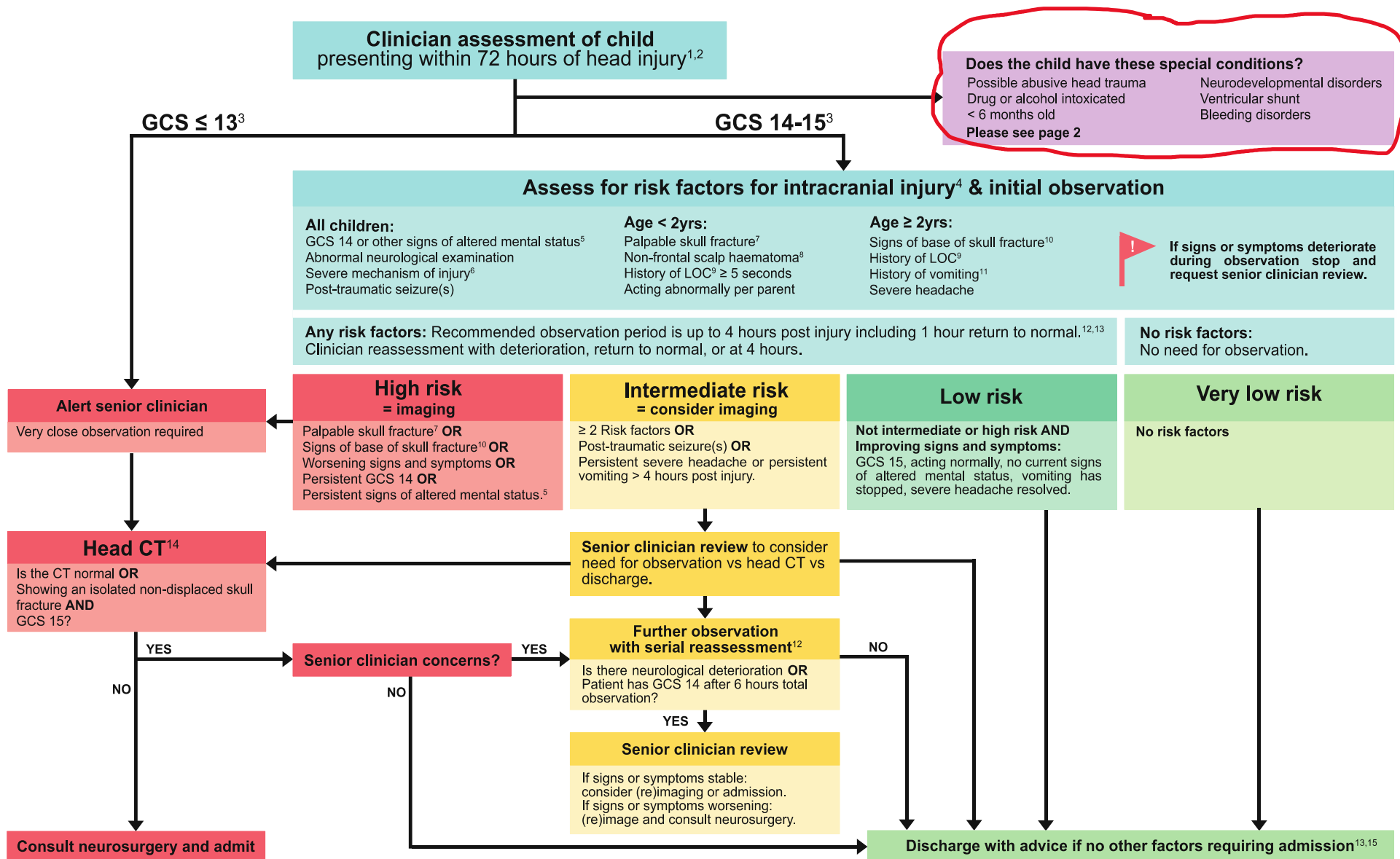
lower threshold to observe or image

- Children with ventricular-peritoneal shunts
- Children with known bleeding disorders e.g. ITP
- Children on anticoagulant or anti-platelet therapy
- Children with neurodevelopmental disorders
- Children or young people who are intoxicated
- Possibility of abusive head trauma
- Children < 6 months of age



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

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Further details to aid algorithm interpretation

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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.

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Decision rules for Head CT scan

Recommendation 5 – Evidence Informed

“Clinicians should take into account the number, severity and persistence of symptoms and signs, and family factors (e.g. distance from hospital and social context) when choosing between structured observation and a head CT scan.”

Recommendation 6 – Evidence Informed

“For children presenting to an acute care setting within 24 hours of an head injury and a GCS of 15, a head CT scan should not be performed without any risk factors for clinically important traumatic brain injury.”

Recommendation 7 – Evidence Informed

“For children presenting to an acute care setting within 72 hours of an head injury and a GCS of 13 or less should undergo an immediate head CT scan”

Discharge after structured observation without Head CT scan

Observation for up to 4 hours from time of injury

- Observation frequency every ½ hour for first 2 hours
- Hourly until 4 hours post injury
- After 4 hours , continue 2nd hourly observation for as long as child remains in hospital
- Discharge if patient returns to normal for at least an hour
- Duration of structured observation may be modified based on patient and family variables, including time since injury or signs or symptoms

Applicability to General Practice setting

Triage

- who should be assessed in the acute hospital setting
- who can be safely managed at home without going to hospital

Imaging

- which children seen in ED will require immediate CT brain
- Which children can be observed without CT scan

Discharge

- what discharge advice will be given by ED in regards to representation
- what advice will be given regarding need for physical and cognitive rest for concussion management
- what follow-up is required for Return to School, Return to Sport and Screen time

Cases to guide
through the
algorithm

What about the child with.....

[GET STARTED](#) [SKIN DEEP](#) [DFTB MODULES](#) [COVID](#) [QUICK REF](#) [X-RAYS](#) [BUBBLE WRAP](#) [OUR CONFERENCE](#) [PODCAST](#) [ABOUT US](#)

PREDICTING PAEDIATRIC TRAUMATIC BRAIN INJURIES

Dani Hall and Mieke Foster



Cite this article as:

Dani Hall and Mieke Foster. Predicting paediatric traumatic brain injuries, Don't Forget the Bubbles, 2021. Available at:
<https://doi.org/10.31440/DFTB.30993>

The biggest challenge in managing a child with a mild to moderate head injury is deciding whether to organise a CT scan or not. Balancing the risk of ionising radiation (and with it the small, but definite, risk of a future brain tumour or leukaemia) against the risk of missing a significant brain injury is mitigated to some extent by using a clinical decision rule, like the PECARN, CATCH or CHALICE rules. These rules are extremely sensitive with very few false negatives and excellent negative prediction values, meaning if you follow them, you're unlikely to miss a clinically important brain injury (cTBI). Their problem is their specificity is low with plenty of false positives, meaning most of the children who have a scan won't actually have a brain injury. (If you'd like a refresher on sensitivity, specificity, NPV and PPV in head injury decision rules, check out Damian's critical appraisal talks in [DFTB Essentials](#).)

Over the last 6 years, Australasia's PREDICT network has been a publishing powerhouse on paediatric head injuries from their [Australasian Paediatric Head Injury Research Study](#) (APHIRST for short). In their cohort of

DFTB - Applying the algorithm

A toddler with vomiting



An absentminded teenager forgets to shut the stair gate and her curious **20 month old** brother takes a tumble down **six stairs**. He cries immediately then promptly vomits.

An adolescent with a post injury seizure



A **14 year old** girl is galloping on her horse. She goes for a jump, but the horse stumbles and **she's tossed to the ground**.

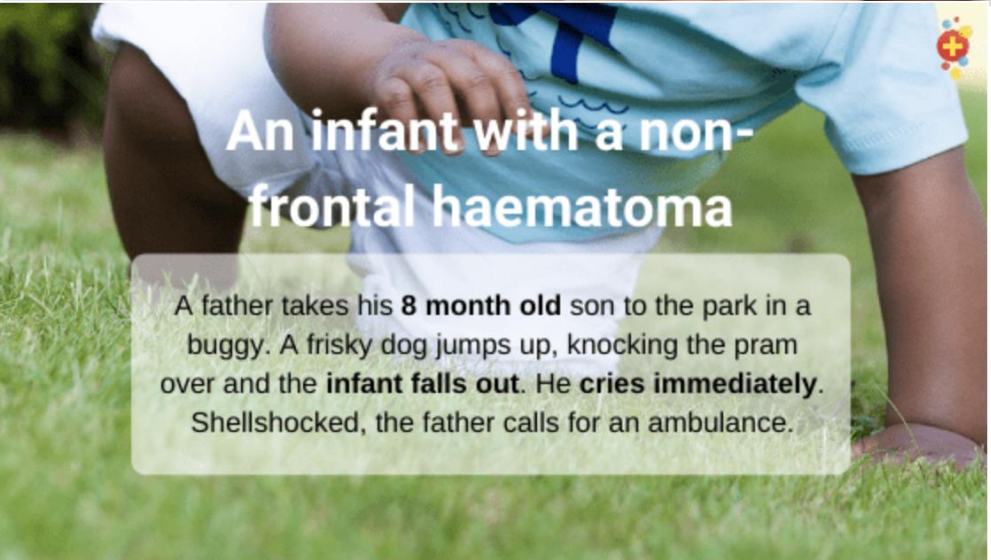
Special circumstances

Infants



A 2 month old infant

A 3 year old is delighted with her **2 month old** brother. She picks him up from the playmat but **he slips from her arms onto the floor**. He **cries immediately** but **settles quickly** in his mother's arms. Terrified, his mother calls for an ambulance.



An infant with a non-frontal haematoma

A father takes his **8 month old** son to the park in a buggy. A frisky dog jumps up, knocking the pram over and the **infant falls out**. He **cries immediately**. Shellshocked, the father calls for an ambulance.

DFTB – Applying the Algorithm

A delayed presentation



A **9 year old** competitive **rugby player** hits her head on the ground during a scrum. She was taken out of play. She **felt a little nauseous and vomited once** and was taken home to rest. She had a **headache** but this settled with paracetamol. She didn't feel up to dinner and went to bed early.

Follow-up post discharge from ED

- Children presenting within 72 hours of mild to moderate head injury and deemed low risk of ciTBI* as determined by
 - Negative head CT scan
 - Structured observation
 - Absence of risk factors for ciTBI*

do not require specific follow-up for acute intracranial injury

Parent and caregivers should be given written and verbal advice

- on when to return to the ED, including worsening symptoms, decreased level of consciousness or seizures
- on **possibility of persistent or delayed post concussive** symptoms

*Clinically important traumatic brain injury

Concussion in children and young people

5P study: Predicting and Preventing Post-concussive Problems in Pediatrics

- Children's Hospital of Eastern Ontario (CHEO) and including nine paediatric emergency departments across Canada
- enrolled over 3,000 children
- participants were aged 5-18 years old and evaluated within the first 48-hours after head injury
- most patients presenting within 3 hours of their injury.

Predicting persisting post concussion symptoms

Table 1: 5P Criteria for PPCS Risk⁶

PPCS Risk Factor	Categories	PTS
Age Group	5 to 7	0
	8 to 12	1
	13 to 18	2
Sex	Male	0
	Female	2
Longest Symptom Duration	No Prior or <1 week	0
	1+ week	1
Personal History of Migraine	No	0
	Yes	1
Answers Questions Slowly	No	0
	Yes	1
Tandem Stance	0-3	0
	4+, or unable to do test	1
Headache	No	0
	Yes	1
Sensitivity to Noise	No	0
	Yes	1
Fatigue	No	0
	Yes	2

Concussion management

Recovery Stages of Concussion

Each stage must be separated by at least 24 hours.
If symptoms occur at any one stage, athlete must return to previous stage.



Step	Goal
1. Daily activities at home Start your child on typical daily activities, such as reading or gentle walking. Begin with 5 to 15 minutes at a time and gradually build up.	A gradual return to typical activities.
2. School activities at home Introduce homework, school reading or other educational activities at home.	To increase tolerance to cognitive work.
3. Return to school part time Your child may need to start with a shorter school day or have increased breaks during the day. School tests may need to be delayed.	To increase academic activities.
4. Return to school full time Gradually increase school activities until your child can tolerate a full day.	Return to full academic activities and catch up on missed work.

RETURN TO LEARN

Step	Goal
1. Symptom-limited activity Simple daily activities that do not provoke symptoms.	A gradual return to typical activities.
2. Light aerobic exercise Gradually introduce walking, swimming or stationary cycling at a slow to medium pace. Do not allow resistance training at this stage.	To gradually increase heart rate.
3. Sport-specific exercise Your child can begin activities such as running, warm-up drills and practicing ball skills (with a soft ball). Do not allow any activities that involve head contact.	To add movement.
4. Non-contact training drills Introduce harder training drills, such as passing drills. Your child may start progressive training.	To introduce exercise, coordination and increased thinking.
5. Full contact practice Following medical clearance, participate in normal training activities.	Restoring confidence, and allowing coaching staff to assess functional skills.
6. Return to sport Your child can now progress to normal game play.	Resume regular sporting activity.

RETURN TO SPORT

Concussion management

- Expected duration of symptoms 10 – 14 days, but 4 weeks is common in children or adolescents
- 24 to 48 hours of complete cognitive rest
- Physical rest at most 48 hours
- Benefits of early light aerobic exercise
- Medical clearance before return to school and sport
- Follow-up with GP or Paediatrician

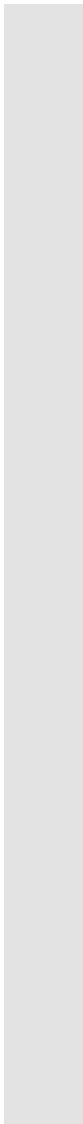


Simple Linear Skull fractures

follow-up for
children < 5
years

- **Growing skull fractures (leptomeningeal cysts)**
- enlarging skull fracture that occurs near post-traumatic encephalomalacia.
- presents with progressive scalp swelling
- skull fractures causes dural tears, allowing leptomeninges and/or cerebral parenchyma to herniate into it.
- Pulsations from CSF erode the fracture margin, resulting in eventual expansion and non-union
- **Very Rare complication**





QUESTIONS?

TAKE HOME POINTS

- Understand assessment of mechanisms of injury and risk factors to determine need for referral to hospital
- Algorithm to guide decision making for CT scan vs structured observation vs discharge
- Discharge advice for representation and follow-up of post concussion symptoms

References

- <https://www.predict.org.au/head-injury-guideline/>
- 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 (2020). PREDICT, Melbourne, Australia.
- Dani Hall and Mieke Foster. Predicting paediatric traumatic brain injuries, Don't Forget the Bubbles, 2021. Available at: <https://doi.org/10.31440/DFTB.30993>

Resources

- <https://kidshealth.schn.health.nsw.gov.au/concussion>



Concussion Action Plan (CAP) for children up to the age of 8

FAMILY NAME	MRN
GIVEN NAME	☐ MALE ☐ FEMALE
D.O.B. / /	M.O.
ADDRESS	
LOCATION/WARD	

Doctor to complete

Your child has a concussion. Their symptoms include:

Physical ☐ Headache ☐ Nausea ☐ Fatigue ☐ Vomiting ☐ Dizziness	☐ Sensitivity to light ☐ Sensitivity to noise ☐ Numbness/tingling ☐ Visual problems ☐ Balance problems	Cognitive (thinking) ☐ Feeling mentally foggy ☐ Problems concentrating ☐ Problems remembering ☐ Feeling slowed down	Emotional ☐ Irritability ☐ Sadness ☐ Feeling more emotional than usual ☐ Nervousness	Sleep ☐ Drowsiness ☐ Sleeping more than usual ☐ Sleeping less than usual ☐ Trouble falling asleep
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Over the next few days, symptoms may worsen or other symptoms may appear. Watch out for HEAD BUMPS (symptoms listed below). If they occur, seek urgent medical attention.

H Headache, seizure, unconscious. E Eye problems (blurred/double vision). A Abnormal behaviour change. D Dizziness, persistent vomiting.	B Balance dysfunction with weakness or numbness in legs/arms. U Unsteady on feet, slurred speech. M Memory impaired, confused, disoriented. P Poor concentration, drowsy, sleepy. S Something's not right (concerned about child).
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Doctor's name: _____ Signature: _____ Date: _____

Direct parents to follow the CAP, overleaf. The CAP, Symptoms Log Sheet and other tools to support a child with concussion are available for download at kidshealth.org.au/concussion

THANK
YOU FOR
LISTENING

