PREDICT

Paediatric Research in Emergency Departments International Collaborative

Australian and New Zealand Guideline for Mild to Moderate Head Injuries in Children (Summary)

2021

Version 1.0

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This document and the full guideline (*Australian and New Zealand Guideline for Mild to Moderate Head Injuries in Children*) can be downloaded from the PREDICT website: http://www.predict.org.au. If alternative file formats are required, please email: predict@mcri.edu.au

Disclaimer: The *PREDICT Australian and New Zealand Guideline for Mild to Moderate Head injuries in Children* aims to combine a review of the available evidence for the management of mild to moderate head injuries in children with current clinical and expert practice and develop general clinical practice recommendations based on the best evidence available at the time of publication. The content provided is not intended to replace personal consultation with, diagnosis and treatment by a qualified health care professional. Care should always be based on professional medical advice, appropriate for a patients specific circumstances.

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Executive summary

Children with head injuries represent some of the most common clinical presentations seen in acute paediatric care. Key management decisions need to be made with respect to triage, diagnostic imaging, admission or observation, and appropriate discharge and follow-up. Failure to do so can have both short-term and long-term sequelae.

The *PREDICT Australian and New Zealand Guideline for Mild to Moderate Head Injuries in Children* (PREDICT Guideline) was designed to provide the highest level evidence and accurate guidance for clinicians providing care for children with mild to moderate head injuries presenting to acute care settings in Australia and New Zealand. The evidence review process was completed in 2019, with the Guideline development process conducted between 2019 and 2020. This Guideline has been developed in accordance with the principles set out in the 2016 National Health and Medical Research Council's (NHMRC) *Standards for Guidelines* (1). We followed a guideline adaption process, modifying steps from the ADAPTE Guideline development framework and the GRADE (Grading of Recommendations Assessment, Development and Evaluation)-ADOLOPMENT approach, including an assessment of existing international high-quality head injury guidelines for children, followed by a systematic review of the literature to update the evidence since the development of those guidelines (2).

The Paediatric Research in Emergency Departments International Collaborative (PREDICT) convened a multidisciplinary Guideline Working Group (GWG) comprising members from across Australia and New Zealand, including emergency physicians, paediatricians, neurosurgeons, paediatric neurologists, sports medicine doctors, retrieval specialists, radiologists, nurses and nurse practitioners, neuropsychologists, general practitioners, ambulance staff, implementation scientists and consumers. The GWG developed 33 consensus-based clinical questions in three key areas – triage, imaging and discharge of children with mild to moderate head injuries presenting to acute care settings. The 33 questions were then considered with respect to recommendations from the existing international guidelines identified and an assessment of new evidence from the updated systematic review of the literature. A decision was then made on whether to adopt or adapt recommendations from existing guidelines, or to develop new recommendations to address the clinical questions and be relevant to the Australian and New Zealand clinical environment. Recommendations were classed as 'evidence-informed recommendations (EIR)', 'consensus-based recommendations (CBR)' or 'practice points (PP)'.

A summary of the PREDICT Guideline is presented here; please refer to the full guideline (*Australian and New Zealand Guideline for Mild to Moderate Head Injuries in Children (2021) Version 1.0*) for further details and evidence supporting these recommendations. A clinical algorithm (*Algorithm*: *Imaging & Observation Decision-Making for Children with Head Injuries*) has also been developed to support imaging and observation decision-making and is available on the PREDICT website (www.predict.org.au).

We trust that the Guideline will contribute to improved care and greater consistency in clinical practice for children presenting to acute care settings with head injuries.

On behalf of the Guideline Working Group.

Prof Franz Babl, Dr Emma Tavender and Prof Stuart Dalziel.

Recommendations

Type of recommendation	Description
Evidence-informed recommendation (EIR)	Recommendation formulated with evidence from source guideline and/or PREDICT literature search
Consensus-based recommendation (CBR)	Recommendation formulated by consensus, where evidence was sought but none was identified, or where the identified evidence was limited by indirectness
Practice point (PP)	A recommendation that was outside the scope of the evidence search and was based on consensus

Each recommendation is classed as new (i.e. created by the Guideline Working Group), adopted (i.e. taken from existing guidelines) or adapted (i.e. adapted from existing guidelines).

Triage

1	CBR	Children with head injury should be assessed in a hospital setting if the mechanism of injury was severe[1] 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) • vomiting[2] • 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]	New
2	CBR	Children with trivial head injury[4] do not need to attend hospital for assessment; they can be safely managed at home.[3]	New
3	EIR	Consultation with a neurosurgical service may not be routinely required for infants and children with an isolated, non-displaced, linear skull fracture on a head CT scan without intracranial injury and a GCS score of 15.[5]	New

[1] 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.

[2] A case of a single isolated vomit can be assessed in general practice.

[3] In children aged less than 2 years the signs of intracranial injury may not be apparent in the first hour.

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

[5] Measured using an age-appropriate GCS.

A	PP	Children aged less than 2 years with a suspected or identified isolated, non-displaced, linear skull fracture should have a medical follow-up within 1–2 months to assess for a growing skull fracture.[6]	New
B	PP	In all children presenting with mild to moderate head injury, the possibility of abusive head trauma should be considered.	New
4	CBR	Consultation with a neurosurgical service should occur in all cases of intracranial injury or skull fracture shown on a head CT scan, other than in infants and children with an isolated, non-displaced, linear skull fracture on a head CT scan without intracranial injury and a GCS score of 15.[5]	Adapted

Decision rules for CT scan

5	EIR	In children with mild to moderate head injury and a GCS score of 14–15[5] who have one or more risk factors for a clinically-important traumatic brain injury[7] (see below or Box A for risk factors, and *Algorithm: Imaging & Observation Decision-making for Children with Head Injuries*), clinicians should take into account the number, severity and persistence of signs and symptoms, and family factors (e.g. distance from hospital and social context) when choosing between structured observation and a head CT scan.[8] ***Risk factors for clinically-important traumatic brain injury:[7]*** – GCS score of 14[5] or other signs of altered mental status[9] – Severe mechanism of injury[1] – Post-traumatic seizure(s) – Abnormal neurological examination <u>Specific risk factors for children aged less than 2 years</u>: – Palpable skull fracture[10] – Occipital or parietal or temporal scalp haematoma[11] – History of LOC 5 seconds or more – Not acting normally per parent <u>Specific risk factors for children aged 2 years and older</u>: – Signs of base of skull fracture[12] – History of LOC – History of vomiting[13] – Severe headache.	New

[6] A growing skull fracture is a rare complication of linear skull fractures. It can occur in children aged less than 2 years with a skull bone fracture, and it represents the diastatic enlargement of the fracture due to a dural tear, with herniating brain tissue or a cystic cerebrospinal fluid-filled mass underneath. In the setting of a known skull fracture, a growing fracture is indicated by any of the following: persistent boggy swelling along a fracture line; palpable diastasis; an enlarging, asymmetrical head circumference; or delayed onset neurological symptoms. This can be assessed by a neurosurgeon, paediatrician or GP who is able to assess for a growing skull fracture.

[7] Clinically-important traumatic brain injury is defined as death from traumatic brain injury, neurosurgical intervention for traumatic brain injury, intubation for more than 24 hours for traumatic brain injury, or hospital admission of 2 nights or more associated with traumatic brain injury on CT.

[8] Sedation is usually not required in children for non-contrast CT scans as they generally only take seconds to complete. If sedation is required for uncooperative children requiring imaging local safe sedation practice should be followed.

[9] Agitation, drowsiness, repetitive questioning, slow response to verbal communication.

[10] Palpable skull fracture: on palpation or possible on the basis of swelling or distortion of the scalp.

[11] Non-frontal scalp haematoma: occipital, parietal or temporal.

[12] Signs of base of skull fracture: haemotympanum, 'raccoon eyes', cerebrospinal fluid (CSF) otorrhoea or CSF rhinorrhoea, Battle's signs.

[13] Isolated vomiting, without any other risk factors, is an uncommon presentation of clinically-important traumatic brain injury. Vomiting, regardless of the number or persistence of vomiting, in association with other risk factors increases concern for clinically-important traumatic brain injury.

6	EIR	For children presenting to an acute care setting within 24 hours of a head injury and a GCS score of 15,[5] a head CT scan should not be performed without any risk factors for clinically-important traumatic brain injury[7] (see PREDICT Recommendation 5 or Box A for risk factors, and *Algorithm: Imaging & Observation Decision-making for Children with Head Injuries*).	New
7	EIR	Children presenting to an acute care setting within 72 hours of a head injury and a GCS score of 13 or less[5] should undergo an immediate head CT scan.[8]	New
8	CBR	Children with delayed initial presentation (24–72 hours after head injury) and a GCS score of 15[5] should be risk stratified in the same way as children presenting within 24 hours.	New
C	PP	For children with mild to moderate head injury, consider shared decision-making[14] with parents, caregivers and adolescents (e.g. a head CT scan[8] or structured observation).	New
D	PP	All cases of head injured infants aged 6 months and younger should be discussed with a senior clinician. These infants should be considered at higher risk of intracranial injury, with a lower threshold for observation or imaging.[8]	New

Ventricular shunts

9	EIR	In children with a ventricular shunt (e.g. ventriculoperitoneal shunt) presenting to an acute care setting following mild to moderate head injury, who have no risk factors for clinically-important traumatic brain injury[7] (see PREDICT Recommendation 5 or Box A for risk factors), consider structured observation over an immediate head CT scan.	Adapted
E	PP	In children with a ventricular shunt and mild to moderate head injury, consider obtaining a shunt series, based on consultation with a neurosurgical service, if there are local signs of shunt disconnection, shunt fracture (e.g. palpable disruption or swelling), or signs of shunt malfunction.	New

Anticoagulant or antiplatelet therapy, and known bleeding disorders

10	EIR	In children with congenital or acquired bleeding disorders, following a head injury that results in presentation to an acute care setting, where there are no risk factors for clinically-important traumatic brain injury[7] (see PREDICT Recommendation 5 or Box A for risk factors), consider structured observation over an immediate head CT scan. If there is a risk factor for intracranial injury, a head CT should be performed. If there is a deterioration in neurological status, a head CT should be performed urgently.	Adapted
F	PP	In children with coagulation factor deficiency (e.g. haemophilia), following a head injury that results in presentation to an acute care setting, the performance of a head CT scan or the decision to undertake structured observation must not delay the urgent administration of replacement factor.	New
G	PP	In all children with a bleeding disorder or on anticoagulant or antiplatelet therapy, following a head injury that results in presentation to an acute care setting, clinicians should urgently seek advice from the haematology team treating the child in relation to risk of bleeding and management of the coagulopathy.	New

[14] Validated tools should be adapted for shared decision-making with parents, caregivers and adolescents.

11	CBR	In children with immune thrombocytopaenias, following a head injury which results in presentation to an acute care setting, where there are no risk factors for clinically-important traumatic brain injury[7] (see PREDICT Recommendation 5 or Box A for risk factors), consider structured observation over an immediate head CT scan. If there is a risk factor for intracranial injury, a head CT should be performed. If there is a deterioration in neurological status, a head CT should be performed urgently. Clinicians should check a platelet count in all children with immune thrombocytopaenias, and blood group in all symptomatic patients, if not already available.	Adapted
H	PP	In children with immune thrombocytopaenia with mild to moderate head injury and platelet counts of less than 20×10^9/L, consider empirical treatment after discussion with the haematology team treating the child.	New
12	EIR	In children with mild to moderate head injury on warfarin therapy, other anticoagulants (e.g. direct oral anticoagulants) or antiplatelet therapy, consider a head CT scan regardless of the presence or absence of risk factors for clinically-important traumatic brain injury[7] (see PREDICT Recommendation 5 or Box A for risk factors). Seek senior clinician review to inform timing of the head CT scan. Discuss the patient with the team managing the anticoagulation regarding early consideration of reversal agents. Check the appropriate anticoagulant measure (if available); for example, international normalised ratio (INR), activated partial thromboplastin time (APTT) or anti-Xa assay.	Adapted
I	PP	In adolescents with mild to moderate head injury and taking anticoagulants, including warfarin, consider managing according to adult literature and guidelines.	New

Neurodevelopmental disorders

13	CBR	It is unclear whether children with neurodevelopmental disorders presenting to an acute care setting following mild to moderate head injury have a different background risk for intracranial injury. Consider structured observation or a head CT scan for these children because they may be difficult to assess. For these children, shared decision-making with parents, caregivers and the clinical team that knows the child is particularly important.	New

Intoxication

14	CBR	In children who are drug or alcohol intoxicated presenting to an acute care setting following mild to moderate head injury, treat as if the neurological findings are due to the head injury. The decision to undertake structured observation or a head CT scan should be informed by the risk factors for clinically-important traumatic brain injury[7] (see PREDICT Recommendation 5 or Box A for risk factors and *Algorithm:Imaging & Observation Decision-making for Children with Head Injuries*) rather than the child being intoxicated.	New

Discharge without CT scan

15	EIR	In children presenting to an acute care setting following mild to moderate head injury, the risk of clinically-important traumatic brain injury[7] requiring hospital care is low enough to warrant discharge home without a head CT scan if the patient has no risk factors for a clinically important traumatic brain injury[7] (see PREDICT Recommendation 5 or Box A for risk factors), has a normal neurological examination and has no other factors warranting hospital admission (e.g. other injuries, clinician concerns [e.g. persistent vomiting], drug or alcohol intoxication, social factors, underlying medical conditions such as bleeding disorders or possible abusive head trauma).	New
J	PP	In children undertaking structured observation following mild to moderate head injury, consider observation up to 4 hours from the time of injury, with discharge if the patient returns to normal for at least 1 hour. Consider an observation frequency of every half hour for the first 2 hours, then 1-hourly until 4 hours post injury. After 4 hours, continue observation at least 2-hourly for as long as the child remains in hospital.	Adapted
K	PP	The duration of structured observation may be modified based on patient and family variables, including time elapsed since injury or signs and symptoms, and reliability and ability of the child or parent to follow advice on when to return to hospital.	New

Normal initial CT scan

16	EIR	After a normal initial head CT scan in children presenting to an acute care setting following mild to moderate head injury, the clinician may conclude that the risk of clinically-important traumatic brain injury[7] requiring hospital care is low enough to warrant discharge home, provided that the child has a GCS score of 15,[5] normal neurological examination and no other factors warranting hospital admission (e.g. other injuries, clinician concerns [e.g. persistent vomiting], drug or alcohol intoxication, social factors, underlying medical conditions such as bleeding disorders or possible abusive head trauma).	Adapted
L	PP	The duration of structured observation for children with mild to moderate head injury who have a normal initial head CT scan but do not meet discharge criteria should be based on individual patient circumstances. Consider an observation frequency of every half hour for the first 2 hours, then 1-hourly until 4 hours post injury. After 4 hours, continue at least 2-hourly for as long as the child remains in hospital.	New

Repeat imaging

17	EIR	After a normal initial head CT scan in children presenting to an acute care setting following mild to moderate head injury, neurological deterioration should prompt urgent reappraisal by the treating clinician, with consideration of an immediate repeat head CT scan and consultation with a neurosurgical service. Children who are being observed after a normal initial head CT scan[15] who have not achieved a GCS score of 15[5] after up to 6 hours observation from the time of injury should have a senior clinician review for consideration of a further head CT scan or MRI scan and/or consultation with a neurosurgical service. The differential diagnosis of neurological deterioration or lack of improvement should take account of other injuries, drug or alcohol intoxication and non-traumatic aetiologies.	Adapted

Abusive head trauma

18	EIR	In children presenting to an acute care setting following mild to moderate head injury where abusive head trauma is suspected, a head CT scan should be used as the initial diagnostic tool to evaluate possible intracranial injury and other injuries (e.g. skull fractures) relevant to the evaluation of abusive head trauma. The extent of the assessment should be coordinated with the involvement of an expert in the evaluation of non-accidental injury.	Adapted
M	PP	Detection of skull fractures, even in the absence of other intracranial injury, is important in cases of suspected abusive head trauma.	New

X-ray

19	EIR	In children presenting to an acute care setting following mild to moderate head injury, clinicians should not use plain X-rays of the skull prior to, or in lieu of, a head CT scan to diagnose skull fracture or to determine the risk of intracranial injury.	Adapted

Ultrasound

20	EIR	In children presenting to an acute care setting following mild to moderate head injury, clinicians should not use ultrasound of the skull prior to, or in lieu of, a head CT scan to diagnose or determine the risk of intracranial injury.	Adapted
21	EIR	In infants presenting to an acute care setting following mild to moderate head injury, clinicians should not use transfontanelle ultrasound prior to, or in lieu of, a head CT scan to diagnose intracranial injury.	Adopted

MRI versus CT scan

22	EIR	In children presenting to an acute care setting following mild to moderate head injury, for safety, logistical and resource reasons, MRI should not be routinely used for primary investigation of clinically-important traumatic brain injury.[16]	Adopted
N	PP	In certain settings with the capacity to perform MRI rapidly and safely in children, MRI may be equivalent to a head CT scan in terms of utility.	New

[15] The initial head CT scan should be interpreted by a radiologist to ensure no injuries were missed.
[16] If an MRI is planned, the concurrent imaging of the spine should be considered and may warrant discussion with other specialist teams.

Biomarker testing

23	EIR	In infants and children with mild to moderate head injury, presenting to an acute care setting, healthcare professionals should not use biomarkers to diagnose or determine the risk of intracranial injury outside of a research setting.	Adopted

CT scan protocols

24	EIR	In children with head injury, radiation dose should be optimised for head CT scans, with the primary aim being to produce diagnostic quality images that can be interpreted by the radiologist and are sufficient to demonstrate a small volume of intracranial haemorrhage (e.g. thin-film subdural haematoma).	New
25	EIR	Age-based CT scanning protocols that are optimised and as low as reasonably achievable (ALARA) for a paediatric population should be used.	New
26	EIR	Soft tissue and bone algorithm standard thickness and fine-slice images and multiplanar 2D and bony 3D reconstructions should be acquired, archived and available to the radiologist for review at the time of initial interpretation.	New
27	CBR	Cervical spine imaging should not be routine in all children with mild to moderate head injury who require imaging.	New

Follow-up and discharge advice

28	EIR	Children presenting within 72 hours of a mild to moderate head injury can be safely discharged into the community if they meet all the following criteria: • deemed at low risk of a clinically-important traumatic brain injury[7] as determined either by a negative head CT scan, or structured observation, or the absence of risk factors for a clinically-important traumatic brain injury (see PREDICT Recommendation 5 or Box A for risk factors, and *Algorithm:Imaging & Observation Decision-making for Children with Head Injuries*) • neurologically normal • a GCS score of 15[5] • no other factors that warrant admission or a longer period of structured observation (e.g. other injuries or suspected abusive head trauma, clinician concerns [e.g. persistent vomiting], drug or alcohol intoxication).	Adapted
29	CBR	Children presenting within 72 hours of a mild to moderate head injury, and deemed appropriate for discharge with respect to low risk of a clinically-important traumatic brain injury[7] should be discharged home according to local clinical practice regarding their ability to return to hospital (in terms of distance, time, social factors and transport).	Adapted
30	CBR	Children discharged from hospital after presenting within 72 hours of a mild to moderate head injury should have a suitable person at home to supervise them for the first 24 hours post injury.	Adapted
31	EIR	All parents and caregivers of children discharged from hospital after presenting within 72 hours of a mild to moderate head injury should be given clear, age-appropriate, written and verbal advice on when to return to the emergency department; this includes worsening symptoms (e.g. headache, confusion, irritability, or persistent or prolonged vomiting), a decreased level of consciousness or seizures.	Adopted

32	EIR	All parents and caregivers of children discharged from hospital after presenting within 72 hours of mild to moderate head injury should be given contact information for the emergency department, telephone advice line or other local providers of advice.	Adopted
33	EIR	All parents and caregivers of children discharged from hospital after presenting within 72 hours of mild to moderate head injury should be given clear, age-appropriate written and verbal advice on the possibility of persistent or delayed post-concussive symptoms, and the natural history (including the recovery process) of post-concussive symptoms in children.	Adopted
34	EIR	All parents and caregivers of children discharged from hospital after presenting within 72 hours of mild to moderate head injury should be given clear, age-appropriate written and verbal advice on exercise, return to sport, return to school, alcohol and drug use, and driving.	Adopted
35	EIR	Children presenting within 72 hours of a mild to moderate head injury deemed at low risk of a clinically-important traumatic brain injury,[7] as determined by any of the following – a negative head CT scan, structured observation or the absence of risk factors for clinically-important traumatic brain injury (see PREDICT Recommendation 5 or Box A for risk factors) – do not require specific follow-up for an acute intracranial lesion (e.g. bleeding).	New
36	EIR	All parents and caregivers of children discharged from hospital after presenting within 72 hours of mild to moderate head injury should be advised that their child should attend primary care 1–2 weeks post injury for assessment of post-concussive symptoms and to monitor clinical status.	New
37	EIR	In children at high risk of persistent post-concussive symptoms (more than 4 weeks) (see Practice point O), clinicians should consider provision of referral to specialist services for post-concussive symptom management.	Adapted
O	PP	For children presenting within 72 hours of mild to moderate head injury, emergency department clinicians should consider factors known to be associated with an increased risk of developing post-concussive symptoms. Examples include, but are not restricted to, a high degree of symptoms at presentation, girls aged over 13 years, previous concussion with symptoms lasting more than a week, or past history of learning difficulties or attention deficit hyperactivity disorder (ADHD). There are validated prediction rules (e.g. Predicting Persistent Post-concussive Problems in Pediatrics (5P) clinical risk score) or risk tables to provide prognostic counselling and follow-up advice to children and their caregivers on their potential risk of developing post-concussive symptoms (see Tables 6.3.3 and 6.3.4 in full Guideline for further details).	New
38	EIR	In children whose post-concussive symptoms do not resolve within 4 weeks, clinicians should provide or refer the child to specialist services for persistent post-concussive symptom management.	Adapted

Return to sport

39	CBR	Children with mild to moderate head injury should not return to contact sport until they have successfully returned to school. Early introduction (after 24 hours) of gradually increasing, low to moderate physical activity is appropriate, provided it is at a level that does not result in exacerbation of post-concussive symptoms.	Adapted

40	CBR	Children with post-concussive symptoms should avoid activities with a risk of contact, fall or collisions that may increase the risk of sustaining another concussion during the recovery period.	Adapted
41	CBR	Children with post-concussive symptoms who play sport should commence a modified non-contact exercise program and must subsequently be asymptomatic before full contact training or game day play can resume.	Adapted
P	PP	A modified non-contact exercise program can be supervised by a parent (for younger children) or sports or health personnel (for children with ongoing significant symptoms or older children wanting to resume contact sport).	New

Physical rest

42	EIR	Children with mild to moderate head injury should have a brief period of physical rest post injury (not more than 24–48 hours post injury).	Adapted
43	EIR	Following a mild to moderate head injury, children should be introduced to early (between 24 and 48 hours post injury), gradually increasing, low to moderate physical activity, provided that it is at a level that does not result in significant exacerbation of post-concussive symptoms. Physical activities that pose no or low risk of sustaining another concussion can be resumed whenever symptoms improve sufficiently to permit activity, or even if mild residual post-concussive symptoms are present.	Adapted

Cognitive rest

44	EIR	Children with mild to moderate head injury should have a brief period of cognitive rest[17] post injury (not more than 24–48 hours post injury).	New
45	EIR	Following a mild to moderate head injury, children should be introduced to early (between 24 and 48 hours post injury), gradually increasing, low to moderate cognitive activity, at a level that does not result in significant exacerbation of post-concussive symptoms.	New

Return to school

46	EIR	Children with post-concussive symptoms should gradually return to school at a level that does not result in significant exacerbation of post-concussive symptoms. This may include temporary academic accommodations and temporary absences from school.	Adapted
47	EIR	All schools should have a concussion policy that includes guidance on sport-related concussion prevention and management for teachers and staff, and should offer appropriate short-term academic accommodations and support to students recovering from concussion.	Adopted
48	EIR	Clinicians should assess risk factors and modifiers that may prolong recovery and may require more, prolonged or formal academic accommodations. In particular, adolescents recovering from concussion may require more academic support during the recovery period.	Adopted

[17] Low-level cognitive activity, in appropriate short periods, that does not exacerbate symptoms.

Q	PP	Protocols for return to school should be personalised and based on severity of symptoms, with the goal being to increase student participation without exacerbating symptoms. Academic accommodations and modifications after concussion may include a transition plan and accommodations designed to reduce demands, monitor recovery and provide emotional support (see Box B).	New

Screen time

49	CBR	Following a mild to moderate head injury, children's use of screens should be consistent with the recommendation for gradually increasing, low to moderate cognitive activity; that is, activity at a level that does not result in significant exacerbation of post-concussive symptoms.	New
R	PP	Parents and caregivers should be aware of general recommendations for screen use in children aged 2–5 years; that is, limiting screen use to 1 hour per day, no screens 1 hour before bed, and devices to be removed from bedrooms before bedtime.	New
S	PP	Parents and caregivers should be aware of general recommendations for screen use in children aged over 5 years; that is, promote that children get adequate sleep (8–12 hours, depending on age), recommend that children not sleep with devices in their bedrooms (including TVs, computers and smartphones) and avoid exposure to devices or screens for 1 hour before bedtime.	New

Return to driving/operating machinery

50	CBR	Adolescents (and children as appropriate) who have had a mild to moderate head injury causing loss of consciousness must not drive a car, motorbike or bicycle, or operate machinery for at least 24 hours.	New
51	CBR	Adolescents (and children as appropriate) who have had a mild to moderate head injury should not drive a car or motorbike, or operate machinery until completely recovered or, if persistent post-concussive symptoms are present, until they have been assessed by a medical professional.	New

Repeat concussion

52	CBR	Children diagnosed with a repeat concussion soon after the index injury (within 12 weeks) or after multiple repeat episodes are at increased risk of persistent post-concussive symptoms. Parents and caregivers of children with repeat concussion should be referred for appropriate medical review (e.g. to a paediatrician).	New

Box A	**Head injury risk factors for clinically-important traumatic brain injury[1]**
GCS score of 14[2] or other signs of altered mental status[3] Severe mechanism of injury[4] Post-traumatic seizures Abnormal neurological examination	
Age less than 2 years	**Age 2 years or older**
Palpable skull fracture[5] Occipital or parietal or temporal scalp haematoma[6] History of LOC ≥5 seconds Not acting normally per parent	Signs of base of skull fracture[7] History of LOC History of vomiting[8] Severe headache
Adapted from the PECARN rule, Kuppermann et al. (2009) (3)	

1 Clinically-important traumatic brain injury is defined as death from traumatic brain injury, neurosurgical intervention for traumatic brain injury, intubation for more than 24 hours for traumatic brain injury, or hospital admission of 2 nights or more associated with traumatic brain injury on CT.

2 Measured using an age-appropriate GCS.

3 Other signs of altered mental status: agitation, drowsiness, repetitive questioning, slow response to verbal communication.

4 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.

5 Palpable skull fracture: on palpation or possible on the basis of swelling or distortion of the scalp.

6 Non-frontal scalp haematoma: occipital, parietal or temporal.

7 Signs of base of skull fracture: haemotympanum, 'raccoon' eyes, cerebrospinal fluid (CSF) otorrhoea or CSF rhinorrhoea, Battle's signs

8 Isolated vomiting, without any other risk factors, is an uncommon presentation of clinically important traumatic brain injury. Vomiting, regardless of the number of vomits or persistence of vomiting, in association with other risk factors increases concern for clinically-important traumatic brain injury.

Box B	Examples of academic accommodations and modifications that may be used following concussion to facilitate increasing school participation without exacerbating symptoms
Transition plan • Notify school of concussion before or upon returning to school. • Develop a plan for gradual return to school day and activities. • Provide a medical certificate to account for any missed assignments or exams, or design a plan of assistance to support completion of these.	
Accommodations designed to reduce demands, monitor recovery and provide emotional support • Provide an appropriate environment with low stimulus for break times and potential rest times. • Consider exemption from exams. • Reduce both the number and size of classroom and homework assignments. • Allow participation in classes or activities requiring physical activity that does not exacerbate symptoms. • Reschedule, coordinate or pace exams; hold exams when the student is asymptomatic or experiencing low level symptoms that are not exacerbated by the task. • Negotiate the timing of large assignments, to reduce co-occurring deadlines. • Assign a counsellor to meet with the student to evaluate the student's emotional status, assist with problem-solving and ensure that homework needs are being addressed.	
Additional commonly used academic accommodations • Use preferential seating that is designed to reduce exposure to distracting lights and/or noises, allow for teacher monitoring and facilitate focused attention. • Allow for test-taking in a distraction-free environment. • Allow extended time for in-class and out-of-class exams and assignments. • Use a notetaker, whose notes can be photocopied or shared electronically and provided to the student.	
Adapted from O'Neil et al. (2017) (4) (Table 3) and DeMatteo et al. (2020) (5)	

CBR: consensus-based recommendation; CT: computed tomography; EIR: evidence-informed recommendation; GCS: Glasgow Coma Scale; GP: general practitioner; LOC: loss of consciousness; MRI: magnetic resonance imaging; PP: practice point

Appendix A References

1. National Health and Medical Research Council (NHMRC). Guidelines for Guidelines: Adopt, Adapt or Start from Scratch. Canberra: NHMRC; 2018. Available at: https://www.nhmrc.gov.au/guidelinesforguidelines/plan/adopt-adapt-or-start-scratch.
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3. Kuppermann N, Holmes JF, Dayan PS, Hoyle JD, Jr., Atabaki SM, Holubkov R, et al. Identification of Children at Very Low Risk of Clinically-Important Brain Injuries after Head Trauma: A Prospective Cohort Study. Lancet. 2009;374(9696):1160–70.
4. O'Neill JA, Cox MK, Clay OJ, Johnston JM, Novack TA, Schwebel DC, et al. A Review of the Literature on Pediatric Concussions and Return-to-Learn (RTL): Implications for RTL Policy, Research, and Practice. Rehabil Psychol. 2017;62(3):300–23.
5. DeMatteo C, Bednar ED, Randall S, Falla K. Effectiveness of Return to Activity and Return to School Protocols for Children Postconcussion: A Systematic Review. BMJ Open Sport Exerc Med. 2020;6(1).

For a full list of references, see the full Guideline, *Australian and New Zealand Guideline for Mild to Moderate Head Injuries in Children,* available at www.predict.org.au.