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# CLINICAL PRACTICE GUIDELINES

## Head Injury in Children



**NMRC**  
National Medical  
Research Council

**National Committee  
On Neuroscience**

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**MOH Clinical Practice Guidelines 2/2001**

**CLINICAL PRACTICE GUIDELINES**

# **Head Injury in Children**

**MOH Clinical Practice Guidelines 2/2001**

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## **Statement of Intent**

These guidelines are not intended to serve as a standard of medical care. Standards of medical care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge advances and patterns of care evolve.

The contents of this publication are guidelines to clinical practice, based on the best available evidence at the time of development. Adherence to these guidelines may not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care. Each physician is ultimately responsible for the management of his/her unique patient in the light of the clinical data presented by the patient and the diagnostic and treatment options available.

## Foreword

Head injury is a common clinical problem in the paediatric population. The majority of these children who seek medical consultation have minor head injuries with good clinical outcomes. However, a small number may develop intracranial complications following head trauma and subsequently deteriorate, resulting in severe neurological or neuropsychological deficits and even death.

A prompt and accurate diagnosis of the underlying pathology should be made and appropriate investigations ordered. For example, the skull X-ray was a routine investigation used for the assessment of head injuries. However, recent findings show that the sensitivity of skull X-rays in identifying intracranial injury in children is rather low and hence, skull X-rays should not be routinely obtained in children presenting with head injury. Doctors must also take measures to prevent the development of secondary brain injury and seek neurosurgical consultation when necessary.

These guidelines on the management of head injury in children were developed as part of the National Committee on Neuroscience's Paediatric Neurosurgery Programme through a Workgroup on Paediatric Head Injury. These guidelines present to all doctors a framework for the evaluation and management of children with head injury. I hope that doctors will find these guidelines useful and will incorporate them in their practice.

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# 1 Guideline development and objectives

Head trauma is common among children encountered by primary healthcare and Emergency Department physicians.<sup>1-3</sup> Fortunately, the majority of these head injuries are mild with good clinical outcomes. However, some of these children may harbour intracranial lesions and subsequently deteriorate, resulting in severe disability and even death. Ultimately, childhood injury is still the leading cause of death in children, with head injury having the highest morbidity and mortality rates.<sup>4</sup>

Minor head injuries in children pose a major challenge to primary healthcare and Emergency Department physicians because of the following reasons:

- (a) In terms of absolute numbers, it is the most common type of paediatric trauma encountered in daily practice,
- (b) It has the greatest controversies and variability in clinical management, and
- (c) There is a dearth of scientific data for evidence-based management.<sup>5</sup>

Hence, considerable clinical judgement is required when assessing and managing children with head injury.

## 1.1 Etiology and pathophysiology of head injury

The etiology of head injury in children varies according to the age group:<sup>6</sup>

- (a) Infants - falls or possibly child abuse,<sup>7</sup>
- (b) Pre-school children - falls or passengers in motor vehicle accidents,
- (c) School-attending children - falls, motor vehicle accidents or sports-related accidents, and

- (d) Adolescents - motor vehicle accidents or sports-related accidents.

The pathophysiology associated with head injury can be classified into primary or secondary brain injury:

- Primary brain injury – These have already occurred by the time the patient presents to the doctor. It is due to mechanical damage sustained at the time of injury as a result of contact between brain matter and the interior surface of the skull or due to foreign bodies causing direct contact injury and contusion.
- Secondary brain injury - Possible mechanisms include hypoxia, raised intracranial pressure and decreased blood flow,<sup>8</sup> and can result in further neuronal damage. The focus of all current management and most investigational brain injury therapies is aimed at preventing or minimising secondary brain injury.<sup>9</sup>

## **1.2 Guidelines development and target group**

A workgroup, comprising of a paediatric neurologist, a paediatric neurosurgeon, paediatricians and emergency medicine specialists, was tasked by the National Committee on Neuroscience to develop these guidelines on *Head Injury in Children*. The workgroup conducted a systemic review of current medical literature and formulated these guidelines using the best available evidence from literature.

These guidelines were prepared to provide assistance to physicians who have to manage children with head injuries brought to their clinics or to the Emergency Department.

## **1.3 Objectives of the guidelines**

Successful management of children with head injuries requires a proper clinical assessment of the primary injury and an appreciation of the potential for intracranial complications. The need for immediate care, investigations and hospital admission should be determined on the basis of these factors.

Although the majority of children with head injuries will not require hospital admission or diagnostic procedures, it is important that those

at risk of intracranial complications and resultant disability or death be identified and managed accordingly.

These guidelines are intended to:

- Suggest management priorities,
- Give guidelines to determine the need for imaging studies, and
- Provide triage guidelines according to the severity of the head injury.

## 2 Levels of evidence and grades of recommendation

### Levels of evidence

Level	Type of Evidence
<b>Ia</b>	Evidence obtained from meta-analysis of randomised controlled trials.
<b>Ib</b>	Evidence obtained from at least one randomised controlled trial.
<b>IIa</b>	Evidence obtained from at least one well-designed controlled study without randomisation.
<b>IIb</b>	Evidence obtained from at least one other type of well-designed quasi-experimental study.
<b>III</b>	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.
<b>IV</b>	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

### Grades of recommendation

Grade	Recommendation
<b>A</b> (evidence levels Ia, Ib)	Requires at least one randomised controlled trial as part of the body of literature of overall good quality and consistency addressing the specific recommendation.
<b>B</b> (evidence levels IIa, IIb, III)	Requires availability of well conducted clinical studies but no randomised clinical trials on the topic of recommendation.
<b>C</b> (evidence level IV)	Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates absence of directly applicable clinical studies of good quality.
<b>GPP</b> (good practice points)	Recommended best practice based on the clinical experience of the guideline development group.

### 3 Executive summary of recommendations

**C** The first step in the management and resuscitation of children with head injuries is the assessment and management of the A, B, Cs i.e. the airway, breathing and circulation.

**Grade C, Level IV**

**C** A quick and simple way to do a mental status examination in children of all ages is to use the AVPU (A - Alert, V - responds to Vocal stimuli, P - responds only to Painful stimuli, U - Unresponsive) method.

**Grade C, Level IV**

**B** The conscious state of the patient, based on the Glasgow Coma Scale (GCS), is an important indicator of the severity of the injury.

**Grade B, Level IIb**

**GPP** A child with a minor head injury can be classified into low risk, medium risk and high risk minor head injury based on the history and the findings of the physical and neurological examination.

**B** A child with a low risk, minor head injury does not require skull X-rays and can be discharged home to the care of a reliable caregiver.

**Grade B, Level IIb**

**B** Consider skull X-ray in a child who has a completely normal neurological examination but a large scalp haematoma which prevents palpation of the skull in order to rule out a depressed skull fracture.

**Grade B, Level IIb**

**B** A child with a medium risk, minor head injury should be referred to the Emergency Department for assessment, observation and possible admission into hospital.

**Grade B, Level IIb**

**B** Children with high risk, minor head injury should be admitted into hospital and be reviewed by a neurosurgeon. Resuscitation and cardiorespiratory stabilisation should be started immediately and computerized tomography (CT) scanning is mandatory.

**Grade B, Level IIb**

**B** Obtain CT Head scan for minor head injury (medium and high risk) with any of the following:

- Loss of consciousness
- Altered mental status or confusion
- GCS 13-14
- Palpable depressed skull fracture
- Repetitive vomiting
- Focal neurological deficit or change in examination over time
- Infant with bulging fontanelle and/or split sutures
- Concern about possible child abuse

**Grade B, Level IIb**

**B** Children with moderate and severe head injury will require rapid evaluation and resuscitation at the Emergency Department with the involvement of the neurosurgeon.

**Grade B, Level IIb**

## 4 Assessment of head injury in children

### 4.1 Management priorities

**C** The first step in the management and resuscitation of children with head injuries is the assessment of the A, B, Cs i.e. the airway, breathing and circulation.<sup>10</sup>

Grade C, Level IV

#### 4.1.1 Resuscitation

Prompt ventilatory support and treatment of shock are mandatory to prevent secondary brain injury.

#### 4.1.2 History Taking

After initial assessment, the next step is to obtain a brief history of the event.

Useful information include the following:

- Type of injury,
- Mechanism of injury e.g. height of fall or speed of the vehicle, and
- Symptoms that have occurred since the injury has occurred, including any loss of consciousness.

However, these reports may be inconsistent and hence unreliable. Fortunately, the progression of symptoms provides invaluable information to assist the physician in clinical decision-making. A brief seizure at the time of injury may not be clinically significant and may not necessitate therapy. However, one or more prolonged seizures associated with cardiorespiratory compromise would necessitate prompt treatment. Many children will vomit 2-3 times or have transient loss of consciousness (< 1 minute) after even a minor head injury.<sup>11</sup> However, protracted vomiting and retching associated with other symptoms or signs indicate a more severe head injury. Amnesia, irritability, lethargy, pallor or agitation may also indicate severe head injury.

Details of any significant medical history should be obtained. Evidence of conditions such as a predisposition to seizures, previous ventriculo-peritoneal shunt insertion or a bleeding diathesis is important and would further dictate clinical management.

### 4.1.3 Physical examination

After history taking, the medical examination follows.

Vital signs should be documented.

A detailed head examination should be performed, looking in particular for scalp haematoma, depressed fracture, haemotympanum, as well as fluid leaking from the nose or ear. It is important to remember that cervical spine injury may be associated with head injury.

The neurological examination should include the following:

- Eye examination,
- Mental status examination,
- Cranial nerve examination, and
- Checking the extremities for movements.

The neurological examination helps to determine the presence of focal neurological signs that may signify the presence of an intracranial mass or impending brain herniation from increased intracranial pressure. After completion of the neurological examination, a complete physical examination for other injuries is carried out.

**C** A quick and simple way to do a mental status examination in children of all ages is to use the AVPU method, which describes the level of consciousness as follows:<sup>10</sup>

**A - Alert**

**V - responds to Vocal stimuli**

**P - responds only to Painful stimuli**

**U - Unresponsive**

Grade C, Level IV

## 4.2 Glasgow Coma Scale

**B** The conscious state of the patient, based on the Glasgow Coma Scale (GCS), is an important indicator of the severity of the injury.

Grade B, Level IIb

The GCS (Annex 1) is a more detailed examination of the conscious state.<sup>12</sup> It is a qualitative measure based on the sum of scores in 3 areas of assessment: eye opening, motor response and verbal response and is an important tool that influences treatment decisions and outcomes. The verbal response in the GCS has been modified for children less than 2 years of age, who have limited verbal skills, by assigning a full verbal score if the child cries after stimulation.<sup>13</sup>

## 4.3 Head Injury and Child Abuse

Children with head injury as a result of abuse are generally less than 3 to 6 years old and many are infants.

There is a higher incidence of intracranial lesions from such abusive head injuries.

Non-accidental head injuries can result from shaking (Shaken Baby Syndrome) or from direct impact or from a combination of the two. It is characterised by subarachnoid haemorrhage or subdural bleeds with retinal haemorrhages.

While some studies have suggested that intracranial bleeds can occur from short falls, their presence, associated with a history of short falls or vague history, should arouse suspicion of a non-accidental cause.

## **5 Common clinical entities seen in head injuries**

### **5.1 Scalp Lacerations**

Scalp lacerations are very common in children and are also considered as head injuries. Children with scalp lacerations will require a detailed neurological examination as they may also have significant brain injury. Children often have a scalp laceration that requires suturing. When closing a scalp laceration, once haemostasis has been secured, exploration of the wound with a gloved finger should be done to feel for an underlying fracture. If there is no fracture, the laceration is cleaned and stitched. If a fracture is present, the neurosurgeon should be consulted prior to closing the wound. Tetanus status should be checked.

### **5.2 Linear Skull Fractures**

Linear skull fractures are the most common fracture in children and account for 80% of all skull fractures. The presence of a fracture reflects significant impact and therefore increased potential for underlying brain injury. Fractures that cross the path of the middle meningeal artery or dural sinuses are at greater risk for intracranial bleed. Simple linear fractures require no surgical intervention.

### **5.3 Depressed Skull Fractures**

Depressed skull fractures account for 10-20% of fractures in children. A depressed skull fracture occurs when the inner table of the skull is displaced downwards. The bony edges are easily surgically elevated by neurosurgery if the depression is greater than the thickness of the skull.

### **5.4 Base of Skull Fractures**

Base of skull fractures are difficult to diagnose radiologically. The diagnosis of a base of skull fracture should be suspected based on clinical findings such as associated cerebrospinal fluid otorrhoea and rhinorrhoea, haemotympanum, Battle's sign (mastoid ecchymosis), and racoon eyes (periorbital ecchymosis).

## 5.5 Concussion

Concussion is another clinical entity often dealt with. A concussion is a traumatically induced alteration in mental status, associated with confusion, loss of consciousness and post-traumatic amnesia. Symptoms including sleepiness and confusion may present for several hours after the injury. Most patients become normal within a few hours.

## 5.6 Post-Traumatic Seizure

Post-traumatic seizure is a fairly common clinical scenario frequently seen in a child with head injury. This condition is extremely frightening to parents and it is important to be able to answer any questions that they may have. There are 3 categories of post-traumatic seizures - immediate, early and late.<sup>14</sup>

- Immediate seizures occur within seconds of the injury and represent traumatic depolarisation. These patients do not require extensive workup if they are normal on presentation to the Emergency Department. They require no medication and these children have no long-term sequelae.
- Early seizures occur within 1 week of the injury and are the result of focal injury to the brain. 25% of children presenting with early seizure have recurrences. These children should be evaluated with imaging and electroencephalogram (EEG) and many of them may need anticonvulsant therapy. They will need to be reviewed by a paediatric neurologist.
- Late seizures occur after more than 1 week of the injury and are attributed to scarring of brain tissue. Most of these patients require anticonvulsant therapy to prevent recurrences. A referral to the paediatric neurologist is also mandatory.

## **5.7 Intracranial Haematoma**

### **5.7.1 Epidural/Extradural Haematoma**

An epidural or extradural haematoma is a collection of blood between the skull and the dura mater. An overlying fracture is present in 75% of epidural haematoma. Classically, the child has initial loss of consciousness followed by a lucid interval and then subsequent deterioration. An epidural haematoma requires immediate surgical evacuation. It has also been documented that epidural haematomas can occur in children with relatively minor head injury and normal neurological examination.<sup>15</sup>

### **5.7.2 Subdural Hematoma**

A subdural haematoma is a collection of blood between the dura mater and the brain parenchyma. Subdural haematomas often occur as the result of direct trauma or child abuse. A large subdural haematoma requires surgical evacuation while small ones can be observed.

## 6 Classification of severity of head injury

### 6.1 Classification of severity of head injury

There are various ways of grading the severity of head injury. A common way of grading the severity of head injury is based on the GCS:

Minor Head Injury	- GCS 13-15
Moderate Head Injury	- GCS 9-12
Severe Head Injury	- $\leq$ GCS 8

Minor head injury, with brief or no loss of consciousness, is seen in 95% of children. However, the GCS classification of minor head injury (GCS 13-15) has been shown to be inadequate as there is a heterogenous pathophysiology among patients with GCS scores in the 13-15 range, and patients with a GCS score of 13 or 14 are at higher risk of having a haematoma requiring surgery or of neurological deterioration.<sup>16,17</sup>

Patients with mild head injury should be assessed promptly. The neurological examination (including mental status and the GCS) has been shown to be the best predictor of subsequent deterioration or intracranial haemorrhage requiring surgical intervention in patients with minor head injury.<sup>18</sup>

**GPP** A child with a minor head injury can be classified into low risk, medium risk and high risk minor head injury based on the history and the findings of the physical and neurological examination.

Consequently, the degree of risk of deterioration from intracranial injuries can be classified on the basis of the child's history and the findings at physical and neurological examination. These risk categories are similar to the high and low risk groups recommended by Masters et al, but have been adapted to reflect the unique characteristics of children with head injury.<sup>19</sup>

The inclusion of the GCS provides more information to assist in triage, treatment and prediction of outcome.

## 6.2 Risk Classification of Minor Head Injury

### Low risk

- Asymptomatic
- Mild or no headache
- Vomiting (< 3 episodes)
- Glasgow Coma Scale score of 15
- Transient loss of consciousness (seconds)
- Scalp injury - bruise or laceration

### Medium risk

- Loss of consciousness (> 1 minute)
- Progressive lethargy
- Progressive headache
- Vomiting protracted (> 3 times) or associated with other symptoms
- Post-traumatic amnesia
- Post-traumatic seizure
- Multiple trauma
- Serious facial injury
- Signs of basal skull fracture
- Possible penetrating injury or depressed skull fracture
- Possible child abuse
- Neonate or young child (< 2 years)
- Glasgow Coma Scale score of 13-14

### High risk

- Glasgow Coma Scale score of  $\leq 12$ , or decrease of  $\geq 2$  points, not clearly caused by seizures, drugs, decreased cerebral perfusion or metabolic factors
- Focal neurologic signs
- Penetrating skull injury
- Palpable depressed skull fracture
- Compound skull fracture

### **6.3 Triage guidelines**

Patients with minor head injury should be assessed promptly and should have imaging studies and neurosurgical consultation based on their initial assessment. Patients with moderate and severe head injury clearly need rapid evaluation and resuscitation at the Emergency Department with involvement of the neurosurgeon.

## 7 Investigation of head injury in children

### 7.1 Skull X-ray

Before the advent of CTs, this was the only imaging study available to evaluate children with head injuries. There have been multiple investigators who have studied the utility of skull X-rays with varying results. Some of the older studies suggested that skull X-rays might help in the assessment of head injuries but other more recent literature suggest that skull X-rays are an unnecessary expense. A recent neurosurgical literature reports that skull X-rays are not useful and should not routinely be obtained in patients with head injuries.<sup>16</sup>

The suggested indications for skull radiography are:

- possible penetration
- possible depressed fracture
- compound fracture
- previous craniotomy with indwelling shunt
- child less than 2 years of age with "boggy" scalp haematoma
- suspected child abuse

### 7.2 Computerized Tomography (CT) of the Head

CT Head has become the imaging procedure of choice for the assessment of acute head injury in children.<sup>20-22</sup> CT Head has virtually supplanted skull x-rays for acute assessment. It is readily available and obtainable in a timely manner for most emergency services. CT allows visualisation of epidural haematomas, subdural haematomas, intraventricular haemorrhage, brain oedema and skull fractures.

### 7.3 Magnetic Resonance Imaging (MRI) of the Head

MRI provides finer resolution for brain anatomy and is superior to CT for visualising diffuse axonal injury, contusions and brainstem injuries.<sup>23,24</sup> However, it requires a longer imaging time and is less accessible to emergency services. Special ventilatory and resuscitation equipment which are unaffected by the strong magnetic field are also needed and are not readily available in many places.

## 7.4 Recommendations for imaging

**B** No imaging study is indicated in a child with minor head injury with no loss of consciousness, GCS 15, normal neurological examination, and no palpable depressed skull fracture (low risk, minor head injury).<sup>5,16,19,25</sup>

Grade B, Level IIb

**B** Consider skull X-ray in a child who has a completely normal neurological examination but a large scalp haematoma which prevents palpation of the skull in order to rule out a depressed skull fracture.<sup>18,24</sup>

Grade B, Level IIb

If a fracture is seen, a CT Head scan may be indicated.

**B** Obtain CT Head scan for minor head injury (medium and high risk) with any of the following:<sup>5,15,16,21,22,24</sup>

- Loss of consciousness
- Altered mental status or confusion
- GCS 13-14
- Palpable depressed skull fracture
- Repetitive vomiting
- Focal neurological deficit or change in examination over time
- Infant with bulging fontanelle and/or split sutures
- Concern about possible child abuse

Grade B, Level IIb

## 8 Admission criteria

### 8.1 Low risk minor head injury

**B** Children with low risk, minor head injury may be discharged home.<sup>19,24,26</sup>

**Grade B, Level IIb**

An instruction sheet (Annex 2) should be given to the parents or caregiver concerning observation and precautions. These patients usually do not pose a major therapeutic or diagnostic dilemma.

### 8.2 Medium risk minor head injury

**B** A child with a medium risk, minor head injury should be referred to the Emergency Department for assessment, observation and possible admission into hospital.

**Grade B, Level IIb**

These patients should be referred to hospital and close observation for at least 6 hours after injury is warranted. In general, admission is recommended for patients in the medium risk category.

Based on further evaluation at the emergency department, certain cases may be observed in the Emergency Department for 6 hours.

If the condition progressively improves during that time, the child may be discharged home.<sup>18,24</sup> A reliable caregiver should be in charge at home and be given an instruction sheet for observation and precautions.

If any of these criteria are not met, the patient should be admitted for observation. CT scanning and neurosurgical consultation will be necessary if the child's condition does not improve or deteriorates.<sup>8,15,19,24</sup> A child with recent uncomplicated linear skull fracture should be admitted for observation.

### **8.3 High risk minor head injury, moderate and severe head injury**

These children should be admitted to hospital immediately and be reviewed by a neurosurgeon. Resuscitation and cardiorespiratory stabilisation should be started immediately. If the child is brought to a non-tertiary care centre, the physician should consult a neurosurgeon or a critical care specialist at the referral centre before the patient is transferred. CT scanning is required.

**B Children with high risk, minor head injury should be admitted into hospital and be reviewed by a neurosurgeon. Resuscitation and cardiorespiratory stabilisation should be started immediately and CT scanning is mandatory.**

**Grade B, Level IIb**

**B Children with moderate and severe head injury will require rapid evaluation and resuscitation at the Emergency Department with the involvement of the neurosurgeon.**

**Grade B, Level IIb**

## 9 Prevention of head injury in children

Primary prevention offers the greatest opportunities to reduce the "burden of disease" due to head injuries in children.

Doctors in primary healthcare, emergency medicine, paediatric and surgical disciplines have an important role to play as advocates for childhood injury control. This includes the participation in injury control research, promoting child safety awareness in the community and opportunistic injury prevention counselling.

A list of injury prevention tips is given in Annex 3. This can be copied and given to caregivers to reinforce child safety awareness, especially after they have been seen and discharged home after a consultation for a low risk, minor head injury.

Other resources on child safety awareness can be obtained from the Child Safety Centre at the KK Women's & Children's Hospital and from the National Safety Council.

## 10 Recommendations for evaluation

Audit parameters for this set of guidelines should look at

- Rate of request for skull X-rays in children with low risk, minor head injury
- Missed intracranial injury due to failure to refer to the Emergency Department based on neurological deterioration at subsequent attendance at the Emergency Department if initially seen at the primary healthcare level.
- Missed intracranial injury due to failure to admit to the Neurosurgery Department based on neurological deterioration at subsequent re-attendance at the Emergency Department if initially seen at the Emergency Department.

## 11 References

1. Borczuk P. Mild head trauma. *Emerg Med Clin North Am* 1997; 15:563-79.
2. Division of Injury Control, Center for Environmental Health and Injury Control, Centers for Disease Control. Childhood injuries in the United States. *Am J Dis Child* 1990; 144:627-46.
3. Ang A, Ng KC, Sim TP. Children's Emergency based Childhood Accidental Injuries Surveillance – one year perspective. *Sing Paediatr J* 1999; 41 (1):27-34.
4. Shackford SR, MacKersie RC, Holbrook TL, et al. The epidemiology of traumatic deaths: a population-based analysis. *Arch Surg* 1993; 128:571.
5. Homer CJ, Kleinman L. American Academy of Pediatrics Technical Report: Minor head injury in children. *Pediatrics* 1999; 104(6):e78.
6. Gallagher SS, Finison K, Guyer B, et al. The incidence of injuries among 87,000 Massachusetts children and adolescents: results of the 1980-81 Statewide Childhood Prevention Program Surveillance System. *Am J Public Health* 1987; 74:1340-7.
7. Bruce DA, Zimmerman RA. Shaken impact syndrome. *Pediatr Ann* 1989; 18:483-94.
8. Rose J, Valtonen S, Jennett B. Avoidable factors contributing to death after head injury. *BMJ* 1977; 2:625.
9. Savitsky EA, Votey SR. Current controversies in the management of minor pediatric head injuries. *Am J Emerg Med* 2000; 18(1):96-101.
10. Committee on Trauma, American College of Surgeons. *Advanced Trauma Life Support for Physicians Student Manual*; 1993.
11. Hugenholtz H, Izukawa D, Shear P, et al. Vomiting in children following head injury. *Childs Nerv Syst* 1987; 3:266-70.

12. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. *Lancet* 1974; 2:81-4.
13. Management of children with head trauma. Emergency Paediatrics Section, Canadian Paediatric Society. *Canadian Medical Association Journal* 1990; 142(9):949-52.
14. Jennett B, Teasdale G. Management of Head Injuries. Philadelphia: F.A. Davis & Co; 1976.
15. Hahn YS, McLone DG. Risk factors in the outcome of children with minor head injury. *Pediatr Neurosurg* 1993; 19:135-42.
16. Feuerman T, Wackym PA, Gade GF, et al. Value of skull radiography, head computed tomography, and admission for observation in cases of minor head injury. *Neurosurgery* 1998; 22:449-53.
17. Hsiang JNK, Yeung T, Yu ALM, et al. High-risk mild head injury. *J Neurosurg* 1997; 87:234-8.
18. Lloyd DA, Carty H, Patterson M, et al. Predictive value of skull radiography for intracranial injury in children with blunt head injury. *Lancet* 1997; 349:821-4.
19. Masters SJ, McClean PM, Arcarese MS, et al. Skull x-ray examinations after head trauma: recommendations by a multidisciplinary panel and validation study. *New Engl J Med* 1987; 316:84-91.
20. Livingston DH, Loder PA, Koziol J, et al. The use of CT scanning to triage patients requiring admission following minimal head injury. *J Trauma* 1991; 31:483.
21. Shackford SR, Wald SL, Ross SE, et al. The clinical utility of computerized tomographic scanning and neurologic examination in the management of patients with minor head injuries. *J Trauma* 1992; 33(3): 385-94.
22. Stein SC, Ross SE. The value of computerized tomography in patients with low risk head injuries. *Neurosurgery* 1990; 26(4): 638.

23. Gentry LR. Imaging of closed head injury. *Radiology* 1994; 191: 1-17.
24. Committee on Quality Improvement, American Academy of Pediatrics and Commission on Clinical Policies and research, American Academy of Family Physicians. The management of minor closed head injury in children. *Pediatrics*, 1999; 104(6): 1407.
25. Borczuk P. Predictors of intracranial injury in patients with mild head trauma. *Ann Emerg Med* 1995; 25:731.
26. Taheri PA, Karamanoukian H, Gibbons K, et al. Can patients with minor head injuries be safely discharged home ? *Arch Surg* 1993; 128: 289.

## 12 Workgroup members

The members of the workgroup are:

Chairperson: Dr Seow Wan Tew

Members: Dr Angelina Ang  
Assoc Prof Peter Manning  
Dr Ng Kee Chong

Advisor: Assoc Prof Lee Wei Ling

## The Glasgow Coma Scale

### Eye-opening response

Spontaneous	4
To speech	3
To pain	2
None	1

### Verbal response\*

Oriented	5
Confused conversation	4
Inappropriate words	3
Incomprehensible sounds	2
None	1

### Best upper limb motor response

Obeys commands	6
Localises to pain	5
Withdraws	4
Abnormal flexion	3
Extensor response	2
None	1

\* *Children less than 2 years of age should receive full verbal score for crying after stimulation.*

## Annex 2

### **Instructions to parents or caregivers for home observation of children with head injury**

Bring child immediately to the Emergency Department if any of the following signs and symptoms appear within the first 72 hours after discharge:

- Any unusual behaviour
- Confusion as to name and place
- Inability to wake child from sleep
- Increasing or persistent headache
- Seizures
- Unsteadiness on feet
- Unusual drowsiness and sleepiness
- Vomiting > 3 times

### **Childhood Head Injury Prevention - Tips for caregivers**

Nothing can replace close supervision in childhood injury prevention that an adult caregiver can provide. Your child is not able to identify the potential injury hazards in their environment and they need your care and protection.

#### Infants and toddlers

1. Do not leave your baby unattended, even for a few seconds, on an adult bed or baby cot without proper barriers.
2. Do not use the sarong cradle. Head injuries, skull fractures and even deaths have occurred when infants fall off the sarong or when the springs or attachments of the cradle breaks.
3. Do not use a baby walker. They can topple over and many falls causing head injuries have been documented locally and overseas. Some cases of deaths as a result of these injuries have been reported.
4. Do not shake the baby violently even though you may feel frustrated or angry. This can cause severe and fatal internal head bleeding.
5. Ensure that the high chair your child uses is of a sturdy design and use the appropriate restraints when your child is seated on it.
6. Use an age-appropriate car seat for your child.

### School aged children

1. Supervise children closely in playgrounds. Prevent them from climbing onto unstable and high structures. Avoid playgrounds that are poorly maintained or have unsafe designs (e.g. hard flooring, rusted or broken metal parts).
2. Ensure that a properly fitted protective helmet is used for activities like cycling, skating, skateboarding, roller blading, or during the use of the skate scooter.
3. Teach your child road safety habits. Do not allow your child to play or go on the roads unsupervised.
4. Ensure that your child puts on age-appropriate seat belts or booster seat restraints while in a vehicle.
5. Teach your child sports and recreational safety rules.

Head Injury in Children

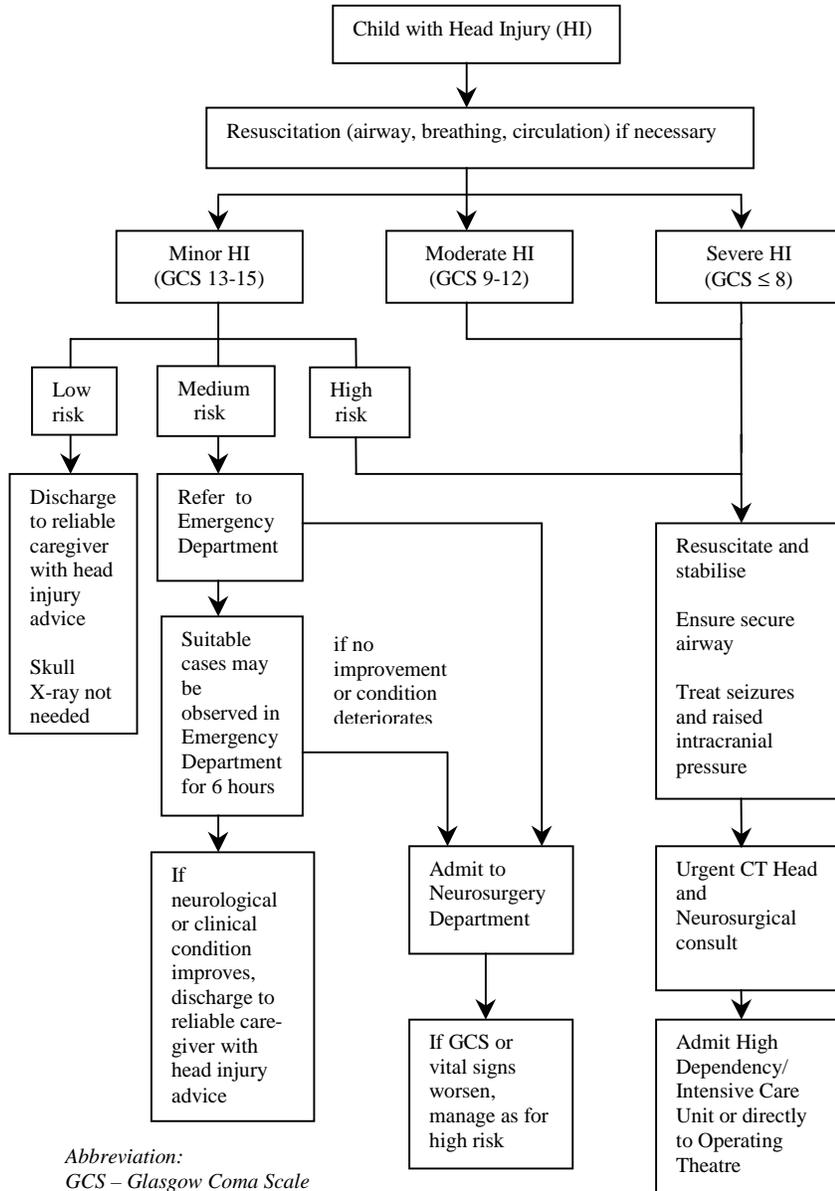


Ministry of Health

NMRC  
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Research Council

National Committee  
On Neuroscience

Management Algorithm in Paediatric Head Injury (HI)



## **Risk Classification of Minor Head Injury**

### **Low risk**

- Asymptomatic
- Mild or no headache
- Vomiting (< 3 episodes)
- Glasgow Coma Scale score of 15
- Transient loss of consciousness (seconds)
- Scalp injury - bruise or laceration

### **Medium risk**

- Loss of consciousness (> 1 minute)
- Progressive lethargy
- Progressive headache
- Vomiting protracted (> 3 times) or associated with other symptoms
- Post-traumatic amnesia
- Post-traumatic seizure
- Multiple trauma
- Serious facial injury
- Signs of basal skull fracture
- Possible penetrating injury or depressed skull fracture
- Possible child abuse
- Neonate or young child (< 2 years)
- Glasgow Coma Scale score of 13-14

### **High risk**

- Glasgow Coma Scale score of  $\leq 12$ , or decrease of  $\geq 2$  points, not clearly caused by seizures, drugs, decreased cerebral perfusion or metabolic factors
- Focal neurologic signs
- Penetrating skull injury
- Palpable depressed skull fracture
- Compound skull fracture



