110 Early management of patients with a head injury

A national clinical guideline

May 2009
KEY TO EVIDENCE STATEMENTS AND GRADES OF RECOMMENDATIONS

LEVELS OF EVIDENCE

1++ High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+ Well conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1- Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++ High quality systematic reviews of case control or cohort studies
   High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+ Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2- Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3 Non-analytic studies, eg case reports, case series
4 Expert opinion

GRADES OF RECOMMENDATION

Note: The grade of recommendation relates to the strength of the evidence on which the recommendation is based. It does not reflect the clinical importance of the recommendation.

A At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or
   A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or
   Extrapolated evidence from studies rated as 1++ or 1+
C A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or
   Extrapolated evidence from studies rated as 2++
D Evidence level 3 or 4; or
   Extrapolated evidence from studies rated as 2+

GOOD PRACTICE POINTS

☑ Recommended best practice based on the clinical experience of the guideline development group.

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SIGN guidelines are produced using a standard methodology that has been equality impact assessed to ensure that these equality aims are addressed in every guideline. This methodology is set out in the current version of SIGN 50, our guideline manual, which can be found at www.sign.ac.uk/guidelines/fulltext/50/index.html The EQIA assessment of the manual can be seen at www.sign.ac.uk/pdf/sign50eqia.pdf The full report in paper form and/or alternative format is available on request from the NHS QIS Equality and Diversity Officer.

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Early management of patients with a head injury
A national clinical guideline

May 2009
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1 Introduction

1.1 THE NEED FOR A GUIDELINE

1.1.1 FEATURES OF PATIENTS WITH A HEAD INJURY ATTENDING SCOTTISH HOSPITALS

Head injury accounts for a significant proportion of emergency department (ED) and prehospital (primary care and ambulance service) workload. In the UK the annual incidence of attendance at the ED with a head injury is 6.6% and around 1% of all patients attending the ED are admitted with a head injury. In Scotland, this equates to 100,000 attendances at EDs each year, of which over 15% lead to admission, a rate of around 330 per 100,000 of the population. Of the attendances, the majority (93%) are Glasgow Coma Scale (GCS; see section 3.2.1) 15 on presentation, whilst only 1% have a GCS score of 8 or less. Although case fatality is low, trauma is the leading cause of death under the age of 45 and up to 50% of these are due to a head injury. Up to half of all inpatient adults with a head injury experience long term psychological and/or physical disability, as defined by the Glasgow Outcome Scale (GOS), and patients who sustain intracranial events as a complication of head injury can suffer long term sequelae, especially if definitive therapy is delayed. Evidence based guidelines can help to achieve optimal care.

In Scotland about half of those attending are children under the age of 14 years. The majority of patients are fully conscious (see Table 1), without a history of loss of consciousness or amnesia or other signs of brain damage.

Table 1: Level of responsiveness in 7,656 patients with a head injury attending ED in Scotland

<table>
<thead>
<tr>
<th>GCS (/15)</th>
<th>Adults</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>93%</td>
<td>96%</td>
</tr>
<tr>
<td>9-14</td>
<td>6%</td>
<td>3.5%</td>
</tr>
<tr>
<td>≤8</td>
<td>1%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

1.1.2 UPDATING THE EVIDENCE

Guidelines for the management of patients with a head injury were first endorsed by the Department of Health in 1983 and the expansion of trauma services and greater availability of computed tomography (CT) scanning resources have been taken into account in subsequent guidelines. In 1984 the Harrogate guidelines made suggestions on the early management of patients with a head injury, followed in 1999 by the Galasko report from the Royal College of Surgeons. SIGN published SIGN 46: Early management of patients with a head injury in August 2000. Since publication of SIGN 46 there have been developments in several aspects of head injury management, including imaging, transfer to neurosurgical and neurointensive care, and rehabilitation. Much of the debate has focused on the management of patients with apparently minor head injuries, who can still suffer life threatening or disabling consequences. The National Institute for Health and Clinical Excellence (NICE) guidelines were published in 2003 and updated in 2007. Both SIGN 46 and the NICE guidelines are designed to optimise the early management of patients with a head injury but differ in their recommendations, especially the indications for radiological investigation. The NICE guideline emphasises CT scanning as the definitive way to image patients with head injury.

This new guideline takes into account these developments and makes recommendations that are appropriate to the population of Scotland.
Where no new evidence was identified to support a change to existing recommendations, the guideline text and recommendations are reproduced verbatim from SIGN 46. The original supporting evidence was not re-appraised by the current guideline development group.

The evidence in SIGN 46 was appraised using an earlier grading system. Details of how the grading system was translated to SIGN’s current grading system are available on the SIGN website: www.sign.ac.uk.

1.2 REMIT OF THE GUIDELINE

1.2.1 OVERALL OBJECTIVES

This guideline makes recommendations on the early management of patients with head injury, focusing on topics of importance throughout NHSScotland. The guideline development group was comprised of individuals representing all aspects of health services involved in the care of patients with a head injury (see section 13.2).

The guideline development group based its recommendations on the evidence available to answer a series of key questions, listed in Annex 1.

One aim of the guideline is to determine which patients are at risk of intracranial complications. Another is how to identify which patients are likely to benefit from transfer to neurosurgical care, and who should be followed up after discharge. The guideline does not discuss the detailed management of more severe head injuries, either pre- or in-hospital, which are already incorporated into guidelines from the American College of Surgeons,4 the American Association of Neurosurgeons/Brain Trauma Foundation,18 the European Brain Injury Consortium,19 the Association of Anaesthetists/British Neuroanaesthesia Society,20 and the Society of British Neurological Surgeons.21

1.2.2 TARGET USERS OF THE GUIDELINE

This guideline will be of particular interest to anyone who has responsibility for the care of patients with head injury, including those who work in pre-hospital care, general practice, emergency departments, radiology, surgical and critical care specialties, paediatric and rehabilitation services, as well as members of voluntary organisation and patients.

1.3 DEFINITIONS

1.3.1 HEAD INJURY

Head injury is defined differently in many of the studies used as evidence in this guideline. The definition used by the guideline development group is based on a broad definition by Jennett and MacMillan and includes patients with ‘a history of a blow to the head or the presence of a scalp wound or those with evidence of altered consciousness after a relevant injury’.22 The level of consciousness as assessed by the Glasgow Coma Scale has been used to categorise the severity of a head injury (see Table 2 and Table 4).

Table 2: Definition of mild, moderate and severe head injury by GCS score

<table>
<thead>
<tr>
<th>Degree of head injury</th>
<th>GCS score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>13-15</td>
</tr>
<tr>
<td>Moderate</td>
<td>9-12</td>
</tr>
<tr>
<td>Severe</td>
<td>8 or less</td>
</tr>
</tbody>
</table>
1.3.2 PAEDIATRIC RECOMMENDATIONS AND GOOD PRACTICE POINTS

Paediatric recommendations and good practice points are marked with this symbol.

1.4 STATEMENT OF INTENT

This guideline is not intended to be construed or to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. Adherence to guideline recommendations will 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 aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan. This judgement should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available. It is advised, however, that significant departures from the national guideline or any local guidelines derived from it should be fully documented in the patient’s case notes at the time the relevant decision is taken.

1.4.1 ADDITIONAL ADVICE TO NHSSCOTLAND FROM NHS QUALITY IMPROVEMENT SCOTLAND AND THE SCOTTISH MEDICINES CONSORTIUM

NHS Quality Improvement Scotland (NHS QIS) processes multiple technology appraisals (MTAs) for NHSScotland that have been produced by NICE in England and Wales.

The Scottish Medicines Consortium (SMC) provides advice to NHS Boards and their Area Drug and Therapeutics Committees about the status of all newly licensed medicines and any major new indications for established products.

No SMC advice or NHS QIS validated NICE MTAs relevant to this guideline were identified.
2 Key recommendations

The following recommendations were highlighted by the guideline development group as the key clinical recommendations that should be prioritised for implementation. The grade of recommendation relates to the strength of the supporting evidence on which the evidence is based. It does not reflect the clinical importance of the recommendation.

2.1 ADULTS

2.1.1 INITIAL ASSESSMENT

- The management of patients with a head injury should be guided by clinical assessments and protocols based on the Glasgow Coma Scale and Glasgow Coma Scale Score.

2.1.2 INDICATIONS FOR REFERRAL TO HOSPITAL

- Adult patients with any of the following signs and symptoms should be referred to an appropriate hospital for further assessment of potential brain injury:
  - GCS <15 at initial assessment (if this is thought to be alcohol related observe for two hours and refer if GCS score remains <15 after this time)
  - post-traumatic seizure (generalised or focal)
  - focal neurological signs
  - signs of a skull fracture (including cerebrospinal fluid from nose or ears, haemotympanum, boggy haematoma, post auricular or periorbital bruising)
  - loss of consciousness
  - severe and persistent headache
  - repeated vomiting (two or more occasions)
  - post-traumatic amnesia >5 minutes
  - retrograde amnesia >30 minutes
  - high risk mechanism of injury (road traffic accident, significant fall)
  - coagulopathy, whether drug-induced or otherwise.

2.1.3 INDICATIONS FOR HEAD CT

- Immediate CT scanning should be done in an adult patient who has any of the following features:
  - eye opening only to pain or not conversing (GCS 12/15 or less)
  - confusion or drowsiness (GCS 13/15 or 14/15) followed by failure to improve within at most one hour of clinical observation or within two hours of injury (whether or not intoxication from drugs or alcohol is a possible contributory factor)
  - base of skull or depressed skull fracture and/or suspected penetrating injuries
  - a deteriorating level of consciousness or new focal neurological signs
  - full consciousness (GCS 15/15) with no fracture but other features, eg severe and persistent headache - two distinct episodes of vomiting
  - a history of coagulopathy (eg warfarin use) and loss of consciousness, amnesia or any neurological feature.
CT scanning should be performed within eight hours in an adult patient who is otherwise well but has any of the following features:

- age $> 65$ (with loss of consciousness or amnesia)
- clinical evidence of a skull fracture (e.g., boggy scalp hematoma) but no clinical features indicative of an immediate CT scan
- any seizure activity
- significant retrograde amnesia ($> 30$ minutes)
- dangerous mechanism of injury (e.g., pedestrian struck by motor vehicle, occupant ejected from motor vehicle, significant fall from height) or significant assault (e.g., blunt trauma with a weapon).

In adult patients who are GCS $< 15$ with indications for a CT head scan, scanning should include the cervical spine.

2.1.4 INDICATIONS FOR ADMISSION TO HOSPITAL

An adult patient should be admitted to hospital if:

- the level of consciousness is impaired (GCS $< 15/15$)
- the patient is fully conscious (GCS $15/15$) but has any indication for a CT scan (if the scan is normal and there are no other reasons for admission, then the patient may be considered for discharge)
- the patient has significant medical problems, e.g., anticoagulant use
- the patient has social problems or cannot be supervised by a responsible adult.

2.1.5 REFERRAL TO NEUROSURGICAL UNIT

A patient with a head injury should be discussed with a neurosurgeon:

- when a CT scan in a general hospital shows a recent intracranial lesion
- when a patient fulfills the criteria for CT scanning but facilities are unavailable
- when the patient has clinical features that suggest that specialist neuroscience assessment, monitoring, or management are appropriate, irrespective of the result of any CT scan.

All salvageable patients with severe head injury (GCS score $8/15$ or less) should be transferred to, and treated in, a setting with 24-hour neurological ICU facility.

2.1.6 DISCHARGE ADVICE

Patients and carers should be given advice and information in a variety of formats tailored to their needs.
2.2 CHILDREN

2.2.1 INITIAL ASSESSMENT

Great care should be taken when interpreting the Glasgow Coma Scale in the under fives and this should be done by those with experience in the management of the young child.

2.2.2 INDICATIONS FOR REFERRAL TO HOSPITAL

In addition to the indications for referral of adults to hospital, children who have sustained a head injury should be referred to hospital if any of the following risk factors apply:
- clinical suspicion of non-accidental injury
- significant medical comorbidity (e.g., learning difficulties, autism, metabolic disorders)
- difficulty making a full assessment
- not accompanied by a responsible adult
- social circumstances considered unsuitable.

2.2.3 INDICATIONS FOR HEAD CT

Immediate CT scanning should be done in a child (<16 years) who has any of the following features:
- GCS≤13 on assessment in emergency department
- witnessed loss of consciousness >5 minutes
- suspicion of open or depressed skull injury or tense fontanelle
- focal neurological deficit

CT scanning should be considered within eight hours if any of the following features are present (excluding indications for an immediate scan):
- presence of any bruise/swelling/laceration >5 cm on the head
- post-traumatic seizure, but no history of epilepsy nor history suggestive of reflex anoxic seizure
- amnesia (anterograde or retrograde) lasting >5 minutes
- clinical suspicion of non-accidental head injury
- a significant fall
- age under one year: GCS<15 in emergency department assessed by personnel experienced in paediatric GCS monitoring
- three or more discrete episodes of vomiting
- abnormal drowsiness (slowness to respond).

If a child meets head injury criteria for admission and was involved in a high speed road traffic accident, scanning should be done immediately.
2.2.4 INDICATIONS FOR ADMISSION TO HOSPITAL

Children who have sustained a head injury should be admitted to hospital if any of the following risk factors apply:
- any indication for a CT scan
- suspicion of non-accidental injury
- significant medical comorbidity
- difficulty making a full assessment
- child not accompanied by a responsible adult
- social circumstances considered unsuitable.

2.2.5 REFERRAL TO NEUROSURGICAL UNIT

A patient with a head injury should be discussed with a neurosurgeon:
- when a CT scan in a general hospital shows a recent intracranial lesion
- when a patient fulfils the criteria for CT scanning but facilities are unavailable
- when the patient has clinical features that suggest that specialist neuroscience assessment, monitoring, or management are appropriate, irrespective of the result of any CT scan.

All salvageable patients with severe head injury (GCS score 8/15 or less) should be transferred to, and treated in, a setting with 24-hour neurological ICU facility.

2.2.6 DISCHARGE ADVICE

Clear written instruction should be given to and discussed with parents or carers before a child is discharged.
3 Initial assessment

3.1 TELEPHONE ADVICE SERVICES

A person with a head injury may present via a telephone advice service. No evidence was identified to support or refute the safety or efficacy of telephone triage of patients with a suspected head injury. Consensus criteria and guidance for referral by telephone advice services (for example, NHS24, emergency department helplines) to an emergency ambulance service (see section 3.1.1) or to a hospital emergency department (see section 3.1.2) have been developed.17

3.1.1 CRITERIA FOR REFERRAL TO AN EMERGENCY AMBULANCE SERVICE BY TELEPHONE ADVICE SERVICES

Telephone advice services should refer people who have sustained a head injury to the emergency ambulance services (999) for emergency transport to the emergency department if they have experienced any of the following risk factors:

- unconsciousness, or lack of full consciousness (e.g., problems keeping eyes open)
- any focal (i.e., restricted to a particular part of the body or a particular activity) neurological deficit since the injury (see Table 3)
- any suspicion of a skull fracture or penetrating head injury (see Table 3)
- any seizure (convulsion or fit) since the injury
- a high energy head injury (see Table 3)
- if it cannot be ensured that the injured person will reach hospital safely.

Table 3: Clinical indicators for referral to an emergency ambulance service

<table>
<thead>
<tr>
<th>Focal neurological deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>problems understanding, speaking, reading or writing</td>
</tr>
<tr>
<td>loss of feeling in part of the body</td>
</tr>
<tr>
<td>problems balancing</td>
</tr>
<tr>
<td>unilateral weakness</td>
</tr>
<tr>
<td>any changes in eyesight</td>
</tr>
<tr>
<td>problems walking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skull fracture or penetrating head injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>fluid running from the ears or nose</td>
</tr>
<tr>
<td>black eye with no direct orbital trauma</td>
</tr>
<tr>
<td>bleeding from one or both ears</td>
</tr>
<tr>
<td>new deafness in one or both ears</td>
</tr>
<tr>
<td>bruising behind one or both ears</td>
</tr>
<tr>
<td>penetrating injury</td>
</tr>
<tr>
<td>major scalp wound or skull trauma.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High energy head injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>pedestrian struck by motor vehicle</td>
</tr>
<tr>
<td>occupant ejected from motor vehicle</td>
</tr>
<tr>
<td>a fall from a height of greater than one metre or more than five stairs</td>
</tr>
<tr>
<td>diving accident</td>
</tr>
<tr>
<td>high speed motor vehicle collision</td>
</tr>
<tr>
<td>rollover motor accident</td>
</tr>
<tr>
<td>accident involving motorised recreational vehicles</td>
</tr>
<tr>
<td>bicycle collision</td>
</tr>
<tr>
<td>impact from golf club, cricket or baseball bat</td>
</tr>
<tr>
<td>any other potentially high energy mechanism.</td>
</tr>
</tbody>
</table>
3.1.2 CRITERIA FOR REFERRAL TO A HOSPITAL EMERGENCY DEPARTMENT BY TELEPHONE ADVICE SERVICES

Telephone advice services should refer people who have sustained a head injury to a hospital emergency department if the history related indicates the presence of any of the following risk factors:

- any loss of consciousness (‘knocked out’) as a result of the injury, from which the injured person has now recovered
- amnesia for events before or after the injury (‘problems with memory’)
- persistent headache since the injury
- any vomiting episodes since the injury
- any previous cranial neurosurgical interventions (brain surgery)
- history of bleeding or clotting disorder
- current anticoagulant therapy such as warfarin
- current drug or alcohol intoxication
- suspicion of non-accidental injury
- irritability or altered behaviour (‘easily distracted’, ‘not themselves’, ‘no concentration’, ‘no interest in things around them’) particularly in infants and young children (aged under five years)
- continuing concern by the helpline personnel about the diagnosis.

The assessment of amnesia will not be possible in pre-verbal children and is unlikely to be possible in any child aged under five years.

In the absence of any risk factors listed in 3.1.1 and 3.1.2 callers should be advised to contact the telephone advice service again if symptoms worsen or there are any new developments.

Telephone advice services should advise the injured person to seek medical advice from community services (eg, general practice) if any of the following factors are present:

- adverse social factors (eg, no one able to supervise the injured person at home)
- continuing concern by the injured person or their carer about the diagnosis.

3.2 ASSESSING THE PATIENT

The approach to management of head injuries which depended on taking urgent action following the detection of deterioration has been superseded by pre-emptive investigation to detect lesions before they lead to neurological deterioration. The management of individual patients with a head injury, and the formulation and application of guidelines depends upon the use of a widely accepted and applicable method of assessment and classification of the so-called ‘level of consciousness’ as defined by the Glasgow Coma Scale Score. This provides the most useful indication of the initial severity of brain damage and its subsequent changes over time.
3.2.1 THE GLASGOW COMA SCALE AND COMA SCORE

The Glasgow Coma Scale\(^{23}\) and its derivative, the Glasgow Coma Scale Score,\(^{24}\) are used widely for assessing patients, both before and after arrival at hospital.\(^{25-27}\) Extensive studies have supported their repeatability,\(^{28-31}\) and validity.\(^{24,32-35}\)

The management of patients with a head injury should be guided by clinical assessments and protocols based on the Glasgow Coma Scale and Glasgow Coma Scale Score.

The Glasgow Coma Scale provides a framework for describing the state of a patient in terms of three aspects of responsiveness: eye opening, verbal response, and best motor response, each stratified according to increasing impairment. In the first description of the scale for general use, the motor response had only five options, with no demarcation between ‘normal’ and ‘abnormal’ flexion. The distinction between these movements can be difficult to make consistently\(^{28,31}\) and is rarely useful in monitoring an individual patient but is relevant to prognosis and is therefore part of an extended six option scale used to classify severity in groups of patients.\(^{32,36}\)

The Glasgow Coma Scale Score is an artificial index; obtained by adding scores for the three responses.\(^{24}\) The notation for the score was derived from the extended scale, incorporating the distinction between normal and abnormal flexion movements, producing a total score of 15 (see Table 4). This score can provide a useful single figure summary and a basis for systems of classification, but contains less information than a description separately of the three responses.

The three responses of the original scale (developed in 1974), not the total score, should therefore be of use in describing, monitoring and exchanging information about individual patients. The guideline development group recommends that the progress of the patient should be recorded on a chart, incorporating the Glasgow Coma Scale and other features. An example of a chart which is widely used is included in Annex 2.

Examination of the cranial nerves, in particular pupil reactivity, and neurological examination of the limbs, focusing on the pattern and power of movement, provide supplementary information about the site and severity of local brain damage. Information about mechanisms of injury, other injuries and complications should also be recorded.

Patients with a head injury can be assessed using information from the Glasgow Coma Scale or Score. In view of the widespread use of both systems, the recommendations in this guideline are framed in both terms where appropriate.

Annex 3 summarises the procedure for assessing a patient using the Glasgow Coma Scale.

- Monitoring and exchange of information about individual patients should be based on three separate responses of the Glasgow Coma Scale.

- A standard chart should be used to record and display assessments, including the Glasgow Coma Scale, pupil size and reaction and movements of right and left limbs.
Table 4: The Glasgow Coma Scale and Score

<table>
<thead>
<tr>
<th>Feature</th>
<th>Scale Responses</th>
<th>Score Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye opening</td>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>To speech</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>To pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Verbal response</td>
<td>Orientated</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Confused conversation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Words (inappropriate)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sounds (incomprehensible)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Best motor response</td>
<td>Obey commands</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Localise pain</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Flexion - normal</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>- abnormal</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Extend</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL COMA ‘SCORE’</strong></td>
<td></td>
<td><strong>3/15 – 15/15</strong></td>
</tr>
</tbody>
</table>
3.2.2 THE PAEDIATRIC COMA SCALE AND SCORE

The Glasgow Coma Scale is difficult to apply to young children. A modified GCS lists specific indications for assessing children under five years of age (see Table 5).

Great care should be taken when interpreting the Glasgow Coma Scale in the under fives and this should be done by those with experience in the management of the young child.

Table 5: The Paediatric Coma Scale and Score for use in children under five years of age

<table>
<thead>
<tr>
<th>Feature</th>
<th>Scale Responses</th>
<th>Score Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye opening</td>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>To voice</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>To pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Verbal response</td>
<td>Orientated/interacts/follows objects/smiles/alert/coos/babbles words to usual ability</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Confused/consolable</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Inappropriate words/moaning</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Incomprehensible sounds/irritable/inconsolable</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Best motor response</td>
<td>Obey commands/normal movement</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Localise pain/withdraw to touch</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Withdraw to pain</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Flexion to pain</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Extension to pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

**TOTAL COMA ‘SCORE’** 3/15 – 15/15
4 Referral to the emergency department

4.1 Principles of Advanced Trauma Life Support

A detailed review of all aspects of care of patients with a head injury before arrival and in the ED is not within the scope of this guideline.

The guideline development group endorses the principles of Advanced Trauma Life Support (ATLS), the systematic, internationally accepted approach for assessment and resuscitation developed by the American College of Surgeons Committee on Trauma. For children, the Advanced Paediatric Life Support system is recommended (APLS).

An adult patient with a head injury should initially be assessed and managed according to clear principles and standard practice as embodied in the Advanced Trauma Life Support system and for children the Advanced Paediatric Life Support system.

4.2 Indications for Referral to Hospital

An apparently minor blow to the head is a common event in everyday life and many patients do not require hospital referral. The principal reasons for hospital referral are the existence or potential for brain injury or the presence of a wound that may require surgical repair.

Four meta-analyses and six studies either formulated or tested established criteria for predicting intracranial injury. The total number of patients in the six studies was 46,610.

A meta-analysis found that decreased GCS was a strong predictor of intracranial injury in adults with a minor head injury (relative risk, RR of 5.58). A study of the Canadian computed tomography (CCT) head rule (see section 5.1.1) found that an initial GCS of 13 and GCS < 15 after two hours of observation were predictive of intracranial injury (odds ratio, OR of 3.8 and 7.3 respectively). In children a GCS < 14 had a positive predictive value (PPV) of 0.45 and GCS < 15 a PPV of 0.1. Using the New Orleans Criteria (NOC), patients with a GCS < 15 received a CT scan, compared to those with GCS 13-15 following the CCT head rule.

Loss of consciousness (LOC) is one of the entry criteria for the CCT head rule and NOC. LOC is predictive of an intracranial lesion in adults (RR 2.23). Two trials found ORs of 1.6 and 6.54. An LOC of greater than five minutes in children had a PPV of 0.45.

The presence of focal neurology is highly associated with intracranial injury (RR 9.43). An OR of 1.8 for focal neurology in adults and PPV of 0.36 in children were also reported.

Signs of a skull fracture are a strong predictor of intracranial lesion in adults (RR 6.13) with ORs of 2.91, 5.2, 11.24 reported. In children, suspected penetrating or depressed skull injury or tense fontanelle had a PPV of 0.44 for significant brain injury while suspected base of skull fracture had a PPV of 0.16.

Repeated vomiting is a weaker predictor (RR 0.88) with reported OR ranging from 2.13 to 4.08 in three studies. In children, repeated vomiting had a PPV of 0.065.

In adults, severe headache had an RR of 1.02 for intracranial lesion. A meta-analysis reported an OR of 3.37 for seizure was a predictive indicator of intracranial injury in adults. Seizure had a PPV of 0.29 in children.

The evidence for the predictive value of post-traumatic amnesia is less compelling, but it was considered a medium risk factor in the NOC and CCT head rule. Retrograde amnesia of greater than 30 minutes prior to the injury was also a medium risk factor. Amnesia in children five minutes or longer had a PPV of 0.22.

A meta-analysis found that age > 65 years was a predictor of intracranial injury in patients with minor head trauma (OR 3.7). The NOC included patients aged 60 years and over as high risk and the CCT head rule included patients over 65 years of age.
Mechanism of injury was associated with intracranial injury, with ORs of 1.65 and 2.8 reported.39,47 In children, high-risk mechanisms include road traffic accident (PPV 0.43), fall from higher than three metres (PPV 0.2), projectile injury (PPV 0.39).49

There was little evidence on whether coagulopathy was a risk factor for intracranial lesion. One study of 13,728 patients found a high association,44 while a smaller study reported an OR of 4.48.43

Suspicion of non-accidental injury (NAI) in children had a PPV for significant brain injury of 0.33.40

Adult patients with any of the following signs and symptoms should be referred to an appropriate hospital for further assessment of potential brain injury:

- GCS<15 at initial assessment (if this is thought to be alcohol related observe for two hours and refer if GCS score remains <15 after this time)
- post-traumatic seizure (generalised or focal)
- focal neurological signs
- signs of a skull fracture (including cerebrospinal fluid from nose or ears, haemotympanum, boggy haematoma, post auricular or periorbital bruising)
- loss of consciousness
- severe and persistent headache
- repeated vomiting (two or more occasions)
- post-traumatic amnesia >5 minutes
- retrograde amnesia >30 minutes
- high risk mechanism of injury (road traffic accident, significant fall)
- coagulopathy, whether drug-induced or otherwise

- significant medical comorbidity (eg previous or persisting stroke, diabetes, dementia)
- social problems or cannot be supervised by a responsible adult.

Adult patients who have sustained a mild head injury and are taking antiplatelet medication (eg aspirin, clopidogrel) should be considered for referral to hospital.

Adult patients who have sustained a head injury and who re-present with ongoing or new symptoms (headache not relieved by simple analgesia, vomiting, seizure, drowsiness, limb weakness) should be referred to hospital.

In addition to the above, children who have sustained a head injury should be referred to hospital if any of the following risk factors apply:

- clinical suspicion of non-accidental injury

- significant medical comorbidity (eg learning difficulties, autism, metabolic disorders)
- difficulty making a full assessment
- not accompanied by a responsible adult
- social circumstances considered unsuitable.

In injured children, especially the very young, the possibility of non-accidental injury must be considered:

- when findings are not consistent with the explanation given
- if the history changes, or
- if the child is known to be on the Child Protection Register.

In such cases a specialist paediatrician with responsibility for child protection should be involved. Child protection procedures should be followed.

Emergency department information systems should be able to identify children on the Child Protection Register and frequent attenders.
4.3 INDICATIONS FOR REFERRAL AFTER A SPORT-RELATED HEAD INJURY

Injuries to the head are common in sport, especially contact sport and represent a significant number of head injuries seen in EDs. A systematic review of concussion in various contact sports found that the incidence of concussion ranged from 0.18 to 3.6 per 1,000 athlete exposures for non-professional sports people and was as high as 9.05 per 1,000 player games at the professional level.48 Doctors, including general practitioners (GPs), who rarely see patients with a head injury in day to day practice, are now more commonly covering sporting events as medical officers. While indications for referral to hospital after a sport-related head injury are as for any head injury (see section 4.2), training in and understanding the management of sports people after a head injury is poor in terms of what evaluation should be carried out and when it is safe to return to play.

4.3.1 THE SPORT CONCUSSION ASSESSMENT TOOL

Recommendations for the improvement of the health and safety of athletes who suffer concussive injuries in ice hockey, football (soccer) as well as other sports are available.49 The Sport Concussion Assessment Tool (SCAT) is a widely used standardised tool developed for physician assessment of sports concussion (see Annex 4).49 It can be used for patient education as well as for physician assessment of sports concussion. SCAT can also be used to compile a baseline evaluation prior to the beginning of a competitive sport season which allows more meaningful interpretation of post-concussive symptoms.

People with a sport-related head injury should be referred to hospital if the indications for referral are present.

4.4 INDICATIONS FOR TRANSFER FROM A REMOTE AND RURAL LOCATION

The initial assessment of a patient with a head injury, particularly in remote and rural areas, may not be in an emergency department (see section 3) with the facilities outlined in sections 5, 6 and 7. This assessment may be undertaken by a practitioner (doctor, or nurse or paramedic with extended training), in a variety of settings, including rural hospitals and surgeries capable of assessing the signs and symptoms detailed in section 4.2.

Arranging transfer of a patient with a head injury to an acute hospital can be a major undertaking because of the distance and/or sea crossings involved. There is evidence to suggest that reduced level of consciousness, loss of consciousness, focal neurology and skull fracture are strong risk factors for requiring surgical intervention in adults and children.40,41,47 The evidence suggests that patients with these signs and symptoms must be transferred to a centre with a 24 hour CT scanning capability (and paediatric cover if the patient is a child), as rapidly as possible regardless of the logistic problems. If transfer is by air transport this should be to a centre with the resources for undertaking surgical intervention, which will require early notification and discussion with the Scottish Ambulance Service.

For patients with other indicators found as a single sign or symptom the clinician will have to use clinical judgement as to the merit of transferring the patient. The clinician may wish to consider the criteria for an immediate CT scan and the criteria for a CT scan within eight hours (see sections 5.1.1 and 5.2.1). The evidence supporting the recommendations in section 4.1 shows that if none of the indicators listed are present, the risk of requiring surgical intervention is extremely low. If transfer is not undertaken appropriate observation of the patient must be put in place.

The decision to transfer should be made by the transferring practitioner, receiving emergency department and neurosurgeon, where appropriate, after risk benefit analysis taking into account the appropriate mode of transport.
5 Imaging

Intracranial lesions can be detected radiologically before they produce clinical changes. Early imaging, rather than awaiting neurological deterioration, reduces the delay in the detection and treatment of acute traumatic intracranial injury. This is reflected in better outcomes.\textsuperscript{50,51} Exclusion or demonstration of intracranial injury can also guide decisions about the intensity and duration of observation in apparently less severe injuries. It may also help to explain the patient’s symptoms and predict a likely pattern of recovery and the need for follow up.

5.1 Adults

5.1.1 Indications for Head CT

A number of rules have been developed to predict the presence of intracranial injury and therefore the need for a CT in patients with a minor head injury. These all aim to have as high a sensitivity as possible so few injuries are missed. The CCT head rule combines high sensitivity (98.4\%) and relatively high specificity (49.6\%)\textsuperscript{47} compared to other studies such as the NOC (specificity of 25\%)\textsuperscript{52} and the National Emergency X-Radiography Utilization Study II (NEXUS II) (specificity of 17.3\%).\textsuperscript{44} By applying the CCT head rule very few head injuries will be missed although some non-injuries will be included.

The CCT head rule was developed for patients with minor head injury. Entry criteria were loss of consciousness or post-traumatic amnesia following a head injury, in patients with a GCS of 13-15. The study excluded all patients with focal neurology, prior seizure, a bleeding disorder or receiving anticoagulants, an obvious penetrating or depressed injury (as they will have a CT scan), no clear injury or trauma, and less than 16 years old.\textsuperscript{47} Multivariate and univariate analyses of a series of signs and symptoms that were most predictive of an abnormal CT were carried out and a model was devised and applied to the population.

Nine criteria were devised and seven were used (see Table 6).\textsuperscript{47} The top five criteria predict neurosurgical intervention (100\% sensitivity) and all seven predict significant brain injury and CT scanning.

\textit{Table 6: Canadian CT head rule}\textsuperscript{47}

<table>
<thead>
<tr>
<th>High risk (for predicting neurosurgical intervention)</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCS score &lt; 15 at two hours after injury</td>
<td>7.3</td>
</tr>
<tr>
<td>any sign of basal skull fracture</td>
<td></td>
</tr>
<tr>
<td>• haemotympanum</td>
<td></td>
</tr>
<tr>
<td>• bilateral periorbital haematoma</td>
<td></td>
</tr>
<tr>
<td>• ‘raccoon or panda eyes’</td>
<td></td>
</tr>
<tr>
<td>• cerebrospinal fluid otorrhea/rhinorrhoea</td>
<td></td>
</tr>
<tr>
<td>• Battle’s sign.</td>
<td>5.2</td>
</tr>
<tr>
<td>≥ 65 years of age.</td>
<td>4.1</td>
</tr>
<tr>
<td>≥ two episodes of vomiting</td>
<td>3.8</td>
</tr>
<tr>
<td>suspected open or depressed skull fracture</td>
<td>3.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium risk (for brain injury on CT)</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>amnesia before impact of ≥ 30 minutes (retrograde)</td>
<td>1.6</td>
</tr>
<tr>
<td>dangerous mechanism of injury</td>
<td></td>
</tr>
<tr>
<td>• pedestrian struck by motor vehicle</td>
<td></td>
</tr>
<tr>
<td>• occupant ejected from motor vehicle</td>
<td></td>
</tr>
<tr>
<td>• fall from height &gt; three feet or five stairs.</td>
<td>1.4</td>
</tr>
</tbody>
</table>
There was an odds ratio of 7.3 for an abnormal CT scan in patients who were GCS 13 or 14 two hours after injury. In patients who were GCS <15 there was no advantage in delaying CT from two to four hours observation as both had similarly high abnormal CT rates (64% risk after four hours compared to 65% after two hours).42 This finding was also seen in the validation study by the same group, where 71% of patients with GCS 13 or 14 at two hours had a brain injury.46

Two studies have validated the CCT rule. One study from the Netherlands used different exclusion criteria (including some patients who were not included in the CCT head rule).45 All patients received a head scan and the criteria for abnormal scans showed that the CCT head rule had a sensitivity of 84.5% for significant brain injury and 100% for neurosurgical intervention. This compared to 100% sensitivity for neurosurgical intervention and clinically important brain injury in the validation study by the authors of the CCT rule.46 Both studies compared the CCT head rule to the NOC.45,46 The NOC had very low specificity in both studies (12.7% and 5.5%) although in the study from the Netherlands the sensitivity was 97.7%.45,46

In the Canadian CT study 11% of people with a minor head injury had been assaulted.47 In comparison, the rate of assault in people with head injuries in Scotland, over a one month period in 2001 was 34.3%.53 Alcohol is contributory in 40% of head injuries in Scotland but in only 15% in Canada. The assault rate in the Netherlands study (24%) is more similar to Scotland, so the Dutch validation is more generalisable to the Scottish population.45

NEXUS II was a retrospective multicentre study of 13,728 patients which correlated clinical features with abnormalities on CT scan to develop a decision instrument to guide CT imaging of patients with blunt head injury.44 Patients with a GCS ≤14 were included although other inclusion criteria were not clear. CTs were on request. There was 98.3% sensitivity and 13.7% specificity for the decision rule they devised. The study concluded that there is not one rule that will detect all abnormalities.

Vomiting at presentation of the acute injury had a predictive factor >4.17 for an abnormal scan. Blurred vision and headache were not predictive of an abnormal scan. Severe headache and headache in patients with a GCS ≤15 are predictive of an abnormal scan.38,54

Using the NOC, a single seizure in a well patient is a low predictor of an abnormal scan with an OR of 3.52

The OR for an abnormal CT is 4.1 in patients over 65 years of age.47

The NEXUS II study of 13,728 patients found a CT abnormalities rate of 5% in patients with a coagulopathy (on warfarin, aspirin, heparin or with another clotting disorder), which was similar to those with no coagulopathy (4%).44 A smaller study (1,101 patients) reported an OR of 3.16 for patients with a coagulopathy.43 There are no large prospective studies looking specifically at the risk in anticoagulated patients.

**Immediate CT scanning should be done in an adult patient who has any of the following features:**

- eye opening only to pain or not conversing (GCS 12/15 or less)
- confusion or drowsiness (GCS 13/15 or 14/15) followed by failure to improve within at most one hour of clinical observation or within two hours of injury (whether or not intoxication from drugs or alcohol is a possible contributory factor)
- base of skull or depressed skull fracture and/or suspected penetrating injuries
- a deteriorating level of consciousness or new focal neurological signs
- full consciousness (GCS 15/15) with no fracture but other features, eg severe and persistent headache
- two distinct episodes of vomiting
- a history of coagulopathy (eg warfarin use) and loss of consciousness, amnesia or any neurological feature.
CT scanning should be performed within eight hours in an adult patient who is otherwise well but has any of the following features:

- age > 65 (with loss of consciousness or amnesia)
- clinical evidence of a skull fracture (eg boggy scalp haematoma) but no clinical features indicative of an immediate CT scan
- any seizure activity
- significant retrograde amnesia (> 30 minutes)
- dangerous mechanism of injury (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, significant fall from height) or significant assault (eg blunt trauma with a weapon)
- a history of coagulopathy (eg warfarin use) irrespective of clinical features (high quality observation is an appropriate alternative to scanning in this group of patients).

5.1.2 IMAGING WITH NO CT AVAILABILITY

Skull X-ray previously played a major role in imaging head injuries as the presence of a skull fracture was used as a risk factor for intracranial injury.

A previous study found that the risk of having an operable intracranial haematoma in patients who had sustained a skull fracture and were GCS 3-8 was 1 in 4.12

A recent meta-analysis found that in patients with a minor head injury (GCS 13-15) the estimated sensitivity of a radiographic finding of skull fracture for the diagnosis of intracranial haemorrhage (ICH) was 0.38 with a corresponding specificity of 0.95.42

Skull X-rays identify fractures but provide no direct information on whether or not there is an underlying brain injury.

Where CT is available skull X-rays should not be performed.

Where CT is unavailable, skull X-ray should be considered in adult patients with minor head injury who do not require transfer for an immediate CT scan.

The patient should be referred for a CT if a skull fracture is detected.

Adult patients with a normal skull X-ray should have good quality observation if they are not being referred.

5.1.3 IMAGING THE CERVICAL SPINE

A head injury may, infrequently, be accompanied by a cervical injury. The need to consider the possibility of spinal injury and to take measures to ‘clear the cervical spine’ are well established components of assessment of a patient with a head injury. The approach depends upon whether or not the patient is conscious and talking and able to report any symptoms and cooperate in clinical examination.

A study of CT scanning in 202 patients with a head injury and GCS 3-6 carried out prior to the introduction of multislice helical scanning found that 5.4% of all patients had fractures of either C1 or C2 and 4.0% had occipital condyle fractures.55 A systematic review of patients with blunt polytrauma and reduced levels of consciousness (GCS < 15) showed an incidence of cervical spinal injury of between 5.2% and 13.9%.56

The sensitivity of plain radiography is between 39% and 61% implying that one in 25 polytrauma patients with reduced consciousness will have cervical spinal injury not seen on plain radiography.56 CT is more effective in detecting cervical spine injury in high risk patients, with a specificity of 98% for CT (95% confidence interval, CI 96% to 99%) compared to 52% for X-ray (95% CI 47% to 56%). High risk is defined as ‘significant depression of mental status’ or requiring intensive care unit (ICU) admission.57
CT screening of the cervical and upper thoracic (T1/T4) spine is cost effective for people who have sustained blunt-force trauma. Although CT imaging costs are greater than plain radiography, identifying difficult to image, clinically occult injuries may avoid the cost of caring for patients with neurological deterioration.58

**B** In adult patients who are GCS < 15 with indications for a CT head scan, scanning should include the cervical spine.

**D** CT scanning of the cervical spine should include the base of skull to T4 images.

 Patients who meet the criteria for a CT scan should not have plain radiographs of the cervical spine taken as routine.

### 5.2 CHILDREN

#### 5.2.1 INDICATIONS FOR HEAD CT

A well conducted meta-analysis of 16 heterogeneous studies of minor head injuries in children under 18 years of age with GCS 13-15 attempted to rationalise the clinical indications for CT scanning in children where an ICH is suspected.39 There was a significant relative risk of ICH if any of the following variables were present: skull fracture, focal neurology, loss of consciousness, and GCS abnormality.

A further study used these variables to provide a rule (CHALICE, children’s head injury algorithm for the prediction of important clinical events; see Table 7) for selection of children with head injury for CT scanning. The CHALICE rule has a sensitivity of 98% (95% CI 96% to 100%) and a specificity of 87% (95% CI 86% to 87%) for the prediction of clinically significant brain injury.40

*Table 7: Association between significant clinical variables and clinically significant intracranial injury*

<table>
<thead>
<tr>
<th>History</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>loss of consciousness &gt; five minutes</td>
<td>0.45</td>
</tr>
<tr>
<td>suspicion of NAI</td>
<td>0.33</td>
</tr>
<tr>
<td>seizure after head injury <em>(in patient with no history of epilepsy)</em></td>
<td>0.29</td>
</tr>
<tr>
<td>amnesia &gt; five minutes</td>
<td>0.22</td>
</tr>
<tr>
<td>≥ three episodes of vomiting</td>
<td>0.065</td>
</tr>
<tr>
<td>drowsiness</td>
<td>0.036</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examination</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCS score &lt; 14</td>
<td>0.48</td>
</tr>
<tr>
<td>GCS score &lt; 15 if age &lt; one year</td>
<td>0.10</td>
</tr>
<tr>
<td>suspected penetrating or depressed skull injury or tense fontanelle</td>
<td>0.44</td>
</tr>
<tr>
<td>positive focal neurology</td>
<td>0.36</td>
</tr>
<tr>
<td>suspected base of skull fracture</td>
<td>0.16</td>
</tr>
<tr>
<td>presence of any bruise/swelling/laceration &gt; 5 cm in children aged &lt; one year of age</td>
<td>0.12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>high speed road traffic accident</td>
<td>0.43</td>
</tr>
<tr>
<td>fall from height &gt; three metres</td>
<td>0.20</td>
</tr>
<tr>
<td>high speed injury from projectile or object</td>
<td>0.039</td>
</tr>
</tbody>
</table>
Skull fractures in children, although significantly associated with an increased risk of intracranial injury, are not as discriminating as in adults. In children with a head injury, significant intracranial injury occurs more frequently in the absence of a skull fracture than is the case in adults. Clinical assessment is important in determining the need for a CT scan to rule out intracranial injury. In a study of 608 patients under two years of age, 177 (29%) were symptomatic and 431 (71%) were asymptomatic. Of the latter group, nine had palpable depressions of the skull and were excluded. Scalp haematoma size was directly related to the likelihood of a skull fracture and intracranial injury (ICI). The location of the scalp haematoma was related to ICI. Temporal and parietal haematomas had odds ratios of 16 and 38.2 for an ICI respectively compared to 0.6 for a frontal haematoma. One third of patients with parietal and one quarter with temporal scalp haematoma were at risk of ICI.60

Examination of children with a suspected head injury should be carried out by a clinician with experience in paediatric care.

Immediate CT scanning should be done in a child (<16 years) who has any of the following features:
- GCS≤13 on assessment in emergency department
- witnessed loss of consciousness >5 minutes
- suspicion of open or depressed skull injury or tense fontanelle
- focal neurological deficit

CT scanning should be considered within eight hours if any of the following features are present (excluding indications for an immediate scan):
- presence of any bruise/swelling/laceration >5 cm on the head
- post-traumatic seizure, but no history of epilepsy nor history suggestive of reflex anoxic seizure
- amnesia (anterograde or retrograde) lasting >5 minutes
- clinical suspicion of non-accidental head injury
- a significant fall
- age under one year: GCS<15 in emergency department assessed by personnel experienced in paediatric GCS monitoring
- three or more discrete episodes of vomiting
- abnormal drowsiness (slowness to respond).

If a child meets head injury criteria for admission and was involved in a high speed road traffic accident, scanning should be done immediately.

A child with a head injury who meets criteria for admission but not for an immediate CT scan should have active observation by experienced paediatric trained medical and nursing staff in an appropriate unit/ward. The decision to scan should be based on these observations.

Standards for radiological investigations in children with suspected non-accidental injury are available.61

In any child where abuse is suspected a head CT scan should be performed as ‘soon as the patient is stable’ (within 24 hours of admission) for children:
- who present with evidence of encephalopathic features or focal neurological signs or haemorrhagic retinopathy, or
- under the age of one.
Implementation of the CHALICE criteria would lead to a CT rate of about 14% of all head injuries in children. This is significantly higher than present rates in Scotland (1%). Direct application of CHALICE criteria has not been validated. A 14% CT scan rate would expose a large number of children to a non-trivial radiation dose, especially as some children will re-attend with subsequent head injuries. CHALICE has identified a stratified level of risk and the guideline development group has based its recommendations on these data and has also taken into account the potential risk of ‘out of hours’ CT scanning in a population that may occasionally require anaesthesia to achieve a scan.

5.2.2 SCANNING PROTOCOLS

Children should not be scanned using adult protocols. Multislice CT scanners have paediatric protocols for reduced dose scanning, based on patient age or weight, and use active tube current modulation. These techniques vary according to the machine, and specific advice on optimal paediatric scanning parameters should be sought from the manufacturer. One example of age-based tube milliampere second (mAs) settings is:

- < 6 months – 90 milliampere second (mAs)
- 6 months to 3 years – 150 mAs
- 3 to 6 years – 220 mAs.

5.2.3 ANAESTHESIA

General anaesthesia may be required to secure the airway of a child with a deteriorating conscious level, but should not be routinely needed to facilitate scanning. Immobilisation techniques are usually effective for the short time in which modern CT scanners acquire the images.

5.2.4 IMAGING WITH NO CT AVAILABILITY

Children under the age of 16 should not have a skull X-ray unless there is a specific clinical indication such as skeletal survey for non-accidental injury. Patients with impaired consciousness are at risk of physiological instability that can result in secondary insults during transport and a worse outcome. These adverse events can be minimised by resuscitation before transport and high level monitoring and care during transport.

Transfer of patients purely for the purpose of imaging should be avoided.

5.2.5 IMAGING THE CERVICAL SPINE

Traumatic injury to the cervical spine in children is rare. Children under the age of 10 tend to sustain upper cervical injuries (C1–C4), with older children having a more adult pattern of lower cervical injuries (C5–C7). Younger children have a relatively higher proportion of spinal cord injuries without radiographic abnormality (SCIWORA), which are best assessed with magnetic resonance imaging (MRI).

In children under 10 years initial assessment of the cervical spine is by anteroposterior and lateral plain radiography. Cervical spine CT scanning should be directed at patients with a severe head injury, or where there are signs or symptoms of cord injury, or where plain radiography is abnormal or inadequate.

Criteria for imaging the cervical spine in children over 10 years of age should reflect those for adults (see section 5.1.3).
5.3 INTERPRETATION OF IMAGES

Emergency department staff have been found to miss 10% of skull fractures on X-rays reviewed by radiologists.11

A blinded comparison of interpretation of plain CT scans of the head performed out of hours for a variety of pathologies, of which the minority were head injuries, comparing senior ED medical staff with radiologists’ reports as a gold standard found that interpretation by ED staff had a sensitivity of 0.57 (95%CI 0.45 to 0.69) and a specificity of 0.70 (95%CI 0.64 to 0.76).69

A meta-analysis of 15 studies of inter-observer reliability of assessing CT scans for early changes of cerebral infarction (1,281 scans, 709 readers) concluded that there was little evidence regarding who is best to read a scan. Experienced readers were more consistent and accurate than less experienced readers and training improved performance.70

D CT brain scans should be interpreted by experienced, trained personnel.

All scans should be formally reported by an experienced radiologist.

There is evidence that the ability to send images to a specialist for interpretation influences local decision making and may reduce unnecessary transfers of patients with a head injury and promote more rapid transfer in appropriate cases.71-73

The national Picture Archiving and Communications Systems (PACS) programme supports the acquisition, storage, retrieval and display of digital patient images within and between clinical sites across Scotland. PACS allows radiology reporting to be done remotely, utilising teledmedicine, resulting in streamlined care and more timely diagnosis and treatment.

To avoid delay and possible clinical deterioration due to transporting patients only for imaging, CT scans should be performed at the hospital of first admission. Scans should be initially assessed and reported locally. This report can be provisional, however, and can indicate that a second radiological or specialist radiological opinion is being sought.24 Immediate neurosurgical issues can be discussed with that specialty. A regional model of care should be established that provides routine second opinions from specialist centres via PACS to support local service provision.

☐ Teleradiology links, such as PACS, should be available to transfer brain images to a remote specialist.

5.4 RADIATION RISK

Unavoidable natural background radiation gives adults and children in the UK a mean radiation dose of 2.4 millisieverts (mSv) every year of their lives. Variations in geology mean that some people receive several times this amount. The lifetime risk of developing cancer is one in three.75

CT scanning delivers low-dose ionising radiation equivalent to 1.3 to 2 mSv for brain CT, and about 3 mSv for the cervical spine.76 The Centre for Radiation, Chemical and Environmental Hazards Radiation Protection Division and the International Commission on Radiological Protection assume, from historical extrapolated data, that there is a finite risk of inducing a fatal cancer associated with the use of radiation at medical doses (<100 mSv).77,78 This equates to a 1 in 20,000 risk per mSv or a 1 in 10,000 risk of inducing a fatal cancer associated with a CT of the brain (2 mSv).77 Children are more radiosensitive and the radiation risk increases with decreasing age. At age 0-10 years it is estimated to be 1 in 4,200 compared to 1 in 6,000 at age 20 of inducing a fatal cancer.77,79 The risk depends on which organs are irradiated but careful choice of CT protocol can minimise the risk.

Given that CT will only be carried out when clinically indicated then the direct benefit of the scan to the individual outweighs the theoretical small overall increased lifetime risk of cancer.
6 Care in the emergency department

6.1 Indications for admission to a hospital ward

Around 20% of the patients who attend the ED with a head injury are admitted to hospital.\textsuperscript{9, 80} Reasons for admission include evidence that the patient has not recovered from the effects of the injury and/or any brain damage already sustained or that there are features that indicate the risk that further complications are likely. Some patients with a head injury have other serious injuries, medical problems, or social factors that require admission.\textsuperscript{5}

Patients with persisting impaired consciousness or neurological impairment have a clear need for continuing observation and care. Debate about where and how care should be provided can arise if it is suspected that the patient’s condition is due to other factors such as the effects of alcohol or drugs. If there is doubt, the appropriate course usually is to regard the patient’s condition as due to a head injury.\textsuperscript{81}

If a patient has apparently recovered from the effects of a head injury, so that concern is only about the possibility of a delayed complication, the benefits of admission to hospital are less clear.\textsuperscript{82, 83} The potential advantage lies in the possibility of carrying out repeated observation by trained staff, so that neurological deterioration due to delayed complication could be detected and appropriate action taken promptly. It also imparts confidence that it is safe to mobilise the patient and will pick up other symptoms, for example pain or minor neck injury. Against this has to be set the reality that this event is rare. The frequency of development of an intracranial haematoma in a patient with a Glasgow Coma Scale Score of 15 has been estimated as 1 in 3,615. In addition to the cost, in terms of resources being disproportionately high, it has been argued that observation in hospital is more likely to be effective if it is focused on patients selected to be at higher risk, whereas well conducted home observation can be appropriate in low risk cases.\textsuperscript{83-86}

A large multicentre study of 2,602 patients aged six or over with a mild head injury compared the cost of immediate CT during triage for admission with observation in hospital.\textsuperscript{87} The cost of CT was found to be on average 32\% less than the cost of admission for observation in hospital (95\% CI -272 to -164; p<0.001).\textsuperscript{87} Indications for a head CT for adults and children are discussed in sections 5.1.1 and 5.2.1.

**An adult patient should be admitted to hospital if:**
- the level of consciousness is impaired ($\text{GCS}<15/15$)
- the patient is fully conscious ($\text{GCS 15/15}$) but has any indication for a CT scan (if the scan is normal and there are no other reasons for admission, then the patient may be considered for discharge)
- the patient has significant medical problems, e.g. anticoagulant use
- the patient has social problems or cannot be supervised by a responsible adult.

**Children who have sustained a head injury should be admitted to hospital if any of the following risk factors apply:**
- any indication for a CT scan
- suspicion of non-accidental injury
- significant medical comorbidity
- difficulty making a full assessment
- child not accompanied by a responsible adult
- social circumstances considered unsuitable.
In injured children, especially the very young, the possibility of non-accidental injury must be considered:
- when findings are not consistent with the explanation given
- if the history changes, or
- if the child is known to be on the Child Protection Register.
In such cases a specialist paediatrician with responsibility for child protection should be involved. Child protection procedures should be followed.

Primary and secondary care information systems should identify children on the Child Protection Register and frequent attenders.

Proformas are commonly used in EDs for head injury assessment. They include valuable points on history, mechanism of injury and clinical examination. Proformas are used as a clinical note and may also be useful as an aide-memoir for junior clinical staff who may have limited experience in managing patients with head injuries. Examples of adult and paediatric proformas are shown in Annexes 5-7.

6.2 INDICATIONS FOR DISCHARGE

It is neither feasible nor desirable to admit to hospital the majority of patients attending EDs with a head injury who have recovered and who are at low risk of an intracranial complication. The circumstances in which discharge home is appropriate are therefore the converse of the criteria for admission.

Observation at home is especially appropriate for most patients who are fully conscious and orientated and who have recovered from any brief period of post-traumatic amnesia.\textsuperscript{85,88} Any adverse social factors should be taken into account.

\textbf{C} An adult patient can be discharged from the ED for observation at home if fully conscious (GCS 15/15) with no additional risk factors or other relevant adverse medical and social factors.

The following criteria must be met prior to discharge:
- a responsible adult is available and willing to observe the patient for at least 24 hours
- verbal and written instructions about observations to be made and action to be taken are given to and discussed with that adult
- there is easy access to a telephone
- the patient is within reasonable access of medical care
- transport home is available.

\textbf{C} Children can be discharged from the ED if no additional risk factors are present.

6.3 DISCHARGE ADVICE

No good quality studies were identified that evaluate the impact of providing information and advice about head injury at discharge.

Information leaflets are frequently given at discharge, but their content is not uniform in different EDs in Scotland and elsewhere.\textsuperscript{89,90} Information about medication, participating in sport, alcohol intake and driving is often not given.\textsuperscript{89} The readability of information sheets can be poor and may exclude many people.\textsuperscript{81}

There is similarity between head injury and whiplash in terms of the nature of persisting symptoms and the typical brevity of admission. Many studies on whiplash, however, exclude patients with loss of consciousness and the primary cause of whiplash injury (motor vehicle accident) is not the most common cause of head injury (this is falls and assaults).\textsuperscript{6}
Studies about whiplash injury provide some evidence that provision of video information (in hospital or to take home) and advice about recovery might be beneficial in reducing persisting symptom complaints.92,93

Advice and information is likely to benefit people with a mild head injury or suffering from whiplash. Information should be positive and reassuring, but also indicate how to get help if symptoms cause worry or persist.

There is evidence that information and advice at follow up reduces symptom persistence (see section 9) and it is likely that information at discharge is similarly important. There should be more uniform coverage of key advice areas as suggested in the examples of information leaflets given in Annexes 8, 9 and 10. A return to play protocol for sports people is also available (see Annex 11).49

Patients and carers should be given advice and information in a variety of formats tailored to their needs.

Patients and carers should be encouraged to seek prompt advice from their general practitioner or hospital emergency department by telephone about any worrying symptoms or other concerns.

Clear written instruction should be given to and discussed with parents or carers before a child is discharged.

6.4 UNEXPECTED RETURN TO HOSPITAL

People who return to hospital unexpectedly following a head injury may have significant morbidity. In a retrospective study of 606 patients re-attending a trauma unit after a minor injury, 53.3% of re-attenders had a CT scan. Intracranial abnormalities were found in 14.4% of re-attenders, which equated to 27% of patients scanned at re-attendance. Five per cent of re-attenders required neurosurgical intervention.94

Management of patients who return to hospital unexpectedly following a head injury should be discussed with senior members of staff.
7 Hospital inpatient care

7.1 INPATIENT OBSERVATION

Careful, repeated observation forms a major part of the care of patients admitted to a general (non-neurosurgical) ward according to the criteria described in section 6.1. The aim is to detect promptly patients who deteriorate neurologically who may need referral to a neurosurgical unit, and to confirm satisfactory recovery and to enable discharge in the majority of patients. The process of admission to a hospital ward requires good verbal and written communication and record keeping.

A systematic review of the literature did not identify any systematic reviews or RCTs. Some descriptive studies were identified, mostly focusing on a description of how to undertake observations.95-97

Consistency of observation is important.97 The standardisation of content and structure of neurological observations is well established.98 Consistency is achieved through well trained staff competent in undertaking observations and continuity of observers when caring for patients with a head injury.

The guideline development group reviewed a national benchmark on neurological observations, which focuses on the practicalities of performing the observations (www.nnbg.org.uk). Much of the evidence supporting the benchmark dates from the 1980s and 1990s.

7.1.1 CLINICAL OBSERVATION AND RECORDING

Given the lack of up-to-date evidence, a focus group was held on the 30th August 2007 at the Institute of Neurological Sciences, Glasgow. The participants were five experienced nurse practitioners.

Several trigger questions, focused on undertaking observations based on clinical experience were posed. The guideline development group explored the consequences of actions or omissions and tried to focus on what might contribute to poorer experiences.

Based on results from the focus group, the guideline development group revalidated the principles of SIGN 46, with some rewording to clarify criteria.

- Emergency department medical and nursing staff should communicate details of the mechanism and type of injury and maintain a written record of the neurological progress since arrival in the ED.

- Nursing staff should carry out a neurological assessment (including limb movements, pupil reactions and GCS) on arrival in the ward and compare it with that obtained in the ED. Any discrepancy between these assessments, suggesting deterioration, or other concerns about the patient’s condition should be discussed immediately with the relevant medical staff.

The Glasgow Coma Scale is used widely to make neurological observations, and in trained hands is a good discriminative measure of conscious level (see section 3.2.1). It works best as a monitoring tool if each subscale (eye opening, verbal, and best motor response) rather than a total score is used as a separate predictor. Using only one type of flexor response in the motor component improves the consistency of recording the best motor response. Despite the apparent simplicity and clarity of the GCS, it is open to misinterpretation and misapplication leading to confusion,99 especially when only the total score is reported.100 High levels of consistency can be achieved if training in the use of the scale is provided and reinforced.30
The application of the Glasgow Coma Scale should follow recommended protocols (see Annex 3). It may be possible to add to the richness of observation through knowledge and understanding of nuances that can emerge, for example, a patient responding more slowly to a verbal command than previously but still recorded at the same level. Such subtle observations could supply important supplementary information, although should never substitute for full observations.

☑ All medical and nursing staff involved in the care of patients with a head injury should be trained and competent in the use and recording of the Glasgow Coma Scale.

☑ The GCS should not be used in isolation and other parameters should be considered along with it, such as:
  - pupil size and reactivity
  - limb movements
  - respiratory rate and oxygen saturation
  - heart rate
  - blood pressure
  - temperature
  - unusual behaviour or temperament or speech impairment.

Family members and friends should be used as a source of information.

☑ Observations should be recorded on a chart of a design common to Scottish hospitals, a copy of which must go with the patient throughout the different departments during the patient’s hospital stay.

Children <3 years old who have sustained a head injury are particularly difficult to evaluate and clinicians should have a low threshold of suspicion for early consultation with a specialist paediatric unit.

Children who are admitted should be under the care of a multidisciplinary team that includes a paediatric trained doctor experienced in the care of children with a head injury.

Children should be observed on a children’s ward.

An example of an observation chart is shown in Annex 2.

7.1.2 FREQUENCY OF OBSERVATION

How often observations should be made has not been rigorously studied, but should relate to the estimated risk of clinically influential findings. The risk of rapid deterioration is higher during the first six hours and diminishes as the time since injury increases.\(^{101-104}\)

The guideline development group recommends that the factors to be considered include:

- the history of post-traumatic amnesia
- the time lapse since injury
- the pattern of previous findings in GCS
- the imaging findings
- other risk factors, eg coagulopathy.
Patients with a head injury, who warrant admission, should have neurological observations carried out at least in the following frequency starting after initial assessment in the ED:
- half hourly for two hours
- hourly for four hours
- two hourly for six hours
- four hourly thereafter until agreed to be no longer necessary.

It is necessary for medical staff to know the patient’s condition on admission and to review progress. Medical staff should assess the patient on admission to the ward and should re-assess the patient at least once within the next 24 hours. Assessment should include examination for the GCS, neck movement, limb power, pupil reactions, all cranial nerves and signs of basal skull fracture.

Children who are admitted should be observed in the same way as adults using the Paediatric Coma Scale and Score.

7.1.3 MEDICAL RE-APPRAISAL

Patients with a head injury can develop a wide range of secondary complications, both intracranial and extracranial. The occurrence of such complications may be indicated clinically either if a patient fails to improve at the expected rate or if there is evidence of clinical worsening. In either circumstance the patient should be re-assessed by a member of the medical staff in order to confirm the clinical features, to consider how they may be explained and to arrange for appropriate investigations and intervention.

Although neurological changes direct attention to the possibility of intracranial complication, more often the cause is an extracranial complication and the priority is to ensure that the airway is clear, oxygenation adequate, etc. The effects of alcohol or other drugs may be a factor in persisting impairment of consciousness but these effects are usually short lasting (less than four hours) and the role of estimation of alcohol level is controversial. Sequelae of alcohol withdrawal can also contribute to neurological impairment.

Any of the following examples of neurological deterioration should prompt urgent re-appraisal by a doctor:
- the development of agitation or abnormal behaviour
- a sustained decrease in conscious level of at least one point in the motor or verbal response or two points in the eye opening response of the GCS score
- the development of severe or increasing headache or persisting vomiting
- new or evolving neurological symptoms or signs, such as pupil inequality or asymmetry of limb or facial movement.

If re-assessment confirms a neurological deterioration, many factors need to be evaluated but the first step is to ensure the airway is clear, and that oxygenation and circulation are adequate.

Clinical signs of shock in a patient with a head injury should be assumed, until proven otherwise, to be due to hypovolaemia caused by associated injuries.

Whilst an intoxicating agent may confuse the clinical picture, the assumption that deterioration or failure to improve is due to drugs or alcohol must be resisted.

If systemic causes of deterioration such as hypoxia, fluid and electrolyte imbalance, or hypoglycaemia can be excluded, then resuscitation should continue according to ATLS principles while anaesthetic help and neurosurgical advice are sought (see section 4.1).
7.2 THERAPIES FOR BEHAVIOURAL DISTURBANCE

Agitation, restlessness and aggression are frequent neurobehavioural sequelae in the early stages of recovery from a head injury.\textsuperscript{108} There may be causes of agitation other than the direct effect of the brain injury, such as:\textsuperscript{109}

- drug/alcohol intoxication
- drug/alcohol withdrawal
- hypoxia
- pain
- seizure disorders
- urinary retention.

Agitated patients may resist direct care, be disruptive or pose a physical risk to themselves, family and staff. Behavioural disturbance may include inappropriate vocalisation, intolerance of medical management or equipment and directed or diffuse aggressive behaviours.\textsuperscript{109} To determine a treatment plan it is useful to use a measurement scale such as the Agitated Behaviour Scale (ABS) (see Table 8).\textsuperscript{109} This scale rates 14 behaviours from one (absent) to four (present to an extreme degree). It can provide information about how a patient’s behaviour is changing and help to determine objectively the effectiveness of treatment.

7.2.1 NON-PHARMACOLOGICAL THERAPIES

No robust evidence was identified on the use of non-pharmacological therapies for the management of behavioural disturbance in patients in the acute phase of a head injury.

7.2.2 PHARMACOLOGICAL THERAPIES

A wide range of drugs has been investigated for the management of behavioural disturbance in the acute phase following head injury. There is limited evidence of efficacy, with more support for beta blockers over other agents.\textsuperscript{108,110}

<table>
<thead>
<tr>
<th>D</th>
<th>After traumatic brain injury remedial causes of agitation should be excluded before therapies are started.</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑</td>
<td>Each unit should have an agreed protocol for the management of agitation or aggression.</td>
</tr>
<tr>
<td></td>
<td>Drug treatment should be individually tailored.</td>
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</tbody>
</table>
Table 8: Agitated behaviour scale

Behaviours that may be observed:

1. Short attention span, easy distractibility and inability to concentrate.
2. Impulsive, impatient, low tolerance for pain or frustration.
3. Uncooperative, resistant to care, demanding.
4. Violent and/or threatening violence towards people or property.
5. Explosive and/or unpredictable anger.
6. Rocking, rubbing, moaning or other self stimulating behaviour.
7. Pulling at tubes, restraints etc.
8. Wandering from treatment areas.
9. Restlessness, pacing, excessive movement.
10. Repetitive behaviours, motor and/or verbal.
11. Rapid, loud or excessive talking.
12. Sudden changes of mood.
13. Easily initiated or excessive crying and/or laughter.
14. Self abusiveness, physical and/or verbal.

Each behaviour listed above is scored as either:

1. Absent The behaviour is not present.
2. Present to a slight degree The behaviour is present but does not prevent the conduct of other, contextually appropriate behaviour (the individual may redirect spontaneously or the continuation of the agitated behaviour does not disrupt appropriate behaviour).
3. Present to a moderate degree The individual needs to be redirected from an agitated to an appropriate behaviour, but benefits from such cueing.
4. Present to an extreme degree The individual is not able to engage in appropriate behaviour due to the interference of the agitated behaviour, even when external cueing or redirection is provided.

Total score ranges from 14 to 56

7.3 DISCHARGE PLANNING AND ADVICE

Every patient needs a discharge plan. After inpatient observation, the need for home observation is less, and asking the family to wake the patient at intervals is usually not appropriate.

Whenever possible, relatives should be involved in the patient’s ongoing care and written advice should be given, modified from that given when a patient is discharged from the ED without admission (see section 6.3 and Annex 12). A careful assessment should be made of previous health and home circumstances, particularly in the elderly, who may have an associated illness or be taking medication which may have contributed to a fall, and a referral to the care for the elderly service may reduce the future risk of injury.
Written discharge information should be given to the patient or a relative prior to leaving the ward.

Staff should review this information with the patient and/or relative, clarifying any issues and ascertaining their understanding of the information.

Before discharge from the ward a patient with a head injury must be assessed by an experienced doctor, who must establish that all the following criteria have been met:

- consciousness has recovered fully and is sustained at the pre-injury state
- the patient is eating and drinking normally and not vomiting
- neurological symptoms/signs have either resolved, or are minor and resolving or are amenable to simple advice/treatment, (eg headache relieved by simple analgesia, or momentary positional vertigo due to vestibular disturbance)
- the patient is either mobile and self caring or returning to a safe environment with suitable social support
- the results of imaging and other investigations have been reviewed and no further investigation is required
- extracranial injury has been excluded or treated.

An immediate discharge document should be sent to the patient’s general practitioner, in advance of the more detailed discharge letter (see section 9).
Referral to a neurosurgical unit

The economic burden of head injury in the acute care setting is substantial and treatment outcomes and costs vary considerably by injury severity and mechanism. Appropriate use of the limited neurological intensive care unit (NICU) resource is therefore of considerable importance. No randomised controlled trials of the effectiveness of NICU compared with general ICU were identified. A large, well conducted prospective observational database reported consistent treatment effects, such as a reduction in mortality, from admission of patients with a traumatic brain injury (TBI) to specialist centres, including NICU, compared to non-neurosurgical centres. Analysis of prospectively collected data from the Trauma Audit and Research Network (TARN) database for patients presenting between 1989 and 2003 (n = 22,216) compared mortality and odds of death adjusted for case mix for patients with and without head injury, and for those treated in a neurological versus a non-neurosurgical centre. The analysis strongly suggests that improvement of care for patients with severe head injury represents the best strategy for reduction of case fatality in those hospitalised after blunt trauma and that neurological intensive care intervention is central to such a strategy.

8.1 Consultation and Referral

The circumstances when consultation about referral is appropriate include when a CT scan shows an intracranial lesion potentially appropriate for neurosurgical management, or when a CT scan has not been done but there are features indicating a high likelihood of an intracranial lesion requiring urgent attention. Occasionally, consultation may be needed if the patient’s condition is causing clinical concern and this has not been resolved by the findings of a CT scan. The benefits of specialist neuroscience care, in addition to the skills and facilities for intracranial surgery, include expertise and facilities for patient assessment and investigation, as well as the sophisticated monitoring and management of intracranial conditions that constitute specialised neurointensive care. There are also benefits in the access to enhanced knowledge and experience resulting from the concentration of experience.

The potential disadvantages of secondary transfer include the possible exposure to secondary insults or added delay in action. These factors are of most concern to patients with serious multiple injuries whose continuing care requires ready access to a range of expertise.

D A patient with a head injury should be discussed with a neurosurgeon:
- when a CT scan in a general hospital shows a recent intracranial lesion
- when a patient fulfils the criteria for CT scanning but facilities are unavailable
- when the patient has clinical features that suggest that specialist neuroscience assessment, monitoring, or management are appropriate, irrespective of the result of any CT scan.

D Features suggesting that specialist neuroscience assessment, monitoring, or management are appropriate include:
- **Persisting coma (GCS score 8/15 or less)** after initial resuscitation
- confusion which persists for more than four hours
- **Deterioration in level of consciousness after admission** (a sustained drop of one point on the motor or verbal subscales, or two points on the eye opening subscale of the GCS)
- focal neurological signs
- a seizure without full recovery
- compound depressed skull fracture
- definite or suspected penetrating injury
- a CSF leak or other sign of a basal fracture.
8.2 TRANSFER BETWEEN A GENERAL HOSPITAL AND A NEUROSURGICAL UNIT

Patients with impaired consciousness are at risk of physiological instability that can result in secondary insults during transport and a worse outcome.\textsuperscript{64,65} These adverse events can be minimised by resuscitation before transport and high level monitoring and care during transport.\textsuperscript{66} Recommendations on the transfer of patients with a head injury are available from the Association of Anaesthetists of Great Britain and Ireland.\textsuperscript{21} The Scottish Paediatric Retrieval Service specialises in paediatric transfers.

D Transfer of adult patients should follow the principles set out by the Association of Anaesthetists of Great Britain and Ireland and the Neuroanaesthesia Society of Great Britain and Ireland.

- Transfer of a child to a specialist neurosurgical unit should be undertaken by staff experienced in the transfer of ill children, such as the Scottish Paediatric Retrieval Service.
- Consultation on the best method of transfer for an individual patient should be with referring healthcare professionals, transfer clinicians and the receiving neurosurgeon. It should take into account the clinical circumstances, skill of available staff, imaging, mode of transfer and timing issues.

D Transfer of patients purely for the purpose of imaging should be avoided.

A standard method of verbal or written communication between referring doctors and neurosurgeons facilitates patient care. Good communication between nursing teams is also important. An example of a neurosurgical checklist for referral to a specialist neuroscience unit is shown in Annex 13.

To facilitate communication between general hospitals and specialist neuroscience unit staff, a proforma containing the Glasgow Coma Scale and other relevant features should be used.

The details of specialist neuroscience care are beyond the scope of this guideline, but require an integrated approach which includes operative neurosurgery, neurointensive care (including care of potential organ donors), and neurorehabilitation. The care of patients with a severe head injury should follow the guidelines from the Brain Trauma Foundation and recommended by the American Association of Neurosurgeons,\textsuperscript{18} and the European Brain Injury Consortium.\textsuperscript{19}

8.3 SPECIALIST CARE

The impact of a newly appointed neurointensivist on outcomes in patients with a head injury in a neurological intensive care unit was assessed.\textsuperscript{116} The institution of a neurointensivist led team had an independent, positive impact on patient outcomes, including a lower NICU-associated mortality rate and length of hospital stay, improved disposition, and better chart documentation.\textsuperscript{116}

For patients with acute intracerebral haemorrhage, admission to a neurological ICU compared with general ICU is associated with reduced mortality rate.\textsuperscript{117} An evaluation of the impact of specialised NICU on the population admitted to a neurovascular centre and on the outcome of patients with severe aneurysmal subarachnoid haemorrhage, showed benefit from such care.\textsuperscript{118}
8.3.1 NEUROINTENSIVE CARE PROTOCOLS

Little evidence was identified to support the many complex interventions that comprise NICU care for patients with TBI. In common with general intensive care, introduction of protocols based on best available evidence and implemented by specialists has improved outcome.

Comparison of presentation, therapy and outcome in patients with head injury referred to a regional neurosurgical centre, before and after establishment of protocol-driven therapy showed that when all referred patients were considered, institution of protocol-driven therapy was not associated with a statistically significant increase in favourable outcomes (56.0% compared to 66.4%).119 A significant increase in favourable outcomes in patients with a severe head injury was observed (40.4% compared to 59.6%). The proportion of favourable outcomes was also high (66.6%) in those presenting with evidence of raised intracranial pressure (ICP) in the absence of a mass lesion and (60.0%) in those that required complex interventions to optimise ICP/cerebral perfusion pressure (CPP).

C All salvageable patients with severe head injury (GCS score 8/15 or less) should be transferred to, and treated in, a setting with 24-hour neurological ICU facility.
9 Follow up

The guideline focuses on the follow up of people admitted to hospital for up to 72 hours, whilst recognising that head injuries can cause a wide variety of problems beyond the first 72 hours. Detailed advice on their treatment and rehabilitation is beyond the scope of this guideline. The availability of these services varies widely in different localities.

There is limited good quality evidence to address how follow up affects outcome in patients who have had a head injury. The population of patients with a head injury is heterogeneous. Studies tend to focus either on patients with mild head injury admitted largely for observation or more severe (head) injuries where admission is on average for longer than 72 hours. Some studies include other acquired brain injury pathology (for example, stroke) and some exclude individuals with comorbidities, such as substance misuse, making the study groups unrepresentative of the head injured population. Criteria for mild head injury vary between studies: some are based on GCS scores (13-15); some on duration of loss of consciousness (less than 30 minutes); or duration of disturbance of consciousness, for example, post-traumatic amnesia (PTA) less than 24 hours. These criteria may conflict with each other, for example, a patient with GCS 13-15 may have PTA lasting for more than 24 hours.

In Scotland head injury admissions are common (an annual rate of 330 per 100,000 of the population) and persisting disability at one and 5-7 year follow up is high, even in people admitted briefly with mild head injury (GCS 13-15). People with a head injury constitute a vulnerable group of patients with a high proportion of individuals from socially deprived areas, who are often involved in drug and alcohol misuse.

There is a body of evidence to suggest that the majority of patients with PTA of less than 24 hours make good recovery of cognitive function within three months of injury. People admitted after a head injury benefit from follow up, which should include education, advice and reassurance. This can be by telephone. If problems that seem severe or persisting are identified, a clinic visit is appropriate. Detailed assessment and treatment is not necessary for all and simple education in a single session is likely to be as effective in cases of mild injury.

Evidence for the effectiveness of follow up of people who attend emergency departments with a head injury, but are not admitted is very limited. It is not clear whether any subgroups should be routinely followed up.

- Patients admitted with mild head injury (GCS 13-15) benefit from brief, routine follow up consisting of advice, education and reassurance that they are likely to recover.
- Follow up can be delivered by telephone.
- Telephone contact may be used to identify those who need to be seen in person to provide follow up in greater depth.

Telephone consultation should be carried out by a healthcare professional experienced in the early management of patients with a head injury (eg clinical nurse specialist).

If a more severe head injury has been identified, despite being admitted for up to 72 hours only, the patient’s need for more intensive rehabilitation should be assessed. In these patients problems are more likely to stem from cognitive or emotional impairments as they will not be discharged if they also have significant physical impairment.

- Patients with a more severe head injury admitted for up to 72 hours should be assessed for intensive rehabilitation.
A discharge letter should be sent to the general practitioner of every patient, whether or not admitted to hospital indicating whether or not follow up has been arranged.

- If no follow up has been offered, the letter should indicate that good recovery is likely within a few weeks.
- The letter should indicate how follow up can be arranged if unforeseen or persisting difficulties arise.

There is some evidence to show that following mild traumatic brain injury a proportion of children will have moderate disability at follow up and that this group of patients would benefit from telephone/postal follow up. Follow up is of benefit in patients with moderate/severe traumatic brain injury in terms of reducing reporting of symptoms, reducing anxiety and reducing behavioural changes.

Children suffering from moderate/severe head injury should be followed up by a specialist multidisciplinary team to assess rehabilitation needs.

- Parents should be given information and advice about the possible short/longer term difficulties that their child may have.
- The primary healthcare team, school health team and teachers should be notified of all children with a head injury regardless of severity.
10 Provision of information

This section reflects the issues likely to be of most concern to patients and their carers. These points are provided for use by health professionals when discussing head injury with patients and carers and in guiding the production of locally produced information materials.

10.1 KEY MESSAGES FROM PATIENTS

In addition to the information provided by the guideline development group, a focus group was held in February 2007 with patients who had suffered from a head injury. The aim was to hear about the treatment people had received and to highlight their information needs. Ten people took part in the focus group, eight male and two female. The people who contributed were a selected sample but their perspectives emphasise the need for adequate information provision and the importance of patients and carers being involved in discussions.

The key messages from the focus group were fed back to the guideline development group and informed the algorithm for provision of information in section 10.3.

10.1.1 EMERGENCY AMBULANCE SERVICE

Patients felt it was important for ambulance staff to keep them informed of any procedures carried out in the ambulance. They felt that general conversation was important to help people deal with anxiety and concern.

10.1.2 ASSESSMENT

Patients who had been taken to a hospital emergency department expressed a need for information on what tests were likely to be carried out and how long they could expect to wait for results. Patients reported seeing different clinicians in various hospital departments, for example X-ray. They would like information on why it was necessary to visit these departments and what tests or treatments were likely to be given at each one.

10.1.3 REFERRAL TO NEUROINTENSIVE CARE

When being transferred to and treated in a neurointensive care unit patients expressed the need to be informed of why treatment in this setting was necessary and what was likely to happen there.

10.1.4 IN-HOSPITAL CARE

Patients who had been unconscious reported anxiety and confusion when they regained consciousness. Most had been informed of what had happened by a relative but expressed a preference for an explanation by healthcare professionals. Patients would have found written information useful explaining what had happened, for example “you have been in a road traffic accident and you are in hospital X”. Being reminded of their name was seen to be important for patients. Patients also expressed a need to be involved in discussions rather than healthcare professionals communicating only with relatives.

10.1.5 OBSERVATION

Patients reported that they found observations boring and frustrating, but it would have helped them to know why they were being observed and what exactly healthcare staff were trying to find out.
10.1.6 DISCHARGE AND FOLLOW UP

The majority of patients reported that they left hospital not knowing what they could or could not do. They expressed a need for written and verbal information. Patients felt it would be helpful to offer people with a head injury contact details of support groups. When leaving hospital patients wanted to know “what happens next?” They felt it was important for patients to receive information on whether they should be followed up and how frequently this was likely to happen.

10.1.7 INFORMATION-GIVING THROUGHOUT THE JOURNEY OF CARE

The best approach for patients is a mix of written and verbal information. The level of detail required varies from patient to patient. Written details of organisations offering support was seen to be beneficial. Information for family and friends was also required.

☐ Information should be available in a variety of formats and the most appropriate format should be offered to patients and carers taking into account the extent of the head injury and any other physical, mental and social issues.

10.2 SOURCES OF FURTHER INFORMATION

10.2.1 NATIONAL ORGANISATIONS PROVIDING SUPPORT FOR PATIENTS WITH MODERATE TO SERIOUS HEAD INJURIES

**Brain and Spine Foundation**
7 Winchester House, Cranmer Road, Kennington Park, London, SW9 6EJ
Tel: 020 7793 5900 • Fax: 020 7793 5939 • Helpline: 0808 808 1000 • Email: helpline@brainandspine.org.uk
www.brainandspine.org.uk • Email: info@brainandspine.org.uk

The Brain and Spine Foundation develops research, education and information programmes aimed at improving the prevention, treatment and care of people affected by disorders of the brain and spine and to stimulate the greater allocation of resources across all neurological disorders.

**Brain and Spinal Injury Charity (BASIC)**
The Neurocare Centre, 554 Eccles New Road, Salford, Manchester, M5 5AP
Tel: 0161 707 6441 • Fax: 0161 206 4558 • Helpline: 0870 750 0000
www.basiccharity.org.uk

BASIC provides a specialist resource at the Neurocare Centre for people and their families in crisis following a traumatic brain injury or neurological diagnosis.

**Brain Injury Rehabilitation Trust (BIRT)**
60 Queen Street, Normanton, Wakefield, WF6 2BU
Tel: 01924 896100 • Fax: 01924 899264
www.birt.co.uk • Email: director@birt.co.uk

The Brain Injury Rehabilitation Trust provides community based rehabilitation and support for people with acquired/traumatic brain injury.

**Child Brain Injury Trust**
Unit 1, The Great Barn, Baynards Green Farm, Nr Bicester, Oxfordshire, OX27 7SG
Tel: 01869 341 075 • Helpline: 0845 601 4939 • Email: helpline@cbituk.org
www.cbituk.org • Email: info@cbituk.org

The Child Brain Injury Trust (CBIT) supports children, young people and families affected by an acquired brain injury.
Headway – The Brain Injury Association
Scotland Office, Astley Ainslie Hospital, Grange Loan, Edinburgh EH9 2HL
Tel: 0131 537 9481 • Helpline: 0808 800 2244 • Email: helpline@headway.org.uk
www.headway.org.uk • Email: headway.scotland@lineone.net

Headway is a charity set up to give help and support to people affected by a head injury. A network of local groups throughout the UK offer a range of services including rehabilitation programmes, carer support, community outreach and respite care.

Momentum Head Office
Pavilion 7 Watermark Park, 325 Govan Road, Glasgow, G51 2SE
Tel: 0141 419 5299 • Fax: 0141 419 0821
www.momentumscotland.org • Email: headoffice@momentum.org

Momentum is a voluntary organisation offering a range of support and rehabilitation programmes to those who have had a head injury.

Scottish Acquired Brain Injury Managed Clinical Network
MCN Office Administration Building, Astley Ainslie Hospital, 133 Grange Loan, Edinburgh, EH9 2HL
Tel: 0131 537 9092
www.sabin.scot.nhs.uk/ • Email: cflannery@nhs.net

10.2.2 NATIONAL ORGANISATIONS PROVIDING SUPPORT FOR CARERS AND FAMILIES

Carers Scotland
91 Mitchell Street, Glasgow, G1 3LN
Tel: 0141 221 9141
www.carerscotland.org • Email: info@carerscotland.org

Carers Scotland provides information and advice to carers on all aspects of caring.

Contact a family – Scotland
Craigmillar Social Enterprise and Arts Centre, 11/9 Harewood Road, Edinburgh, EH16 4NT
Tel: 0131 659 2930
Helpline: 0808 808 3555 • Textphone: 0808 808 3556 • Email: helpline@cafamily.org.uk
www.cafamily.org.uk • Email: scotland.office@cafamily.org.uk

Contact a family is a charity which provides support, information and advice to families of children and young people with a disability or health condition.

Crossroads Caring Scotland
24 George Square, Glasgow, G2 1EN
Tel: 0141 226 3793
www.crossroads-scotland.co.uk

Crossroads provides practical support to carers.

The Princess Royal Trust for Carers
Scotland Office, Charles Oakley House, 125 West Regent Street, Glasgow, G2 2SD
Tel: 0141 221 5066 • Fax: 0141 221 4623
www.carers.org • Email: infoscotland@carers.org

The Princess Royal Trust for Carers provides information, advice and support to Scotland’s carers and young carers.
10.3 ALGORITHM FOR PROVISION OF INFORMATION

This section gives examples of the information patients/carers may find helpful at the key stages of the patient journey. The checklist was designed by members of the guideline development group based on their experience and their understanding of the evidence base. The checklist is neither exhaustive nor exclusive.

**Presentation via telephone advice services**
- Advise patient and carers to contact the emergency ambulance service for transport to the ED if they meet the criteria for referral.
- Advise patients and carers to seek medical advice from community services, for example, GP, if the criteria for referral to the ED are not met.

**Presentation via general practice**
- Advise patients and carers of the need for referral to hospital if criteria for referral are met.
- Advise patients and carers who do not meet the criteria for referral to contact the emergency ambulance service if symptoms occur or worsen.

**Presentation via emergency ambulance**
- Keep patients informed of any procedures taking place in the ambulance.

**Attendance at the emergency department**
- Explain to patient and carers what tests the patient is likely to receive and how long they can expect to wait for results.

**Discharge from the emergency department**
- Provide all patients and the person responsible for taking them home with verbal and written advice (example leaflets are given in Annexes 8-10).
- Encourage patients and carers to seek prompt advice from their GP or ED by telephone about any worrying symptoms or other concerns.
- Patients and carers should be given advice and information in a variety of formats tailored to their needs.

**Refer to neurosurgical unit**
- Explain that transfer of patients will be undertaken by experienced staff.
- Ensure patients and carers have an understanding of the need for the transfer.

**Admission to hospital ward**
- Inform patients and carers of the assessment process and explain the need for frequent observation.
- Allow sufficient time for explanations and ensure patients are involved in discussions.

**Discharge**
- Provide all patients and the person responsible for taking them home with verbal and written advice (example leaflets are given in Annexes 10-12).
- Encourage patients and carers to seek prompt advice by telephone from their GP or ED about any worrying symptoms or other concerns.
- Ensure patients and carers are aware of where they can go for further information and support (sources of support are listed in section 10.2).
- Inform patients and carers of how patients are likely to be followed up (ie by whom, where and when).
- Patients and carers should be given advice and information in a variety of formats tailored to their needs.

**Follow up**
- Ensure patients and carers are aware of where they can go for further information and support (sources of support are listed in section 10.2).
- Advise patients that assessment for rehabilitation may not be necessary if they have had a mild/moderate head injury.
- Advise patients of the assessment procedure for rehabilitation when appropriate.
11 Implementing the guideline

This section provides advice on the resource implications associated with implementing the key clinical recommendations, and advice on audit as a tool to aid implementation.

Implementation of national clinical guidelines is the responsibility of each NHS Board and is an essential part of clinical governance. Mechanisms should be in place to review care provided against the guideline recommendations. The reasons for any differences should be assessed and addressed where appropriate. Local arrangements should then be made to implement the national guideline in individual hospitals, units and practices.

The guideline development group recognises that different methods should be employed to ensure that the guideline is implemented throughout Scotland. These include:

- disseminating printed and electronic copies of the guideline to all NHS Boards to be cascaded to staff
- workshops and teaching initiatives based on the guideline recommendations.

11.1 RESOURCE IMPLICATIONS OF KEY RECOMMENDATIONS

This section is based on discussions with the guideline development group regarding current resource use in Scotland and the likely impact of implementing the recommendations made in the guideline. Where current practice will not change as a result of the recommendations it is unlikely there will be resource implications.

The group has identified seven recommendations that will have additional resource implications for NHSScotland.

11.1.1 INDICATIONS FOR HEAD CT

**Immediate CT scanning should be done in an adult patient who has any of the following features:**

- eye opening only to pain or not conversing (GCS 12/15 or less)
- confusion or drowsiness (GCS 13/15 or 14/15) followed by failure to improve within at most one hour of clinical observation or within two hours of injury (whether or not intoxication from drugs or alcohol is a possible contributory factor)
- base of skull or depressed skull fracture and/or suspected penetrating injuries
- a deteriorating level of consciousness or new focal neurological signs
- full consciousness (GCS 15/15) with no fracture but other features, eg severe and persistent headache
  - two distinct episodes of vomiting
  - any seizure activity
- a history of coagulopathy (eg warfarin use) and loss of consciousness, amnesia or any neurological feature.

**CT scanning should be performed within eight hours in an adult patient who is otherwise well but has any of the following features:**

- age > 65 (with loss of consciousness or amnesia)
- clinical evidence of a skull fracture (eg boggy scalp haematoma) but no clinical features indicative of an immediate CT scan
- significant retrograde amnesia (> 30 minutes)
  - any seizure activity
- dangerous mechanism of injury (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, significant fall from height) or significant assault (eg blunt trauma with a weapon).

**In adult patients who are GCS < 15 with indications for a CT head scan, scanning should include the cervical spine.**
Immediate CT scanning should be done in a child (<16 years) who has any of the following features:
- GCS≤13 on assessment in emergency department
- witnessed loss of consciousness >5 minutes
- suspicion of open or depressed skull injury or tense fontanelle
- focal neurological deficit
- any sign of basal skull fracture.

CT scanning should be considered within eight hours if any of the following features are present (excluding indications for an immediate scan):
- presence of any bruise/swelling/laceration >5 cm on the head
- post-traumatic seizure, but no history of epilepsy nor history suggestive of reflex anoxic seizure
- amnesia (anterograde or retrograde) lasting >5 minutes
- clinical suspicion of non-accidental head injury
- a significant fall
- age under one year: GCS<15 in emergency department assessed by personnel experienced in paediatric GCS monitoring
- three or more discrete episodes of vomiting
- abnormal drowsiness (slowness to respond).

The recommendations for adults and children suggest that up to 5,500 CT scans will be required per annum, based on the following calculations:

Using the number of patients with GCS<15 (see Table 1) as a proxy for the total number requiring CT scans, 50,000 adults attending ED will result in 3,500 scans, of which a significant proportion will require immediate scanning. For 50,000 children, the corresponding figure is 2,000 scans per annum.

Mendelow and colleagues identify that the resource implications associated with similar recommendations in the NICE clinical guideline 56: Head injury. Triage, assessment, investigation and early management of head injury in infants, children and adults require 24 hour scanning and imaging facilities, electronically linked to regional neurosurgical units. The NICE guideline was accompanied by a costing report, but this concluded that the recommendations for urgency of imaging of the head did not reflect significant changes to practice in England and that there is unlikely to be significant training or equipment costs as a result of greater access to CT scans. They conclude that the cost of additional CT head scans in children under 16 is likely to be in the region of £870,000 for the whole of England and Wales.

In Scotland, it is likely that the resource implications of the CT scanning recommendations will be around the need for 24 hour CT availability, with associated staffing implications, and the requirements of electronic linkage to regional services. There may also be a ‘knock on’ effect on CT scan availability for other conditions.

11.1.2 REFERRAL TO A NEUROSURGICAL UNIT

All salvageable patients with severe head injury (GCS score 8/15 or less) should be transferred to, and treated in, a setting with 24-hour neurological ICU facility.

The Neuroscience Implementation Group Report to the Cabinet Secretary for Health and Wellbeing recognised that this recommendation will have resource implications, both in local hospitals without a specialist service, where experienced staff will be tasked with resuscitating and transferring the patient, and in the specialist centres where additional neurointensive care beds will be required. The costing report accompanying the NICE guideline estimated the cost of implementing a similar recommendation to be in the region of £15.5 million for the whole of England and Wales, but that £15.2 million could be potentially offset by savings in admissions to intensive care units in district general hospitals, reducing the need for additional investment in the future.
11.2 AUDITING CURRENT PRACTICE

A first step in implementing a clinical practice guideline is to gain an understanding of current clinical practice. Audit tools designed around guideline recommendations can assist in this process. Audit tools should be comprehensive but not time consuming to use. Successful implementation and audit of guideline recommendations requires good communication between staff and multidisciplinary team working.

Repeating the audit after local implementation will indicate whether or not the guideline has been successfully implemented.

A clinical audit of patients attending the emergency department of the Royal Infirmary of Edinburgh with a head injury compared clinical practice in the management of head-injured patients before and after the publication of SIGN 46. Despite positive reinforcement of the SIGN recommendations in the ED and at ward level practice did not change significantly, emphasising the need for a structured audit with regular feedback to ensure a continued improvement in clinical practice.

11.2.1 KEY POINTS TO AUDIT

The following have been identified as key points to audit to assist with the implementation of this guideline:

<table>
<thead>
<tr>
<th>Patients discharged from the ED department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the patient discharged from the ED?</td>
</tr>
<tr>
<td>Did the patient have a documented pupil check prior to discharge?</td>
</tr>
<tr>
<td>Did the patient have a documented CNS (central nervous system) examination prior to discharge?</td>
</tr>
<tr>
<td>Did the patient have a documented GCS prior to discharge?</td>
</tr>
<tr>
<td>Was PTA duration assessed before discharge?</td>
</tr>
<tr>
<td>Did the patient meet the criteria for a CT scan prior to discharge? (see sections 5.1.1 and 5.2.1)</td>
</tr>
<tr>
<td>Did the patient have a CT scan prior to discharge?</td>
</tr>
<tr>
<td>Was the patient given advice and an information leaflet on head injury before discharge?</td>
</tr>
<tr>
<td>Did the patient meet the criteria for ‘safe discharge’? (see section 6.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patients admitted to a ward from the ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the patient meet the criteria for admission? (see section 6.1)</td>
</tr>
<tr>
<td>Is the reason for admission documented?</td>
</tr>
<tr>
<td>Has the patient had a documented pupil check in the ED?</td>
</tr>
<tr>
<td>Has the patient had a documented CNS examination in the ED?</td>
</tr>
<tr>
<td>Has the patient had a documented GCS in the ED?</td>
</tr>
<tr>
<td>Does the patient meet the criteria for a CT scan? (see sections 5.1.1 and 5.2.1)</td>
</tr>
<tr>
<td>Did the patient have a CT after meeting the criteria?</td>
</tr>
<tr>
<td>Was the scan abnormal?</td>
</tr>
</tbody>
</table>
### Ward management

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the patient admitted to a ward?</td>
<td>Yes</td>
</tr>
<tr>
<td>Was the patient assessed on admission?</td>
<td>Yes</td>
</tr>
<tr>
<td>Was the patient self discharged within 24 hours?</td>
<td>Yes</td>
</tr>
<tr>
<td>Did the patient have a documented review within 24 hours?</td>
<td>Yes</td>
</tr>
<tr>
<td>Did the patient have a complete review within 24 hours?</td>
<td>Yes</td>
</tr>
<tr>
<td>Did the patient fulfil the criteria for “safe discharge” from the ward?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Safe discharge from ward

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the patient assessed for:</td>
<td>Yes</td>
</tr>
<tr>
<td>- eating and drinking</td>
<td>Yes</td>
</tr>
<tr>
<td>- resolution of neurological signs</td>
<td>Yes</td>
</tr>
<tr>
<td>- mobility</td>
<td>Yes</td>
</tr>
<tr>
<td>Were the results of the patient’s assessments reviewed before discharge?</td>
<td>Yes</td>
</tr>
<tr>
<td>Was the patient given advice and an information leaflet on head injury before discharge?</td>
<td>Yes</td>
</tr>
<tr>
<td>Has follow up or assessment for rehabilitation been arranged?</td>
<td>Yes</td>
</tr>
<tr>
<td>Was the patient safely discharged (all of the points above met)?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Patient and carer feedback

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>How would you rate care in:</td>
<td></td>
</tr>
<tr>
<td>- the ED?</td>
<td></td>
</tr>
<tr>
<td>- the ward?</td>
<td></td>
</tr>
<tr>
<td>- the radiology department?</td>
<td></td>
</tr>
<tr>
<td>How would you rate staff communication in</td>
<td></td>
</tr>
<tr>
<td>- the ED?</td>
<td></td>
</tr>
<tr>
<td>- the ward?</td>
<td></td>
</tr>
<tr>
<td>- the radiology department?</td>
<td></td>
</tr>
</tbody>
</table>
12 The evidence base

12.1 SYSTEMATIC LITERATURE REVIEW

The evidence base for this guideline was synthesised in accordance with SIGN methodology. A systematic review of the literature was carried out using an explicit search strategy devised by a SIGN Information Officer. Databases searched include Medline, Embase, Cinahl, PsycINFO and the Cochrane Library. The year range covered was 2001-2007. Internet searches were carried out on various websites including the US National Guidelines Clearinghouse. The main searches were supplemented by material identified by individual members of the development group. Each of the selected papers was evaluated by two members of the group using standard SIGN methodological checklists before conclusions were considered as evidence.

12.1.1 LITERATURE SEARCH FOR ECONOMIC ISSUES

A SIGN Information Officer conducted a literature search of the NHS Economics Evaluations database (NEED) for studies that highlighted economic issues related to early management of patients with a head injury.

12.1.2 LITERATURE SEARCH FOR PATIENT ISSUES

At the start of the guideline development process, a SIGN Information Officer conducted a literature search for qualitative and quantitative studies that addressed patient issues of relevance to early management of patients with a head injury. Databases searched include Medline, Embase, Cinahl and PsycINFO, and the results were summarised and presented to the guideline development group. A copy of the Medline version of the patient search strategy is available on the SIGN website.

12.2 RECOMMENDATIONS FOR RESEARCH

The guideline development group was not able to identify sufficient evidence to answer all of the key questions asked in this guideline (see Annex 1). The following areas for further research have been identified:

- Devising evidence based protocols for performing GCS in adults and children.
- The validity of telephone triage for head injury patients initially presenting by telephone.
- The clinical signs for the presence of a non-accidental injury in paediatric head injury.
- Criteria for referral of children with head injury to specialist units and criteria for ventilation of children with a head injury.
- Patients attending the ED with a head injury who are not admitted, to ascertain whether any subgroup requires follow up and whether these can be identified prospectively.
- The pharmacological and non-pharmacological management of behavioural disturbance in the acute phase of head injury.
- Information and advice at discharge for patients with head injury.
- Follow up, for example, telephone review and monitoring, one-off visits and signposting especially within 48 hours of a head injury, to indicate which patients require inpatient rehabilitation.
- The effectiveness of brief follow up in improving outcome for less severe head injury.
- Patient and relative/carer perceptions of hospital care in terms of communication by medical and nursing staff in the ED, the observation ward and neurosurgery unit.
- Validation of measurement scales for assessing agitated patients such as the Agitated Behaviour Scale.
- Implications for the use of PACS compared to existing image transfer technology for remote reporting of CT scans.
- Comparison of the accuracy of reporting of CT head scans by neuroradiologists, consultant radiologists and consultants in emergency medicine.
12.3 REVIEW AND UPDATING

This guideline was issued in 2009 and will be considered for review in three years. Any updates to the guideline in the interim period will be noted on the SIGN website: www.sign.ac.uk.
13 Development of the guideline

13.1 INTRODUCTION
SIGN is a collaborative network of clinicians, other healthcare professionals and patient organisations and is part of NHS Quality Improvement Scotland. SIGN guidelines are developed by multidisciplinary groups of practising clinicians using a standard methodology based on a systematic review of the evidence. Further details about SIGN and the guideline development methodology are contained in ‘SIGN 50: A Guideline Developer’s Handbook’, available at www.sign.ac.uk

13.2 THE GUIDELINE DEVELOPMENT GROUP

Mr Ian Swann  Consultant in Emergency Medicine, Glasgow Royal Infirmary
(Chair)

Mr Jacques Kerr  Consultant in Emergency Medicine, Borders General Hospital, Melrose
(Secretary)

Mr Douglas Allan  Senior Lecturer, School of Nursing, Midwifery and Community Health, Glasgow Caledonian University

Dr Peter Andrews  Consultant in Intensive Care, Western General Hospital, Edinburgh

Dr Tom Beattie  Consultant in Paediatric Emergency Medicine, Royal Hospital for Sick Children, Edinburgh

Ms Juliet Brown  Information Officer, SIGN

Dr John Burton  Consultant in Emergency Medicine, Dumfries and Galloway Royal Infirmary

Mr Carl Davis  Consultant in Paediatric Surgery, Royal Hospital for Sick Children, Glasgow

Mr Laurence Dunn  Consultant in Neurosurgery, Southern General Hospital, Glasgow

Mr Michael Fitzpatrick  Consultant in Neurosurgery, Western General Hospital, Edinburgh

Ms Shona Forsyth  Neuropaediatric Outreach Nurse Specialist, Southern General Hospital, Glasgow

Mr Douglas Gentleman  Honorary Consultant in Neurosurgery, Royal Victoria Hospital, Dundee

Dr Julie Gordon  Consultant in Paediatric Emergency Medicine, Royal Hospital for Sick Children, Glasgow

Sister Margaret Greville  Paediatric Ward Sister, Southern General Hospital, Glasgow

Dr Greg Irwin  Consultant Paediatric Radiologist, Royal Hospital for Sick Children, Glasgow

Dr Roberta James  Programme Manager, SIGN

Dr Mike Johnston  Consultant in Emergency Medicine, Ninewells Hospital, Dundee

Dr Tadhg Kelliher  Specialist Registrar in Emergency Medicine, Western Infirmary, Glasgow

Ms Jane Knox  Lecturer in Nursing, The Robert Gordon University, Aberdeen

Dr Colville Laird  Director of Education, BASICS Scotland, Aberuthven

Ms Claire Mavin  Practice Development Nurse, Southern General Hospital, Glasgow
13.2.1 PATIENT INVOLVEMENT

In addition to the identification of relevant patient issues from a broad literature search, SIGN involves patients and carers throughout the guideline development process in several ways. SIGN recruits a minimum of two patient representatives to guideline development groups by inviting nominations from the relevant ‘umbrella’, national and/or local patient-focused organisations in Scotland. Where organisations are unable to nominate, patient representatives are sought via other means, eg from consultation with health board public involvement staff.

Further patient and public participation in guideline development was achieved by involving patients, carers and voluntary organisation representatives at the National Open Meeting (see section 13.3.1). Patient representatives were invited to take part in the peer review stage of the guideline and specific guidance for lay reviewers was circulated. Members of the SIGN patient network were also invited to comment on the draft guideline section on provision of information.

13.2.2 ACKNOWLEDGEMENTS

SIGN is grateful to the following former members of the guideline development group.

Mr Patrick Grant  
Consultant in Emergency Medicine, Western Infirmary, Glasgow

Ms Lynn Myles  
Honorary Consultant in Neurosurgery, Western General Hospital, Edinburgh
13.3 CONSULTATION AND PEER REVIEW

13.3.1 NATIONAL OPEN MEETING

A national open meeting is the main consultative phase of SIGN guideline development, at which the guideline development group presents its draft recommendations for the first time. The national open meeting for this guideline was held on 12th December 2007 and was attended by 170 representatives of all the key specialties relevant to the guideline. The draft guideline was also available on the SIGN website for a limited period at this stage to allow those unable to attend the meeting to contribute to the development of the guideline.

13.3.2 SPECIALIST REVIEW

This guideline was also reviewed in draft form by the following independent expert referees, who were asked to comment primarily on the comprehensiveness and accuracy of interpretation of the evidence base supporting the recommendations in the guideline. The guideline group addresses every comment made by an external reviewer, and must justify any disagreement with the reviewers’ comments.

SIGN is very grateful to all of these experts for their contribution to the guideline.

Mr Eric Ballantyne  Consultant Neurosurgeon, Ninewells Hospital, Dundee
Mrs Avril Beattie  Clinical Coordinator, Centre for Brain Injury Rehabilitation, Royal Victoria Hospital, Dundee
Ms Jennifer Brown  Consultant Neurosurgeon, Paediatric Neurosurgery, Queen Elizabeth National Spinal Injuries Unit, Southern General Hospital, Glasgow
Dr Dave Caesar  Consultant in Emergency Medicine, Emergency Department, Royal Infirmary of Edinburgh
Dr Alan Carson  Consultant Neuropsychiatrist, Scottish Neurobehavioural Rehabilitation Service, Royal Edinburgh Hospital
Mr David Currie  Consultant Neurosurgeon, Aberdeen Royal Infirmary
Dr Carol Davidson  Director of Public Health, NHS Ayrshire and Arran
Dr Graham Foster  Consultant in Public Health (Acute Services/Child Health Commissioner), NHS Forth Valley, Stirling
Dr Julie Freeman  Consultant in Paediatric Intensive Care, Royal Hospital for Sick Children, Edinburgh
Professor Fiona Gilbert  Roland Sutton Chair of Radiology, Research MRI Centre, University of Aberdeen
Mr Patrick Grant  Consultant in Emergency Medicine, Western Infirmary, University of Aberdeen
Dr Gerry Haggerty  Glasgow Warriors Team Doctor
Dr Greg Hamill  GP Principal, Shiskine Surgery, Isle of Arran
Emeritus Professor David Lloyd  Professor of Paediatric Surgery, The Institute of Child Health, University of Liverpool
Mr William Mason  National Continuous Improvement Manager, Scottish Ambulance Service, Edinburgh
Dr Douglas McCarter  Radiologist, Royal Alexandra Hospital, Paisley
Dr John MacLean  Medical Director, The National Stadium Sports Medicine Centre, Hampden Park, Glasgow
Dr Sharon Mulhern  Clinical Psychologist in Acquired Brain Injury, Ayrshire Central Hospital, Irvine
Dr Leo Murray  Rural Practitioner, MacKinnon Memorial Hospital, Isle of Skye
Dr Olivia Robb  Consultant Neuroradiologist, Research MRI Centre, University of Aberdeen
Dr Martin Sambrook  Consultant Radiologist, Glasgow Royal Infirmary
Dr Lance Sloan  Consultant in Rehabilitation Medicine, Kirkcaldy and Levenmouth Community Health Partnership

The following expert referees commented collectively on behalf of the Royal College of Paediatrics and Child Health.

Dr Ian Maconochie  Consultant in Paediatric Accident and Emergency, Association of Paediatric Emergency Medicine
Dr Andrew Curran  Consultant Paediatric Neurologist, Alder Hey Children’s Hospital
Dr Peter Wilson  Consultant Paediatric Intensivist, Paediatric Intensive Care Society
Dr Kathleen Berry  Consultant in Paediatric Accident and Emergency, Emergency Medicines CSAC
Dr Alison Mott  Consultant Paediatrician, Child Protection Special Interest Group

13.3.3 SIGN EDITORIAL GROUP

As a final quality control check, the guideline was reviewed by an editorial group comprising the relevant specialty representatives on SIGN Council to ensure that the specialist reviewers’ comments have been addressed adequately and that any risk of bias in the guideline development process as a whole has been minimised. The editorial group for this guideline was as follows.

Dr Keith Brown  Chair of SIGN; Co-Editor
Professor Robert Carachi  Royal College of Physicians and Surgeons of Glasgow
Mr Andrew de Beaux  Royal College of Surgeons of Edinburgh
Professor Chris Kelnar  Royal College of Paediatrics and Child Health
Professor John Kinsella  Royal College of Anaesthetists
Dr Graham Leese  Royal College of Physicians of Edinburgh
Dr Safia Qureshi  SIGN Programme Director; Co-Editor
Dr Vijay Sonthalia  Scottish General Practice Committee
Dr Sara Twaddle  Director of SIGN; Co-Editor
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Agitated Behaviour Scale</td>
</tr>
<tr>
<td>APLS</td>
<td>Advanced Paediatric Life Support</td>
</tr>
<tr>
<td>ATLS</td>
<td>Advanced Trauma Life Support</td>
</tr>
<tr>
<td>BNF</td>
<td>British National Formulary</td>
</tr>
<tr>
<td>CCT</td>
<td>Canadian computed tomography</td>
</tr>
<tr>
<td>CHALICE</td>
<td>children’s head injury algorithm for the prediction of important clinical events</td>
</tr>
<tr>
<td>CI</td>
<td>confidence interval</td>
</tr>
<tr>
<td>CNS</td>
<td>central nervous system</td>
</tr>
<tr>
<td>CPP</td>
<td>cerebral perfusion pressure</td>
</tr>
<tr>
<td>CSF</td>
<td>cerebrospinal fluid</td>
</tr>
<tr>
<td>CT</td>
<td>computed tomography</td>
</tr>
<tr>
<td>ED</td>
<td>emergency department</td>
</tr>
<tr>
<td>ENP</td>
<td>emergency nurse practitioner</td>
</tr>
<tr>
<td>GCS</td>
<td>Glasgow Coma Scale</td>
</tr>
<tr>
<td>GOS</td>
<td>Glasgow Outcome Scale</td>
</tr>
<tr>
<td>GP</td>
<td>general practitioner</td>
</tr>
<tr>
<td>ICH</td>
<td>intracranial haemorrhage</td>
</tr>
<tr>
<td>ICI</td>
<td>intracranial injury</td>
</tr>
<tr>
<td>ICP</td>
<td>intracranial pressure</td>
</tr>
<tr>
<td>ICU</td>
<td>intensive care unit</td>
</tr>
<tr>
<td>LOC</td>
<td>loss of consciousness</td>
</tr>
<tr>
<td>mAs</td>
<td>milliampere second</td>
</tr>
<tr>
<td>mSv</td>
<td>milliseivert</td>
</tr>
<tr>
<td>MRI</td>
<td>magnetic resonance imaging</td>
</tr>
<tr>
<td>MTA</td>
<td>multiple technology appraisal</td>
</tr>
<tr>
<td>NAI</td>
<td>non-accidental injury</td>
</tr>
<tr>
<td>NEED</td>
<td>NHS Economics Evaluations database</td>
</tr>
<tr>
<td>NEXUS II</td>
<td>The National Emergency X-Radiography Utilization Study II</td>
</tr>
<tr>
<td>NHS QIS</td>
<td>NHS Quality Improvement Scotland</td>
</tr>
<tr>
<td>NICE</td>
<td>National Institute for Health and Clinical Excellence</td>
</tr>
<tr>
<td>NICU</td>
<td>neurological intensive care unit</td>
</tr>
<tr>
<td>NOC</td>
<td>New Orleans Criteria</td>
</tr>
<tr>
<td>OR</td>
<td>odds ratio</td>
</tr>
<tr>
<td>PACS</td>
<td>Picture Archiving and Communications Systems</td>
</tr>
<tr>
<td>PICO</td>
<td>population, intervention, comparison, outcome</td>
</tr>
<tr>
<td>PPV</td>
<td>positive predictive value</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>PTA</td>
<td>post-traumatic amnesia</td>
</tr>
<tr>
<td>RR</td>
<td>relative risk</td>
</tr>
<tr>
<td>SCAT</td>
<td>Sport Concussion Assessment Tool</td>
</tr>
<tr>
<td>SCIWORA</td>
<td>spinal cord injuries without radiographic abnormality</td>
</tr>
<tr>
<td>SIGN</td>
<td>Scottish Intercollegiate Guidelines Network</td>
</tr>
<tr>
<td>SMC</td>
<td>Scottish Medicines Consortium</td>
</tr>
<tr>
<td>TARN</td>
<td>Trauma Audit and Research Network</td>
</tr>
<tr>
<td>TBI</td>
<td>traumatic brain injury</td>
</tr>
</tbody>
</table>
## Annex 1

### Key questions used to develop the guideline

The guideline is based on a series of structured key questions that, where possible, define the population concerned, the intervention (or diagnostic test, etc) under investigation, the type of comparison used, and the outcomes used to measure the effectiveness of the interventions. These questions form the basis of the systematic literature search.

### THE KEY QUESTIONS USED TO DEVELOP THE GUIDELINE

#### INITIAL ASSESSMENT AND REFERRAL TO HOSPITAL

<table>
<thead>
<tr>
<th>Key question</th>
<th>See guideline section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is the telephone triage of patients with a head injury safe and effective?</td>
<td>3.1</td>
</tr>
<tr>
<td>Consider: in the community, pre-hospital, telephone advice, general practice, out of hours</td>
<td></td>
</tr>
<tr>
<td>2. In patients with a head injury, which signs and symptoms are predictors of brain injury (including late/delayed presentation, and re-presentation)?</td>
<td>4.2, 4.3</td>
</tr>
<tr>
<td>Consider: advice, general practice, rural</td>
<td></td>
</tr>
<tr>
<td>3. How does age/GCS/severity of coagulopathy, whether iatrogenic, from anticoagulants/antiplatelet drugs (warfarin, heparin, aspirin or clopidogrel) or pre-existing, especially in patients with a history of alcohol excess affect management of patients with a head injury?</td>
<td>4.2, 5.1, 6.1</td>
</tr>
<tr>
<td>Consider: increased risk of intracranial haemorrhage/focal brain injury, neurosurgery, observation, scanning</td>
<td></td>
</tr>
<tr>
<td>4. Which patients with a head injury who present/re-present more than three days post-injury need imaging and/or specialist referral?</td>
<td>no evidence identified</td>
</tr>
<tr>
<td>Consider: comorbidities, paediatrics</td>
<td></td>
</tr>
</tbody>
</table>

#### IMAGING

<table>
<thead>
<tr>
<th>Key question</th>
<th>See guideline section</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. What are the indications for a CT head scan in terms of initial/presenting GCS; how this changes over time; age of patient; other clinical features?</td>
<td>5.1.1, 5.2.1</td>
</tr>
<tr>
<td>6. Where a CT scan is indicated what are the indications for performing an immediate CT scan as opposed to an urgent/emergency scan and what should be the time scale?</td>
<td>5.1.1, 5.2.1</td>
</tr>
<tr>
<td>Consider: 30min, 4hrs, 24hrs</td>
<td></td>
</tr>
<tr>
<td>7. What percentage of negative skull X-rays predict an abnormal CT scan that will necessitate hospital admission and neurosurgical intervention?</td>
<td>5.1.2</td>
</tr>
<tr>
<td>8. What percentage of patients with a skull fracture have no external evidence of trauma such as a scalp laceration or haematoma?</td>
<td>no evidence identified</td>
</tr>
<tr>
<td>9. What are the indications for a skull X-ray rather than a CT head scan?</td>
<td>5.1.2, 5.2.4</td>
</tr>
<tr>
<td>10. If a patient is having a CT head scan and there is GCS compromise, should they then have a cervical spine CT scan since the neck cannot be cleared clinically?</td>
<td>5.1.3, 5.2.5</td>
</tr>
</tbody>
</table>
11. Does specialist reporting on a CT scan reduce misreporting, missed pathology, false positive and negative results?
   Consider: neuroradiologist vs district general radiologist or radiographer, image transfer, all head CTs

12. What is the radiation risk from an X-ray or standard or new generation CT scanner and does this have any clinical sequelae, especially in the paediatric population and in those who have repeat scans?
   Consider: risk on a dose-related basis or population basis

**IN-HOSPITAL CARE, DISCHARGE AND FOLLOW UP**

<table>
<thead>
<tr>
<th>Key question</th>
<th>See guideline section</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. In patients with a head injury what is the optimal method and frequency of neurological observation (GCS, pupils, blood pressure)? Consider: severity of injury, timing of observation, training requirements</td>
<td>7.1.1, 7.1.2</td>
</tr>
<tr>
<td>14. In patients with a head injury what are the optimal therapies for behavioural disturbance during the first 72 hours in a non-specialist/general ward? Consider: non-pharmacological interventions, drugs (benzodiazepines, antipsychotic, analgesics, antiepileptic), alcohol or drug withdrawal</td>
<td>7.2</td>
</tr>
<tr>
<td>15. What signs and symptoms/assessments predict safe discharge from the ward and adverse outcome? Consider: headache, balance, gait, nausea, confusion, neurological signs and symptoms, social issues, length of hospital stay</td>
<td>7.3</td>
</tr>
<tr>
<td>16. What discharge advice should be provided to patient and/or carers of patients with a head injury? Consider: post-concussion syndrome, driving</td>
<td>6.3, 7.3</td>
</tr>
<tr>
<td>17. What evidence is there that neurointensive care or expertise is of more benefit than general intensive care (ICU)? Consider: severity of head injury, ICP monitoring, microdialysis, imaging, neurocritical care team</td>
<td>8.3</td>
</tr>
<tr>
<td>18. Does follow up affect outcome in patients with a head injury and who should be followed up? Consider: assessment, consultation, information, referral, interventions that are not rehabilitation, reassurance Indicators: severity of injury, return to work/school, sport and leisure, psychosocial, symptom complaints, disability and handicap, vulnerable groups, rurality, home environment, social work, timing of follow up Excluding: inpatient/outpatient rehabilitation programmes</td>
<td>9</td>
</tr>
</tbody>
</table>
### MANAGING CHILDREN

<table>
<thead>
<tr>
<th>Key question</th>
<th>See guideline section</th>
</tr>
</thead>
<tbody>
<tr>
<td>19. In paediatric patients is there evidence that a structured history taking and examination aids assessment of head injury severity? Consider: mechanism of injury, prior attendance, non-accidental injury, which assessments and scales to use for which age groups</td>
<td>3.2.2, 4.2</td>
</tr>
<tr>
<td>20. What are the clinical signs for the presence of a non-accidental injury (NAI) in paediatric head injury?</td>
<td>no evidence identified</td>
</tr>
<tr>
<td>21. What specific services do children with head injury require (children’s services)? Consider: severity, requirement for surgery, ventilation, staff (paediatric anaesthetists, nurses, surgeons, child psychologist), intensive care unit, environment</td>
<td>7.1.1, 7.1.2</td>
</tr>
<tr>
<td>22. Which children with a head injury should be admitted? Consider: age, psychosocial needs, parental anxiety</td>
<td>6.1</td>
</tr>
<tr>
<td>23. What are the criteria for ventilation of children with a head injury?</td>
<td>no evidence identified</td>
</tr>
<tr>
<td>24. What are the criteria for referral of children with head injury to specialist units?</td>
<td>no evidence identified</td>
</tr>
<tr>
<td>25. What are the criteria for safe transfer of children with head injury to specialist units?</td>
<td>8.2</td>
</tr>
<tr>
<td>26. Which children with head injury require follow up following head injury? Consider: which services, which staff, where</td>
<td>9</td>
</tr>
</tbody>
</table>
Annex 2
Example of head injury observation chart

<table>
<thead>
<tr>
<th>NAME</th>
<th>RECORD No.</th>
<th>DATE</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMA SCALE**

- **Eyes open**
  - Spontaneously
  - To speech
  - To pain
  - None

- **Oriented**
  - Confused
  - Inappropriate words
  - Incomprehensible sounds
  - None

- **Obey commands**
  - Locates pain
  - Flexion to pain
  - Extension to pain
  - None

| + | 1 | 240 | 40 |
| 2 | 230 | 39 |
| 3 | 220 | 38 |
| 4 | 210 | 37 |
| 5 | 200 | 36 |
| 6 | 190 | 35 |
| 7 | 180 | 34 |
| 8 | 170 | 33 |
| 9 | 160 | 32 |
| 10| 150 | 31 |
| 11| 140 | 30 |
| 12| 130 |   |
| 13| 120 |   |
| 14| 110 |   |
| 15| 100 |   |
| 16| 90  |   |
| 17| 80  |   |
| 18| 70  |   |
| 19| 60  |   |
| 20| 50  |   |
| 21| 40  |   |
| 22| 30  |   |
| 23| 20  |   |
| 24| 10  |   |

**PUPILS**

- Right
  - Size
  - Reaction
  - Size
  - Reaction

<table>
<thead>
<tr>
<th>Pupils scale (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils size</td>
</tr>
<tr>
<td>Pupils reaction</td>
</tr>
</tbody>
</table>

**RESPIRATION**

- Respiration
- 20
- 10

**LUMS MOVEMENT**

- Normal power
- Mild weakness
- Severe weakness
- Spastic flexion
- Extension
- No response

<table>
<thead>
<tr>
<th>Area</th>
<th>Normal power</th>
<th>Mild weakness</th>
<th>Severe weakness</th>
<th>Spastic flexion</th>
<th>Extension</th>
<th>No response</th>
</tr>
</thead>
</table>

**Note:** In this example, abnormal (level 3) and normal (level 4) flexion are combined.
Annex 3
Neurological assessment using the Glasgow Coma Scale

The procedure

<table>
<thead>
<tr>
<th>Explain the procedure to the patient.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascertain the patient’s acuity of hearing.</td>
</tr>
<tr>
<td>Ideally, use an interpreter if the patient does not speak English.</td>
</tr>
<tr>
<td>Check the patient’s notes for any medical condition that may affect the accuracy of the GCS, for example previous stroke, affecting the movement of the patient’s arms (see figure 1).</td>
</tr>
<tr>
<td>Check the neurological observation chart for the GCS scale (see figure 2).</td>
</tr>
<tr>
<td>Check if the patient opens their eyes without the need to speak or to touch them; if the patient does, then the score is 4E. If the patient does not open their eyes, talk to them (see figure 3). Start off with a normal volume and speak louder if necessary. If they now open their eyes, the score is 3E.</td>
</tr>
<tr>
<td>If the patient does not open their eyes to speech, administer a painful stimulus, for example trapezius squeeze (use the thumb and two fingers to grasp the trapezius muscle where the neck meets the shoulder and twist) (see figure 4). Or apply supra-orbital pressure (locate the notch on the supra-orbital margin and apply pressure to it) (see figure 5). If there is any doubt in distinguishing between flexion to a painful stimulus and localisation to pain, supra-orbital notch pressure should be used. If supra-orbital notch pressure is contraindicated due to bruising or swelling in this region then finger nail pressure could be used.</td>
</tr>
<tr>
<td>If the patient opens their eyes to a painful stimulus record the score as 2E. If the patient does not respond, then the score is 1E.</td>
</tr>
</tbody>
</table>

Fig 1. Check for any factors that could affect the accuracy of the GCS

Fig 2. Use a neurological observation chart incorporating the GCS

Fig 3. If the patient does not open their eyes spontaneously, talk to them

Fig 4. Use the thumb and two fingers to apply a trapezius squeeze

Fig 5. Apply pressure to the notch on the supra-orbital margin
### Annex 3

#### continued

<table>
<thead>
<tr>
<th><strong>Eye opening</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment of eye opening involves the evaluation of arousal (being aware of the environment):</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Score 4</strong></td>
<td>Eyes open spontaneously.</td>
</tr>
<tr>
<td><strong>Score 3</strong></td>
<td>Eyes open to speech.</td>
</tr>
<tr>
<td><strong>Score 2</strong></td>
<td>Eyes open in response to pain only, for example trapezius squeeze (caution if applying a painful stimulus).</td>
</tr>
<tr>
<td><strong>Score 1</strong></td>
<td>Eyes do not open to verbal or painful stimuli.</td>
</tr>
</tbody>
</table>

*Record ‘C’ if the patient is unable to open her or his eyes because of swelling, ptosis (drooping of the upper eye lid) or a dressing.*

<table>
<thead>
<tr>
<th><strong>Verbal response</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment involves evaluating awareness:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Score 5</strong></td>
<td>Orientated.</td>
</tr>
<tr>
<td><strong>Score 4</strong></td>
<td>Confused.</td>
</tr>
<tr>
<td><strong>Score 3</strong></td>
<td>Inappropriate words.</td>
</tr>
<tr>
<td><strong>Score 2</strong></td>
<td>Incomprehensible sounds.</td>
</tr>
<tr>
<td><strong>Score 1</strong></td>
<td>No response. This is despite both verbal and physical stimuli.</td>
</tr>
</tbody>
</table>

*Record ‘D’ if the patient is dysphasic and ‘T’ if the patient has a tracheal or tracheostomy tube in situ.*

<table>
<thead>
<tr>
<th><strong>Motor response</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment of motor response is designed to determine the patient’s ability to obey a command and to localise, and to withdraw or assume abnormal body positions, in response to a painful stimulus:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Score 6</strong></td>
<td>Obeys commands. The patient can perform two different movements.</td>
</tr>
<tr>
<td><strong>Score 5</strong></td>
<td>Localises to central pain. The patient does not respond to a verbal stimulus but purposely moves an arm to remove the cause of a central painful stimulus.</td>
</tr>
<tr>
<td><strong>Score 4</strong></td>
<td>Withdraws from pain. The patient flexes or bends the arm towards the source of the pain but fails to locate the source of the pain (no wrist rotation).</td>
</tr>
<tr>
<td><strong>Score 3</strong></td>
<td>Flexion to pain. The patient flexes or bends the arm; characterised by internal rotation and adduction of the shoulder and flexion of the elbow, much slower than normal flexion.</td>
</tr>
<tr>
<td><strong>Score 2</strong></td>
<td>Extension to pain. The patient extends the arm by straightening the elbow and may be associated with internal shoulder and wrist rotation.</td>
</tr>
<tr>
<td><strong>Score 1</strong></td>
<td>No response to painful stimuli.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Painful stimulus</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A true localising response to pain involves the patient bringing an arm up to chin level. Painful stimuli that can elicit this response include trapezius squeeze (see figure 4), supra-orbital ridge pressure (see figure 5) (not recommended if there is a suspected/confirmed facial fracture).</strong></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Phil Jevon. Neurological assessment Part 3 – Glasgow Coma Scale. Nursing Times; 104: 29, 28-29 by kind permission of the Nursing Times.
Annex 4
Sport Concussion Assessment Tool (SCAT)49

This tool represents a standardized method of evaluating people after concussion in sport. This Tool has been produced as part of the Summary and Agreement Statement of the Second International Symposium on Concussion in Sport, Prague 2004

Sports concussion is defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces. Several common features that incorporate clinical, pathological and biomechanical injury constructs that may be utilized in defining the nature of a concussive head injury include:

1. Concussion may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an “impulsive” force transmitted to the head.
2. Concussion typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously.
3. Concussion may result in neuropathological changes but the acute clinical symptoms largely reflect a functional disturbance rather than structural injury.
4. Concussion results in a graded set of clinical syndromes that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course.
5. Concussion is typically associated with grossly normal structural neuroimaging studies.

Post Concussion Symptoms
Ask the athlete to score themselves based on how they feel now. It is recognized that a low score may be normal for some athletes, but clinical judgment should be exercised to determine if a change in symptoms has occurred following the suspected concussion event.

It should be recognized that the reporting of symptoms may not be entirely reliable. This may be due to the effects of a concussion or because the athlete’s passionate desire to return to competition outweighs their natural inclination to give an honest response.

If possible, ask someone who knows the athlete well about changes in affect, personality, behavior, etc.

The SCAT Card (Sport Concussion Assessment Tool)
Athlete Information

What is a concussion? A concussion is a disturbance in the function of the brain caused by a direct or indirect force to the head. It results in a variety of symptoms (like those listed below) and may, or may not, involve memory problems or loss of consciousness.

How do you feel? You should score yourself on the following symptoms, based on how you feel now.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>None</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>“Pressure in head”</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Neck Pain</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Balance problems or dizzy</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Vision problems</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Hearing problems / ringing</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>“Don’t feel right”</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Feeling “dinged” or “dazed”</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Confusion</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Feeling slowed down</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Feeling like “in a fog”</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Fatigue or low energy</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>More emotional than usual</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Irritability</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Difficulty remembering</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
</tbody>
</table>

(follow up symptoms only)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>None</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sadness</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Nervous or Anxious</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Trouble falling asleep</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Sleeping more than usual</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Sensitivity to light</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Sensitivity to noise</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Other:</td>
<td>0</td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
</tbody>
</table>

What should I do?
Any athlete suspected of having a concussion should be removed from play, and then seek medical evaluation.

Signs to watch for:
Problems could arise over the first 24-48 hours. You should not be left alone and must go to a hospital at once if you:
- Have a headache that gets worse
- Are very drowsy or can’t be awakened (woken up)
- Can’t recognize people or places
- Have repeated vomiting
- Behave unusually or seem confused; are very irritable
- Have seizures (arms and legs jerk uncontrollably)
- Have weak or numb arms or legs
- Are unsteady on your feet; have slurred speech

Remember, it is better to be safe. Consult your doctor after a suspected concussion.

What can I expect?
Concussion typically results in the rapid onset of short-lived impairment that resolves spontaneously over time. You can expect that you will be told to rest until you are fully recovered (that means resting your body and your mind). Then, your doctor will likely advise that you go through a gradual increase in exercise over several days (or longer) before returning to sport.

For more information see the “Summary and Agreement Statement of the Second International Symposium on Concussion in Sport” in the April, 2005 edition of the Clinical Journal of Sport Medicine (vol 15), British Journal of Sports Medicine (vol 39), Neurosurgery (vol 59) and the Physician and Sportsmedicine (vol 33). This tool may be copied for distribution to teams, groups and organizations. ©2005 Concussion in Sport Group
Annex 4
continued

The SCAT Card
(Sport Concussion Assessment Tool)

Medical Evaluation

Name: ___________________________ Date __________
Sport/Team: ___________________ Mouth guard? Y N

1) SIGNS
Was there loss of consciousness or unresponsiveness? Y N
Was there seizure or convulsive activity? Y N
Was there a balance problem / unsteadiness? Y N

2) MEMORY
Modified Maddocks questions (check correct)
At what venue are we? __; Which half is it? __; Who scored last? __
What team did we play last? __; Did we win last game? __

3) SYMPTOM SCORE
Total number of positive symptoms (from reverse side of the card) = _____

4) COGNITIVE ASSESSMENT

5 word recall (Examples) Immediate Delayed
Word 1 _____________ cat ___ ___
Word 2 _____________ pen ___ ___
Word 3 _____________ shoe ___ ___
Word 4 _____________ book ___ ___
Word 5 _____________ car ___ ___

Months in reverse order: Jun-May-Apr-Mar-Feb-Jan-Dec-Nov-Oct-Sep-Aug-Jul (circle incorrect)

6-2-9-4 4-3-7-1 ___ ___
8-3-2-7-9 1-4-9-3-6 ___ ___
7-3-9-1-4-2 5-1-8-4-6-8 ___ ___

Ask delayed 5-word recall now

Digits backwards (check correct)
5-2-8 3-8-1 __
6-2-9-4 4-3-7-1 ___
8-3-2-7-9 1-4-9-3-6 ___
7-3-9-1-4-2 5-1-8-4-6-8 ___

5) NEUROLOGIC SCREENING

Pass Fail
Speech ___ ___
Eye Motion and Pupils ___ ___
Gait Assessment ___ ___

Any neurologic screening abnormality necessitates formal neurologic or hospital assessment

6) RETURN TO PLAY
Athletes should not be returned to play the same day of injury. When returning athletes to play, they should follow a stepwise symptom-limited program, with stages of progression. For example:
1. rest until asymptomatic (physical and mental rest)
2. light aerobic exercise (e.g. stationary cycle)
3. sport-specific exercise
4. non-contact training drills (start light resistance training)
5. full contact training after medical clearance
6. return to competition (game play)

There should be approximately 24 hours (or longer) for each stage and the athlete should return to stage 1 if symptoms recur. Resistance training should only be added in the later stages. Medical clearance should be given before return to play.

Instructions:
This side of the card is for the use of medical doctors, physiotherapists or athletic therapists. In order to maximize the information gathered from the card, it is strongly suggested that all athletes participating in contact sports complete a baseline evaluation prior to the beginning of their competitive season. This card is a suggested guide only for sports concussion and is not meant to assess more severe forms of brain injury. Please give a COPY of this card to the athlete for their information and to guide follow-up assessment.

Signs:
Assess for each of these items and circle Y (yes) or N (no).

Memory: If needed, questions can be modified to make them specific to the sport (e.g. "period" versus "half").

Cognitive Assessment:
Select any 5 words (an example is given). Avoid choosing related words such as "dark" and "moon" which can be recalled by means of word association. Read each word at a rate of one word per second. The athlete should not be informed of the delayed testing of memory (to be done after the reverse months and/or digits). Choose a different set of words each time you perform a follow-up exam with the same candidate.

Ask the athlete to recite the months of the year in reverse order, starting with a random month. Do not start with December or January. Can any months not recited in the correct sequence.

For digits backwards, if correct, go to the next string length. If incorrect, read trial 2. Stop after incorrect on both trials.

Neurologic Screening:
Trained medical personnel must administer this examination. These individuals might include medical doctors, physiotherapists or athletic therapists. Speech should be assessed for fluency and lack of slurring. Eye motion should reveal no diplopia in any of the 4 planes of movement (vertical, horizontal and both diagonal planes). The pronator drift is performed by asking the patient to hold both arms in front of them, palms up, with eyes closed. A positive test is pronating the forearm, dropping the arm, or drift away from midline. For gait assessment, ask the patient to walk away from you, turn and walk back.

Return to Play:
A structured, graded exertion protocol should be developed, individualized on the basis of sport, age and the concussion history of the athlete. Exercise or training should be commenced only after the athlete is clearly asymptomatic with physical and cognitive rest. Final decision for clearance to return to competition should ideally be made by a medical doctor.

For more information see the "Summary and Agreement Statement of the Second International Symposium on Concussion in Sport" in the April, 2005 Clinical Journal of Sport Medicine (vol 15), British Journal of Sports Medicine (vol 38), Neurosurgery (vol 59) and the Physician and Sportsmedicine (vol 33), ©2005 Concussion in Sport Group.
## Annex 5

Example of a proforma for routine documentation of head injury in adult patients

![Diagram of head injury assessment in ED]

### Head injury assessment in ED

<table>
<thead>
<tr>
<th>Name:</th>
<th>PATIENT LABEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>/ / Time</td>
</tr>
</tbody>
</table>

#### History:

- **Recall of incident:** No Yes
- **Mechanism:** Fall Assault RTA Alcohol / Drugs Other _____________
- **PTA:** None < 5 mins 5 – 60 mins > 1 hr (__ hrs)
- **Present symptoms:** Headache Dizziness Nausea Vomited in last 12 hours
  - Disturbance of speech / hearing / vision / balance Other _____________
- **PMH:**
- **Medication:** Warfarin Anticonvulsants Other _____________
- **O/E:** Resp. rate /min Pulse rate /min BP
- **GCS:** Eye opening -- Best motor -- Verbal --
- **Neck injury status:** Cleared Immobilised
- **Scalp:** Wound (Laceration / Incised or Contusion); Fracture (felt or seen or unsure)
## Head injury assessment in ED

### Continuation

<table>
<thead>
<tr>
<th>Neurological signs (✓ if normal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensation - scalp / face Hearing R L Romberg’s</td>
</tr>
<tr>
<td>Smell Tongue &amp; Palate mvnt Visual Acuity R L Visual fields</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tympanic membranes normal:</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. Yes No Obscured by wax</td>
</tr>
<tr>
<td>L. Yes No Obscured by wax</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Signs of basal skull fracture:</th>
</tr>
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<tr>
<td>No Yes _________________________</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Other injuries / problems:</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Yes _________________________</td>
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### ASSESSMENT (List injuries)  |  PLAN

Signature:
# Annex 6

Example of a proforma for routine documentation of head injury in children over five years of age

## Head Injury History: Children of 5 years and older

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<thead>
<tr>
<th>Affix Patient Label Here</th>
<th>Person responsible at home:</th>
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<tbody>
<tr>
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<table>
<thead>
<tr>
<th>DOB</th>
<th>YO</th>
<th>Sex</th>
<th>Male</th>
<th>Female</th>
</tr>
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<table>
<thead>
<tr>
<th>Injury Date</th>
<th>Injury Time</th>
<th>Exam Date</th>
<th>Exam Time</th>
<th>History from:</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Patient: Parent</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Injury Date</th>
<th>Injury Time</th>
<th>Exam Date</th>
<th>Exam Time</th>
<th>History from:</th>
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<td>Patient: Parent</td>
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<td>Other:</td>
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<th>Drug Therapy</th>
<th>Yes</th>
<th>No</th>
<th>Other Drugs</th>
<th>Drug Allergies</th>
<th>Known Allergies</th>
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<th>Hand Dominance</th>
<th>Right</th>
<th>Left</th>
<th>Ambidextrous</th>
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<th>History</th>
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<tr>
<th>Incident Description:</th>
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<tr>
<th>Safety Equipment:</th>
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<table>
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<th>Loss of consciousness</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>How long?</th>
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<th>How long?</th>
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<th>No</th>
<th>Unsure</th>
<th>How long?</th>
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<th>How long?</th>
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<tr>
<th>Seizure since injury</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Describe:</th>
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<th>Describe:</th>
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<th>No</th>
<th>Unsure</th>
<th>Describe:</th>
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<th>Headache</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Describe:</th>
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<th>Nausea</th>
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<table>
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<th>Unsure</th>
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<table>
<thead>
<tr>
<th>Vomiting</th>
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<th>No</th>
<th>Unsure</th>
<th>No of times:</th>
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<th>Vomiting</th>
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<th>No</th>
<th>Unsure</th>
<th>No of times:</th>
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<table>
<thead>
<tr>
<th>Drowsy / unusually tired</th>
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<th>No</th>
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<th>Comment:</th>
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<th>Drowsy / unusually tired</th>
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<th>No</th>
<th>Unsure</th>
<th>Comment:</th>
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<table>
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<tr>
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<tr>
<th>Evidence of alcohol/drug consumption</th>
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<th>No</th>
<th>Unsure</th>
<th>Comment:</th>
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<th>Comment:</th>
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<th>Comment:</th>
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<th>Limb weakness</th>
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<table>
<thead>
<tr>
<th>Other neurological symptoms</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Details:</th>
</tr>
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<th>No</th>
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<th>Details:</th>
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<table>
<thead>
<tr>
<th>Pre-existing disorders</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Give details of known pre-existing disorders eg epilepsy, diabetes, cardiac arrhythmias, bleeding disorders, mental disorders, other medical.</th>
</tr>
</thead>
<tbody>
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<tr>
<th>Pre-existing disorders</th>
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<th>No</th>
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<table>
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<tr>
<th>Tetanus State</th>
<th>Covered</th>
<th>Needs Booster</th>
<th>Needs Course</th>
<th>Not Known</th>
</tr>
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<tbody>
<tr>
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<th>Needs Booster</th>
<th>Needs Course</th>
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**Annex 6**

**continued**

---

### Head Injury Examination: Adults and children of 5 years and older

Tick the boxes corresponding to the injured areas, and illustrate with appropriate measurements of lacerations and bruises in cms:

- Vertex
- Right Parietal
- Left Parietal
- Forehead/Face
- Occiput

**Head Examination**

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<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
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<tr>
<td>Boggy haematoma</td>
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<td></td>
</tr>
<tr>
<td>Laceration(s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruising</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspicion of compound skull fracture or penetrating injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sign of base of skull fracture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF/Blood leak from right ear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF/Blood leak from left ear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF/Blood leak from nose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence of injury to neck</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**C Spine Examination**

- Normal
- Abnormal
- Immobilised

**Neurological Examination: Score from Glasgow Coma Scale**

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td></td>
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</tr>
<tr>
<td>Right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pupil reacting</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Movements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>N</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebellar signs</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td></td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
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<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gait</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td></td>
<td></td>
</tr>
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</table>

**Comments on injuries, neuro-examination and treatment:**

---

### Investigations and Results

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BM/Temp not relevant</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain CT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Spine CT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Spine X-ray</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Findings on Imaging:**

---

### Management

- **Discharge home**
- **Request opinion**
- **Refer to surgeons**
- **Admit to ward**
- **Transfer to SGU**

**Signature:**

---

### Diagnosis from ED

- **Head injury**
- **Skull fracture**
- **Facial injury**
- **Other diagnosis**

**Additional notes on ED card**

---

*Annex 6 continued*
## Annex 7

Example of a proforma for routine documentation of head injury in children under five years of age

<table>
<thead>
<tr>
<th>Head Injury History: Children under 5 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affix Patient Label Here</td>
</tr>
<tr>
<td>DOB [Day] / [Month] / [Year]</td>
</tr>
<tr>
<td>YO [Year of Birth]</td>
</tr>
<tr>
<td>Sex [Male] / [Female]</td>
</tr>
<tr>
<td>Person responsible at home:</td>
</tr>
<tr>
<td>Injury Date [Day] / [Month] / [Year]</td>
</tr>
<tr>
<td>Exam Date [Day] / [Month] / [Year]</td>
</tr>
<tr>
<td>Injury Time [Time]</td>
</tr>
<tr>
<td>Exam Time [Time]</td>
</tr>
<tr>
<td>History from:</td>
</tr>
</tbody>
</table>

### Incident Description:
- F/S Passenger
- B/S Passenger
- Motor Cycle / Pillion
- Pedestrian
- Fall
- School Accident
- Sport / Play
- Home Accident
- Other
- Assault or NAI

### Safety Equipment:
- Seatbelt [Yes] / [No]
- Helmet [Yes] / [No]

### History (if NAI suspected, see ED Dept Child Protection protocol ~ Head Injury)

<table>
<thead>
<tr>
<th>Incident Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Details]</td>
</tr>
</tbody>
</table>

### Safety Equipment:
- [Yes] / [No]

### Other neurological symptoms
- [Yes] / [No] / [Unable To Assess]

### Details:
- [None] / [Unknown]

### Pre-existing disorders
- [None] / [Unknown]

### Tetanus State
Annex 7
continued

**Head Injury Examination : Children under 5 years of age**

Tick the boxes corresponding to the injured areas, and illustrate with appropriate measurements of lacerations and bruises in cms:

<table>
<thead>
<tr>
<th>Area</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right Parietal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Parietal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forehead / Face</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occiput</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Head Examination**

- Boggy haematoma
- Laceration(s)
- Bruising
- Suspicion of compound skull fracture or penetrating injury
- Sign of base of skull fracture
- CSF/Blood leak from right ear
- CSF/Blood leak from left ear
- CSF/Blood leak from nose
- Evidence of injury to neck

- Fontanelle / Sutures
- Normal
- Bulging / tense

- Head circumference cm
- Normal
- Abnormal
- Immobilised

- C Spine movements
- Normal
- Abnormal
- Immobilised

**Neurological Examination**

- Score from Glasgow Coma Scale

<table>
<thead>
<tr>
<th>E</th>
<th>M</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupil reacting</td>
<td>Movements</td>
<td>Cerebellar signs</td>
</tr>
<tr>
<td>Left</td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>Normal Abnormal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Abnormal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Abnormal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Tone
- Power
- Cerebellar signs
- No
- Yes

- Gait
- Normal
- Abnormal

- Developmental milestone consistent with history
- Observed
- Not seen

- If <1 year old
- Sits
- Rolls
- Crawls
- Walks
- Yes
- No

Comments on injuries, neuro-examination and treatment:

**Investigations and Results**

<table>
<thead>
<tr>
<th>Test</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BM/Temp not relevant</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Brain CT
- C Spine CT
- C Spine X-ray

**Findings on Imaging:**

**Management**

- Discharge home
- Request opinion
- Refer to surgeons
- Admit to ward
- Transfer to SGU

**ED Diagnosis**

- Head injury
- Nose injury
- Skull fracture
- Facial injury
- Other diagnosis give details in box below:

**Signature:** ____________________________  Additional notes on ED card  Yes  No
Annex 8
Example advice leaflet for person taking a patient home from the ED

IMPORTANT THINGS TO LOOK FOR AFTER A HEAD INJURY

Advice for the person taking a patient home from the Emergency Department

[Name] has suffered a head injury, but does not need to be admitted to a hospital ward. We have examined the patient, and believe that the injury is not serious. Please watch the patient closely over the next day or so as very rarely complications may develop as a result of the injury. Overnight rouse the patient gently every couple of hours, and follow this advice:

1. Do not leave the patient alone at home.
2. Make sure that there is a nearby telephone, and that the patient stays within easy reach of medical help.
3. Symptoms to look out for:
   - Is it difficult to wake the patient up?
   - Is the patient very confused?
   - Does the patient complain of a very severe headache?
   - Has the patient:
     - vomited (been sick)?
     - had a fit (collapsed and felt a bit out of touch afterwards)?
     - passed out suddenly?
     - complained of weakness or numbness in an arm or a leg?
     - complained about not seeing as well as usual?
     - had any watery fluid coming out of their ear or nose?

If the answer to any of these questions is ‘Yes’ or you are worried about anything else, you should telephone the Emergency Department on:

TEL. NO.: ....................................................

Or if you are very worried take the patient straight back to the Emergency Department.
Annex 9
Example advice leaflet for patient allowed home from the ED

ADVICE FOR A PATIENT ALLOWED HOME FROM THE EMERGENCY DEPARTMENT FOLLOWING HEAD INJURY

Do you feel well?
Often people can feel unwell after a head injury even when they are back home.
Common symptoms are:
- slight headache
- dizziness
- memory problems
- poor concentration
- irritability or being easily annoyed
- tiredness
- poor sleep.

If you have any of these symptoms, do not worry because they should clear up in time without any treatment.

If you still have any of the symptoms after two weeks you should see your own doctor.

Some extra advice to help you get well:
Following this advice will help you to recover from your head injury more quickly, and it may stop some of the symptoms from happening.
- DO have plenty of rest and avoid stressful and noisy situations.
- DO NOT take any alcohol or any non prescribed drugs.
- DO NOT take sleeping pills, sedatives or tranquillisers. If in doubt contact your GP.
- DO NOT play any contact sport (eg football or squash) for at least three weeks without talking to your doctor first.
Annex 10
Example discharge advice leaflet for carers of children who have sustained a head injury

HEAD INJURY OBSERVATION INSTRUCTIONS FOR PARENTS AND CARERS
Your child has suffered a head injury and should be watched closely for the next 24 hours. If you are worried that he/she is developing a problem, please contact your doctor or this Emergency Department or, if necessary, make arrangements to bring him/her back to hospital by ambulance, taxi or car.

Important things to look out for are:
- increasing confusion (not knowing where they are, getting things muddled up)
- increasing drowsiness (feeling very sleepy all the time)
- persisting headache
- vomiting (being sick)
- weakness of one or more limbs
- not seeing or breathing as well as usual
- watery fluid or blood coming from the ear, nose or mouth
- a fit (collapsing and feeling a bit out of touch afterwards)
- any behaviour not normal for your child.

When your child is sleeping, you should arrange to check him/her for the first night at two-hour intervals to find out:
- Does he/she appear to be breathing normally?
- Is he/she sleeping in a normal posture?
- Does he/she make the expected response when you rouse him/her gently? (eg pulling up sheets, cuddling teddy bear)?

If you cannot satisfy yourself that your child is sleeping normally, he/she should be wakened fully to be checked.

Things you shouldn’t worry about:
Your child may feel some other symptoms over the next few days which should disappear in the next two weeks. These include a mild headache, feeling sick (without vomiting), dizziness, irritability or bad temper, problems concentrating or problems with their memory, tiredness, lack of appetite or problems sleeping. If you feel concerned about any of these symptoms in the first few days after discharge you should bring the patient to their doctor.

If these problems do not go away after two weeks, you should bring the patient to see their doctor

CONTACT NO:.................................................................
Annex 11
Example advice leaflet for patients returning to sport after a head injury: a return to play protocol.

Adapted from McCrory et al (2005)49

The majority of sport-related injuries will be simple concussions that will recover spontaneously over several days. In these situations, it is expected that an athlete will proceed rapidly through the step-wise return to play protocol.

In the first few days following an injury, it is important to emphasise to the athlete that physical and cognitive rest is required. Activities that require concentration and attention may exacerbate the symptoms and as a result delay recovery. The return to play following a concussion follows a step-wise process.

**ADVICE FOR GRADUAL RETURN TO SPORT AFTER A HEAD INJURY**

- You have sustained a concussion or minor head injury.
- Before you return to sport full time it is important that you follow a step-wise return to play protocol to allow you to return safely.
- It is likely that you may experience a number of symptoms as a result of your head injury, such as: mild headache, dizziness, memory problems, poor concentration, irritability, tiredness, sleep disruption.
- You must be sure that your symptoms have completely cleared at each exercise level for at least 24 hours before you progress to the next level.
- If symptoms develop at any exercise level then you should return to level one and have 24 hours rest.
- Contact your GP if your symptoms are not improving.
- You should not return to any full sporting activity in less than one week.
- If you were unconscious or had a significant memory loss after your head injury you should have no full contact activity (level 5) within three weeks. Ask your doctor for advice before going back to full contact activity.
## RETURN TO PLAY PROTOCOL

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No physical activity / complete rest</td>
</tr>
</tbody>
</table>
| 2     | Low levels of physical activity ie symptoms do not come back during or after the activity.  
   eg walking, light jogging, light stationary biking, light weightlifting (lower weight, higher reps, no bench, no squat). |
| 3     | Sport specific training or moderate levels of physical activity with body/head movement  
   eg running in football, moderate jogging, brief running, moderate-intensity stationary biking, moderate-intensity weightlifting (reduced time and/or reduced weight from your typical routine). |
| 4     | Heavy non-contact physical activity / training drills  
   eg sprinting/running, high-intensity stationary biking, regular weightlifting, routine non-contact sport-specific drills. |
| 5     | Full contact in controlled training/practice. |
| 6     | Full contact in games/ Return to competition. |
Annex 12
Example advice leaflet for patient discharged home after admission

Whenever possible, this leaflet should be given to the responsible adult taking the patient home, as well as to the patient.

IMPORTANT ADVICE FOR A PATIENT WITH HEAD INJURY WHEN YOU GET HOME

Ward ___________________ Ward telephone number: __________________

We think that it is okay for you to leave hospital now. We have kept a close eye on you since your head injury, and you seem to be well on the road to recovery. So when you get home you will probably not have any serious symptoms. But if any of the following symptoms do happen, you should return to the hospital or telephone the ward for advice.

Important symptoms to look out for:
- severe headache which is not helped by pain-killers such as paracetamol
- vomiting (being sick)
- confusion (not knowing where you are, getting things muddled up)
- drowsiness (feeling very sleepy all the time)
- a fit (collapsing and feeling a bit out of touch afterwards)
- passing out suddenly
- fluid coming out of your ear or nose
- not seeing as well as usual.

Other symptoms

People who have had a head injury sometimes have other symptoms. You may feel a slight headache, dizziness, memory problems, poor concentration, irritability (being easily annoyed), tiredness, or poor sleep. These symptoms usually clear up after two weeks or so without any treatment, so do not worry about them.

But if these symptoms do not clear up after two weeks, you must go and see your own doctor.

Some extra advice to help you get well:

Following this advice will help you to recover from your head injury more quickly, and it may stop any symptoms from happening.
- DO have plenty of rest and avoid stressful and noisy situations.
- DO NOT take any alcohol.
- DO NOT take sleeping pills, sedatives or tranquillisers. If in doubt contact your GP
- DO NOT play any contact sport (eg football or squash) for at least three weeks without talking to your doctor first.
Annex 13
Example of a neurosurgical referral form

<table>
<thead>
<tr>
<th>Referring Hospital:</th>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultant</td>
<td></td>
</tr>
<tr>
<td>Sex: Male ☐ Female ☐</td>
<td>Age:</td>
</tr>
<tr>
<td>DOB:</td>
<td></td>
</tr>
</tbody>
</table>

**NEUROSURGICAL CHECK LIST and REFERRAL FORM**

From Glasgow Royal Infirmary

ED ☐ Ward ☐ Consultant: ______________________

Date of Incident: ___ / ___ / ___

Time of Incident: ___ : ___

**History:**

- ✓ = Normal
- ↓ = Diminished
- ↑ = Absent

<table>
<thead>
<tr>
<th>Physiological Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>on arrival</td>
</tr>
<tr>
<td>on transfer</td>
</tr>
</tbody>
</table>

- CT Scan at referring hospital: No ☐ Yes ☐
- Cranial Injuries:

<table>
<thead>
<tr>
<th>Extra-cranial injuries (proven or suspected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-spine: Cleared ☐ Controlled ☐</td>
</tr>
<tr>
<td>Pelvis: No ☐ Yes ☐</td>
</tr>
<tr>
<td>Thoracolumbar: No ☐ Yes ☐</td>
</tr>
<tr>
<td>Limbs: No ☐ Yes ☐</td>
</tr>
<tr>
<td>Other: No ☐ Yes ☐</td>
</tr>
</tbody>
</table>

**Past Medical History:**

- Current Medication: Warfarin: ☐ Other: ☐
- Allergies: No ☐ Yes ☐

**Interventions**

- Airway: Patent: ☐ Intubated ☐ Other ☐
- Ventilation: Spontaneous ☐ IPPV ☐ FiO2 _________ %
- Urinary catheter: Yes ☐ No ☐
- Urinalysis:

<table>
<thead>
<tr>
<th>Drugs given</th>
<th>Dose</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetanus immunoglobulin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetanus toxoid</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Blood Tests**

<table>
<thead>
<tr>
<th>Time</th>
<th>Hb</th>
<th>Na⁺</th>
<th>PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>pO₂</td>
<td>WCC</td>
<td>K⁺</td>
<td>APTT</td>
</tr>
<tr>
<td>pCO₂</td>
<td>Platelets</td>
<td>Urea</td>
<td>TCT</td>
</tr>
<tr>
<td>H⁺</td>
<td>Glucose</td>
<td>Creat</td>
<td>X-match</td>
</tr>
<tr>
<td>HCO₃</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Next of kin**

Valuables: patient ☐ relatives ☐ police ☐ none ☐

**NB: Have you excluded all possible sites of blood loss?**

<table>
<thead>
<tr>
<th>Transfer with the patient:</th>
<th>Observation charts ☐</th>
<th>Medical notes ☐</th>
<th>X-rays ☐</th>
<th>CT Scan ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving Neurosurgeon:</td>
<td>Referral Time: ___ : ___</td>
<td>Accepted: ___ : ___</td>
<td>Transfer: ___ : ___</td>
<td></td>
</tr>
<tr>
<td>Signed:</td>
<td>Print:</td>
<td>Grade:</td>
<td>Date: ___ / ___ / ___</td>
<td></td>
</tr>
</tbody>
</table>
EARLY MANAGEMENT OF PATIENTS WITH A HEAD INJURY

References


110. Fleminger S, Greenwood RJ. Pharmacological management for agitation and aggression in people with acquired brain injury. Cochrane Database of Systematic Reviews 2003; 1
117. Diringer MN, Edwards DF. Admission to a neurologic/neurosurgical intensive care unit is associated with reduced mortality rate after intracerebral hemorrhage. [see comment]. Critical Care Medicine 2001; 29(3):635-40.
120. Swan I, Teasdale GM. Current concepts in the management of patients with so-called ‘minor’ or ‘mild’ head injury Trauma 1999; 1(2):143-55.