

Head injury: assessment and early management

Clinical guideline

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Your responsibility

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. It is not mandatory to apply the recommendations, and the guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and carers or guardian.

Local commissioners and providers of healthcare have a responsibility to enable the guideline to be applied when individual professionals and people using services wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with complying with those duties.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

Contents

Overview	5
Who is it for?	5
Introduction	6
Key priorities for implementation	9
Transport to hospital	9
Assessment in the emergency department	9
Criteria for performing a CT head scan.....	9
Investigating injuries to the cervical spine.....	11
Discharge and follow-up	12
1 Recommendations	14
Terms used in this guideline	14
1.1 Pre-hospital assessment, advice and referral to hospital	15
1.2 Immediate management at the scene and transport to hospital.....	18
1.3 Assessment in the emergency department	20
1.4 Investigating clinically important brain injuries	23
1.5 Investigating injuries to the cervical spine	26
1.6 Information and support for families and carers	30
1.7 Transfer from hospital to a neuroscience unit	31
1.8 Admission and observation	34
1.9 Discharge and follow-up.....	37
More information.....	39
2 Research recommendations	41
2.1 Criteria for CT head scanning	41
2.2 Antiplatelet and anticoagulant drugs.....	41
2.3 Using biomarkers to diagnose brain injury.....	42
2.4 Predictors of long-term sequelae following head injury.....	43
Update information.....	45

About this guideline	46
Recommendations from NICE clinical guideline 56 that have been amended.....	46

This guideline replaces CG56.

This guideline is the basis of QS74.

Overview

This guideline covers the assessment and early management of head injury in children, young people and adults. It promotes effective clinical assessment so that people receive the right care for the severity of their head injury, including referral directly to specialist care if needed.

In September 2019, we updated the advice in recommendation 1.4.12 on when to have a CT scan to change warfarin to anticoagulants.

Who is it for?

- Healthcare professionals
- People with head injury, their families and carers

Introduction

This guideline updates and replaces 'Head injury' (NICE clinical guideline 56). The recommendations are labelled according to when they were originally published (see [update information](#) for details).

For the purposes of this guideline, head injury is defined as any trauma to the head other than superficial injuries to the face. Head injury is the commonest cause of death and disability in people aged 1–40 years in the UK. Each year, 1.4 million people attend emergency departments in England and Wales with a recent head injury. Between 33% and 50% of these are children aged under 15 years. Annually, about 200,000 people are admitted to hospital with head injury. Of these, one-fifth have features suggesting skull fracture or have evidence of brain damage. Most patients recover without specific or specialist intervention, but others experience long-term disability or even die from the effects of complications that could potentially be minimised or avoided with early detection and appropriate treatment.

The incidence of death from head injury is low, with as few as 0.2% of all patients attending emergency departments with a head injury dying as a result of this injury. Ninety five per cent of people who have sustained a head injury present with a normal or minimally impaired conscious level (Glasgow Coma Scale [GCS] greater than 12) but the majority of fatal outcomes are in the moderate (GCS 9–12) or severe (GCS 8 or less) head injury groups, which account for only 5% of attenders. Therefore, emergency departments see a large number of patients with minor or mild head injuries and need to identify the very small number who will go on to have serious acute intracranial complications. It is estimated that 25–30% of children aged under 2 years who are hospitalised with head injury have an abusive head injury. This guideline has updated some of the terminology used in relation to safeguarding of children and also of vulnerable adults.

The previous head injury guideline produced by NICE in 2003 (NICE clinical guideline 4) and updated in 2007 (NICE clinical guideline 56) resulted in CT scanning replacing skull radiography as the primary imaging modality for assessing head injury. It also led to an increase in the proportion of people with severe head injury having their care managed in specialist centres. This has been associated with a decline in fatality among patients with severe head injury. This update is needed because of the continuing importance of up-to-date evidence-based guidance on the initial assessment and early management of head injury. Appropriate guidance can enable early detection and treatment of life-threatening brain injury, where present, but also early discharge of patients with negligible risk of brain injury. It can therefore save lives while at the same time preventing needless crowding in emergency departments and observation wards.

Further key NHS changes have driven the scope of this update. These include the introduction in 2012 of regional trauma networks with major trauma triage tools within NHS England; the extension of indications for anticoagulation therapy; the expanding use of biomarkers to guide emergent clinical management in other conditions, such as chest pain; and the establishment of local safeguarding boards. The last of these addresses the requirement for front-line clinical staff to assess not only the severity of the head injury but also why it occurred.

This update addresses these areas, including in particular:

- indications for transporting patients with a head injury from the scene of injury directly to the nearest neuroscience centre, bypassing the nearest emergency department
- indications for and timing of CT head scans in the emergency department, with particular reference to anticoagulant therapy and levels of circulating brain injury biomarkers
- the relative cost effectiveness of different strategies for initial imaging of the cervical spine
- information that should be provided to patients, family members and carers on discharge from the emergency department or observation ward.

Safeguarding children

Remember that child maltreatment:

- is common
- can present anywhere – including emergency departments and primary care.

Consider or suspect abuse as a contributory factor to or cause of head injury in children. Abuse may also coexist with a head injury. See the NICE guideline on [child maltreatment](#) for clinical features that may be associated with maltreatment^[1].

Drug recommendations

The guideline will assume that prescribers will use a drug's summary of product characteristics to inform decisions made with individual patients.

This guideline recommends some drugs for indications for which they do not have a UK marketing authorisation at the date of publication, if there is good evidence to support that use. The prescriber should follow relevant professional guidance, taking full responsibility for the decision.

The patient (or those with authority to give consent on their behalf) should provide informed consent, which should be documented. See the General Medical Council's [Good practice in prescribing and managing medicines and devices](#) for further information. Where recommendations have been made for the use of drugs outside their licensed indications ('off-label use'), these drugs are marked with a footnote in the recommendations.

^[1] This section has been agreed with the Royal College of Paediatrics and Child Health.

Key priorities for implementation

The following recommendations have been identified as priorities for implementation. The full list of recommendations is in [section 1](#).

Transport to hospital

- Transport patients who have sustained a head injury directly to a hospital that has the resources to further resuscitate them and to investigate and initially manage multiple injuries. All acute hospitals receiving patients with head injury directly from an incident should have these resources, which should be appropriate for a patient's age^[2]. [new 2014]

Assessment in the emergency department

- A clinician with training in safeguarding should be involved in the initial assessment of any patient with a head injury presenting to the emergency department. If there are any concerns identified, document these and follow local safeguarding procedures appropriate to the patient's age. [2003, amended 2014]

Criteria for performing a CT head scan

- For adults who have sustained a head injury and have any of the following risk factors, perform a CT head scan within 1 hour of the risk factor being identified:
 - GCS less than 13 on initial assessment in the emergency department.
 - GCS less than 15 at 2 hours after the injury on assessment in the emergency department.
 - Suspected [open or depressed skull fracture](#).
 - Any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from the ear or nose, Battle's sign).
 - Post-traumatic seizure.
 - [Focal neurological deficit](#).
 - More than 1 episode of vomiting.

A provisional written radiology report should be made available within 1 hour of the

- – scan being performed. [new 2014]
- For children who have sustained a head injury and have any of the following risk factors, perform a CT head scan within 1 hour of the risk factor being identified:
 - Suspicion of non-accidental injury.
 - Post-traumatic seizure but no history of epilepsy.
 - On initial emergency department assessment, GCS less than 14, or for children under 1 year GCS (paediatric) less than 15.
 - At 2 hours after the injury, GCS less than 15.
 - Suspected open or depressed skull fracture or tense fontanelle.
 - Any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from the ear or nose, Battle's sign).
 - Focal neurological deficit.
 - For children under 1 year, presence of bruise, swelling or laceration of more than 5 cm on the head.

A provisional written radiology report should be made available within 1 hour of the scan being performed. [new 2014]

- For children who have sustained a head injury and have **more than one** of the following risk factors (and none of those in [recommendation 1.4.9](#) above), perform a CT head scan within 1 hour of the risk factors being identified:
 - Loss of consciousness lasting more than 5 minutes (witnessed).
 - Abnormal drowsiness.
 - Three or more discrete episodes of vomiting.
 - Dangerous mechanism of injury (high-speed road traffic accident either as pedestrian, cyclist or vehicle occupant, fall from a height of greater than 3 metres, high-speed injury from a projectile or other object).
 - Amnesia (antegrade or retrograde) lasting more than 5 minutes.^[3]

- – A provisional written radiology report should be made available within 1 hour of the scan being performed. [new 2014]
- Children who have sustained a head injury and have **only 1** of the risk factors in [recommendation 1.4.10](#) (and none of those in [recommendation 1.4.9](#)) should be observed for a minimum of 4 hours after the head injury. If during observation any of the risk factors below are identified, perform a CT head scan within 1 hour.
 - GCS less than 15.
 - Further vomiting.
 - A further episode of abnormal drowsiness.

A provisional written radiology report should be made available within 1 hour of the scan being performed. If none of these risk factors occur during observation, use clinical judgement to determine whether a longer period of observation is needed. [new 2014]

- For patients (adults and children) who have sustained a head injury with no other indications for a CT head scan and who are having anticoagulant treatment, perform a CT head scan within 8 hours of the injury. A provisional written radiology report should be made available within 1 hour of the scan being performed. (For advice on reversal of warfarin anticoagulation in people with suspected traumatic intracranial haemorrhage, see the NICE guideline on [blood transfusion](#).) [new 2014]

Investigating injuries to the cervical spine

- For adults who have sustained a head injury and have any of the following risk factors, perform a CT cervical spine scan within 1 hour of the risk factor being identified:
 - GCS less than 13 on initial assessment.
 - The patient has been intubated.
 - Plain X-rays are technically inadequate (for example, the desired view is unavailable).
 - Plain X-rays are suspicious or definitely abnormal.
 - A definitive diagnosis of cervical spine injury is needed urgently (for example, before surgery).
 - The patient is having other body areas scanned for head injury or multi-region trauma.

- – The patient is alert and stable, there is clinical suspicion of cervical spine injury and any of the following apply:
 - ◊ age 65 years or older
 - ◊ dangerous mechanism of injury (fall from a height of greater than 1 metre or 5 stairs; axial load to the head, for example, diving; high-speed motor vehicle collision; rollover motor accident; ejection from a motor vehicle; accident involving motorised recreational vehicles; bicycle collision)
 - ◊ focal peripheral neurological deficit
 - ◊ paraesthesia in the upper or lower limbs.

A provisional written radiology report should be made available within 1 hour of the scan being performed. [new 2014]

Discharge and follow-up

- Give verbal and printed discharge advice to patients with any degree of head injury who are discharged from an emergency department or observation ward, and their families and carers. Follow recommendations in [patient experience in adult NHS services](#) [NICE clinical guideline 138] about providing information in an accessible format. [new 2014]
- Printed advice for patients, family members and carers should be age-appropriate and include:
 - Details of the nature and severity of the injury.
 - Risk factors that mean patients need to return to the emergency department (see [recommendations 1.1.4 and 1.1.5](#)).
 - A specification that a responsible adult should stay with the patient for the first 24 hours after their injury
 - Details about the recovery process, including the fact that some patients may appear to make a quick recovery but later experience difficulties or complications.
 - Contact details of community and hospital services in case of delayed complications.
 - Information about return to everyday activities, including school, work, sports and driving.
 - Details of support organisations. [new 2014]

^[2] In the NHS in England these hospitals would be trauma units or major trauma centres. In the NHS in Wales this should be a hospital with equivalent capabilities.

^[3] Assessment of amnesia will not be possible in preverbal children and is unlikely to be possible in children aged under 5 years.

1 Recommendations

The following guidance is based on the best available evidence. The [full guideline](#) gives details of the methods and the evidence used to develop the guidance.

Within this guideline children are defined as patients aged under 16 years and infants as those aged under 1 year at the time of presentation to hospital with head injury.

People have the right to be involved in discussions and make informed decisions about their care, as described in [your care](#).

[Making decisions using NICE guidelines](#) explains how we use words to show the strength (or certainty) of our recommendations and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity) and safeguarding.

Terms used in this guideline

Focal neurological deficit

Problems restricted to a particular part of the body or a particular activity, for example, difficulties with understanding, speaking, reading or writing; decreased sensation; loss of balance; general weakness; visual changes; abnormal reflexes; and problems walking.

High-energy head injury

For example, pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from a height of greater than 1 metre or more than 5 stairs, diving accident, high-speed motor vehicle collision, rollover motor accident, accident involving motorised recreational vehicles, bicycle collision, or any other potentially high-energy mechanism.

Base of open or depressed skull fracture or penetrating head injury

Signs include clear fluid running from the ears or nose, black eye with no associated damage around the eyes, bleeding from one or both ears, bruising behind one or both ears, penetrating injury signs, visible trauma to the scalp or skull of concern to the professional.

1.1 *Pre-hospital assessment, advice and referral to hospital*

- 1.1.1 Public health literature and other non-medical sources of advice (for example, St John Ambulance, police officers) should encourage people who have any concerns following a head injury to themselves or to another person, regardless of the injury severity, to seek immediate medical advice. [2003]

Telephone advice services

- 1.1.2 Telephone advice services (for example, NHS 111, emergency department helplines) should refer patients who have sustained a head injury to the emergency ambulance services (that is, 999) for emergency transport to the emergency department if they have experienced any of the following:
- Unconsciousness or lack of full consciousness (for example, problems keeping eyes open).
 - Any focal neurological deficit since the injury.
 - Any suspicion of a skull fracture or penetrating head injury.
 - Any seizure ('convulsion' or 'fit') since the injury.
 - A high-energy head injury.
 - The injured person or their carer is incapable of transporting the injured person safely to the hospital emergency department without the use of ambulance services (providing any other risk factor indicating emergency department referral is present; see recommendation 1.1.3). [2003, amended 2007 and 2014]
- 1.1.3 Telephone advice services (for example, NHS 111 or emergency department helplines) should refer patients who have sustained a head injury to a hospital emergency department if they have any of the following risk factors:
- Any loss of consciousness ('knocked out') as a result of the injury, from which the person has now recovered.
 - Amnesia for events before or after the injury ('problems with memory')^[4].
 - Persistent headache since the injury.

- Any vomiting episodes since the injury.
- Any previous brain surgery.
- Any history of bleeding or clotting disorders.
- Current anticoagulant therapy.
- Current drug or alcohol intoxication.
- There are any safeguarding concerns (for example, possible non-accidental injury or a vulnerable person is affected).
- Irritability or altered behaviour ('easily distracted', 'not themselves', 'no concentration', 'no interest in things around them'), particularly in infants and children aged under 5 years.
- Continuing concern by helpline staff about the diagnosis. [2003, amended 2014]

Community health services and NHS minor injury clinics

1.1.4 Community health services (GPs, ambulance crews, NHS walk-in centres, dental practitioners) and NHS minor injury clinics should refer patients who have sustained a head injury to a hospital emergency department, using the ambulance service if deemed necessary, if any of the following are present:

- Glasgow coma scale (GCS) score of less than 15 on initial assessment.
- Any loss of consciousness as a result of the injury.
- Any focal neurological deficit since the injury.
- Any suspicion of a skull fracture or penetrating head injury since the injury.
- Amnesia for events before or after the injury^[4].
- Persistent headache since the injury.
- Any vomiting episodes since the injury (clinical judgement should be used regarding the cause of vomiting in those aged 12 years or younger and the need for referral).
- Any seizure since the injury.
- Any previous brain surgery.

- A high-energy head injury.
- Any history of bleeding or clotting disorders.
- Current anticoagulant therapy.
- Current drug or alcohol intoxication.
- There are any safeguarding concerns (for example, possible non-accidental injury or a vulnerable person is affected).
- Continuing concern by the professional about the diagnosis. [2003, amended 2007 and 2014]

1.1.5 In the absence of any risk factors in recommendation 1.1.4, consider referral to an emergency department if any of the following factors are present, depending on judgement of severity:

- Irritability or altered behaviour, particularly in infants and children aged under 5 years.
- Visible trauma to the head not covered in recommendation 1.1.4 but still of concern to the professional.
- No one is able to observe the injured person at home.
- Continuing concern by the injured person or their family or carer about the diagnosis. [2003, amended 2014]

Transport to hospital from community health services and NHS minor injury clinics

1.1.6 Patients referred from community health services and NHS minor injury clinics should be accompanied by a competent adult during transport to the emergency department. [2003]

1.1.7 The referring professional should determine if an ambulance is required, based on the patient's clinical condition. If an ambulance is deemed not required, public transport and car are appropriate means of transport providing the patient is accompanied. [2003]

1.1.8 The referring professional should inform the destination hospital (by phone) of the impending transfer and in non-emergencies a letter summarising signs and symptoms should be sent with the patient. [2003]

Training in risk assessment

- 1.1.9 GPs, nurse practitioners, dentists and ambulance crews should receive training, as necessary, to ensure that they are capable of assessing the presence or absence of the risk factors listed in recommendations 1.1.4 and 1.1.5. [2003, amended 2007]

1.2 *Immediate management at the scene and transport to hospital*

Glasgow coma scale

- 1.2.1 Base monitoring and exchange of information about individual patients on the three separate responses on the GCS (for example, a patient scoring 13 based on scores of 4 on eye-opening, 4 on verbal response and 5 on motor response should be communicated as E4, V4, M5). [2003]
- 1.2.2 If a total score is recorded or communicated, base it on a sum of 15, and to avoid confusion specify this denominator (for example, 13/15). [2003]
- 1.2.3 Describe the individual components of the GCS in all communications and every note and ensure that they always accompany the total score. [2003]
- 1.2.4 In the paediatric version of the GCS, include a 'grimace' alternative to the verbal score to facilitate scoring in preverbal children. [2003]
- 1.2.5 In some patients (for example, patients with dementia, underlying chronic neurological disorders or learning disabilities) the pre-injury baseline GCS may be less than 15. Establish this where possible, and take it into account during assessment. [new 2014]

Initial assessment and care

- 1.2.6 Initially assess adults who have sustained a head injury and manage their care according to clear principles and standard practice, as embodied in the:
- Advanced Trauma Life Support (ATLS) course/European Trauma course.
 - International Trauma Life Support (ITLS) course.
 - Pre-hospital Trauma Life Support (PHTLS) course.

- Advanced Trauma Nurse Course (ATNC).
- Trauma Nursing Core Course (TNCC).
- Joint Royal Colleges Ambulance Service Liaison Committee (JRCALC) Clinical Practice Guidelines for Head Trauma. [2003, amended 2007]

1.2.7 Initially assess children who have sustained a head injury and manage their care according to clear principles outlined in the:

- Advanced Paediatric Life Support (APLS)/European Paediatric Life Support (EPLS) course.
- Pre-hospital Paediatric Life Support (PHPLS) course.
- Paediatric Education for Pre-hospital Professionals (PEPP) course. [2003, amended 2007]

1.2.8 When administering immediate care, treat first the greatest threat to life and avoid further harm. (For advice on volume resuscitation in people with traumatic brain injury and haemorrhagic shock, see the NICE guideline on [major trauma: assessment and initial management.](#)) [2003]

1.2.9 Attempt full cervical spine immobilisation for patients who have sustained a head injury and present with any of the following risk factors unless other factors prevent this:

- GCS less than 15 on initial assessment by the healthcare professional.
- Neck pain or tenderness.
- Focal neurological deficit.
- Paraesthesia in the extremities.
- Any other clinical suspicion of cervical spine injury. [2003, amended 2007]

1.2.10 Maintain cervical spine immobilisation until full risk assessment including clinical assessment (and imaging if deemed necessary) indicates it is safe to remove the immobilisation device. [2003, amended 2007]

1.2.11 Make standby calls to the destination emergency department for all patients

with GCS 8 or less to ensure appropriately experienced professionals are available for their treatment and to prepare for imaging. [2003]

- 1.2.12 Manage pain effectively because it can lead to a rise in intracranial pressure. Provide reassurance, splintage of limb fractures and catheterisation of a full bladder, where needed. [2007, amended 2014]
- 1.2.13 Follow at all times best practice in paediatric coma observation and recording as detailed by the National Paediatric Neuroscience Benchmarking Group. [2003]

Transport to hospital

- 1.2.14 Transport patients who have sustained a head injury directly to a hospital that has the resources to further resuscitate them and to investigate and initially manage multiple injuries. All acute hospitals receiving patients with head injury directly from an incident should have these resources, which should be appropriate for a patient's age^[5]. [new 2014]

Training for ambulance crews

- 1.2.15 Ambulance crews should be fully trained in the use of the adult and paediatric versions of the GCS and its derived score. [2003]
- 1.2.16 Ambulance crews should be trained in the safeguarding of children and vulnerable adults and should document and verbally inform emergency department staff of any safeguarding concerns. [2003, amended 2014]

1.3 *Assessment in the emergency department*

- 1.3.1 Be aware that the priority for all emergency department patients is the stabilisation of airway, breathing and circulation (ABC) before attention to other injuries. [2003]
- 1.3.2 Ascribe depressed conscious level to intoxication only after a significant brain injury has been excluded. [2003]
- 1.3.3 All emergency department clinicians involved in the assessment of patients with a head injury should be capable of assessing the presence or absence of the risk factors for CT head and cervical spine imaging listed in [recommendations](#)

1.4.7-1.4.12 and recommendations 1.5.8-1.5.14. Training should be made available as required to ensure that this is the case. [2003]

- 1.3.4 Patients presenting to the emergency department with impaired consciousness (GCS less than 15) should be assessed immediately by a trained member of staff. [2003]
- 1.3.5 In patients with GCS 8 or less, ensure there is early involvement of an anaesthetist or critical care physician to provide appropriate airway management, as described in recommendations 1.7.7 and 1.7.8, and to assist with resuscitation. [2003]
- 1.3.6 A trained member of staff should assess all patients presenting to an emergency department with a head injury within a maximum of 15 minutes of arrival at hospital. Part of this assessment should establish whether they are high risk or low risk for clinically important brain injury and/or cervical spine injury, using recommendations 1.4.7-1.4.12 and recommendations 1.5.8-1.5.14. [2003]
- 1.3.7 In patients considered to be at high risk for clinically important brain injury and/or cervical spine injury, extend assessment to full clinical examination to establish the need to request CT imaging of the head and/or imaging of the cervical spine and other body areas. Use recommendations 1.4.7-1.4.12 and recommendations 1.5.8-1.5.14 as the basis for the final decision on imaging after discussion with the radiology department. [2003, amended 2007]
- 1.3.8 Patients who, on initial assessment, are considered to be at low risk for clinically important brain injury and/or cervical spine injury should be re-examined within a further hour by an emergency department clinician. Part of this assessment should fully establish the need to request CT imaging of the head and/or imaging of the cervical spine. Use recommendations 1.4.7-1.4.12 and recommendations 1.5.8-1.5.14 as the basis for the final decision on imaging after discussion with the radiology department. [2003, amended 2007]
- 1.3.9 Patients who return to an emergency department within 48 hours of transfer to the community with any persistent complaint relating to the initial head injury should be seen by or discussed with a senior clinician experienced in head injuries, and considered for a CT scan. [2003]

- 1.3.10 Manage pain effectively because it can lead to a rise in intracranial pressure. Provide reassurance, splintage of limb fractures and catheterisation of a full bladder, where needed. Treat significant pain with small doses of intravenous opioids titrated against clinical response and baseline cardiorespiratory measurements^[6]. [2007]
- 1.3.11 A clinician with training in safeguarding should be involved in the initial assessment of any patient with a head injury presenting to the emergency department. If there are any concerns identified, document these and follow local safeguarding procedures appropriate to the patient's age. [2003, amended 2014]
- 1.3.12 Throughout the hospital episode, use a standard head injury proforma in documentation when assessing and observing patients with head injury. This form should be of a consistent format across all clinical departments and hospitals in which a patient might be treated. Use a separate proforma for those under 16 years. Areas to allow extra documentation should be included (for example, in cases of non-accidental injury). Examples of proforma that should be used in patients with head injury are provided in appendix O of the [full guideline](#). [2003, amended 2007]

Involving the neurosurgical department

- 1.3.13 Discuss with a neurosurgeon the care of all patients with new, surgically significant abnormalities on imaging. The definition of 'surgically significant' should be developed by local neurosurgical centres and agreed with referring hospitals, along with referral procedures. [2003, amended 2014]
- 1.3.14 Regardless of imaging, other reasons for discussing a patient's care plan with a neurosurgeon include:
- Persisting coma (GCS 8 or less) after initial resuscitation.
 - Unexplained confusion which persists for more than 4 hours.
 - Deterioration in GCS score after admission (greater attention should be paid to motor response deterioration).
 - Progressive focal neurological signs.

- A seizure without full recovery.
- Definite or suspected penetrating injury.
- A cerebrospinal fluid leak. [2003]

1.4 *Investigating clinically important brain injuries*

- 1.4.1 The current primary investigation of choice for the detection of acute clinically important brain injuries is CT imaging of the head. [2003]
- 1.4.2 For safety, logistic and resource reasons, do not perform magnetic resonance imaging (MRI) scanning as the primary investigation for clinically important brain injury in patients who have sustained a head injury, although it is recognised that additional information of importance to the patient's prognosis can sometimes be detected using MRI. [2003]
- 1.4.3 Ensure that there is appropriate equipment for maintaining and monitoring the patient within the MRI environment and that all staff involved are aware of the dangers and necessary precautions for working near an MRI scanner. [2003]
- 1.4.4 Do not use plain X-rays of the skull to diagnose significant brain injury without prior discussion with a neuroscience unit. However, they are useful as part of the skeletal survey in children presenting with suspected non-accidental injury. [2007]
- 1.4.5 If CT imaging is unavailable because of equipment failure, patients with GCS 15 may be admitted for observation. Arrangements should be in place for urgent transfer to a centre with CT scanning available should there be a clinical deterioration that indicates immediate CT scanning is necessary. [2007]
- 1.4.6 In line with good radiation exposure practice, make every effort to minimise radiation dose during imaging of the head and cervical spine, while ensuring that image quality and coverage is sufficient to achieve an adequate diagnostic study. [2003]

Criteria for performing a CT head scan

Adults

1.4.7 For adults who have sustained a head injury and have any of the following risk factors, perform a CT head scan within 1 hour of the risk factor being identified:

- GCS less than 13 on initial assessment in the emergency department.
- GCS less than 15 at 2 hours after the injury on assessment in the emergency department.
- Suspected open or depressed skull fracture.
- Any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from the ear or nose, Battle's sign).
- Post-traumatic seizure.
- Focal neurological deficit.
- More than 1 episode of vomiting.

A provisional written radiology report should be made available within 1 hour of the scan being performed. [new 2014]

1.4.8 For adults with any of the following risk factors who have experienced some loss of consciousness or amnesia since the injury, perform a CT head scan within 8 hours of the head injury:

- Age 65 years or older.
- Any history of bleeding or clotting disorders.
- Dangerous mechanism of injury (a pedestrian or cyclist struck by a motor vehicle, an occupant ejected from a motor vehicle or a fall from a height of greater than 1 metre or 5 stairs).
- More than 30 minutes' retrograde amnesia of events immediately before the head injury.

A provisional written radiology report should be made available within 1 hour of the

- scan being performed. [new 2014]

Children

1.4.9 For children who have sustained a head injury and have any of the following risk factors, perform a CT head scan within 1 hour of the risk factor being identified:

- Suspicion of non-accidental injury
- Post-traumatic seizure but no history of epilepsy.
- On initial emergency department assessment, GCS less than 14, or for children under 1 year GCS (paediatric) less than 15.
- At 2 hours after the injury, GCS less than 15.
- Suspected open or depressed skull fracture or tense fontanelle.
- Any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from the ear or nose, Battle's sign).
- Focal neurological deficit.
- For children under 1 year, presence of bruise, swelling or laceration of more than 5 cm on the head.

A provisional written radiology report should be made available within 1 hour of the scan being performed. [new 2014]

1.4.10 For children who have sustained a head injury and have **more than 1** of the following risk factors (and none of those in recommendation 1.4.9), perform a CT head scan within 1 hour of the risk factors being identified:

- Loss of consciousness lasting more than 5 minutes (witnessed).
- Abnormal drowsiness.
- Three or more discrete episodes of vomiting.
- Dangerous mechanism of injury (high-speed road traffic accident either as pedestrian, cyclist or vehicle occupant, fall from a height of greater than 3 metres, high-speed injury from a projectile or other object).

- Amnesia (antegrade or retrograde) lasting more than 5 minutes^[a].

A provisional written radiology report should be made available within 1 hour of the scan being performed. [new 2014]

1.4.11 Children who have sustained a head injury and have only 1 of the risk factors in recommendation 1.4.10 (and none of those in recommendation 1.4.9) should be observed for a minimum of 4 hours after the head injury. If during observation any of the risk factors below are identified, perform a CT head scan within 1 hour:

- GCS less than 15.
- Further vomiting.
- A further episode of abnormal drowsiness.

A provisional written radiology report should be made available within 1 hour of the scan being performed. If none of these risk factors occur during observation, use clinical judgement to determine whether a longer period of observation is needed. [new 2014]

Patients having anticoagulant treatment

1.4.12 For patients (adults and children) who have sustained a head injury with no other indications for a CT head scan and who are having anticoagulant treatment, perform a CT head scan within 8 hours of the injury. A provisional written radiology report should be made available within 1 hour of the scan being performed. (For advice on reversal of warfarin anticoagulation in people with suspected traumatic intracranial haemorrhage, see the NICE guideline on [blood transfusion](#).) [2014, amended 2019]

1.5 Investigating injuries to the cervical spine

1.5.1 Be aware that, as a minimum, CT should cover any areas of concern or uncertainty on X-ray or clinical grounds. [2003]

1.5.2 Ensure that facilities are available for multiplanar reformatting and interactive viewing of CT cervical spine scans. [2003, amended 2014]

- 1.5.3 MR imaging is indicated if there are neurological signs and symptoms referable to the cervical spine. If there is suspicion of vascular injury (for example, vertebral malalignment, a fracture involving the foramina transversaria or lateral processes, or a posterior circulation syndrome), CT or MRI angiography of the neck vessels may be performed to evaluate for this. [2003, amended 2014]
- 1.5.4 Be aware that MRI may add important information about soft tissue injuries associated with bony injuries demonstrated by X-ray and/or CT. [2003]
- 1.5.5 MRI has a role in the assessment of ligamentous and disc injuries suggested by X-ray, CT or clinical findings. [2003]
- 1.5.6 In CT, routinely review on 'bone windows' the occipital condyle region for patients who have sustained a head injury. Reconstruction of standard head images onto a high-resolution bony algorithm is readily achieved with modern CT scanners. [2003]
- 1.5.7 In patients who have sustained high-energy trauma or are showing signs of lower cranial nerve palsy, pay particular attention to the region of the foramen magnum. If necessary, perform additional high-resolution imaging for coronal and sagittal reformatting while the patient is on the scanner table. [2003]

Criteria for performing a CT cervical spine scan in adults

- 1.5.8 For adults who have sustained a head injury and have any of the following risk factors, perform a CT cervical spine scan within 1 hour of the risk factor being identified:
- GCS less than 13 on initial assessment.
 - The patient has been intubated.
 - Plain X-rays are technically inadequate (for example, the desired view is unavailable).
 - Plain X-rays are suspicious or definitely abnormal.
 - A definitive diagnosis of cervical spine injury is needed urgently (for example, before surgery).

- The patient is having other body areas scanned for head injury or multi-region trauma.
- The patient is alert and stable, there is clinical suspicion of cervical spine injury and any of the following apply:
 - age 65 years or older
 - dangerous mechanism of injury (fall from a height of greater than 1 metre or 5 stairs; axial load to the head, for example, diving; high-speed motor vehicle collision; rollover motor accident; ejection from a motor vehicle; accident involving motorised recreational vehicles; bicycle collision)
 - focal peripheral neurological deficit
 - paraesthesia in the upper or lower limbs.

A provisional written radiology report should be made available within 1 hour of the scan being performed. [new 2014]

1.5.9 For adults who have sustained a head injury and have neck pain or tenderness but no indications for a CT cervical spine scan (see recommendation 1.5.8), perform 3-view cervical spine X-rays within 1 hour if either of these risk factors are identified:

- It is not considered safe to assess the range of movement in the neck (see recommendation 1.5.10).
- Safe assessment of range of neck movement shows that the patient cannot actively rotate their neck to 45 degrees to the left and right.

The X-rays should be reviewed by a clinician trained in their interpretation within 1 hour of being performed. [new 2014]

Assessing range of movement in the neck

1.5.10 Be aware that in adults and children who have sustained a head injury and in whom there is clinical suspicion of cervical spine injury, range of movement in the neck can be assessed safely before imaging **only** if no high-risk factors (see recommendations 1.5.8, 1.5.11 and 1.5.12) and at least 1 of the following low-risk features apply. The patient:

- was involved in a simple rear-end motor vehicle collision
- is comfortable in a sitting position in the emergency department
- has been ambulatory at any time since injury
- has no midline cervical spine tenderness
- presents with delayed onset of neck pain. [new 2014]

Criteria for performing a CT cervical spine scan in children

1.5.11 For children who have sustained a head injury, perform a CT cervical spine scan only if any of the following apply (because of the increased risk to the thyroid gland from ionising radiation and the generally lower risk of significant spinal injury):

- GCS less than 13 on initial assessment.
- The patient has been intubated.
- Focal peripheral neurological signs.
- Paraesthesia in the upper or lower limbs.
- A definitive diagnosis of cervical spine injury is needed urgently (for example, before surgery).
- The patient is having other body areas scanned for head injury or multi-region trauma.
- There is strong clinical suspicion of injury despite normal X-rays.
- Plain X-rays are technically difficult or inadequate.
- Plain X-rays identify a significant bony injury.

The scan should be performed within 1 hour of the risk factor being identified. A provisional written radiology report should be made available within 1 hour of the scan being performed. [new 2014]

1.5.12 For children who have sustained a head injury and have neck pain or tenderness but no indications for a CT cervical spine scan (see recommendation 1.5.11), perform 3-view cervical spine X-rays **before** assessing range of movement in the

neck if either of these risk factors are identified:

- Dangerous mechanism of injury (that is, fall from a height of greater than 1 metre or 5 stairs; axial load to the head, for example, diving; high-speed motor vehicle collision; rollover motor accident; ejection from a motor vehicle; accident involving motorised recreational vehicles; bicycle collision).
- Safe assessment of range of movement in the neck is not possible (see recommendation 1.5.10).

The X-rays should be carried out within 1 hour of the risk factor being identified and reviewed by a clinician trained in their interpretation within 1 hour of being performed. [new 2014]

1.5.13 If range of neck movement can be assessed safely (see recommendation 1.5.10) in a child who has sustained a head injury and has neck pain or tenderness but no indications for a CT cervical spine scan, perform 3-view cervical spine X-rays if the child cannot actively rotate their neck 45 degrees to the left and right. The X-rays should be carried out within 1 hour of this being identified and reviewed by a clinician trained in their interpretation within 1 hour of being performed. [new 2014]

1.5.14 In children who can obey commands and open their mouths, attempt an odontoid peg view. [2003, amended 2014]

1.6 *Information and support for families and carers*

1.6.1 Staff caring for patients with a head injury should introduce themselves to family members or carers and briefly explain what they are doing. [2003, amended 2014]

1.6.2 Ensure that information sheets detailing the nature of head injury and any investigations likely to be used are made available in the emergency department. NICE's [information for the public](#) about this guideline may be helpful. [2003]

1.6.3 Staff should consider how best to share information with children and introduce them to the possibility of long-term complex changes in their parent or sibling. Literature produced by patient support groups may be helpful. [2003]

- 1.6.4 Encourage family members and carers to talk and make physical contact (for example, holding hands) with the patient. However, it is important that relatives and friends do not feel obliged to spend long periods at the bedside. If they wish to stay with the patient, encourage them to take regular breaks. [2003, amended 2007]
- 1.6.5 Ensure there is a board or area displaying leaflets or contact details for patient support organisations either locally or nationally to enable family members and carers to gather further information. [2003]

1.7 *Transfer from hospital to a neuroscience unit*

Transfer of adults

- 1.7.1 Local guidelines on the transfer of patients with head injuries should be drawn up between the referring hospital trusts, the neuroscience unit and the local ambulance service, and should recognise that:
- transfer would benefit all patients with serious head injuries (GCS 8 or less) irrespective of the need for neurosurgery
 - if transfer of those who do not require neurosurgery is not possible, ongoing liaison with the neuroscience unit over clinical management is essential. [2003, amended 2007]
- 1.7.2 The possibility of occult extracranial injuries should be considered for adults with multiple injuries, and they should not be transferred to a service that is unable to deal with other aspects of trauma. [2007]
- 1.7.3 There should be a designated consultant in the referring hospital with responsibility for establishing arrangements for the transfer of patients with head injuries to a neuroscience unit and another consultant at the neuroscience unit with responsibility for establishing arrangements for communication with referring hospitals and for receipt of patients transferred. [2003]
- 1.7.4 Patients with head injuries requiring emergency transfer to a neuroscience unit should be accompanied by a doctor with appropriate training and experience in the transfer of patients with acute brain injury. They should be familiar with the pathophysiology of head injury, the drugs and equipment they will use and

working in the confines of an ambulance (or helicopter if appropriate). They should have a dedicated and adequately trained assistant. They should be provided with appropriate clothing for the transfer, medical indemnity and personal accident insurance. Patients requiring non-emergency transfer should be accompanied by appropriate clinical staff. [2003, amended 2007]

- 1.7.5 Provide the transfer team responsible for transferring a patient with a head injury with a means of communicating changes in the patient's status with their base hospital and the neurosurgical unit during the transfer. [2003, amended 2014]
- 1.7.6 Although it is understood that transfer is often urgent, complete the initial resuscitation and stabilisation of the patient and establish comprehensive monitoring before transfer to avoid complications during the journey. Do not transport a patient with persistent hypotension, despite resuscitation, until the cause of the hypotension has been identified and the patient stabilised. [2003, amended 2007]
- 1.7.7 Intubate and ventilate all patients with GCS 8 or less requiring transfer to a neuroscience unit, and any patients with the indications detailed in recommendation 1.7.8. [2003]
- 1.7.8 Intubate and ventilate the patient immediately in the following circumstances:
- Coma – not obeying commands, not speaking, not eye opening (that is, GCS 8 or less).
 - Loss of protective laryngeal reflexes.
 - Ventilatory insufficiency as judged by blood gases: hypoxaemia ($\text{PaO}_2 < 13 \text{ kPa}$ on oxygen) or hypercarbia ($\text{PaCO}_2 > 6 \text{ kPa}$).
 - Spontaneous hyperventilation causing $\text{PaCO}_2 < 4 \text{ kPa}$.
 - Irregular respirations. [2003, amended 2007]
- 1.7.9 Use intubation and ventilation before the start of the journey in the following circumstances:
- Significantly deteriorating conscious level (1 or more points on the motor score), even if not coma.

- Unstable fractures of the facial skeleton.
 - Copious bleeding into mouth (for example, from skull base fracture).
 - Seizures. [2003, amended 2007]
- 1.7.10 Ventilate an intubated patient with muscle relaxation and appropriate short-acting sedation and analgesia. Aim for a PaO₂ greater than 13 kPa, PaCO₂ 4.5 to 5.0 kPa unless there is clinical or radiological evidence of raised intracranial pressure, in which case more aggressive hyperventilation is justified. If hyperventilation is used, increase the inspired oxygen concentration. Maintain the mean arterial pressure at 80 mm Hg or more by infusion of fluid and vasopressors as indicated. In children, maintain blood pressure at a level appropriate for the child's age. [2003, amended 2007]
- 1.7.11 Education, training and audit are crucial to improving standards of transfer; appropriate time and funding for these activities should be provided. [2003]
- 1.7.12 Give family members and carers as much access to the patient as is practical during transfer. If possible, give them an opportunity to discuss the reasons for transfer and how the transfer process works with a member of the healthcare team. [2003, amended 2014]

Transfer of children

- 1.7.13 Recommendations 1.7.1–1.7.12 were written for adults, but apply these principles equally to children and infants, providing that the paediatric modification of the GCS is used. [2003]
- 1.7.14 Service provision in the area of paediatric transfer to tertiary care should also follow the principles outlined in the National Service Framework for Paediatric Intensive Care. These do not conflict with the principles outlined in this section. [2003]
- 1.7.15 The possibility of occult extracranial injuries should be considered for children with multiple injuries. Do not transfer them to a service that is unable to deal with other aspects of trauma. [2007]
- 1.7.16 Transfer of a child or infant to a specialist neurosurgical unit should be

undertaken by staff experienced in the transfer of critically ill children. [2003]

1.7.17 Give family members and carers as much access to their child as is practical during transfer. If possible, give them an opportunity to discuss the reasons for transfer and how the transfer process works with a member of the healthcare team. [2003, amended 2014]

1.8 *Admission and observation*

1.8.1 Use the criteria below for admitting patients to hospital following a head injury:

- Patients with new, clinically significant abnormalities on imaging.
- Patients whose GCS has not returned to 15 after imaging, regardless of the imaging results.
- When a patient has indications for CT scanning but this cannot be done within the appropriate period, either because CT is not available or because the patient is not sufficiently cooperative to allow scanning.
- Continuing worrying signs (for example, persistent vomiting, severe headaches) of concern to the clinician.
- Other sources of concern to the clinician (for example, drug or alcohol intoxication, other injuries, shock, suspected non-accidental injury, meningism, cerebrospinal fluid leak). [2003]

1.8.2 Be aware that some patients may require an extended period in a recovery setting because of the use of general anaesthesia during CT imaging. [2003, amended 2007]

1.8.3 Admit patients with multiple injuries under the care of the team that is trained to deal with their most severe and urgent problem. [2003]

1.8.4 In circumstances where a patient with a head injury requires hospital admission, admit the patient only under the care of a team led by a consultant who has been trained in the management of this condition during their higher specialist training. The consultant and their team should have competence (defined by local agreement with the neuroscience unit) in assessment, observation and indications for imaging (see recommendations [1.4.7–1.4.12](#) and [1.5.8–1.5.14](#));

inpatient management; indications for transfer to a neuroscience unit (see [section 1.7](#)); and hospital discharge and follow-up (see [section 1.9](#)). [2003, amended 2007]

Observation of admitted patients

- 1.8.5 In-hospital observation of patients with a head injury should only be conducted by professionals competent in the assessment of head injury. [2003]
- 1.8.6 For patients admitted for head injury observation the minimum acceptable documented neurological observations are: GCS; pupil size and reactivity; limb movements; respiratory rate; heart rate; blood pressure; temperature; blood oxygen saturation. [2003]
- 1.8.7 Perform and record observations on a half-hourly basis until GCS equal to 15 has been achieved. The minimum frequency of observations for patients with GCS equal to 15 should be as follows, starting after the initial assessment in the emergency department:
- Half-hourly for 2 hours.
 - Then 1-hourly for 4 hours.
 - Then 2-hourly thereafter. [2003]
- 1.8.8 Should the patient with GCS equal to 15 deteriorate at any time after the initial 2-hour period, observations should revert to half-hourly and follow the original frequency schedule. [2003]
- 1.8.9 Any of the following examples of neurological deterioration should prompt urgent reappraisal by the supervising doctor.
- Development of agitation or abnormal behaviour.
 - A sustained (that is, for at least 30 minutes) drop of 1 point in GCS score (greater weight should be given to a drop of 1 point in the motor response score of the GCS).
 - Any drop of 3 or more points in the eye-opening or verbal response scores of the GCS, or 2 or more points in the motor response score.

- 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. [2003, amended 2007]

1.8.10 To reduce inter-observer variability and unnecessary referrals, a second member of staff competent to perform observation should confirm deterioration before involving the supervising doctor. This confirmation should be carried out immediately. Where a confirmation cannot be performed immediately (for example, no staff member available to perform the second observation) the supervising doctor should be contacted without the confirmation being performed. [2003]

1.8.11 If any of the changes noted in recommendation 1.8.9 are confirmed, an immediate CT scan should be considered, and the patient's clinical condition re-assessed and managed appropriately. [2003, amended 2007]

1.8.12 In the case of a patient who has had a normal CT scan but who has not achieved GCS equal to 15 after 24 hours' observation, a further CT scan or MRI scanning should be considered and discussed with the radiology department. [2003]

Observation of infants and young children

1.8.13 Observation of infants and young children (that is, aged under 5 years) is a difficult exercise and therefore should only be performed by units with staff experienced in the observation of infants and young children with a head injury. Infants and young children may be observed in normal paediatric observation settings, as long as staff have the appropriate experience. [2003]

Training in observation

1.8.14 Medical, nursing and other staff caring for patients with head injury admitted for observation should all be capable of performing the observations listed in recommendations 1.8.6, 1.8.9 and 1.8.10. [2003]

1.8.15 The acquisition and maintenance of observation and recording skills require dedicated training and this should be made available to all relevant staff. [2003]

1.8.16 Specific training is required for the observation of infants and young children.

[2003]

1.9 *Discharge and follow-up*

- 1.9.1 If CT is not indicated on the basis of history and examination the clinician may conclude that the risk of clinically important brain injury to the patient is low enough to warrant transfer to the community, as long as no other factors that would warrant a hospital admission are present (for example, drug or alcohol intoxication, other injuries, shock, suspected non-accidental injury, meningism, cerebrospinal fluid leak) and there are appropriate support structures for safe transfer to the community and for subsequent care (for example, competent supervision at home). [2003]
- 1.9.2 After normal imaging of the head, the clinician may conclude that the risk of clinically important brain injury requiring hospital care is low enough to warrant transfer to the community, as long as the patient has returned to GCS equal to 15, and no other factors that would warrant a hospital admission are present (for example, drug or alcohol intoxication, other injuries, shock, suspected non-accidental injury, meningism, cerebrospinal fluid leak) and there are appropriate support structures for safe transfer to the community and for subsequent care (for example, competent supervision at home). [2003]
- 1.9.3 After normal imaging of the cervical spine the clinician may conclude that the risk of injury to the cervical spine is low enough to warrant transfer to the community, as long as the patient has returned to GCS equal to 15 and their clinical examination is normal, and no other factors that would warrant a hospital admission are present (for example, drug or alcohol intoxication, other injuries, shock, suspected non-accidental injury, meningism, cerebrospinal fluid leak) and there are appropriate support structures for safe transfer to the community and for subsequent care (for example, competent supervision at home). [2003]
- 1.9.4 Do not discharge patients presenting with head injury until they have achieved GCS equal to 15, or normal consciousness in infants and young children as assessed by the paediatric version of the GCS. [2003]
- 1.9.5 All patients with any degree of head injury should only be transferred to their home if it is certain that there is somebody suitable at home to supervise the

patient. Discharge patients with no carer at home only if suitable supervision arrangements have been organised, or when the risk of late complications is deemed negligible. [2003]

Discharge after observation

1.9.6 Patients admitted after a head injury may be discharged after resolution of all significant symptoms and signs providing they have suitable supervision arrangements at home. [2003]

Discharge advice

1.9.7 Give verbal and printed discharge advice to patients with any degree of head injury who are discharged from an emergency department or observation ward, and their families and carers. Follow recommendations in [patient experience in adult NHS services](#) [NICE clinical guideline 138] about providing information in an accessible format. [new 2014]

1.9.8 Printed advice for patients, families and carers should be age-appropriate and include:

- Details of the nature and severity of the injury.
- Risk factors that mean patients need to return to the emergency department (see [recommendations 1.1.4 and 1.1.5](#)).
- A specification that a responsible adult should stay with the patient for the first 24 hours after their injury.
- Details about the recovery process, including the fact that some patients may appear to make a quick recovery but later experience difficulties or complications.
- Contact details of community and hospital services in case of delayed complications.
- Information about return to everyday activities, including school, work, sports and driving.
- Details of support organisations. [new 2014]

1.9.9 Offer information and advice on alcohol or drug misuse to patients who presented to the emergency department with drug or alcohol intoxication when

they are fit for discharge. [2003]

- 1.9.10 Inform patients and their families and carers about the possibility of persistent or delayed symptoms following head injury and whom to contact if they experience ongoing problems. [new 2014]
- 1.9.11 For all patients who have attended the emergency department with a head injury, write to their GP within 48 hours of discharge, giving details of clinical history and examination. This letter should also be shared with health visitors (for pre-school children) and school nurses (for school-age children). If appropriate, provide a copy of the letter for the patient and their family or carer. [new 2014]

Follow-up

- 1.9.12 When a patient who has undergone imaging of the head and/or been admitted to hospital experiences persisting problems, ensure that there is an opportunity available for referral from primary care to an outpatient appointment with a professional trained in assessment and management of sequelae of brain injury (for example, clinical psychologist, neurologist, neurosurgeon, specialist in rehabilitation medicine). [2003]

More information

You can also see this guideline in the NICE Pathway on [head injury](#).

To find out what NICE has said on topics related to this guideline, see our web page on [injuries, accidents and wounds](#).

See also the guideline committee's discussion and the evidence reviews (in the [full guideline](#)), and information about [how the guideline was developed](#), including details of the committee.

^[4] Assessment of amnesia will not be possible in preverbal children and is unlikely to be possible in children aged under 5 years.

^[5] In the NHS in England these hospitals would be trauma units or major trauma centres. In the NHS in Wales this should be a hospital with equivalent capabilities.

^[6] At the time of publication (January 2014), intravenous opioids did not have a UK marketing

authorisation for this indication. The prescriber should follow relevant professional guidance, taking full responsibility for the decision. Informed consent should be obtained and documented. See the General Medical Council's [Good practice in prescribing and managing medicines and devices](#) for further information.

2 Research recommendations

The Guideline Development Group has made the following recommendations for research, based on its review of evidence, to improve NICE guidance and patient care in the future. The Guideline Development Group's full set of research recommendations is detailed in the [full guideline](#).

2.1 *Criteria for CT head scanning*

What is the clinical and cost effectiveness of the 2014 NICE guideline recommendation on CT head scanning versus clinical decision rules (including CHALICE, CATCH and PECARN) for selecting children and infants for head CT scanning?

Why this is important

The recommendations in this updated guideline for determining which patients need a CT head scan are based on the CHALICE clinical decision rule. CHALICE was derived in the UK but has yet to be validated, and limited evidence has been identified since the NICE clinical guideline was published in 2007. There is a need for a prospective validation and direct comparison of the 2014 NICE guideline and CHALICE, CATCH and PECARN clinical decision rules in a UK setting to determine diagnostic accuracy (sensitivity, specificity, and predictive values for intracranial injury and the need for neurosurgery) and cost effectiveness within the relevant population to which the NICE guideline is applied.

The study should be a prospective study with economic evaluation and should capture subgroups by age, separating out infants (under 2 years), children and young people (under 16 years) and adolescents (16–18 years). The results of such a study will confirm whether current practice is optimal and, if not, which would be the ideal clinical decision rule to implement in a UK population. To warrant recommendation of a different clinical decision rule and a consequent substantial change in practice, significant improvement in diagnostic accuracy must be demonstrated. This can only be done through such a prospective comparative validation study performed in our population.

2.2 *Antiplatelet and anticoagulant drugs*

In patients with head injury does the use of antiplatelet and anticoagulant drugs increase the risk of intracranial haemorrhage over and above factors included in the current recommendations for CT head scans?

Why this is important

Antiplatelet and anticoagulant drugs are widely and increasingly prescribed, and many patients presenting with a head injury to the emergency department are taking these drugs. While the majority of these drugs are prescribed in older patients they are also used in younger people. This guideline provides recommendations on performing CT head scans in patients on warfarin. However, limited evidence has been identified for patients using other antiplatelet or anticoagulant drugs within studies deriving or validating clinical decision rules for determining which patients need CT head scans. There is a particular paucity of evidence in determining whether they are at increased risk of intracranial haemorrhage.

A study with appropriate economic evaluation is needed to quantify the risk of taking these drugs over and above the risk factors included in an existing clinical decision rule. Antiplatelet and anticoagulant drugs should be studied as a predictor of intracranial injury and analysed within a multivariate analysis with other predictors (including the risk factors used in this guideline to determine when a CT head scan is needed). Univariable analyses of risk of intracranial injury in groups of head injury patients who are taking these agents and those who are not, and who have no other indications for CT head scan under current guidance would also be useful.

The GDG felt that, where possible, each drug should be considered separately, particularly aspirin and clopidogrel, and that the reference standard should include CT head scan and a follow-up period of sufficient duration to capture delayed bleeding, for example, at 7 days and 1 month. Analysis would benefit from subgroup results by age (children, adults and patients over 65 years). The GDG suggested reporting similar data used in the [AHEAD study](#).

2.3 *Using biomarkers to diagnose brain injury*

In adults with medium risk indications for brain injury under the 2014 NICE CT head injury guidance, what is the clinical and cost effectiveness of using the diagnostic circulating biomarker S100B to rule out significant intracranial injury?

Why this is important

Circulating biomarkers, if validated, could provide a convenient and clinically applicable aid to the diagnosis of mild traumatic brain injury (TBI) – a 'troponin for the brain'. If such biomarkers were sufficiently sensitive as well as specific for injury type (separating patients with traumatic axonal injury (TAI) from those with contusions), panels of biomarkers might not only help to determine which patients need neuroimaging but also allow us to devise rational, cost-effective pathways for neuroimaging – perhaps reserving primary use of advanced MRI for patients who have TAI as these

lesions are undetectable on CT head scans. In addition, the availability of quantifiable biomarkers, scaled with the severity of injury, could help clinicians monitor the progression of brain injury in patients with more severe TBI, help stratify patients for trials and therapies, and provide significant prognostic information across all severities of TBI.

There is low-quality clinical effectiveness data for using the biomarker S100B to rule out significant intracranial injury in patients in the emergency department. Current evidence suggests that there is variation in the use of biomarker tests, including in the timing of testing, the concentration of biomarker used as a diagnostic cut-off, protocols used for sample transport and storage, and the equipment used for biomarker assays in laboratories. A diagnostic study (using randomised or consecutively selected patients) is needed to investigate the role of S100B in patients with selected head injury patterns.

The GDG also recognised the potential utility use of near-patient testing for biomarker tests to reduce the time from injury and blood sampling to test results. In addition, the GDG would welcome an additional outcome of 3-month follow-up of functional outcome/post-concussion symptoms alongside this study with appropriate economic evaluation. This research would provide UK-based evidence as to the potential benefit of biomarkers and any associated reduction in CT head scans and hospital admissions.

2.4 *Predictors of long-term sequelae following head injury*

Research is needed to summarise and identify the optimal predictor variables for long-term sequelae following mild traumatic brain injury (TBI). A systematic review of the literature could be used to derive a clinical decision rule to identify relevant patients at the time of injury. This would in turn lay the foundation for a derivation cohort study.

Why this is important

Although this recommendation was first made in 2007, the GDG felt that this is still an area of high priority for research and the question remains unanswered. The diagnosis of TBI is essentially a clinical one. However, although this approach provides the best current solution it can be imprecise, particularly in mild TBI where conventional imaging may be normal and cognitive abnormalities may be due to confounders such as pre-existing dementia, hypoxia or hypotension from associated injuries, alcohol or recreational drugs, and/or other conditions (such as post-traumatic stress disorder) which result in overlapping phenotypes (and possibly even imaging findings).

The availability of novel, objective methods of detecting brain injury provides an attractive means of better defining the presence of TBI in these contexts, with improvements in epidemiological precision. Perhaps more importantly, there is an increasing recognition that even mild TBI can result in prolonged cognitive and behavioural deficits, and the ability to identify patients at risk of these sequelae would aid clinical management, help determine which patients need novel therapeutic interventions, and refine resource allocation.

The techniques that have been explored in this regard include advanced neuroimaging with MRI, electroencephalographic (EEG) based diagnosis, and circulating biomarkers. The relative effectiveness and cost effectiveness of these techniques, individually and in combination, is not yet completely defined, and their role in contributing to a clinical decision rule that allows triage of patients to specific management pathways needs definition. A systematic review would be the first step in collating the available evidence in this area, followed by a rational application of available evidence, identification of key research questions that need to be addressed, and definition of the data collection needed in a derivation cohort study that allows these questions to be addressed.

Update information

September 2019: Recommendation 1.4.12 on when to have a CT scan was updated to change warfarin to anticoagulants.

June 2017: Recommendations 1.2.8 and 1.4.12 were updated with cross-references to related NICE guidelines. An outdated research recommendation was stood down and removed.

Minor updates since publication

October 2019: A section heading was amended to match with the change made to recommendation 1.4.12 in September 2019. Recommendations 1.1.3 and 1.1.4 have been amended to remove warfarin as an example of an anticoagulant so it's clear it applies to all anticoagulants.

About this guideline

This guideline updates and replaces NICE clinical guideline 56 (published September 2007).

Recommendations are marked as [new 2014], [2003], [2003, amended 2007], [2003, amended 2014], [2003, amended 2007 and 2014], [2007], [2007, amended 2014] or [2014, amended 2019].

[new 2014] indicates that the evidence has been reviewed and the recommendation has been added or updated.

[2003] indicates that the evidence has not been reviewed since 2003.

[2003, amended 2007] indicates that the evidence has not been reviewed since 2003 but minor changes were made in 2007 for clarification.

[2003, amended 2014] indicates that the evidence has not been reviewed since 2003 but changes have been made to the recommendation wording that change the meaning (see below).

[2003, amended 2007 and 2014] indicates that the evidence has not been reviewed since 2003 but changes have been made that change the meaning (see below).

[2007] indicates that the evidence has not been reviewed since 2007.

[2007, amended 2014] indicates that the evidence has not been reviewed since 2007 but changes have been made that change the meaning (see below).

[2014, amended 2019] indicates that the evidence has not been reviewed since 2014 but minor changes were made in 2019 for clarification (see September 2019 update information for details).

Recommendations from NICE clinical guideline 56 that have been amended

Recommendations are labelled [2003, amended 2014], [2007, amended 2014] or [2003, amended 2007 and 2014] if the evidence has not been reviewed but changes have been made to the recommendation wording (indicated by highlighted text) that change the meaning.

Recommendation in 2003 or 2007 guideline	Recommendation in current guideline	Reason for change
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<p>1.1.4.1 There should be a protocol for all staff to introduce themselves to family members or carers and briefly explain what they are doing. In addition a photographic board with the names and titles of personnel in the hospital departments caring for patients with head injury can be helpful. [2003]</p>	<p>1.6.1 Staff caring for patients with a head injury should introduce themselves to family members or carers and briefly explain what they are doing. [2003, amended 2014]</p>	<p>Second sentence detailing photographic board has been removed. The GDG considered this to be a safety/security risk for staff in some departments.</p>
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<p>1.2.1.1 Telephone advice services (for example, NHS Direct, emergency department helplines) should refer people who have sustained a head injury to the emergency ambulance services (that is, 999) for emergency transport to the emergency department if they have experienced any of the risk factors in box 1 (alternative terms to facilitate communication are in parentheses).</p> <ul style="list-style-type: none"> • Unconsciousness, or lack of full consciousness (for example, problems keeping eyes open). • Any focal (that is, restricted to a particular part of the body or a particular activity) neurological deficit since the injury (examples include problems understanding, speaking, reading or writing; loss of feeling in part of the body; problems balancing; general weakness; any changes in eyesight; and problems walking). • Any suspicion of a skull fracture or penetrating head injury (for example, clear fluid running from the ears or nose, black eye with no associated damage around the eye, bleeding from one or both ears, new deafness in one or both ears, bruising behind one or both ears, penetrating injury signs, visible trauma to the scalp or skull). • Any seizure ('convulsion' or 'fit') since the injury. 	<p>1.1.2 Telephone advice services (for example, NHS 111, emergency department helplines) should refer patients who have sustained a head injury to the emergency ambulance services (that is, 999) for emergency transport to the emergency department if they have experienced any of the following:</p> <ul style="list-style-type: none"> • Unconsciousness, or lack of full consciousness (for example, problems keeping eyes open). • Any <u>focal neurological deficit</u> since the injury. • Any suspicion of a <u>skull fracture or penetrating head injury</u>. • Any seizure ('convulsion' or 'fit') since the injury. • A <u>high-energy head injury</u>. • The injured person or their carer is incapable of transporting the injured person safely to the hospital emergency department without the use of ambulance services (providing any other risk factor indicating emergency department referral is present). [2003, amended 2007 and 2014] 	<p>Updated to NHS 111</p>
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<ul style="list-style-type: none">• A high-energy head injury (for example, pedestrian struck by motor vehicle, occupant ejected from motor vehicle, a fall from a height of greater than 1 m or more than five stairs, diving accident, high-speed motor vehicle collision, rollover motor accident, accident involving motorized recreational vehicles, bicycle collision, or any other potentially high-energy mechanism).• The injured person or their carer is incapable of transporting the injured person safely to the hospital emergency department without the use of ambulance services (providing any other risk factor indicating emergency department referral is present). <p>[2003, amended 2007]</p>		
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<p>1.2.1.2 Telephone advice services (for example, NHS Direct, emergency department helplines) 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 risk factors in box 2 (alternative terms to facilitate communication are in parentheses).</p> <ul style="list-style-type: none"> • Any previous 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'). The assessment of amnesia will not be possible in pre-verbal children and is unlikely to be possible in any child aged under 5 years. • Persistent headache since the injury. <p>Any vomiting episodes since the injury.</p> <ul style="list-style-type: none"> • Any previous cranial neurosurgical interventions ('brain surgery'). • History of bleeding or clotting disorder. • Current anticoagulant therapy such as warfarin. • Current drug or alcohol intoxication. • Age 65 years or older. • Suspicion of non-accidental injury. • Irritability or altered behaviour 	<p>1.1.3 Telephone advice services (for example, NHS 111 or emergency department helplines) should refer patients who have sustained a head injury to a hospital emergency department if they have any of the following risk factors:</p> <ul style="list-style-type: none"> • Any loss of consciousness ('knocked out') as a result of the injury, from which the 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 brain surgery. • Any history of bleeding or clotting disorders. • Current anticoagulant therapy such as warfarin. • Current drug or alcohol intoxication. • There are any safeguarding concerns (for example, possible non-accidental injury or a vulnerable person is affected). • Irritability or altered behaviour ('easily distracted', 'not themselves', 'no concentration', 'no interest in 	<p>Updated to NHS 111 'Age 65 years or older' as a factor for referring to the emergency department' removed (equality consideration).</p>
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<p>('easily distracted', 'not themselves', 'no concentration', 'no interest in things around them') particularly in infants and young children (that is, aged under 5 years).</p> <ul style="list-style-type: none">• Continuing concern by the helpline personnel about the diagnosis. <p>[2003]</p>	<p>things around them'), particularly in infants and children aged under 5 years.</p> <ul style="list-style-type: none">• Continuing concern by helpline staff about the diagnosis. [2003, amended 2014]	
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<p>1.2.2.1 Community health services (general practice, ambulance crews, NHS walk-in centres, dental practitioners) and NHS minor injury clinics should refer patients who have sustained a head injury to a hospital emergency department, using the ambulance service if deemed necessary (see section 1.3.1), if any of the risk factors listed in box 3 are present.</p> <ul style="list-style-type: none"> • GCS less than 15 on initial assessment. • Any loss of consciousness as a result of the injury. • Any focal neurological deficit since the injury (examples include problems understanding, speaking, reading or writing; decreased sensation; loss of balance; general weakness; visual changes; abnormal reflexes; and problems walking). • Any suspicion of a skull fracture or penetrating head injury since the injury (for example, clear fluid running from the ears or nose, black eye with no associated damage around the eyes, bleeding from one or both ears, new deafness in one or both ears, bruising behind one or both ears, penetrating injury signs, visible trauma to the scalp or skull of concern to the professional). • Amnesia for events before or after the injury. The assessment of amnesia will not be possible in pre-verbal children and is unlikely to be 	<p>1.1.4 Community health services (GPs, ambulance crews, NHS walk-in centres, dental practitioners) and NHS minor injury clinics should refer patients who have sustained a head injury to a hospital emergency department, using the ambulance service if deemed necessary, if any of the following are present:</p> <ul style="list-style-type: none"> • Glasgow coma scale (GCS) score of less than 15 on initial assessment. • Any loss of consciousness as a result of the injury. • Any <u>focal neurological deficit</u> since the injury. • Any suspicion of a <u>skull fracture or penetrating head injury</u> since the injury. • Amnesia for events before or after the injury (assessment of amnesia will not be possible in preverbal children and is unlikely to be possible in children aged under 5 years). • Persistent headache since the injury. • Any vomiting episodes since the injury (clinical judgement should be used regarding the cause of vomiting in those aged 12 	<p>'Age 65 years or older' as a factor for referring to the emergency department' removed (equality consideration) and risk covered by loss of consciousness rec.</p> <p>Extra bullet point added in to highlight safeguarding concerns (widely used terminology).</p> <p>Clinical judgement re vomiting reflects high incidence of single vomit in younger children in head injury which alone is not of concern.</p>
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<p>possible in any child aged under 5 years.</p> <ul style="list-style-type: none"> • Persistent headache since the injury. • Any vomiting episodes since the injury. • Any seizure since the injury. • Any previous cranial neurosurgical interventions. • A high-energy head injury (for example, pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from a height of greater than 1 m or more than five stairs, diving accident, high-speed motor vehicle collision, rollover motor accident, accident involving motorized recreational vehicles, bicycle collision, or any other potentially high-energy mechanism). • History of bleeding or clotting disorder. • Current anticoagulant therapy such as warfarin. • Current drug or alcohol intoxication. • Age 65 years or older. • Suspicion of non-accidental injury. • Continuing concern by the professional about the diagnosis. <p>[2003, amended 2007]</p>	<p>years or younger and the need for referral).</p> <ul style="list-style-type: none"> • Any seizure since the injury. • Any previous brain surgery. • A <u>high-energy head injury</u>. • Any history of bleeding or clotting disorders. • Current anticoagulant therapy such as warfarin. • Current drug or alcohol intoxication. • There are any safeguarding concerns (for example, possible non-accidental injury or a vulnerable person is affected). • Continuing concern by the professional about the diagnosis. [2003, amended 2007 and 2014] 	
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<p>1.2.2.2 In the absence of any the factors listed in box 3, the professional should consider referral to an emergency department if any of the following factors are present depending on their own judgement of severity.</p> <ul style="list-style-type: none"> • Irritability or altered behaviour, particularly in infants and young children (that is, aged under 5 years). • Visible trauma to the head not covered above but still of concern to the professional. • Adverse social factors (for example, no one able to supervise the injured person at home). • Continuing concern by the injured person or their carer about the diagnosis. [2003] 	<p>1.1.5 In the absence of any risk factors in recommendation 1.1.4, consider referral to an emergency department if any of the following factors are present, depending on judgement of severity:</p> <ul style="list-style-type: none"> • Irritability or altered behaviour, particularly in infants and children aged under 5 years. • Visible trauma to the head not covered in recommendation 1.1.4 but still of concern to the healthcare professional. • No one is able to observe the injured person at home. • Continuing concern by the injured person or their family or carer about the diagnosis. [2003, amended 2014] 	<p>Adverse social factors removed from penultimate bullet point, as the GDG considered this was inappropriate terminology.</p>
<p>1.3.2.3 Ambulance crews should be trained in the detection of non-accidental injury and should pass information to emergency department personnel when the relevant signs and symptoms arise. [2003]</p>	<p>1.2.16 Ambulance crews should be trained in the safeguarding of children and vulnerable adults and should document and verbally inform emergency department staff of any safeguarding concerns. [2003, amended 2014]</p>	<p>The term 'non-accidental injury' has been replaced with safeguarding as non-accidental injury is a child specific term and therefore appears to exclude adults. Text has been added to indicate that information should be documented</p>

<p>1.3.2.9 Pain should be managed effectively because it can lead to a rise in intracranial pressure. Reassurance and splintage of limb fractures are helpful; catheterisation of a full bladder will reduce irritability. Analgesia as described in 1.4.1.9 should be given only under the direction of a doctor. [2007]</p>	<p>1.2.12 Manage pain effectively because it can lead to a rise in intracranial pressure. Provide reassurance, splintage of limb fractures and catheterisation of a full bladder where needed. [2007, amended 2014]</p>	<p>Second sentence about analgesia removed (analgesia as described in 1.4.1.9 should be given only under the direction of a doctor), as this is covered in the first sentence. The GDG felt that this needs to be managed under local protocols. It covers additional complexities which have not been reviewed and may be confusing to readers.</p>
<p>1.4.3.3 With modern multislice scanners the whole cervical spine can be scanned at high resolution with ease and multiplanar reformatted images generated rapidly. Facilities for multiplanar reformatting and interactive viewing should be available. [2003]</p>	<p>1.5.2 Ensure that facilities are available for multiplanar reformatting and interactive viewing of CT cervical spine scans. [2003, amended 2014]</p>	<p>First sentence removed as this is now unnecessary. Imaging practice has moved on: with modern multislice scanners the whole cervical spine can be scanned at high resolution with ease and multiplanar reformatted images generated rapidly.</p>

<p>1.4.3.4 MRI is indicated in the presence of neurological signs and symptoms referable to the cervical spine and if there is suspicion of vascular injury (for example, subluxation or displacement of the spinal column, fracture through foramen transversarium or lateral processes, posterior circulation syndromes). [2003]</p>	<p>1.5.3 MR imaging is indicated if there are neurological signs and symptoms referable to the cervical spine. If there is suspicion of vascular injury (for example, vertebral malalignment, a fracture involving the foramina transversaria or lateral processes, or a posterior circulation syndrome), CT or MRI angiography of the neck vessels may be performed to evaluate for this. [2003, amended 2014]</p>	<p>Changes based on updated terminology and current practice.</p>
<p>1.4.3.12 Children under 10 years should receive anterior/posterior and lateral plain films without an anterior/posterior peg view. [2003]</p>	<p>1.5.14 In children who can obey commands and open their mouths, attempt an odontoid peg view. [2003, amended 2014]</p>	<p>Amended based on GDG consensus as satisfactory peg views can often be obtained in those younger than 10 (essentially down to the age where they can obey the command to open their mouth nice and wide – usually about 5).</p>

<p>1.4.4.1 A clinician with expertise in non-accidental injuries in children should be involved in any suspected case of non-accidental injury in a child. Examinations/investigations that should be considered include: skull X-ray as part of a skeletal survey, ophthalmoscopic examination for retinal haemorrhage, and examination for pallor, anaemia, and tense fontanelle or other suggestive features. Other imaging such as CT and MRI may be required to define injuries. [2003, amended 2007]</p>	<p>1.3.11 A clinician with training in safeguarding should be involved in the initial assessment of any patient with a head injury presenting to the emergency department. If there are any concerns identified, document these and follow local safeguarding procedures appropriate to the patient's age. [2003, amended 2014]</p>	<p>Updated to reflect current terminology.</p> <p>Updated for equality consideration, guideline did not previously include a recommendation for safeguarding concerns in adults ('A clinician with expertise in non-accidental injuries in children should be involved in any suspected case of non-accidental injury in a child').</p> <p>Text removed: 'Examinations/investigations that should be considered include: skull X-ray as part of a skeletal survey, ophthalmoscopic examination for retinal haemorrhage, and examination for pallor, anaemia, and tense fontanelle or other suggestive features. Other imaging such as CT and MRI may be required to define injuries'.</p> <p>Text has been added to indicate that information should be documented.</p>
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<p>1.4.6.1 The care of all patients with new, surgically significant abnormalities on imaging should be discussed with a neurosurgeon. The definition of 'surgically significant' should be developed by local neurosurgical centres and agreed with referring hospitals. An example of a neurosurgical referral letter is provided on the NICE website. [2003]</p>	<p>1.3.13 Discuss with a neurosurgeon the care of all patients with new, surgically significant abnormalities on imaging. The definition of 'surgically significant' should be developed by local neurosurgical centres and agreed with referring hospitals, along with referral procedures. [2003, amended 2014]</p>	<p>Reference to neurosurgical letter removed to reflect current practice.</p>
<p>1.6.1.5 The transfer team should be provided with a means of communication with their base hospital and the neurosurgical unit during the transfer. A portable phone may be suitable providing it is not used in close proximity (that is, within 1 m) of medical equipment prone to electrical interference (for example, infusion pumps). [2003]</p>	<p>1.7.5 Provide the transfer team responsible for transferring a patient with a head injury with a means of communicating changes in the patient's status with their base hospital and the neurosurgical unit during the transfer. [2003, amended 2014]</p>	<p>Reference to portable phone deleted, as this is outdated terminology. Additional text added for clarity: 'changes in the patient's status'.</p>

<p>1.6.1.12 Carers and relatives should have as much access to the patient as is practical during transfer and be fully informed on the reasons for transfer and the transfer process. [2003]</p>	<p>1.7.12 Give family members and carers as much access to the patient as is practical during transfer. If possible, give them an opportunity to discuss the reasons for transfer and how the transfer process works with a member of the healthcare team. [2003, amended 2014]</p> <p>1.7.17 Give family members and carers as much access to their child as is practical during transfer. If possible, give them an opportunity to discuss the reasons for transfer and how the transfer process works with a member of the healthcare team. [2003, amended 2014]</p>	<p>Updated based on equality consideration to allow patient discussion.</p>
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