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Head injury

**Triage, assessment, investigation and
early management of head injury in
infants, children and adults**

**This is a partial update of NICE
clinical guideline 4**

NICE clinical guideline 56

Head injury: triage, assessment, investigation and early management of head injury in infants, children and adults

Ordering information

You can download the following documents from www.nice.org.uk/CG056

- The NICE guideline (this document) – all the recommendations.
- A quick reference guide – a summary of the recommendations for healthcare professionals.
- ‘Understanding NICE guidance’ – information for patients and carers.
- The full guideline – all the recommendations, details of how they were developed, and reviews of the evidence they were based on.

For printed copies of the quick reference guide or ‘Understanding NICE guidance’, phone the NHS Response Line on 0870 1555 455 and quote:

- N1331 (quick reference guide)
- N1332 (‘Understanding NICE guidance’).

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This is a partial update of NICE clinical guideline 4 (published June 2003).

The update has been developed by the National Collaborating Centre for Acute Care using the original scope. The original guideline was also developed by the National Collaborating Centre for Acute Care. In this update, there are new recommendations in the sections on pre-hospital management, emergency department assessment, investigations for clinically important brain injuries, investigation for non-accidental injury in children, and transfer from secondary settings. These are highlighted in the document as '**New**'. A number of amendments have been made to other recommendations from the initial guideline, and these are highlighted in the document as '**Amended**'.

Introduction

This guideline addresses assessment, investigation and early management of head injury. This guidance is evidence based and includes the original guideline published in June 2003. This current version is a partial update of the previous guideline. There was sufficient new evidence to prompt an update to be carried out (see section 2 of the full guideline). This update affects only a few recommendations within the original guideline. A summary of the evidence on which the guidance is based is provided in the full guideline produced by the National Collaborating Centre for Acute Care. This guideline replaces the one published in June 2003, and that guideline and associated algorithms are now withdrawn from use.

The guideline offers best practice for the care of all patients who present with a suspected or confirmed traumatic head injury with or without other major trauma. Separate advice is provided for adults and children (including infants) where different practices are indicated. It offers advice on the management of patients with a suspected or confirmed head injury who may be unaware that they have sustained a head injury because of intoxication or other causes. The guideline does not provide advice on the management of patients with other traumatic injury to the head (for example, to the eye or face). It does not

address the rehabilitation or long-term care of patients with a head injury but the guideline does explore possible criteria for the early identification of patients who require rehabilitation.

Definitions

For the purpose of the guideline it was agreed that 'infants' are aged under 1 year, 'children' are 1–15 years old and 'adults' are aged 16 years or older. In certain circumstances, the age group 'infants and young children' (that is, those aged under 5 years) is used. Cut-off points of 10 years and 12 years are also used.

'Head injury' for the purposes of the guideline is defined as any trauma to the head, other than superficial injuries to the face.

The primary patient outcome of concern throughout the guideline is 'clinically important brain or cervical spine injury'. For the purposes of this guideline, clinically important brain or cervical spine injury is defined as any acute condition that has been identified by imaging or by assessment of risk factors.

Patient-centred care

This guideline offers best practice advice on the care of infants, children and adults with head injury.

Treatment and care should take into account patients' needs and preferences. People with head injury should have the opportunity to make informed decisions about their care and treatment, in partnership with their healthcare professionals. If patients do not have the capacity to make decisions, healthcare professionals should follow the Department of Health guidelines – 'Reference guide to consent for examination or treatment' (2001) (available from www.dh.gov.uk). Since April 2007 healthcare professionals need to follow a code of practice accompanying the Mental Capacity Act (summary available from www.dca.gov.uk/menincap/bill-summary.htm).

Good communication between healthcare professionals and patients is essential. It should be supported by evidence-based written information tailored to the patient's needs. Treatment and care, and the information patients are given about it, should be culturally appropriate. It should also be accessible to people with additional needs such as physical, sensory or learning disabilities, and to people who do not speak or read English.

Carers and relatives should have the opportunity to be involved in decisions about the patient's care and treatment, unless the patient specifically excludes them.

Carers and relatives should also be given the information and support they need.

Key priorities for implementation

Initial assessment in the emergency department

- All patients presenting to an emergency department with a head injury should be assessed by a trained member of staff 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 the guidance on patient selection and urgency for imaging (head and cervical spine).

Urgency of imaging

- **Amended** Computed tomography (CT) imaging of the head should be performed (that is, imaging carried out and results analysed) within 1 hour of the request having been received by the radiology department in those patients where imaging is requested because of any of the risk factors listed in box 7, page 25.
- **Amended** Patients who have any of the risk factors in box 8, page 26 and none of the risk factors in box 7 should have CT imaging of the head performed within 8 hours of the injury (imaging should be performed immediately in these patients if they present 8 hours or more after their injury).
- **New** Children under 10 years of age with a Glasgow Coma Score (GCS) of 8 or less should have CT imaging of the cervical spine within 1 hour of presentation or when they are sufficiently stable.
- **Amended** Imaging of the cervical spine should be performed within 1 hour of a request having been received by the radiology department or when the patient is sufficiently stable. Where a request for urgent CT imaging of the head (that is, within 1 hour) has also been received, the cervical spine imaging should be carried out simultaneously.

Admission

- **Amended** In circumstances where a patient with a head injury requires hospital admission, it is recommended that the patient be admitted only

under the care of a team led by a consultant who has been trained in the management of this condition during his/her higher specialist training. The consultant and his/her team should have competence (defined by local agreement with the neuroscience unit) in assessment, observation and indications for imaging (see recommendations in 1.7); inpatient management; indications for transfer to a neuroscience unit (see recommendations in 1.6); and hospital discharge and follow-up (see recommendations in 1.8).

Organisation of transfer of patients between referring hospital and neuroscience unit

- **Amended** 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 \leq 8), 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.

Advice about long-term problems and support services

- **Amended** All patients and their carers should be made aware of the possibility of long-term symptoms and disabilities following head injury and should be made aware of the existence of services that they could contact should they experience long-term problems. Details of support services should be included on patient discharge advice cards.

Guidance

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 (see section 5 for details).

1.1 General

1.1.1 Glasgow Coma Scale

The assessment and classification of patients who have sustained a head injury should be guided primarily by the adult and paediatric versions of the Glasgow Coma Scale and its derivative the Glasgow Coma Score (GCS). Recommended versions are available from the NICE website (see page 43 for further details). Good practice in the use of the Glasgow Coma Scale and Score should be adhered to at all times, following the principles below.

- 1.1.1.1 Monitoring and exchange of information about individual patients should be based on the three separate responses on the Glasgow Coma Scale (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).
- 1.1.1.2 If a total score is recorded or communicated, it should be based on a sum of 15, and to avoid confusion this denominator should be specified (for example, 13/15).
- 1.1.1.3 The individual components of the GCS should be described in all communications and every note and should always accompany the total score.
- 1.1.1.4 The paediatric version of the Glasgow Coma Scale should include a 'grimace' alternative to the verbal score to facilitate scoring in pre-verbal children.
- 1.1.1.5 Best practice in paediatric coma observation and recording as detailed by the National Paediatric Neuroscience Benchmarking

Group should be followed at all times (these principles are described in an item available from the NICE website – see page 43 for further details).

1.1.2 Public health literature

1.1.2.1 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.

1.1.3 Training in risk assessment

1.1.3.1 **Amended** It is recommended that 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 section 1.2.2.

1.1.4 Support for families and carers

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.

1.1.4.2 Information sheets detailing the nature of head injury and any investigations likely to be used should be available in the emergency department. The patient version of this NICE guideline may be helpful.

1.1.4.3 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.

- 1.1.4.4 **Amended** Healthcare professionals should encourage carers and relatives 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, they should be encouraged to take regular breaks.
- 1.1.4.5 There should be a board or area displaying leaflets or contact details for patient support organisations either locally or nationally to enable family members to gather further information.

1.2 Presentation and referral

A person with a head injury may present via a telephone advice service or to a community health service or minor injury clinic. The following recommendations apply in these settings.

1.2.1 Telephone advice services

- 1.2.1.1 **Amended** 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).

Box 1 Criteria for referral to an emergency ambulance service by telephone advice services

- 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.
- 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).

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).

Box 2 Criteria for referral to a hospital emergency department by telephone advice services

- 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.
- Any vomiting episodes since the injury.
- Any previous cranial neurosurgical interventions ('brain surgery').
- History of bleeding or clotting disorder.
- Current anticoagulant therapy such as warfarin.
- Current drug or alcohol intoxication.
- Age 65 years or older.
- Suspicion of non-accidental injury.
- Irritability or altered behaviour ('easily distracted', 'not themselves', 'no concentration', 'no interest in things around them') particularly in infants and young children (that is, aged under 5 years).
- Continuing concern by the helpline personnel about the diagnosis.

1.2.1.3 In the absence of any of the factors listed in boxes 1 and 2 the helpline should advise the injured person to seek medical advice from community services (for example, general practice) if any of the following factors are present.

- 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.

1.2.2 **Community health services and NHS minor injury clinics**

1.2.2.1 **Amended** 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.

Box 3 Criteria for referral to a hospital emergency department by community health services and NHS minor injury clinics

- 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 possible in any child aged under 5 years.
- 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.

- | |
|---------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none">• Continuing concern by the professional about the diagnosis. |
|---------------------------------------------------------------------------------------------------------------|

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.

- 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.

1.3 *Transport from community health services and NHS minor injury clinics and pre-hospital management*

1.3.1 Transport to the emergency department

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

1.3.1.2 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.

1.3.1.3 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.

1.3.2 Pre-hospital management

The following principles should be adhered to in the immediate care of patients who have sustained a head injury.

- 1.3.2.1 **Amended** Adults who have sustained a head injury should initially be assessed and their care managed according to clear principles and standard practice, as embodied in: the Advanced Trauma Life Support (ATLS) course/European Trauma course; the International Trauma Life Support (ITLS) course; the Pre-hospital Trauma Life Support (PHTLS) course; the Advanced Trauma Nurse Course (ATNC); the Trauma Nursing Core Course (TNCC); and the Joint Royal Colleges Ambulance Service Liaison Committee (JRCALC) Clinical Practice Guidelines for Head Trauma. For children, clear principles are outlined in the Advanced Paediatric Life Support (APLS)/European Paediatric Life Support (EPLS) course, the Pre-hospital Paediatric Life Support (PHPLS) course and the Paediatric Education for Pre-hospital Professionals (PEPP) course.
- 1.3.2.2 Ambulance crews should be fully trained in the use of the adult and paediatric versions of the Glasgow Coma Scale.
- 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.
- 1.3.2.4 The priority for those administering immediate care is to treat first the greatest threat to life and avoid further harm.
- 1.3.2.5 **Amended** Patients who have sustained a head injury should be transported directly to a facility that has been identified as having the resources necessary to resuscitate, investigate and initially manage any patient with multiple injuries. It is expected that all acute hospitals and all neuroscience units accepting patients

directly from an incident will have these resources, and that these resources will be appropriate for a patient's age.

1.3.2.6 **Amended** Patients who have sustained a head injury and present with any of the following risk factors should have full cervical spine immobilisation attempted 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.

1.3.2.7 **Amended** Cervical spine immobilisation should be maintained until full risk assessment including clinical assessment (and imaging if deemed necessary) indicates it is safe to remove the immobilisation device.

1.3.2.8 Standby calls to the destination emergency department should be made for all patients with a GCS less than or equal to 8, to ensure appropriately experienced professionals are available for their treatment and to prepare for imaging.

1.3.2.9 **New** 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.

1.4 *Assessment and investigation in the emergency department*

The main focus of emergency department assessment for patients who have sustained a head injury should be the risk of clinically important brain injuries and injuries to the cervical spine and the consequent need for imaging. Due

attention should also be paid to co-existing injuries and to other concerns the clinician may have (for example, non-accidental injury, possible non-traumatic aetiology such as seizure). Early imaging, rather than admission and observation for neurological deterioration, will reduce the time to detection of life-threatening complications and is associated with better outcomes.

1.4.1 Emergency department assessment

- 1.4.1.1 The priority for all emergency department patients is the stabilisation of airway, breathing and circulation (ABC) before attention to other injuries.
- 1.4.1.2 Depressed conscious level should be ascribed to intoxication only after a significant brain injury has been excluded.
- 1.4.1.3 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 in the guidance on patient selection and urgency for imaging (head and cervical spine – see later recommendations). Training should be available as required to ensure that this is the case.
- 1.4.1.4 Patients presenting to the emergency department with impaired consciousness (GCS less than 15) should be assessed immediately by a trained member of staff.
- 1.4.1.5 In patients with a GCS less than or equal to 8 there should be early involvement of an anaesthetist or critical care physician to provide appropriate airway management, as described in recommendations 1.6.1.7 and 1.6.1.8, and to assist with resuscitation.
- 1.4.1.6 All patients presenting to an emergency department with a head injury should be assessed by a trained member of staff 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

the guidance on patient selection and urgency for imaging (head and neck cervical spine).

- 1.4.1.7 **Amended** In patients considered to be at high risk for clinically important brain injury and/or cervical spine injury, assessment should be extended to full clinical examination to establish the need to request CT imaging of the head and/or imaging of the cervical spine. The guidance on patient selection and urgency for imaging (head and cervical spine) should form the basis for the final decision on imaging after discussion with the radiology department. See recommendations 1.4.2.8 to 1.4.2.12 (imaging of the head) and 1.4.3.1 to 1.4.3.15 (imaging of the cervical spine).
- 1.4.1.8 **Amended** 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. The guidance on patient selection and urgency for imaging (head and cervical spine) should again form the basis for the final decision on imaging after discussion with the radiology department. See recommendations 1.4.2.8 to 1.4.2.12 (imaging of the head) and 1.4.3.1 to 1.4.3.15 (imaging of the cervical spine).
- 1.4.1.9 **New** 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. Significant pain should be treated with small doses of intravenous opioids titrated against clinical response and baseline cardiorespiratory measurements.
- 1.4.1.10 **Amended** Throughout the hospital episode, all healthcare professionals should use a standard head injury proforma in their 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. A separate proforma for those under 16 years should be used. 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 available from the NICE website – see page 43 for further details.)

- 1.4.1.11 It is recommended that in-hospital observation of patients with a head injury, including all emergency department observations, should only be conducted by professionals competent in the assessment of head injury.
- 1.4.1.12 Patients who returned to an emergency department within 48 hours of discharge 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.

1.4.2 Investigation for clinically important brain injuries

- 1.4.2.1 The current primary investigation of choice for the detection of acute clinically important brain injuries is CT imaging of the head.
- 1.4.2.2 For safety, logistic and resource reasons, magnetic resonance imaging (MRI) scanning is not currently indicated 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.
- 1.4.2.3 MRI is contraindicated in both head and cervical spine investigations unless there is absolute certainty that the patient does not harbour an incompatible device, implant or foreign body.
- 1.4.2.4 There should be appropriate equipment for maintaining and monitoring the patient within the MRI environment and all staff

involved should be aware of the dangers and necessary precautions for working near an MRI scanner.

- 1.4.2.5 **New** Plain X-rays of the skull should not be used 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.
- 1.4.2.6 **New** Unless the CT result is required within 1 hour, it is acceptable to admit a patient for effective overnight observation and delay the CT scan until the next morning if the patient presents out of hours and any of the following risk factors are present in addition to a period of loss of consciousness or amnesia:
- age 65 years or older
 - amnesia for events more than 30 minutes before impact
 - 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 m or five stairs).
- 1.4.2.7 **New** 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.

Selecting patients for CT imaging of the head

For adults

- 1.4.2.8 **Amended** Adult patients who have sustained a head injury and present with any one of the risk factors in box 4 should have CT scanning of the head requested immediately.

Box 4 Criteria for immediate request for CT scan of the head (adults)

- 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 one episode of vomiting.
- Amnesia for events more than 30 minutes before impact.

1.4.2.9 CT should also be requested immediately in patients with any of the risk factors in box 5, provided they have experienced some loss of consciousness or amnesia since the injury.

Box 5 Criteria for immediate request for CT scan of the head provided patient has experienced some loss of consciousness or amnesia since the injury (adults)

- Age 65 years or older.
- Coagulopathy (history of bleeding, clotting disorder, current treatment with warfarin).
- 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 m or five stairs).

For children

1.4.2.10 **New** Children (under 16 years) who have sustained a head injury and present with any one of the risk factors in box 6 should have CT scanning of the head requested immediately.

Box 6 Criteria for immediate request for CT scan of the head (children)

- Loss of consciousness lasting more than 5 minutes (witnessed).
- Amnesia (antegrade or retrograde) lasting more than 5 minutes.
- Abnormal drowsiness.
- Three or more discrete episodes of vomiting.
- Clinical suspicion of non-accidental injury.
- Post-traumatic seizure but no history of epilepsy.
- GCS less than 14, or for a baby under 1 year GCS (paediatric) less than 15, on assessment in the emergency department.
- Suspicion of open or depressed skull injury 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.
- If under 1 year, presence of bruise, swelling or laceration of more than 5 cm on the head.
- Dangerous mechanism of injury (high-speed road traffic accident either as pedestrian, cyclist or vehicle occupant, fall from a height of greater than 3 m, high-speed injury from a projectile or an object).

Urgency in performing CT imaging of the head

1.4.2.11 **Amended** CT imaging of the head should be performed (that is, imaging carried out and results analysed) within 1 hour of the request having been received by the radiology department in those patients where imaging is requested because of any of the risk factors in box 7.

Box 7 Criteria for CT scan to be performed within 1 hour of receipt of request by radiology department

- GCS less than 13 on initial assessment in the emergency department.
- GCS less than 15 at 2 hours after the injury.
- 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).
- More than one episode of vomiting in adults; three or more episodes of vomiting in children.
- Post-traumatic seizure.
- Coagulopathy (history of bleeding, clotting disorder, current treatment with warfarin) providing that some loss of consciousness or amnesia has been experienced; patients receiving antiplatelet therapy may be at increased risk of intracranial bleeding, though this is currently unquantified – clinical judgement should be used to assess the need for an urgent scan in these patients.
- Focal neurological deficit.

1.4.2.12 **Amended** Patients who have any of the risk factors in box 8 and none of the risk factors in box 7 should have CT imaging of the head performed within 8 hours of the injury (imaging should be performed immediately in these patients if they present 8 hours or more after their injury).

Box 8 Criteria for CT scan to be performed within 8 hours of injury

- Amnesia for events more than 30 minutes before impact (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).
- Age 65 years or older providing that some loss of consciousness or amnesia has been experienced.
- Dangerous mechanism of injury (a pedestrian struck by a motor vehicle, an occupant ejected from a motor vehicle or a fall from a height of greater than 1 m or five stairs) providing that some loss of consciousness or amnesia has been experienced.

1.4.3 Investigation for injuries to the cervical spine

- 1.4.3.1 **Amended** The current initial investigation of choice for the detection of injuries to the cervical spine is the plain radiograph. Three views should be obtained and be of sufficient quality for reliable interpretation. However, in certain circumstances CT is preferred.
- 1.4.3.2 As a minimum, CT should cover any areas of concern or uncertainty on plain film or clinical grounds.
- 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.
- 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).

- 1.4.3.5 MRI may add important information about soft tissue injuries associated with bony injuries demonstrated by plain films and/or CT.
- 1.4.3.6 MRI has a role in the assessment of ligamentous and disc injuries suggested by plain films, CT or clinical findings.
- 1.4.3.7 In CT, the occipital condyle region should be routinely reviewed on 'bone windows' 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.
- 1.4.3.8 In patients who have sustained high-energy trauma or are showing signs of lower cranial nerve palsy, particular attention should be paid to the region of the foramen magnum. If necessary, additional high-resolution imaging for coronal and sagittal reformatting should be performed while the patient is on the scanner table.

Selection of patients for imaging of the cervical spine

- 1.4.3.9 **Amended** Adult patients should have three-view radiographic imaging of the cervical spine requested immediately if any of the points listed in box 9 apply.

Box 9 Criteria for immediate request for three-view radiographic imaging of the cervical spine (adults)

- There is neck pain or midline tenderness with:
 - age 65 years or older, or
 - dangerous mechanism of injury (fall from greater than 1 m or five stairs; axial load to head for example, diving; high-speed motor vehicle collision; rollover motor accident; ejection from a motor vehicle; accident involving motorized recreational vehicles; bicycle collision).
- It is not considered safe to assess the range of movement in the neck for reasons other than those above.
- It is considered safe to assess the range of movement in the neck and, on assessment, the patient cannot actively rotate the neck to 45 degrees to the left and right; safe assessment can be carried out if 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 with no midline cervical spine tenderness
 - presents with delayed onset of neck pain.
- A definitive diagnosis of cervical spine injury is required urgently (for example, before surgery).

1.4.3.10 **New** Adult patients who have any of the risk factors in box 10 should have CT imaging of the cervical spine requested immediately.

Box 10 Criteria for immediate request for CT imaging of the cervical spine (adults)

- GCS below 13 on initial assessment.
- Has been intubated.
- Plain film series is technically inadequate (for example, desired view unavailable), suspicious or definitely abnormal.
- Continued clinical suspicion of injury despite a normal X-ray.
- The patient is being scanned for multi-region trauma.

1.4.3.11 Children aged 10 years or more can be treated as adults for the purposes of cervical spine imaging.

1.4.3.12 Children under 10 years should receive anterior/posterior and lateral plain films without an anterior/posterior peg view.

1.4.3.13 **New** In children under 10 years, because of the increased risks associated with irradiation, particularly to the thyroid gland, and the generally lower risk of significant spinal injury, CT of the cervical spine should be used only in cases where patients have a severe head injury (GCS \leq 8), or where there is a strong clinical suspicion of injury despite normal plain films (for example, focal neurological signs or paraesthesia in the extremities), or where plain films are technically difficult or inadequate.

Urgency in performing cervical spine imaging

1.4.3.14 **New** Children under 10 years of age with GCS of 8 or less should have CT imaging of the cervical spine within 1 hour of presentation or when they are sufficiently stable.

1.4.3.15 **Amended** Imaging of the cervical spine should be performed within 1 hour of a request having been received by the radiology department or when the patient is sufficiently stable. Where a request for urgent CT imaging of the head (that is, within 1 hour)

has also been received, the cervical spine imaging should be carried out simultaneously.

1.4.4 Investigations of non-accidental injury in children

1.4.4.1 **Amended** 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.

1.4.5 Radiation exposure management

1.4.5.1 In line with good radiation exposure practice every effort should be made 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.

1.4.6 Involving the neurosurgeon

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 (www.nice.org.uk).

1.4.6.2 Regardless of imaging, other reasons for discussing a patient's care plan with a neurosurgeon include:

- persisting coma (GCS \leq 8) after initial resuscitation
- unexplained confusion which persists for more than 4 hours
- deterioration in GCS 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.

1.5 **Admission**

1.5.1 The patients listed in box 11 meet the criteria for admission to hospital following a head injury.

Box 11 Criteria for admission

- Patients with new, clinically significant abnormalities on imaging.
- Patients who have not returned to GCS 15 after imaging, regardless of the imaging results.
- When a patient fulfils the criteria 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).

1.5.2 **Amended** Some patients may require an extended period in a recovery setting because of the use of general anaesthesia during CT imaging.

1.5.3 Patients with multiple injuries should be admitted under the care of the team that is trained to deal with their most severe and urgent problem.

1.5.4 **Amended** In circumstances where a patient with a head injury requires hospital admission, it is recommended that the patient be

admitted only under the care of a team led by a consultant who has been trained in the management of this condition during his/her higher specialist training. The consultant and his/her team should have competence (defined by local agreement with the neuroscience unit) in assessment, observation and indications for imaging (see section 1.7); inpatient management; indications for transfer to a neuroscience unit (see section 1.6); and hospital discharge and follow-up (see section 1.8).

- 1.5.5 It is recommended that in-hospital observation of patients with a head injury should only be conducted by professionals competent in the assessment of head injury.

1.6 *Transfer from secondary settings to a neuroscience unit*

1.6.1 Transfer of adults

- 1.6.1.1 **Amended** 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 \leq 8), 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.

- 1.6.1.2 **New** The possibility of occult extracranial injuries should be considered for the multiply injured adult, and he or she should not be transferred to a service that is unable to deal with other aspects of trauma.

- 1.6.1.3 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.

- 1.6.1.4 **Amended** 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. The doctor should be familiar with the pathophysiology of head injury, the drugs and equipment they will use and with 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.
- 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).
- 1.6.1.6 **Amended** Although it is understood that transfer is often urgent, initial resuscitation and stabilisation of the patient should be completed and comprehensive monitoring established before transfer to avoid complications during the journey. A patient who is persistently hypotensive, despite resuscitation, should not be transported until the cause of the hypotension has been identified and the patient stabilised.
- 1.6.1.7 All patients with a GCS less than or equal to 8 requiring transfer to a neuroscience unit should be intubated and ventilated as should any patients with the indications detailed in recommendation 1.6.1.8.

1.6.1.8 **Amended** Intubation and ventilation should be used immediately in the following circumstances.

- Coma – not obeying commands, not speaking, not eye opening (that is, GCS \leq 8).
- Loss of protective laryngeal reflexes.
- Ventilatory insufficiency as judged by blood gases: hypoxaemia (PaO₂ < 13 kPa on oxygen) or hypercarbia (PaCO₂ > 6 kPa).
- Spontaneous hyperventilation causing PaCO₂ < 4 kPa.
- Irregular respirations.

1.6.1.9 **Amended** Intubation and ventilation should be used before the start of the journey in the following circumstances.

- Significantly deteriorating conscious level (one 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.

1.6.1.10 **Amended** An intubated patient should be ventilated 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, the inspired oxygen concentration should be increased. The mean arterial pressure should be maintained at 80 mm Hg or more by infusion of fluid and vasopressors as indicated. In children, blood pressure should be maintained at a level appropriate for the child's age.

1.6.1.11 Education, training and audit are crucial to improving standards of transfer; appropriate time and funding for these activities should be provided.

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.

1.6.2 Transfer of children

1.6.2.1 The recommendations in section 1.6.1 above were written for adults but the principles apply equally to children and infants, providing that the paediatric modification of the Glasgow Coma Scale is used.

1.6.2.2 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 1.6.1.

1.6.2.3 **New** The possibility of occult extracranial injuries should be considered for the multiply injured child, and he or she should not be transferred to a service that is unable to deal with other aspects of trauma.

1.6.2.4 Transfer of a child or infant to a specialist neurosurgical unit should be undertaken by staff experienced in the transfer of critically ill children.

1.6.2.5 Families should have as much access to their child as is practical during transfer and be fully informed on the reasons for transfer and the transfer process.

1.7 Observation of admitted patients

1.7.1 Training in observation

1.7.1.1 Medical, nursing and other staff caring for patients with head injury admitted for observation should all be capable of performing the observations listed in 1.7.2 and 1.7.5.

- 1.7.1.2 The acquisition and maintenance of observation and recording skills require dedicated training and this should be available to all relevant staff.
- 1.7.1.3 Specific training is required for the observation of infants and young children.

1.7.2 Minimum documented observations

- 1.7.2.1 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.

1.7.3 Frequency of observations

- 1.7.3.1 Observations should be performed and recorded 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.
- 1.7.3.2 Should a 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.

1.7.4 Observation of children and infants

- 1.7.4.1 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.

1.7.5 Patient changes requiring review while under observation

1.7.5.1 **Amended** 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 one point in GCS (greater weight should be given to a drop of one point in the motor response score of the Glasgow Coma Scale).
- Any drop of three or more points in the eye-opening or verbal response scores of the Glasgow Coma Scale, or two 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.

1.7.5.2 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.

Imaging following confirmed patient deterioration

1.7.5.3 **Amended** If any of the changes noted in 1.7.5.1 above are confirmed, an immediate CT scan should be considered, and the patient's clinical condition should be re-assessed and managed appropriately.

Further imaging if GCS equal to 15 not achieved at 24 hours

1.7.5.4 In the case of a patient who has had a normal CT scan but who has not achieved GCS 15 after 24 hours' observation, a further CT scan

or MRI scanning should be considered and discussed with the radiology department.

1.8 Discharge

1.8.1 General

Discharge and Glasgow Coma Scale status

1.8.1.1 No patients presenting with head injury should be discharged until they have achieved GCS equal to 15, or normal consciousness in infants and young children as assessed by the paediatric version of the Glasgow Coma Scale.

Discharge advice

1.8.1.2 All patients with any degree of head injury who are deemed safe for discharge from an emergency department or the observation ward should receive verbal advice and a written head injury advice card. The details of the card should be discussed with the patients and their carers. If necessary (for example, patients with literacy problems, visual impairment or speaking languages without a written format), other formats (for example, tapes) should be used to communicate this information. Communication in languages other than English should also be facilitated.

1.8.1.3 The risk factors outlined in the card should be the same as those used in the initial community setting to advise patients on emergency department attendance. Patients and carers should also be alerted to the possibility that some patients may make a quick recovery, but go on to experience delayed complications. Instructions should be included on contacting community services in the event of delayed complications.

1.8.1.4 Patients who presented to the emergency department with drug or alcohol intoxication and are now fit for discharge should receive information and advice on alcohol or drug misuse.

- 1.8.1.5 Suggested written advice cards for patients and carers are available from the NICE website (see page 43 for further details).

Discharge of patients with no carer at home

- 1.8.1.6 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. Patients with no carer at home should only be discharged if suitable supervision arrangements have been organised, or when the risk of late complications is deemed negligible.

1.8.2 Discharge of specific patient groups

Low-risk patients with GCS equal to 15

- 1.8.2.1 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 discharge, 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 discharge and for subsequent care (for example, competent supervision at home).

Patients with normal imaging of the head

- 1.8.2.2 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 discharge, 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 discharge and for subsequent care (for example, competent supervision at home).

Patients with normal imaging of the cervical spine

- 1.8.2.3 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 discharge, 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 discharge and for subsequent care (for example, competent supervision at home).

Patients admitted for observation

- 1.8.2.4 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 (see also recommendation 1.4.2.6 for those admitted out of hours but who require a CT scan).

Patients at risk of non-accidental injury

- 1.8.2.5 No infants or children presenting with head injuries that require imaging of the head or cervical spine should be discharged until assessed by a clinician experienced in the detection of non-accidental injury.
- 1.8.2.6 It is expected that all personnel involved in the assessment of infants and children with head injury should have training in the detection of non-accidental injury.

1.8.3 Outpatient appointments

- 1.8.3.1 Every patient who has undergone imaging of their head and/or been admitted to hospital (that is, those initially deemed to be at high risk for clinically important brain injury) should be routinely referred to their GP for follow-up within a week after discharge.

1.8.3.2 When a person who has undergone imaging of the head and/or been admitted to hospital experiences persisting problems, there should be 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).

1.8.4 Advice about long-term problems and support services

1.8.4.1 **Amended** All patients and their carers should be made aware of the possibility of long-term symptoms and disabilities following head injury and should be made aware of the existence of services that they could contact if they experience long-term problems. Details of support services should be included on patient discharge advice cards.

1.8.5 Communication with community services

1.8.5.1 A communication (letter or email) should be generated for all patients who have attended the emergency department with a head injury, and sent to the patient's GP within 1 week of the end of the hospital episode. This letter should include details of the clinical history and examination. This letter should be open to the person or their carer, or a copy should be given to them.

1.8.5.2 **Amended** A communication (letter or email) should be generated for all school-aged children who received head or cervical spine imaging, and sent to the relevant GP and school nurse within 1 week of the end of the hospital episode. This letter should include details of the clinical history and examination.

1.8.5.3 **Amended** A communication (letter or email) should be generated for all pre-school children who received head or cervical spine imaging, and sent to the GP and health visitor within 1 week of the end of the hospital episode. This letter should include details of the clinical history and examination.

2 Notes on the scope of the guidance

NICE guidelines are developed in accordance with a scope that defines what the guideline will and will not cover. The scope of this guideline is available from www.nice.org.uk/page.aspx?o=267085

The guideline covers the care provided by primary care, ambulance and emergency department staff who have direct contact with and make decisions concerning the care of patients who present with suspected or confirmed head injury. This includes:

- assessment and pre-hospital management
- transfer to hospital
- assessment and investigation in the emergency department
- admission to secondary care
- transfer to a neuroscience unit
- discharge of patients.

The guideline does not address management in the intensive care or neurosurgical unit, but provides guidance on the appropriate circumstances in which to request a neurosurgical opinion. Neither does it address investigative or surgical techniques, but it does make recommendations about the appropriate use of imaging of the patient's head and cervical spine.

After the original guideline (clinical guideline 4) was published in 2003, new studies were published containing some changes in criteria with respect to CT scanning. These studies were reviewed for the update. In addition, the update addressed some issues on interpretation of the original guideline recommendations that were raised in comments received by NICE.

How this guideline was developed

NICE commissioned the National Collaborating Centre for Acute Care to develop the original guideline (NICE clinical guideline 4) and this update. The Centre established Guideline Development Groups (see appendix A), which reviewed the evidence and developed the recommendations. An independent Guideline Review Panel oversaw the development of the guideline (see appendix B).

There is more information in the booklet: 'The guideline development process: an overview for stakeholders, the public and the NHS' (third edition, published April 2007), which is available from www.nice.org.uk/guidelinesprocess or by telephoning 0870 1555 455 (quote reference N0472).

3 Implementation

The Healthcare Commission assesses the performance of NHS organisations in meeting core and developmental standards set by the Department of Health in 'Standards for better health', issued in July 2004. Implementation of clinical guidelines forms part of the developmental standard D2. Core standard C5 says that national agreed guidance should be taken into account when NHS organisations are planning and delivering care.

NICE has developed tools to help organisations implement this guidance (listed below). These are available on our website (www.nice.org.uk/CG056).

- Slides highlighting key messages for local discussion.
- Costing tools
 - costing report to estimate the national savings and costs associated with implementation
 - costing template to estimate the local costs and savings involved.
- Implementation advice on how to put the guidance into practice and national initiatives which support this locally.
- Audit criteria to monitor local practice.
- Supporting items referred to in the guideline recommendations.

4 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 (see section 3.10 in the full guideline).

4.1 *Transport to a specialist neuroscience unit compared with transport to the nearest district general hospital*

A study to determine whether the clinical outcome (mortality/morbidity) of patients with head injuries and reduced levels of consciousness is improved by direct transport from the scene of injury to a tertiary centre with neurosurgical facilities compared with the outcome of those transported initially to the nearest hospital without such facilities.

Why this is important

Limited evidence in this area has shown that patients do better in terms of outcome if they are transported directly to a neuroscience unit. Currently:

- patients are always transported to the nearest district general hospital, as is the case in most land vehicle deployment situations, or
- in some organisations, especially those involving helicopter emergency medical services, the decision is left to the judgement of the clinicians at the scene.

Those transported to the nearest district general hospital may suffer a significant delay in receiving definitive treatment for their head injury.

4.2 *Clinical decision rules on the selection of head-injured infants and children for CT imaging*

Research to establish the validity of previously derived clinical decision rules on the selection of head-injured infants and children for CT imaging to exclude significant brain injury.

Why this is important

The 2002 NICE guidelines recommended that children be selected for CT imaging on the basis of the Canadian Head CT rule, a clinical decision rule derived and validated in adults. There was an absence of such a rule derived in children. Since this date, the CHALICE rule has been published; this is a clinical decision rule derived in a large group of children and infants from the UK, and has good sensitivity and specificity.

However, clinical decision rules often provide an overestimate of their performance when applied to new populations. We now recommend the use of the CHALICE rule for children suffering a head injury in the UK, with the caveat that a validation of the rule in a new population of head-injured UK patients be undertaken urgently to ensure its reliability and reproducibility.

4.3 *Criteria for surgery for intracerebral lesions*

Research to develop consensus on criteria for lesions not currently considered surgically significant following imaging of a patient with a head injury.

Why this is important

One option in the management of traumatic intracerebral haemorrhage and cerebral contusions is to monitor the patient clinically or with intracranial pressure monitoring and other forms of brain tissue monitoring, such as brain tissue oxygen or microdialysis. When the patient deteriorates, he or she is rushed to the operating theatre. This approach has not been validated in a prospective randomised controlled trial. Waiting until the level of consciousness deteriorates or there is deterioration in the monitoring parameters builds delay into the management and results in secondary brain damage occurring and becoming established before surgery in all cases. There is no level 1 evidence about what to do with these patients and the need for research is urgent.

4.4 *Outcomes of severely head injured adults who do not require operative neurosurgical intervention*

Research to determine which patients with significant traumatic brain injury who do not require operative neurosurgical intervention at presentation, but are still cared for in specialist neurosciences centres, have improved clinical outcomes when compared with similar patients treated in non-specialist centres.

Why this is important

Epidemiological evidence suggests that transfer of patients with GCS < 8 to neuroscience units results in improved outcomes, even if they do not require surgical intervention. However, this evidence does not dictate current practice in some regions, and there is a clear need for more information. In particular, we do not know whether specified subsets of patients in this category are more likely to benefit from transfer, and whether some of the factors that may improve outcome in neuroscience units can be translated to non-specialist centres, thus reducing the need for transfer. There are clear risks from transfer, and there could be clear harm, both in terms of clinical outcome and health economics, if the anticipated benefits were not realised. On the other hand, if the benefits from observational studies were confirmed by the trial, the resulting changes in management could potentially reduce case-mix-adjusted mortality by 26% and increase the incidence of favourable outcome in survivors by nearly 20%.

4.5 *Long-term sequelae*

Research is needed to summarise and identify the optimal predictor variables for long-term sequelae following mild traumatic brain injury.

Why this is important

We performed a review of the literature in this area, repeated in this update process. While 394 studies were identified that attempted to use a wide range of variables and tests to predict a range of longer-term outcome measures, no robust clinical decision tools have successfully been derived and validated to identify patients at the time of injury who could be considered for follow-up

because of the higher risk of long-term sequelae. A systematic review of the literature would summarise and identify the optimal predictor variables for such a clinical decision rule and also identify the optimal outcome variables, thus laying the foundation for a derivation cohort study.

5 Other versions of this guideline

5.1 *Full guideline*

The full guideline, 'Head Injury: triage, assessment, investigation and early management of head injury in infants, children and adults' contains details of the methods and evidence used to develop the guideline. It is published by the National Collaborating Centre for Acute Care, and is available from our website (www.nice.org.uk/CG056fullguideline) and the National Library for Health (www.nlh.nhs.uk).

5.2 *Quick reference guide*

A quick reference guide for healthcare professionals is available from www.nice.org/CG056quickrefguide

For printed copies, phone the NHS Response Line on 0870 1555 455 (quote reference number N1331).

5.3 *'Understanding NICE guidance'*

Information for patients and carers ('Understanding NICE guidance') is available from www.nice.org.uk/CG056publicinfo

For printed copies, phone the NHS Response Line on 0870 1555 455 (quote reference number N1332).

6 Related NICE guidance

- Pre-hospital initiation of fluid replacement therapy in trauma. NICE technology appraisal guidance 74 (2004). Available from www.nice.org.uk/TA074

7 Updating the guideline

NICE clinical guidelines are updated as needed so that recommendations take into account important new information. We check for new evidence 2 and 4 years after publication, to decide whether all or part of the guideline

should be updated. If important new evidence is published at other times, we may decide to do a more rapid update of some recommendations.

Appendix A: The Guideline Development Groups

2003 (NICE clinical guideline 4)

Professor David Yates (Chair)

Trauma Audit and Research Network

Mr Kieran Breen

Child Brain Injury Trust; patient representative

Dr Patricia Brennan

British Paediatric Accident and Emergency Group

Dr Niall Cartlidge

Association of British Neurologists

Professor Helen Carty

Royal College of Radiologists

Dr Nichola Chater

British Society of Rehabilitation Medicine

Mr Jack Collin

Association of Surgeons of Great Britain and Ireland

Mr Roger Evans

British Association for Accident and Emergency Medicine

Professor Charles Galasko

British Orthopaedic Association

Ms Gabby Lomas

Royal College of Nursing, Accident and Emergency Association

Professor David Lloyd

British Association of Paediatric Surgeons

Mr Tim Lynch

Ambulance Association

Professor David Mendelow

Society of British Neurological Surgeons

Dr Edward Moss

Royal College of Anaesthetists

Dr David Murfin

Royal College of General Practitioners

Mr Graham Nickson

Headway; patient representative

Dr Christopher Rowland-Hill

British Society of Neuroradiologists

2007 (Update of NICE clinical guideline 4)

Professor David Yates (Chair)

UK Trauma Audit and Research Network

Dr Nichola Chater

British Society of Rehabilitation Medicine

Dr Paul Cooper

Association of British Neurologists

Mrs Hilary Dent

College of Radiographers

Mr Joel Dunning

Cardiothoracic Specialist Registrar, James Cook University Hospital,
Middlesbrough

Dr Roger Evans

British Association for Accident & Emergency Medicine

Professor David Lloyd

British Association of Paediatric Surgeons

Ms Gabrielle Lomas

Royal College of Nursing. Emergency Care Association

Dr Ian Maconochie

Association of Paediatric Emergency Medicine

Professor David Mendelow

Society of British Neurological Surgeons

Professor David Menon

Intensive Care Society

Mr Archie Morson

East of England Ambulance NHS Trust

Dr Edward Moss

Royal College of Anaesthetists

Dr David Murfin

Royal College of General Practitioners

Dr Chris Rowland Hill

British Society of Neuroradiologists

Mr Paul Sidi

Headway Surrey

From the National Collaborating Centre for Acute Care

Ms Rifna Aktar

Project Manager

Dr John Browne

Methodological Adviser

Ms Elisabetta Fenu

Health Economist

Dr Jennifer Hill

Director

Miss Clare Jones

Research Associate

Mr Peter B Katz

Information Scientist

Ms Susan Murray

Project Manager (Feb 2006 – Apr 2006)

Ms Kathryn Oliver

Research Associate (Nov 2006 – Feb 2007)

Mr Carlos Sharpin

Information Scientist/Research Associate

Mr David Wonderling

Senior Health Economist

Appendix B: The Guideline Review Panel

The Guideline Review Panel is an independent panel that oversees the development of the guideline and takes responsibility for monitoring adherence to NICE guideline development processes. In particular, the panel ensures that stakeholder comments have been adequately considered and responded to. The Panel includes members from the following perspectives: primary care, secondary care, lay, public health and industry.

Mr Peter Robb – Chair

Consultant ENT Surgeon, Epsom and St Helier University Hospitals and The Royal Surrey County NHS Trusts

Mrs Jill Freer

Director of Patient Services, Rugby PCT

Mr John Seddon

Patient representative

Mr Mike Baldwin

Project Development Manager, Cardiff Research Consortium

Dr Christine Hine

Consultant in Public Health (Acute), Bristol and South Gloucestershire PCTs