

[HOSPITAL / HEALTH AUTHORITY NAME]

HEAD AND SUSPECTED SPINAL INJURY PATHWAY**Protocol 32: Rapid Assessment, Spinal Motion Restriction, Neuroprotection, Imaging, Neurosurgical / Spine Escalation, Observation, Transfer, and Safe Disposition**

DRAFT FOR EMERGENCY MEDICINE, TRAUMA, NEUROSURGERY, SPINE SURGERY, ORTHOPAEDICS, ANAESTHESIA, CRITICAL CARE, RADIOLOGY, PAEDIATRICS, REHABILITATION, NURSING, EMS, PHARMACY, TRANSFER, SAFEGUARDING, AND CLINICAL-GOVERNANCE REVIEW

STATUS: This is a draft clinical-governance document. CT criteria, spinal-clearance rules, motion-restriction devices, airway procedures, neuroprotection targets, hyperosmolar therapy, tranexamic-acid use, anticoagulant reversal, paediatric pathways, observation capacity, neurosurgical and spinal referral thresholds, rehabilitation access, and inter-island or overseas transfer arrangements must be reconciled with current national guidance, local formulary, imaging capability, specialist availability, and approved linked protocols before implementation.

IMMEDIATE SAFETY RULE: In suspected head or spinal injury, treat airway, ventilation, haemorrhage, shock, seizures, and impending cerebral herniation before or in parallel with imaging. Prevent hypoxia and hypotension, maintain the spine in neutral alignment without forcing deformity, and activate neurosurgical / spine transfer early when definitive capability is unavailable.

Document control	Details
Document owner	Emergency Department / Medical Services Directorate / Nursing Services / Clinical Governance
Clinical leads	Emergency Medicine; Trauma / Surgery; Neurosurgery / Spine Surgery; Anaesthesia / Critical Care; Radiology; Paediatrics; Rehabilitation
Applies to	Adults, children, pregnant patients, older adults, and vulnerable patients with actual or suspected traumatic head, brain, spinal column, or spinal cord injury
Linked protocols	Major trauma; altered mental status; seizures; severe headache / intracranial emergency; airway and ventilatory support; major haemorrhage; anticoagulant reversal; paediatric emergency care; safeguarding; transfer; observation; palliative and death-in-ED care
Version / status	Draft 1.0 for local multidisciplinary validation
Review cycle	After implementation incident review; after major guideline change; and at least every 2 years
Approval required	Emergency Department; Medical Executive; Nursing; Trauma / Surgery; Neurosurgery / Spine referral service; Radiology; Pharmacy; Blood Bank; Paediatrics; Quality and Safety

1. Purpose

To provide a standardized emergency-department pathway for rapid recognition, stabilization, diagnosis, neurological protection, specialist escalation, transfer, observation, and disposition of patients with actual or suspected traumatic head, brain, spinal column, or spinal cord injury. The protocol aims to prevent avoidable secondary neurological injury while ensuring that low-risk patients are not exposed to unnecessary imaging, prolonged motion restriction, or unsafe discharge.

2. Scope

This protocol applies from pre-alert or first contact until discharge, observation, admission, operative or interventional treatment, critical-care transfer, specialist transfer, rehabilitation referral, or death. It includes isolated and multisystem injury, closed and penetrating head injury, concussion, skull fracture, traumatic intracranial haemorrhage, cervical and thoracolumbar injury, spinal cord injury, and delayed presentation. The integrated major-trauma pathway remains primary when there are competing life threats.

3. Core policy statements

- Airway, breathing, circulation, and catastrophic haemorrhage take priority. Spinal protection must support resuscitation and must never prevent life-saving airway or breathing intervention.
- Prevent secondary brain and spinal cord injury by avoiding hypoxaemia, hypotension, hypercarbia, severe hypocarbia, fever, hypoglycaemia, marked hyperglycaemia, seizures, anaemia, coagulopathy, and unnecessary movement.
- Record the Glasgow Coma Scale by components, pupils, and limb motor findings before sedatives or paralysis whenever possible. Trend the examination; a change is more important than a single total score.
- Do not attribute impaired consciousness to alcohol, drugs, dementia, or psychiatric illness until important traumatic brain injury and metabolic causes have been addressed.
- Use spinal motion restriction selectively. Maintain manual in-line stabilization during airway procedures and high-risk movement, but remove rigid extrication devices promptly and avoid forced neutral positioning in fixed deformity.
- CT is the primary acute imaging test for clinically important traumatic brain injury and adult cervical spine injury. MRI is not the primary head-injury test, but is required when neurological findings suggest cord or ligamentous injury despite CT or when there is radio-clinical discordance.
- Any surgically significant imaging abnormality, persistent coma, neurological deterioration, progressive focal deficit, seizure without recovery, penetrating injury, CSF leak, or suspected spinal cord injury requires immediate senior and specialist discussion.
- Routine corticosteroids are not used for traumatic brain injury or acute traumatic spinal cord injury. Routine prophylactic hyperventilation is harmful; use controlled temporary hyperventilation only as a rescue measure for impending herniation while definitive treatment is activated.
- Anticoagulant-related traumatic intracranial haemorrhage requires immediate drug-specific reversal according to the approved pathway. Routine platelet transfusion solely for antiplatelet exposure is not recommended unless an invasive procedure, thrombocytopenia, or specialist-directed indication exists.
- Patients with concussion or mild TBI require written recovery guidance, graded return to activity, responsible supervision, clear danger signs, and follow-up for persistent symptoms. No athlete returns to contact sport on the day of injury.
- If CT, neurosurgery, spine surgery, paediatric neurotrauma, or critical-care capability is unavailable, referral and transfer begin as soon as the need is suspected; non-essential testing must not delay definitive care.
- Every missed injury, unplanned neurological deterioration, delayed imaging, delayed reversal, prolonged collar use, transfer failure, unexpected death, or return with complication requires structured review.

4. Definitions and severity framework

Term	Operational definition
Head injury	Trauma to the head other than a superficial facial injury; may be closed or penetrating and may or may not cause traumatic brain injury.
Traumatic brain injury (TBI)	Alteration in brain function or evidence of brain pathology caused by external force. Clinical severity is assessed after initial resuscitation and may evolve.
Mild TBI / concussion	Usually GCS 13-15 after resuscitation, with possible confusion, amnesia, loss of consciousness, headache, dizziness, cognitive, emotional, sleep, or balance symptoms; a normal CT does not exclude concussion.
Moderate TBI	GCS 9-12 after resuscitation, or clinical / imaging features requiring close neurological observation and specialist discussion.
Severe TBI	GCS 3-8 after resuscitation, usually requiring airway protection, neurocritical care, and transfer to a neuroscience-capable centre.
Spinal column injury	Fracture, dislocation, ligamentous injury, or instability of the cervical, thoracic, lumbar, sacral, or coccygeal spine, with or without neurological deficit.
Spinal cord injury (SCI)	Traumatic motor, sensory, autonomic, or sacral dysfunction attributable to cord injury; may be complete or incomplete and may occur without obvious CT abnormality.
Spinal shock	Transient loss of reflexes and flaccid paralysis below the cord lesion; it is a neurological state and does not itself define haemodynamic shock.
Neurogenic shock	Hypotension, often with relative bradycardia and warm vasodilated skin, due to sympathetic disruption after cervical or high thoracic SCI; diagnose only after excluding haemorrhage and other causes.

Term	Operational definition
Spinal motion restriction (SMR)	Measures that reduce unwanted spinal movement during assessment, transfer, and care. SMR is not absolute immobilisation and must be individualized.

TBI severity after resuscitation	Typical GCS	Minimum ED response
Mild	13-15	Risk-stratify for CT; treat symptoms; observe when indicated; provide written concussion / head-injury advice and follow-up.
Moderate	9-12	Immediate senior review, CT head and cervical spine, airway readiness, neurosurgical discussion, frequent observations, admission / transfer.
Severe	3-8	Trauma and airway activation, intubation when indicated, CT without delaying stabilization, neuroprotection, neurosurgical / neuroscience transfer and critical care.

5. Roles and accountability

Role	Minimum responsibility
Senior ED / trauma clinician	Lead initial resuscitation; assign head and spine risk; authorize imaging and clearance; initiate neuroprotection; contact specialists; decide disposition and transfer.
Airway clinician	Maintain oxygenation, ventilation and manual in-line stabilization; plan RSI and failed airway; confirm tube with waveform capnography; avoid hypotension during induction.
Primary nurse	Apply monitoring; obtain access and samples; administer treatment; perform and record neurological observations; maintain pressure, skin, collar and temperature safety.
Radiology	Prioritize time-critical CT; ensure adequate head and whole-spine coverage / multiplanar reformats; communicate critical findings directly and document time of communication.
Neurosurgery / spine service	Advise on imaging, reversal, ICP / herniation therapy, operative need, spinal stability, cord perfusion, transfer priority and destination.
Paediatric / obstetric service	Provide age- or pregnancy-specific assessment, imaging, medication and monitoring support.
Transfer coordinator / EMS	Secure acceptance, transport platform, escort, oxygen, ventilator, medication, monitoring and contingency arrangements; transmit images and records.
All clinicians	Use closed-loop communication, document exact times and trends, preserve dignity and evidence, escalate deterioration immediately, and activate safeguarding when indicated.

6. Pre-alert, preparation, and triage

- Use ATMIST / MIST handover including injury time and mechanism, GCS components and trend, pupils, focal signs, neck / back pain, weakness or sensory change, anticoagulants / antiplatelets, seizures, vomiting, airway treatment, blood pressure, oxygenation, pregnancy, intoxication, safeguarding concerns, and ETA.
- Activate trauma, anaesthesia, paediatrics, radiology, neurosurgery / spine consultation, blood bank, and transfer services according to physiology and mechanism rather than waiting for CT.
- Prepare suction, difficult-airway equipment, ventilator, capnography, appropriately sized collars and padding, scoop / transfer equipment, warming, hyperosmolar therapy, anticonvulsants, reversal agents, paediatric equipment, and transfer pack.
- Triage any GCS below 15, focal neurological deficit, seizure, suspected skull fracture, penetrating injury, neck / back pain with neurological symptoms, priapism, or progressive symptoms for immediate trained assessment.

7. First 10 minutes: parallel action

1. Receive a structured handover while maintaining airway support, haemorrhage control, and spinal alignment. Remove the patient from a longboard or rigid extrication device as soon as adequate trained staff and an appropriate surface are available.
2. Complete <C>ABCDE. Treat airway obstruction, hypoxaemia, tension pneumothorax, major bleeding, shock, hypoglycaemia, and ongoing seizure immediately.
3. Record pre-sedation GCS components, pupils, limb movement, focal findings, pain, and sensory symptoms. Check glucose and temperature.
4. Attach ECG, pulse oximetry, frequent blood pressure, respiratory rate, and temperature monitoring; use continuous waveform capnography for intubated or deeply sedated patients.
5. Obtain IV / IO access and targeted blood tests: FBC, electrolytes, renal function, glucose, coagulation, group and screen, blood gas / lactate, pregnancy test when relevant, and drug-specific tests where reversal is being considered.
6. Identify imaging urgency and activate CT. CT must not delay resuscitation, immediate haemorrhage control, or transfer when imaging is unavailable.
7. For GCS 8 or less, failure to protect airway, severe agitation compromising care, hypoventilation, or expected deterioration, involve an advanced-airway clinician early and prepare haemodynamically controlled RSI.
8. If anisocoria, rapid GCS decline, extensor posturing, or other herniation signs occur, start the approved herniation-rescue bundle and contact neurosurgery / receiving centre immediately.
9. Reverse anticoagulation promptly when traumatic intracranial haemorrhage is confirmed or strongly suspected and delay would be dangerous; follow the approved drug-specific pathway.
10. Repeat neurological and spinal assessment after every intervention, movement, CT, sedation change, seizure, or physiological deterioration.

8. Primary assessment and neuroprotection

8.1 Airway with spinal motion restriction

- Maintain manual in-line stabilization during airway opening, suction, laryngoscopy, tube placement, and patient movement. The airway takes priority over the collar.
- Use jaw thrust, suction, adjuncts, two-person bag-mask ventilation, and pre-oxygenation. Remove or open the anterior collar during laryngoscopy while a trained assistant maintains alignment.
- Prepare for blood, vomit, facial fractures, base-of-skull injury, cervical deformity, ankylosing spine, and physiological collapse. Use the most experienced available intubator and a difficult / failed-airway plan.
- After intubation, confirm with continuous waveform capnography, secure the tube without excessive neck movement, document depth, and reassess after every transfer.
- Do not force a patient with fixed kyphosis, ankylosing spondylitis, or painful deformity into neutral alignment. Support the position that maintains airway, comfort, and baseline alignment while awaiting specialist advice.

8.2 Breathing and ventilation

- Target oxygen saturation at least 94% and avoid hypoxaemia. Use arterial blood gas when ventilation is controlled or physiology is unstable.
- In the absence of raised intracranial pressure, target PaCO₂ approximately 35-45 mmHg. Avoid routine prophylactic hyperventilation.
- For impending herniation or acute neurological worsening, mild temporary hypocapnia may be used while hyperosmolar therapy and definitive treatment are arranged. Profound hyperventilation is a brief rescue measure only.
- Reassess chest injury, ventilator synchrony, tube position, sedation, and pneumothorax whenever oxygenation, blood pressure, pupils, or ICP-related signs worsen.

8.3 Circulation and perfusion

- Exclude haemorrhagic shock before diagnosing neurogenic shock. Bradycardia does not exclude blood loss, especially in children, athletes, older adults, and high spinal injury.
- For significant TBI without ICP monitoring, aim generally for SBP at least 110 mmHg / MAP above 80 mmHg unless a specialist-directed target applies. Avoid even brief hypotension.
- Use warmed isotonic crystalloid in limited aliquots when needed, blood products for haemorrhage, and vasopressors only after adequate volume assessment or when neurogenic shock persists.
- In acute SCI, prevent hypotension and discuss a perfusion target with the receiving spine / critical-care team. Where local policy uses augmented MAP, apply it with invasive monitoring and attention to arrhythmia, ischaemia, and fluid overload.
- Correct coagulopathy, significant anaemia, hypocalcaemia, severe acidosis, and temperature derangement while avoiding unnecessary fluid loading.

8.4 Disability: neurological examination

Domain	Record and trend
Conscious level	GCS eye, verbal and motor components; orientation; behaviour; amnesia; pre-injury baseline; effect of sedatives, paralytics, alcohol or drugs.
Pupils	Size, symmetry, reactivity, afferent defect, ocular movement and signs of orbital injury; document before and after airway medication.
Motor	Best movement in each limb, asymmetry, pronator drift, weakness, posturing, tone and reflexes where relevant.
Sensation	Light touch / pinprick by limb and approximate spinal level; paraesthesia; saddle and sacral symptoms.
Cord / cauda equina	Anal sensation / voluntary contraction when clinically necessary, sacral sparing, priapism, bladder function, respiratory muscle weakness and autonomic features.
Associated	Seizure, headache, vomiting, vertigo, hearing / vision change, CSF leak, skull / facial signs and intoxication.

8.5 Exposure, comfort, and pressure care

- Inspect scalp, ears, nose, mouth, face, neck, entire spine, skin, and perineum during coordinated movement. Control scalp bleeding without pressing into a suspected depressed fracture.
- Use analgesia and antiemetics; untreated pain, agitation, urinary retention, hypoxia, and poorly fitting devices may raise intracranial pressure or worsen movement.
- Remove wet clothing, prevent fever and hypothermia, pad bony prominences, inspect collar contact points, and use pressure-relieving surfaces for prolonged care.
- Preserve penetrating objects, clothing, and forensic evidence. Do not probe wounds or remove impaled cranial / spinal objects outside a specialist operative plan.

9. Focused history and examination

History / examination	Key points
Mechanism	Blunt or penetrating; height; speed; ejection; axial load / diving; rotation / flexion; sports; assault; blast; fall with syncope; protective equipment; direct head impact.
Time course	Exact injury time; loss of consciousness; seizure; vomiting; amnesia; lucid interval; progressive headache, drowsiness, weakness, sensory or bladder symptoms; delayed presentation.
Medicines / risks	Anticoagulant, antiplatelet, alcohol / drugs, bleeding disorder, epilepsy, shunt, previous neurosurgery / spine surgery, ankylosing disorder, osteoporosis, malignancy, pregnancy.
Head / face	Scalp wound or boggy swelling, open or depressed fracture, haemotympanum, periorbital bruising, Battle sign, CSF leak, ocular injury, dental / facial instability.
Spine	Midline pain / tenderness, deformity, step, swelling, muscle spasm, high-risk mechanism, neurological symptoms, distracting injury, reliability of examination.
Neurology	Serial GCS components, pupils, cranial signs, motor and sensory comparison, coordination / gait only when safe, sacral function if cord / cauda equina injury suspected.
Safeguarding	Inconsistent history, delay, injury pattern, infant injury, domestic or interpersonal violence, self-harm, vulnerable adult, trafficking, custodial or occupational concerns.

10. Spinal motion restriction, clearance, and device safety

- Apply or maintain SMR when the examination is unreliable, there is spinal pain / tenderness, neurological symptom or sign, deformity, high-risk mechanism, significant distracting injury, intoxication, altered consciousness, or prior spinal condition that raises risk.
- Use manual stabilization, a correctly sized collar when not contraindicated, coordinated transfer, head supports, and a scoop / vacuum mattress or suitable trolley. A longboard is an extrication device, not a prolonged transport or ED surface.
- Reassess airway after collar placement. Loosen or remove the anterior collar for airway compromise, vomiting, raised ICP concern, skin injury, or procedures while maintaining manual support.
- Clear an alert, reliable adult clinically only through an approved Canadian C-spine / local decision pathway. Do not test active rotation if high-risk criteria are present or it is not safe.
- In adults who require imaging, a technically adequate negative multidetector CT generally permits collar removal when there is no neurological abnormality, according to the approved clearance pathway. Persistent neurological signs, severe radio-clinical discrepancy, or suspected ligamentous / cord injury require MRI and specialist review.
- Children require age-appropriate assessment. Avoid forced examination; use paediatric radiology / trauma advice when clinical suspicion persists or examination is unreliable.
- For ankylosing spinal disorders, severe kyphosis, osteoporosis, or older age, maintain the pre-injury alignment, use a low threshold for whole-spine CT, and suspect non-contiguous unstable fractures.

11. Imaging pathway

IMAGING RULE: A patient meeting time-critical CT criteria should have imaging and a provisional report within the locally approved emergency target. If CT is unavailable, arrange transfer to a suitable hospital rather than substituting skull radiographs or prolonged observation for indicated imaging.

11.1 Adult CT head criteria

Timing	CT head indication
Within 1 hour	GCS 12 or less initially; GCS below 15 at 2 hours; suspected open / depressed skull fracture; basal skull signs; post-traumatic seizure; focal neurological deficit; more than 1 vomiting episode.
Within 8 hours of injury, or within 1 hour if presenting after 8 hours	Loss of consciousness or amnesia plus age 65 or over, bleeding / clotting disorder, dangerous mechanism, or more than 30 minutes retrograde amnesia.
Consider within 8 hours, or within 1 hour if presenting after 8 hours	Anticoagulant therapy or antiplatelet treatment other than aspirin monotherapy, even without another indication, particularly when risk assessment or reliable return is difficult.
Immediate repeat / urgent CT consideration	Neurological deterioration, new pupil or focal change, persistent vomiting, escalating headache, seizure, or failure to recover as expected.

11.2 Paediatric CT head criteria

Pathway	Risk factors
CT within 1 hour for any one	Suspected non-accidental injury; post-traumatic seizure; initial GCS below 14, or below 15 in a baby under 1 year; GCS below 15 at 2 hours; open / depressed fracture or tense fontanelle; basal skull sign; focal deficit; in a baby under 1 year, scalp bruise / swelling / laceration over 5 cm.
CT within 1 hour when more than one factor	Witnessed loss of consciousness over 5 minutes; abnormal drowsiness; 3 or more vomiting episodes; dangerous mechanism; amnesia over 5 minutes; bleeding or clotting disorder.
Observe at least 4 hours from injury when only one factor above	CT within 1 hour if GCS falls below 15, further vomiting occurs, or abnormal drowsiness recurs; otherwise use senior clinical judgement.

11.3 Cervical and thoracolumbar imaging

Patient / finding	Imaging action
Adult high-risk cervical injury	CT cervical spine within 1 hour for GCS 12 or less, intubation, urgent need for diagnosis, blunt polytrauma, age 65 or over with suspicion, dangerous mechanism, focal peripheral deficit, or limb paraesthesia.

Patient / finding	Imaging action
Adult neck pain / tenderness without high-risk criterion	CT if range-of-motion assessment is unsafe, active rotation 45 degrees left and right is not possible, or a predisposing spinal condition exists.
Adult thoracic / lumbar injury	CT for abnormal neurological findings or strong suspicion of unstable injury; reconstruct thoracolumbar spine from whole-body CT where available. Image the remainder of the spine when a new fracture is found.
Child cervical injury	Use paediatric criteria and radiology advice. CT for severe / urgent high-risk factors; MRI for suspected cord or ligamentous injury; selected lower-risk children may require 3-view radiographs.
Neurological abnormality attributable to cord injury	MRI after CT regardless of whether CT shows the cause. Maintain SMR and contact spine / neurosurgery immediately.
Penetrating injury	Trajectory-directed CT / CTA when stable; unstable patients follow operative / transfer pathway. Do not delay care for non-essential MRI.

12. Traumatic intracranial injury and neurosurgical emergency

- Immediately communicate epidural, subdural, intraparenchymal, intraventricular, posterior fossa, depressed fracture, mass effect, midline shift, obstructive hydrocephalus, penetrating injury, or vascular injury to the senior clinician and neurosurgical / receiving service.
- Use serial examination and repeat CT according to neurological change, lesion type, anticoagulation, specialist advice, and local observation capability. A stable initial scan does not replace clinical monitoring.
- For open or depressed skull fracture, cover with a sterile non-compressive dressing, avoid probing, update tetanus, give antibiotics only according to the approved open / penetrating injury protocol, and arrange neurosurgical management.
- Do not pack the ear or nose in suspected CSF leak. Elevate the head where safe, avoid nasotracheal and nasal instrumentation when a base-of-skull fracture is suspected, and obtain specialist advice. Routine prophylactic antibiotics for isolated CSF leak / basilar fracture are not recommended.
- Treat active seizure using Protocol 19. Consider 7-day early-seizure prophylaxis only for selected high-risk TBI such as severe TBI, cortical contusion, intracranial haematoma, depressed fracture, penetrating injury, or immediate seizure, with specialist / local protocol guidance. Do not continue solely to prevent late epilepsy.
- For traumatic ICH on warfarin, DOAC, heparin, or other anticoagulant, stop the drug, determine agent and last dose, send relevant tests without delaying treatment, and administer approved reversal promptly when indicated.

13. Severe TBI, raised intracranial pressure, and herniation

Parameter	Initial ED goal / action
Oxygenation	SpO2 at least 94%; avoid hypoxaemia. Target PaO2 approximately 80-100 mmHg when arterial monitoring is available.
Ventilation	PaCO2 35-45 mmHg if no raised ICP. Mild temporary hypocapnia for acute worsening / herniation only; avoid routine PaCO2 below 30 mmHg.
Perfusion	Generally SBP at least 110 mmHg / MAP above 80 mmHg before ICP monitoring; individualize for age, bleeding, pregnancy and specialist advice.
Position	Head of bed about 30 degrees when haemodynamically safe; head and neck midline; remove venous obstruction; avoid tight collar / tube ties.
Temperature / glucose	Treat fever and hypothermia; avoid hypoglycaemia and marked hyperglycaemia.
Coagulation	Reverse clinically important anticoagulation; correct severe coagulopathy and thrombocytopenia for bleeding / procedures according to specialist advice.
Sedation / analgesia	Provide adequate analgesia and sedation for intubated patients; avoid coughing, agitation and ventilator dyssynchrony while maintaining haemodynamic stability.
Hyperosmolar rescue	Use an approved bolus regimen of hypertonic saline or mannitol for herniation / intracranial hypertension. Consider sodium, osmolality, renal function, blood pressure and access; do not use scheduled prophylactic dosing without specialist direction.
Steroids	Do not use corticosteroids to treat TBI or raised ICP.

13.1 Herniation rescue bundle

1. Call for senior airway, anaesthesia, neurosurgery and transfer support; state “suspected cerebral herniation” and document time.
2. Ensure oxygenation, ventilation, circulation, glucose, temperature, and tube position; treat seizure and hypotension.
3. Elevate head approximately 30 degrees when safe; keep neck midline; loosen restrictive collar / ties while maintaining alignment.
4. Give approved hyperosmolar bolus promptly. Select hypertonic saline or mannitol according to haemodynamics, sodium, renal status and local monograph.
5. Use brief controlled hyperventilation only for active herniation while definitive surgical / critical-care treatment is being arranged.
6. Proceed to immediate CT only if the patient can tolerate it and it will not delay transfer or operative treatment; repeat pupils and GCS / motor response after each intervention.

14. Acute spinal cord injury and neurogenic shock

- Assume SCI when there is limb weakness, sensory level, sacral dysfunction, priapism, diaphragmatic / respiratory weakness, unexplained hypotension with relative bradycardia, or high-risk pain with neurological symptoms.
- Perform and document a focused motor and sensory examination before sedation when possible, including sacral sparing when clinically required. Repeat after transfer, reduction, and any change.
- Exclude haemorrhage, tension pneumothorax, cardiac injury, medication effect, and sepsis before diagnosing neurogenic shock. Treat bleeding first when uncertainty exists.
- Provide oxygenation, ventilation, warming, careful volume resuscitation, and vasopressor support for persistent neurogenic shock according to critical-care guidance. Atropine or pacing may be required for clinically significant bradycardia.
- Avoid hypotension. Agree any augmented MAP target and duration with spine / critical care; monitor for arrhythmia, myocardial ischaemia, fluid overload, and peripheral injury.
- Do not administer methylprednisolone, nimodipine, or naloxone for acute SCI neuroprotection. Do not delay decompression / stabilization transfer for unproven drug therapy.
- Use pressure-relieving surfaces, skin and collar checks, careful bladder management, bowel awareness, temperature control, DVT prevention planning, respiratory physiotherapy, and early rehabilitation / SCI-centre partnership.

15. Special presentations and populations

Situation	Additional requirements
Anticoagulated / antiplatelet patient	Lower threshold for CT and observation; obtain medication, dose and last administration; reverse anticoagulants for clinically significant ICH; do not use routine platelet transfusion solely for antiplatelet exposure.
Older adult / frailty	Minor mechanisms may cause major injury; establish baseline cognition / function; assess falls, syncope and safeguarding; use low threshold for head and whole-spine imaging and monitor for delirium.
Ankylosing spine / osteoporosis	Do not force neutral alignment; fractures may be unstable and non-contiguous; use whole-spine CT and urgent spine advice when suspected.
Child / infant	Use paediatric GCS and age-adjusted physiology; consider non-accidental injury; avoid routine imaging for uncomplicated concussion; involve experienced paediatric staff for observation.
Pregnancy	Maternal resuscitation and neuroprotection first; do not delay indicated CT, MRI without gadolinium, surgery, reversal, or transfer. Use left uterine displacement after mid-pregnancy and involve obstetrics.
Intoxication / unreliable examination	Do not clear the head or spine solely because symptoms appear intoxication-related. Use CT / observation and reassessment when examination is unreliable.
Penetrating cranial / spinal injury	Do not remove impaled objects; control external bleeding around the object; avoid blind probing; activate surgery / neurosurgery, antibiotics / tetanus per local protocol, vascular imaging when stable, and forensic preservation.
Ventricular shunt / prior surgery	Identify device and baseline; CT and specialist review for new neurological symptoms, shunt track injury, or skull / implant disruption.

16. Observation and reassessment

Observation element	Minimum standard
Neurological set	GCS components, pupils, limb movement, respiratory rate, heart rate, blood pressure, temperature, SpO2, pain, vomiting and behaviour.
Frequency	Half-hourly until GCS 15. Once GCS 15: half-hourly for 2 hours, then hourly for 4 hours, then every 2 hours, unless local higher-acuity policy applies.
Deterioration trigger	Agitation / abnormal behaviour; sustained GCS fall; motor score decline; new anisocoria or focal deficit; severe increasing headache; persistent vomiting; seizure; new weakness / sensory or bladder symptom; worsening neck / back pain.
Response	Immediate senior reassessment; repeat ABC; confirm glucose / oxygen / BP; return to half-hourly observations; consider immediate repeat CT / MRI; contact neurosurgery / spine and escalate destination.
Device / skin	Reassess collar fit, airway, pressure areas, alignment, pain, distal neurological status and need for continued SMR at every handover.

17. Disposition, discharge, and follow-up

Destination	Minimum criteria
Neurosurgical / spine transfer	Surgically significant imaging; severe TBI; persistent coma; neurological deterioration; penetrating injury; CSF leak; unstable fracture; cord / cauda equina deficit; need for ICP monitoring, decompression, stabilization or specialist critical care.
Critical care / high dependency	Ventilation, ongoing vasoactive support, severe / evolving neurological injury, repeated seizures, significant ICH, unstable spine, neurogenic shock, or intensive observation requirement.
Ward / observation	Defined injury plan, reliable serial observations, named responsible service, specialist plan, medication and reversal plan, repeat imaging / examination criteria, and safe device / pressure care.
Discharge after head injury	GCS 15 or baseline; CT not indicated or clinically acceptable normal CT; no other admission factor; symptoms controlled; safe mobility; responsible adult / supervision for first 24 hours; written advice and follow-up.
Discharge after spinal assessment	Clinically cleared or imaging reviewed through the approved pathway; no neurological deficit; pain controlled; functional safety; no unresolved high-risk mechanism or unreliable examination; written return precautions.

- Provide verbal and written danger signs: increasing drowsiness, confusion, unusual behaviour, severe or worsening headache, repeated vomiting, seizure, weakness / numbness, visual or speech change, fluid / blood from ear or nose, worsening neck / back pain, gait difficulty, urinary retention / incontinence, breathing difficulty, or any concern.
- For concussion, advise relative rest for no more than 1-2 days followed by gradual return to ordinary non-contact activity as symptoms allow. Avoid alcohol, recreational drugs, hazardous machinery, driving, heights, swimming alone, and contact / collision sport until medically cleared.
- Provide age-appropriate return-to-school, work, driving and sport guidance. Athletes use a supervised graded return-to-play progression and must not return the same day.
- Arrange timely primary-care communication and follow-up. Refer persistent cognitive, mood, headache, vestibular, sleep, endocrine, pain, neurological, or functional problems to an appropriate TBI / rehabilitation service.

18. Transfer standards

- Activate transfer as soon as specialist need is suspected. Obtain named receiving-clinician acceptance, destination, urgency, treatment before departure, and contingency plan.
- Intubate and ventilate patients with GCS 8 or less who need neuroscience transfer and others unable to maintain airway / ventilation or expected to deteriorate. Use adequate sedation, analgesia, neuromuscular blockade when required, capnography, and haemodynamic support.
- The escort must manage airway loss, ventilator failure, hypotension, seizure, herniation, recurrent bleeding, neurogenic shock, arrhythmia, and spinal device complications.
- Use continuous ECG, SpO2 and capnography when ventilated; frequent BP and neurological checks; secure lines, tubes and collar; carry oxygen, suction, ventilation, emergency drugs, hyperosmolar rescue, anticonvulsant, reversal therapy, fluids / blood when indicated, and power / battery backup.

- Send the injury timeline, serial GCS / pupils / motor findings, CT images and reports, spine assessment, medicines and reversal, airway / ventilation, vital trends, labs, allergies, pregnancy / safeguarding / capacity status, and family contacts.

19. Documentation, communication, and support

- Use a standardized adult or paediatric head / spine proforma. Record injury time, mechanism, witness account, protective equipment, LOC / amnesia / seizure / vomiting, anticoagulants, baseline cognition, examination reliability and safeguarding.
- Document each GCS component and pupil examination rather than only the total score; record timing of sedatives, analgesics, paralytics, intubation, hyperosmolar therapy, reversal, seizure treatment, imaging, referral and transfer.
- Document the indication for applying, changing, loosening, or removing a collar and the clinician authorizing clearance. Record skin and neurological status before and after movement.
- Explain uncertainty honestly. Avoid premature prognosis after severe TBI or acute SCI. Give the patient and family a named point of contact, accessible information, and practical transfer / visitation guidance.
- When the injury may be intentional or legally investigated, preserve evidence, use objective descriptions, maintain chain of custody, and follow consent, safeguarding, police and coroner requirements.

20. Quality indicators and audit

Indicator	Suggested measure
Assessment	Time to trained assessment; completeness of GCS components, pupils and spinal neurological examination; pre-sedation documentation.
Physiological protection	Episodes of SpO2 below target, SBP below target, severe PaCO2 deviation, hypoglycaemia, fever / hypothermia, and time to correction.
Imaging	Eligible patients receiving CT within target; time to provisional report and critical communication; inadequate scans; unnecessary repeat imaging.
Specialist escalation	Time to neurosurgical / spine contact, acceptance, departure and definitive care; treatment before transfer.
Reversal / herniation	Time to anticoagulant reversal and hyperosmolar rescue; appropriateness of agent; adverse events.
SMR / clearance	Appropriate application; time on longboard; collar duration; documented clearance; pressure injury; missed instability.
Observation / discharge	Compliance with neurological observation frequency; documented deterioration response; written advice, 24-hour supervision, and follow-up.
Outcome / equity	Mortality, neurological deterioration, unplanned intubation / ICU, missed injury, return visit, functional disposition, safeguarding, language access and geographic transfer delay.

21. Training and implementation

- Run multidisciplinary simulation for severe TBI, difficult airway with SMR, herniation, anticoagulant-related ICH, paediatric head injury, neurogenic shock, spinal deterioration, and inter-island / overseas transfer.
- Maintain standardized CT decision aids, adult and paediatric observation charts, GCS / pupil competency, cervical-clearance authorization, transfer checklists, hyperosmolar and reversal kits, and pressure-care equipment.
- Revalidate competencies for manual in-line stabilization, coordinated movement, paediatric immobilization, neurological examination, capnography, seizure management, and use of reversal / hyperosmolar therapy.
- Review all deaths, delayed imaging, delayed transfer, neurological deterioration, missed fracture / haemorrhage, device injury, prolonged collar use and readmission with a documented improvement owner and deadline.

ANNEX A. One-page head and spinal injury workflow

Step	Action
PRE-ALERT	Receive ATMIST; activate senior ED / trauma, airway, radiology, neurosurgery / spine, paediatrics and transfer as indicated.
<C>ABC	Treat bleeding, airway, breathing and shock. Maintain manual in-line stabilization during airway and movement. Avoid hypoxia and hypotension.

Step	Action
D	Record GCS components, pupils, limbs, sensation and glucose before sedation when possible. Treat seizure and identify herniation.
SMR	Apply selectively; fit collar if appropriate; do not force deformity; remove longboard promptly; inspect skin and airway.
CT / MRI	Use adult / paediatric CT criteria. CT head and cervical spine urgently when indicated. MRI after CT for neurological cord findings / discordance.
TREAT	Neuroprotection, analgesia / sedation, anticoagulant reversal, hyperosmolar rescue for herniation, SCI perfusion support, no routine steroids.
ESCALATE	Immediate neurosurgery / spine discussion for significant imaging, coma, deterioration, focal signs, seizure without recovery, penetrating injury, CSF leak or SCI.
OBSERVE	Serial GCS / pupils / limbs / vital signs; escalate any deterioration and consider repeat imaging.
DISPOSE	Critical care / specialist transfer / admission / observation / discharge with written advice, supervision and follow-up.

ANNEX B. Adult CT head quick card

CT timing	Criteria
Within 1 hour	GCS \leq 12 initially; GCS $<$ 15 at 2 hours; open / depressed fracture; basal skull sign; post-traumatic seizure; focal deficit; $>$ 1 vomiting episode.
Within 8 hours, or within 1 hour if presenting $>$ 8 hours	LOC / amnesia plus age \geq 65, bleeding / clotting disorder, dangerous mechanism, or $>$ 30 minutes retrograde amnesia.
Consider within 8 hours	Anticoagulant or antiplatelet other than aspirin alone, even without another indication, particularly when assessment or return is unreliable.
Repeat urgently	Any confirmed neurological deterioration, new pupil / focal change, seizure, persistent vomiting, worsening headache or failure to recover.

ANNEX C. Paediatric CT / observation quick card

Pathway	Criteria
One-factor immediate CT	NAI concern; seizure; low GCS; open / depressed fracture or tense fontanelle; basal skull sign; focal deficit; infant scalp lesion $>$ 5 cm.
More than one moderate-risk factor -> CT	LOC $>$ 5 min; abnormal drowsiness; \geq 3 vomiting episodes; dangerous mechanism; amnesia $>$ 5 min; bleeding / clotting disorder.
Only one moderate-risk factor -> observe \geq 4 hours from injury	CT if GCS $<$ 15, more vomiting or recurrent abnormal drowsiness; extend observation by senior judgement.

ANNEX D. Cervical spine clearance and imaging card

Question	Action
Reliable, alert, pain-free, neurologically normal, no high-risk factor?	Apply approved Canadian C-spine / local clinical-clearance pathway; do not image or maintain collar when criteria for no-risk clearance are met.
High-risk factor, unsafe rotation test, inability to rotate 45 degrees, or predisposing condition?	Maintain SMR and obtain CT in adults; use paediatric pathway for children.
Adult adequate CT negative and no neurological deficit?	Remove collar under the approved clearance policy; document CT adequacy, examination and authorizing clinician.
Neurological deficit, radio-clinical mismatch, or suspected ligament / cord injury?	Maintain SMR, obtain MRI after CT, and contact spine / neurosurgery immediately.

Question	Action
Fixed deformity / ankylosing spine?	Maintain baseline alignment; do not force neutral; obtain whole-spine CT and specialist advice.

ANNEX E. Neuroprotection and herniation safety card

Issue	Safety point
Oxygen	SpO2 \geq 94%; PaO2 about 80-100 mmHg when measured.
Ventilation	PaCO2 35-45 mmHg normally; temporary 32-35 mmHg for acute ICP crisis; <30 only brief rescue for actual herniation.
Blood pressure	Avoid hypotension; generally SBP \geq 110 / MAP >80 before ICP monitoring unless individualized.
Position	Head about 30 degrees, neck midline, venous drainage unobstructed, collar not excessively tight.
Hyperosmolar	Approved bolus hypertonic saline or mannitol for herniation / raised ICP; consider sodium, osmolality, renal function and haemodynamics.
Seizure	Treat immediately; selected high-risk TBI may receive 7-day prophylaxis only.
Avoid	Routine steroids, scheduled prophylactic hyperosmolar infusions, routine profound hyperventilation, routine hypothermia below 35 C.

ANNEX F. Concussion / mild TBI discharge card

- Responsible adult / suitable supervision for the first 24 hours; provide verbal and printed advice to both patient and supervisor.
- Return now for worsening headache, repeated vomiting, unusual drowsiness, confusion, seizure, weakness / numbness, speech / vision change, fluid / blood from ear or nose, breathing difficulty, or any concern.
- Relative rest for 1-2 days, then gradual symptom-limited return to ordinary activity. Avoid prolonged strict dark-room rest.
- No alcohol, recreational drugs, driving, hazardous work, heights, swimming alone, or contact / collision sport until safe and medically cleared.
- Return to school / work with temporary adjustments when needed. No same-day return to sport; use supervised stepwise return with at least 24 hours per stage.
- Arrange review if symptoms worsen, are not improving within 2-3 weeks, or interfere with cognition, mood, sleep, balance, school, work or daily function.

ANNEX G. Transfer minimum dataset

- Identity, age / weight, pregnancy, pre-injury cognition / function, allergies, medicines, anticoagulant / antiplatelet agent and last dose.
- Injury time, mechanism, protective equipment, witnessed LOC / seizure / vomiting / amnesia, pre-hospital course.
- Serial GCS components, pupils, motor and sensory findings, sacral / bladder findings when relevant, vital signs and temperature.
- Airway device / depth, ventilation and capnography, oxygen, lines, collar / alignment, wounds, drains and associated injuries.
- CT / MRI images and reports, labs, reversal, hyperosmolar therapy, anticonvulsant, analgesia / sedation, fluids / blood / vasopressor and response.
- Receiving clinician, destination, urgency, outstanding risk, escort, equipment, oxygen / drug supply, contingency plan and family contact.

ANNEX H. Trauma neuro-observation and deterioration triggers

Record	Trigger for immediate senior review
GCS components	Any clinically important decline, especially motor deterioration; failure to recover as expected.
Pupils / focal signs	New anisocoria, non-reactivity, gaze change, facial / limb asymmetry or new sensory level.
Symptoms	Severe increasing headache, repeated vomiting, seizure, abnormal behaviour, increasing drowsiness, new neck / back pain or paraesthesia.

Record	Trigger for immediate senior review
Physiology	Hypoxia, hypotension, bradycardia with hypertension / irregular breathing, fever, hypothermia or ventilatory change.
Response	Repeat ABC / glucose / examination, return to half-hourly observations, urgent imaging consideration, neurosurgery / spine escalation and destination upgrade.

ANNEX I. Audit tool

Audit field	Record
Assessment	Arrival / pre-alert, first trained review, GCS components, pupils, spinal examination, baseline function and reliability.
Physiology	SpO2, BP, PaCO2, glucose, temperature; episodes below / above target and corrective treatment.
Imaging	Indication, order time, scan start, report time, critical communication, repeat imaging and rationale.
Treatment	Airway, SMR, analgesia / sedation, reversal, hyperosmolar, anticonvulsant, vasopressor, blood / fluids, specialist advice.
Transfer / disposition	Decision, referral, acceptance, departure, definitive care, observation compliance, discharge advice and supervisor.
Outcome / learning	Deterioration, missed injury, unplanned ICU / surgery, pressure injury, return visit, mortality, delay, system issue, owner and action.

ANNEX J. Local configuration checklist

- Adult and paediatric CT head criteria, CT cervical / whole-spine protocols, reporting targets, repeat imaging and MRI access.
- GCS and pupil chart, neurological observation frequency, deterioration triggers, paediatric observation competence and escalation authority.
- Approved SMR devices, collar sizes, padding, longboard removal, clinical / CT clearance authorization and documentation.
- Airway / RSI, neuroprotection, herniation rescue, hypertonic saline / mannitol monographs, seizure and TXA pathways.
- Warfarin / DOAC / heparin / antiplatelet reversal, laboratory support, blood bank and neurosurgical procedure platelet targets.
- Neurosurgery, spine surgery, paediatric neurotrauma, SCI centre, critical-care and rehabilitation contacts; image-transfer method.
- Ground, sea and air transfer destinations, acceptance numbers, escort standards, weather / aviation constraints and family travel support.
- Concussion advice sheets, return-to-school / work / sport forms, GP communication, falls / safeguarding referral and persistent-symptom clinic.
- Training calendar, simulation, equipment / medication checks, audit dashboard, incident review and document review date.

ANNEX K. References and source tools

National Institute for Health and Care Excellence. Head injury: assessment and early management (NG232). Published 2023. Current recommendations and imaging algorithms.

National Institute for Health and Care Excellence. Spinal injury: assessment and initial management (NG41). Published 2016; current online recommendations.

American College of Surgeons Trauma Quality Programs. Best Practices Guidelines: The Management of Traumatic Brain Injury. Revised 2024.

American College of Surgeons Trauma Quality Programs. Best Practices Guidelines: Spine Injury. 2022.

Brain Trauma Foundation. Guidelines for the Management of Severe Traumatic Brain Injury, Fourth Edition, with current updates.

Centers for Disease Control and Prevention. Mild TBI / concussion clinical guidance, discharge tools, and HEADS UP return-to-activity resources, current web resources 2025-2026.

World Health Organization. Minimum technical standards and recommendations for spinal cord injury management in emergencies. 2024 / 2025 publication resources.

Local formulary, reversal monographs, trauma and airway protocols, paediatric references, imaging criteria, transfer agreements, and rehabilitation / safeguarding pathways.