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<tr>
<th><strong>Organisation</strong></th>
<th>Birmingham Children’s Hospital</th>
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<td><strong>Document Purpose</strong></td>
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<td><strong>Title</strong></td>
<td>Paediatric Major Trauma Operational Policy</td>
</tr>
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<td><strong>Authors</strong></td>
<td>Tina Newton, Steve Littleson, BCH Trauma Group</td>
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<td>December 2014, Version 2</td>
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<td>Internal to BCHFT, and for network distribution so that MTC’s / TU’s can incorporate paediatric-specific guidelines into their local policies if they wish (uploaded to the K.I.D.S retrieval team website)</td>
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<tr>
<td><strong>Point of Contact</strong></td>
<td>Tina Newton, Clinical Lead for Major Trauma</td>
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Introduction

Background to Major Trauma

Since 1988, a number of studies have identified deficiencies in the care provided to severely injured patients in England. The NCEPOD report ‘Trauma: Who Cares?’ in 2007 found that standards of trauma care were less than good practice and that most parts of the Trauma pathway were deemed as deficient in many cases. Up until more recently there had been little progress made in addressing these deficiencies.

In the summer of 2010, West Midlands Primary Care Trusts (PCTs) requested the West Midlands Specialised Commissioning Team (WMSCT) to undertake a review and a financial appraisal of the options for Major Trauma Centre configuration in the West Midlands recommended by the Strategic Health Authority (SHA) Investing for Health (IfH) group on major trauma. In the autumn of 2010, the WMSCT identified the need for an expanded project to fully assess all the requirements for evaluating the options for Trauma care configuration.

Anticipated benefits of a Trauma Care System

Evidence demonstrates that care based on a network model incorporating a range of specialist units; a MTC, a number of TUs, pre-hospital care and a range of rehabilitation providers is seen to:

- Reduce mortality and disability;
- Improve communication;
- Improve equality of access; and
- Provide more effective educational programmes for clinicians and staff

Model of Care

Several options were considered, and following due process that included formal consultation of the preferred option with the local health economy the project then enter the implementation stage of the Trauma System for the West Midlands where the strategic plans identified and set out in stages 1 and 2 were implemented. This involved a collaborative initiative undertaken by the WMSCT, providers and PCT Cluster based commissioners. The outcome centred around four Major Trauma Centres; 1 Paediatric and 3 Adult. The Trauma Units were approved as fit for purpose following a self-nomination and subsequent validation exercise using the Clinical Advisory Group standards. The remaining hospitals in the West Midlands not wishing to apply for Trauma Unit status were therefore classified as Local Emergency Hospitals.

The model for the West Midlands therefore included three Adult MTC’s, One Paediatric MTC and thirteen TU’s. These were split, based on the nationally recommended maximum travelling isochrones of 45 minutes between the TU’s and the MTC’s, into three Major Trauma Operational Delivery Networks namely:

- Birmingham & The Black Country, Hereford and Worcester TN
As the Paediatric MTC, Birmingham Children's Hospital provides the specialist ‘hub’ for Paediatric Trauma and covers the full geographic footprint of the three adult Major Trauma Networks. This effectively means that Birmingham Children's Hospital is the Paediatric MTC for a Paediatric Trauma Network which is the entirety of the West Midlands region.

“Major trauma” patients are those with an injury severity score (ISS) greater than 15 (Appendix I). This is impossible to ascertain at point of injury and only becomes apparent after full assessment and investigation over hours (if not days) post injury. For that reason, there will often be an over-estimation in paediatric patients needing to be transferred to a Paediatric Major Trauma Centre, with activation of the paediatric trauma team being more often, in retrospect, than was necessary.

Do not worry about calling a trauma call wrongly – the team can be stood down quickly once the patient is assessed in the ED.

Trauma patients are complex and by definition will involve multidisciplinary teams. Emergency trauma management will follow well-defined principles and will not be confined to any one specialty. The factors most commonly causing clinical problems are poor decision-making and lack of effective communication within and between teams. Particular attention needs to be paid to full documentation of decisions, interventions and times. The role of the scribe is pivotal to good documentation. Ensure you feedback any significant issues to the Trauma Team Leader to enable assessments, and changes to practice, to be made.

**Purpose of the Operational Policy**

This Operational Policy is designed to underpin the clinical guidelines found within the later sections, which are a collective from both local and network policies and guidelines, all of which were developed to cover all stages of the trauma pathway. The guidelines, policies, pathways and protocols were based on best available practice (both evidence based and modelled around the approved clinical pathways), and in-line with nationally approved Clinical Advisory Group standards.

The network policies, protocols, guidelines and pathways are all agreed by the participating leads form each ‘member’ organisation and care provider thus ensuring, as best possible, local ownership. Amendments, updates, new additions and audits of effectiveness are all approved by each individual Network Board and overseen by the Networks Performance and Quality Board (PaQ). The PaQ is made up of clinical leads from the three Network Boards, MTC’s, Pre-Hospital care providers and Specialist Rehabilitation leads thus providing an appropriate level of clinical and operational expertise across the complete Major Trauma patient pathway. Members of the appropriate commissioning bodies are also invited to attend Network Trauma Boards and PaQ.
The paediatric / internal policies, protocols, guidelines and pathways are usually led-on by the BCH trauma group and then presented to PaQ for due consideration / ratification as outlined above

The clinical lead for major trauma at BCH is currently Dr Tina Newton, who is one of the ED Consultants. They have allocated programmed activity time for major trauma, which allows them to attend the network meetings outlined above, investigate governance issues (both internal and network related), and to improve the service that paediatric major trauma patients receive, again, at BCH and also within the wider network

Network Governance

The Midlands Trauma Networks have all embraced the principles of ‘open transparency’ and this is supported through a ‘no blame’ culture when discussing sensitive governance related issues at all relevant Boards and Forums. The ‘risk register’ then evolved into a Trauma Risks Issues Incidents and Deaths (TRIID) register and was used to capture all reports from May 2012 to August 2014. The latest iteration of the Trauma Issues Database (TRID) was established in August 2014 that enabled trend and prevalence monitoring. The reporting process has been refined to incorporate ‘drop-own’ menu boxes to speed up the process for ‘reporters whilst work is underway to develop an ‘on-line’ reporting process (expected in March 2015). NHS.NET is the ‘secure’ communication channel through which reports are submitted.

The TRID allows for classification and risk-rating. Local (inter-hospital) TRIDS are captured to support local resolution. Network wide TRIDS are discussed between the agencies concerned and any unresolved TRID’s are taken firstly to the Appropriate Network Boards and if still unresolved, taken to the Networks Performance and Quality Board PaQ. The final step in the Governance framework is to escalate any unresolved TRID’s to the ODN Oversight Board (once established). The TRID reporting framework was reviewed in 2014 Ref No: 53 in the Trauma Handbook.

The Trauma ODN has been developed to incorporate the practices outlined in the National ODN Governance Framework (2013) and World Health Organisation Guidelines for Trauma Quality Improvement Programmes (2009).

Currently Each Trauma Network Board dedicates alternate monthly Board meeting specifically to Governance. Each Network Board has a Governance Lead that chairs the Network Governance Meetings namely:

- BBCH&W TN Governance Lead: Dr Steve Graystone – Worcester Royal Infirmary
- NWM&NW TN Governance Lead: Sue O'Keeffe – North Wales Critical Care Network
- CE TN Governance Lead: Sue Bleasedale - Central England Rehabilitation Unit (CERU)

The Governance Lead for the Performance and Quality Board (PaQ) is currently: Dr Matthew Wyse – University Hospital Coventry and Warwick (Regional Trauma Lead and PaQ Chair)

Each Network hosts weekly Morbidity and Mortality meetings with include ‘unexpected deaths’. These M&M meetings, whilst hosted by the MTC’s are open to all network organisations and available via tele and video conferencing to accommodate the wider geographical area. The Plan for the BBCH&W Trauma Network is to rotate the M&M meetings around the network thus increasing the opportunity for TU engagement and active participation. Specific M&M cases are confidentially discussed at PaQ where wider expert advice is required.
**BCH Key Contact Numbers**

*Internal Bleeps*

PICU Registrar – 55006
Anaesthetic Registrar – 55427
Surgical Registrar – 55420
Surgical SHO – 55421
T&O Registrar – Via switchboard
Neurosurgical Registrar – Via switchboard
Theatre Co-ordinator – 55122
Radiologist – Via Switchboard
Radiographer – 55048 (1700h-0900h) (Phone in-hours)
Porter – 55140 (1700h-0900h) (Phone in-hours)
Haematology Technician – 55034 (1700h-0900h) (Phone in-hours)

(You can access the routine bleep system by dialing 9977, the 55** bleep number, your 4 digit extension, #. To fastbleep, dial 2222 and tell switchboard to fastbleep person / bleep number)

*Phone Numbers*

PICU – 9652
KIDS Retrieval - 9687
Main Theatre – 9562
CT Control Room - 9752
MRI Control Room - 9751
Security - 8480
Blood Bank – 9867
Porters – 8444
Network Key Contact Numbers

Regional Trauma Desk - 01384 215696 (general enquiries)

Network Office

Manager: Jeff Osborne 07825 822265
Service Improvement Sarah Graham 0121 454 7774
Data Analyst Steve Littleson 07809 864416
Events & Administration Juliet Brown 0121 454 2576
Reception and Resuscitation

BCH Trauma Team

Activation Criteria

The ambulance personnel at the scene of an incident will assess paediatric patients against the pre-hospital triage tool (see appendix A). If there are any points on the tool where the patient "triggers", they will call the Regional Trauma Desk at WMAS control centre. The senior paramedics that staff the desk will then call BCH’s ED red phone with an ATMIST handover of the case. All calls passed via the trauma desk are recorded and used for governance and training.

Responsibilities of the staff member taking the pre-alert calls:

- Obtain the information required of the 'alert call' form. This should be given in the ATMIST format (see appendix B). Alert call forms are kept in the black folder by the red alert phone (a copy can be found in appendix C).
- Call the switchboard on 2222 to notify the ED Consultant (if not in the department)
- If the ED Consultant requires the trauma team, call the switchboard on 2222 to send out either:
  i. Trauma Alert – Road – ETA ** mins, or
  ii. Trauma Alert – Helicopter – ETA ** mins

If out-of-hours, the ED Consultant should decide if the CT Radiologist will be required, and contact should be made via switchboard. They may subsequently be contacted with a 'stand-down', but this approach minimises any delays

Do not worry about calling a trauma call wrongly – the team can be stood down quickly once the patient is assessed in the ED.

In the event of an unexpected / unannounced arrival of a major trauma patient to the ED, the triage nurse will quickly obtain:

- Patient’s age
- Mechanism of injury
- Estimated nature of injuries
- Notify ED doctors for immediate assessment of the patient
- Call the ED consultant / Trauma Team (if necessary)

(See flowchart of trauma alerts at BCH in Appendix D)

Switchboard will be notified by the ED that a major trauma has either arrived or is expected and will immediately contact the Trauma Team via the voice bleep. They will make a phone call for specific personnel required that are not on the standard trauma call
Composition and positions

- **ED Middle Grade**
- **ODP / Tech Team Nurse**
- **Nurse 1**
- **Parents Nurse (+/- Parents)**
- **Drugs Nurse**
- **Anaesthetist / PICU**
- **Nurse 2**
- **ED SHO**
- **Specialties Dr**
- **Radiographer**
- **Scribe**
- **Trauma Team Leader**
Roles & Responsibilities

It is a contractual requirement that a Consultant from any specialty should be available to attend within 30 minutes if requested, 24/7. Switchboard hold all the specialty rota’s and will put you in touch with the Consultant you require.

Trauma Team Leader:

The Emergency Department Consultants are the first line trauma team leaders. The rota provides shop floor cover that mirrors peak times of activity for paediatric trauma. The department has 24/7 middle grade cover. It will be expected that the Trauma Team Leader will be present in the Emergency Department before the arrival of an expected patient.

The Trauma Team Leader will be responsible for:

- Giving paediatric-specific advice at the request of the enhanced care team / regional trauma desk during the pre-hospital management of the patient.
- Ensuring that primary transfers into BCH, in conjunction with the Trauma Desk, are carried out appropriately (and possibly in conjunction with KIDS and the trauma desk for secondary transfers).
- Receiving a rapid handover, using ATMIST (full tool in appendix B):
  
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<thead>
<tr>
<th>Field</th>
<th>Description</th>
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<tbody>
<tr>
<td>Age</td>
<td>Age and sex of casualty</td>
</tr>
<tr>
<td>Time</td>
<td>Time of the incident</td>
</tr>
<tr>
<td>MOI</td>
<td>Mechanism of incident. Includes gross mechanism of incident and other factors known to be associated with major injuries</td>
</tr>
<tr>
<td>Injuries</td>
<td>Seen or expected</td>
</tr>
<tr>
<td>Signs</td>
<td>Vital signs, and whether they have improved or deteriorated over time</td>
</tr>
<tr>
<td>Treatment</td>
<td>Treatment given</td>
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- Supervising the primary survey, initiating resuscitation and directing immediate fluid resuscitation for hypovolaemic shock.
- Directing haemostasis and surgical procedures such as chest drain, surgical airway, and urethral catheter.
- Provision of advice on immediate investigations (radiological or laboratory).
- Secondary survey and checking of available results of investigations and handing over any outstanding results.
- Referral of trauma patients to other speciality services (e.g. neurosurgery, maxillo-facial, plastic, orthopaedic).
- Discussing the overall management of the trauma patient with the parents.
- Documentation of medical record sheet and admission notes

The Trauma Team members will carry the trauma bleep at all times. If it becomes necessary that he/she will be unavailable for a period of time the bleep must be handed over to an alternative equivalent team member.
PICU Consultant / Registrar or Anaesthetic Consultant / Registrar

He/she will have responsibility for cervical spine stabilisation and management and stabilisation of airway and ventilation

He/she will be responsible for:

- Controlling the head and cervical spine of the patient
- Assessment of airway patency:
  - Notes facial injuries affecting airway
  - Clears oropharynx
  - Evaluates trachea for midline position
  - Evaluates bilateral breath sounds
  - Observes patient for retractions, stridor etc.
  - Notes presence of crepitation
- Provision of an effective airway based on patient’s condition and associated injuries. In consultation with TTL considers the need for a surgical airway.
- Where necessary, endotracheal intubation and subsequent ventilation of patient.
- Advise on oxygen therapy in non-ventilated trauma patients.
- Administration of anaesthetic agents.
- Co-ordinating cardio-pulmonary resuscitation of the patient.
- Provision of advice regarding admission to PICU.
- Advise on pain relief.

The PICU Consultant will assume position of the TTL in the absence of the ED Consultant

General Surgery Consultant / Registrar

The general surgeons are primarily there to assist the TTL with (a) identifying any source of bleeding and (b) co-ordinating the relevant surgical teams if requires, e.g vascular. The general surgeon will be expected to perform thoracostomies and place chest drains in patients with diagnosed or suspected haemothorax in the trauma resuscitation, and in the peri-arrest patient, a thoracotomy may be required. Whenever possible, thoracotomy should be performed in theatres or the shock room, so if predicted, move early (see later section on managing

Definitive Surgery in Trauma Skills course recommends a left antero-lateral thoracotomy converted into a clamshell

A decision on surgery will be undertaken by the general surgical consultant

OPD / Tech team nurse

They will assist the PICU/Anaesthetic registrar/consultant by:

- Preparing the appropriately sized intubation equipment
- Applying cricoid pressure when required
- Establishing ETCO2 monitoring post intubation
- Taping down ET tubes
**ED Registrar**

The ED Registrar will be responsible for:

- Commencing primary survey and immediate resuscitation under the supervision of the TTL.
- Calling a trauma alert in the case of a deteriorating patient who was stable on arrival.
- Placing an IV cannula and collecting blood for investigations (Group and X-match, FBC U&E/Glucose, Blood gases, Amylase)
- Taking part / carrying out the major part of the practical procedures i.e. IV/IO access, fluid boluses, under direction of TTL.
- Ensuring that proper equipment accompanies patient during transport.

**ED SHO**

The ED SHO will be responsible for:

- Placing an IV cannula
- Taking part / carrying out the major part of the practical procedures i.e. IV/IO access, fluid boluses, under direction of TTL
- If there are enough medical staff to continue management of patient, the ED SHO should discuss with the parents what is happening and also obtain a history if possible of the incident and previous medical history, start medical documentation.

**Nurse 1**

Nurse 1 (patient’s right hand side) is responsible for:

- Ensuring that the room is prepared prior to the patients arrival
- Assisting in the patient transfer onto trolley and with spinal immobilisation.
- Establishing a rapport with the child so that he/she will be able to communicate with the child throughout resuscitation.
- Helping with airway management and assisting the airway doctor
- Helping the ED Registrar with drips, collecting blood
- Assisting in log roll
- Ensuring that the proper equipment is available and accompanies the patient.
- Notifying the receiving area prior to the departure from the ED.
- Ensuring that all documentation accompanies the patient
- Providing a full report and handover to the receiving area personnel

**Nurse 2**

Nurse 2 (patients left hand side) is responsible for:

- Exposure
- Placing 02 probe, BP cuff and ECG leads. Checking temperature
- Ongoing monitoring of vital signs, with 5min update to team
Assisting with insertion of NG/OG tube, urinary catheter, haemostasis or dressing, splinting for fractures and with any other interventions
Will also help in preparation of intravenous lines, warming of Intravenous fluids/blood

Drugs Nurse

The drugs nurse will be responsible for:-

- Drawing up a fluid boluses in advance
- Drawing up any medications requested by TTL or PICU / Anaesthetist in advance
- Prompting to establish if estimated weight needs to be recalculated on patient arrival
- Drawing up any medications or fluids requested by TTL
- Accurate monitoring of fluid input and output, liaising with scribe
- Accurate documentation of medications given, liaising with scribe

Parent / Carer Nurse

The parent’s nurse will be responsible for: -

- Staying beside the parents at all times if they want to remain in the resuscitation room, keeping them informed of what is happening.
- Updating parents or relatives who want to remain in the family room of the situation
- Accompanying the parents to the X-Ray Department, a ward or PICU.

Scribe

The scribe will be responsible for: -

- Documenting those present in the resuscitation room
- Documenting the patients time of arrival
- Documenting the ATMIST handover
- Documenting the observations given every 5mins by Nurse 2
- Documenting the fluids and medications administered by the drugs nurse
Management of Traumatic Cardiac Arrest

Traumatic cardiac arrest caused by trauma has a very high mortality, with an overall survival of 5.6% (range 0-17%). The subgroup of patients who arrest after hypoxic insults, (e.g. hanging, drowning, c-spine injury), have a slightly increased chance of survival. The following guidance aims to maximise the chances of survival in this critically injured cohort and should proceed in a horizontal fashion according to the <C>ABC paradigm.

| <C> Catastrophic Haemorrhage | -Activate Massive Transfusion Protocol  
|                              | -Give 2 units O neg blood stat  
|                              | -Catastrophic limb haemorrhage should be treated with a CAT tourniquet or fully inflated manual BP cuff until the bleeding stops  
|                              | -Haemostatic agents are indicated when catastrophic haemorrhage is uncontrollable by any other means and the patient needs emergency surgery for their injuries |

| <A> Airway | -Secure the airway and ventilate with 100% O2  
|            | -Consider a suxamethonium only intubation if the patient is per-arrest  
|            | -Look for airway obstruction / disruption |

| <B> Breathing | -Perform bilateral thoracostomies  
|               | -Perform an emergency thoracotomy in penetrating trauma if there were vital signs <10mins prior to cardiac arrest and no return of spontaneous circulation  
|               | -Exclude life-threatening chest injuries (e.g. cardiac tamponade, massive haemothorax etc.) |

| <C> Circulation | -Insert two wide-bore IV cannula  
|                 | -Use IO access if unable to secure iv access  
|                 | -Apply pelvic splint and realign limb fractures  
|                 | -Check the heart for shockable VT or VF |

CPR and chest compressions are unlikely to be effective in hypovolaemic cardiac arrest but most survivors do not have hypovolaemia-related arrest so a standard ALS approach can be life-saving. Standard CPR should not delay the treatment of reversible causes (e.g. thoracotomy for cardiac tamponade). Adrenaline should be used cautiously as it can worsen intracellular hypoxia and increase bleeding. If there is no response within 20 minutes despite the above measures, the patient should be pronounced dead. Commotio Cordis is a rare condition where actual or near cardiac arrest is caused by a blunt impact to the chest wall over the heart. A blow to the chest during the vulnerable phase of the cardiac cycle may cause malignant arrhythmias, (usually VF). Commotio cordis occurs mostly during sports and victims are young males, (mean age 14 years). The overall survival rate from commotion cordis is 15%, but 25% if resuscitation is started within 3 minutes.
Management of penetrating torso trauma

Chest injury – cardiac involvement:

If penetrating cardiac injury is suspected, the following actions should be taken. Put out a trauma call, and pre-alert:

- Consultant cardiac surgeon on-call
- Emergency Department consultant on-call
- General surgery consultant on-call
- Anaesthesia consultant on-call
- Theatre co-ordinator

There is an emergency thoracotomy set kept in the resus room in the ED. A thoracotomy should only be performed if the patient arrests in ED, is peri-arrest, or has arrested within 5 minutes of hospital arrival. A decision will need to be made between the trauma team leader and the most senior surgeon present.

Ideally, the patient should not be anaesthetised, intubated and ventilated until the cardiac / operating surgeon is present, as this is often the point at which cardiovascular decompensation occurs.

Transfer patient to theatre immediately. Resuscitation should continue there if required.

Chest injury – non cardiac involvement:

The general surgical consultant or registrar will be expected to perform thoracostomies and place chest drains in patients with diagnosed or suspected haemothorax in the trauma resuscitation. Unstable patients with significant haemothorax will require a thoracotomy:

There is not yet an equivalent thoracic trauma protocol to the cardiac protocol, however in the peri-arrest / arrested patient then a thoracotomy will be required (see above). Whenever possible, thoracotomy should be performed in theatres so if predicted, move early.

Definitive Surgery in Trauma Skills course recommends a left antero-lateral thoracotomy converted into a clamshell

A decision on surgery will be undertaken by the general surgical consultant

Abdominal injury – gunshot wound (GSW):

GSW’s are rare in the UK, and an immediate laparotomy is the most appropriate investigation. CT and occasionally plain xrays have a role in stable patients to assess for associated fractures, foreign body retention and track of the bullet.

Always check THOROUGHLY for an exit wound.
Abdominal injury – stab wound:

‘Stable’ patients with stab wounds to the torso may undergo CT. With a completely normal CT the patient can be observed with regular clinical evaluation. Otherwise:

- Development of peritonitis requires a laparotomy
- Abnormal CT (free air, fluid etc) requires a laparotomy
- CT is poor in patients with thoraco-abdominal wounds – these patients should undergo laparoscopy to exclude diaphragmatic injury

Access to emergency theatre / shock room

BCH does not keep a fully staffed, fully equipped theatre on 24/7 stand-by. The low incidence of penetrating trauma in paediatrics, coupled with the fact BCH has 14 theatres, meant that it assessed the risk of one not being readily available was small enough to accept. To completely mitigate any risk though, the lead surgeon for major trauma established the provision for a “shock room”, whereby an area within main recovery can be converted to a fully functional theatre to enable life-saving surgery to be commenced, whilst awaiting a theatre to be freed-up. After multiple exercises, the “shock room” was able to be set up in around several minutes. To date, this has never had to be used.
Cardiac arrest due to hypovolaemia

Patients who are in a cardiac arrest rhythm due to hypovolaemia will be having rapid volume replacement in the ED. This group may require life-saving invasive surgery within the ED in an attempt to save their lives if they lose their output in the department. ED currently stocks a thoracotomy set and the general surgeons will be tasked with undertaking damage limitation surgery.

Immediate need for surgical intervention

This group will include those with chest or abdominal trauma who may be hypovolaemic, but who still have an output, and need exploratory surgery immediately. The theatre code ‘red system’ should free up an appropriate theatre to go to, but if this is not possible, these will be the patients that would be treated in the “shock room” as an interim measure until the 1st theatre became available.

*You will be met by the theatre co-ordinator and taken either to a theatre or the “shock room”*

Urgent need for theatre within the hour

These patients will be stabilised in the ED and will be called for when the next theatre becomes available. They will go directly to theatre from ED.

Routine need for surgery on the trauma list

These patients will be stabilised in the ED, admitted to an appropriate area, and called to theatre via the emergency trauma list.

All the Consultants providing emergency surgery are required to be trained in the principles and techniques of damage control surgery. At BCH, this is co-ordinated by Mr Arul, who as well as being a Consultant Paediatric General Surgeon also has experience from working alongside the military in war zones.
Specialist Transfusion

The Trust has a Clinical Lead for Transfusion and the transfusion committee hold regular meetings. There is transfusion advice available 24/7, either from the haematology staff in the labs, or from the rostered Consultant

Massive Transfusion Guidelines

Indications for use:-

- Severe traumatic haemorrhagic shock, i.e. hypotensive despite fluid resuscitation

Activation process:-

- TTL to nominate a co-ordinator to liaise with blood bank
- TTL to assess whether patient triggers “Code Red” criteria (see below)
- Co-ordinator to telephone blood bank on 9874 (0900h and 1700h), or bleep haematology technician 55034 (out-of-hours) and either:
  
  (i) Declare “Code Red” (if appropriate) and get shock packs released, OR
  (ii) Liaise with lab regarding timings and availability of blood and clotting products

- If “Code Red” declared, co-ordinator to also contact on-call Consultant Haematologist (transfusion)
- Co-ordinator to identify a runner to go between ED and the labs
- Co-ordinator to inform labs if ‘flyer’ packs of O neg blood have been used
Massive Transfusion Guidelines

The Management of Paediatric Massive Haemorrhage

Take Bloods for:
FBC, Coagulation, Fibrinogen & Blood Gas
Group & Screen

Is Massive Haemorrhage present or likely?
Senior Clinician to Assess
Triggers ‘Massive Haemorrhage Alert’
Nominates Co-ordinator to liaise with Blood Bank

Is blood needed immediately for absolute emergency?
Use Group O Negative Red cells warmed through Active Warming Device

Is there a valid G&S sample with a negative antibody screen?
Blood Bank can issue compatible blood immediately

Does patient fulfill CODE RED criteria?

TRIGGER CODE RED

Shock Pack Available on Request

RE-ASSESS – Is There Ongoing Bleeding?

Results NOT Available
Request further products based on weight
(Chart A) and continue resuscitation

After every 40ml/kg RBC give:
20ml/kg Fresh Frozen Plasma
10ml/kg cryoprecipitate
20ml/kg platelets

Results Available

Regular blood gas analysis and core temperature

Treat:
Hyperthermia
Acidosis
Hypocalcaemia
Hyperkalaemia

Request and replace blood and components based on results:
Hb <10g/dl – give RBCs
if Platelet Count <100 x 10^9/L – give platelets
if PT or APTT > 1.5 x normal range – give FFP
if Fibrinogen <1g/L give cryoprecipitate

Repeat FBC, PT, APTT and fibrinogen until bleeding stopped
If ongoing bleeding consider recombinant factor VIIa
Discuss with on-call Haematology Consultant

Designate a Runner to Blood Bank and instruct

Nominated Co-ordinator
Notify blood bank if O negative blood is used

Discuss timing and availability of
blood and clotting products

Liaise with blood bank:
Blood Bank BCH:
Ext. 9874 (9am-5pm)
On-Call Bleep 55034 (all other times)

Activate CODE RED on instruction from Senior Clinician

Call blood bank & state:
Code Red
Patient Name, Hospital ID, Age, Weight, Gender
Name of Clinician in Charge of Resuscitation
Contact Duty Consultant Haematologist via Switchboard

CODE RED Definition
Consider if:
ACTIVE HAEMORRHAGE SUSPECTED AND
>20ml/kg Red Cells given in 1 hr
>40ml/kg fluid given in 3 hr
>2mls/kg/min blood loss

Code red activation enables release of ‘shock pack’ blood products i.e. red cells
and FFP in 1:1 ratio with platelets and cryoprecipitate if available
Blue light delivery of platelets can be requested if they are unavailable.
In severe trauma red cells, FFP and Platelets can be given in 1:1:1 ratio

Chart A
Blood Products to request by weight

<table>
<thead>
<tr>
<th>up to 10kg</th>
<th>10-20kg</th>
<th>20-50kg</th>
<th>over 50kg</th>
</tr>
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<tbody>
<tr>
<td>Packed Cells</td>
<td>One Unit</td>
<td>Two Units</td>
<td>Three Units</td>
</tr>
<tr>
<td>FFP</td>
<td>One Unit</td>
<td>Two Units</td>
<td>Three Units</td>
</tr>
<tr>
<td>Platelets</td>
<td>One Unit</td>
<td>Two Units</td>
<td>Three Units</td>
</tr>
<tr>
<td>Cryoprecipitate</td>
<td>Five Units</td>
<td>Eight Units</td>
<td>Twelve Units</td>
</tr>
</tbody>
</table>
**Administration of Tranexamic Acid**

**Indications for use:**

Treatment of actual or suspected haemorrhage, associated with trauma.

**Patient Inclusion Criteria:**

- Patients who fulfil ANY of the following:
  - Significant haemorrhage
  - Systolic blood pressure less than the 5th centile (see below)
  - Heart rate greater than normal range (see below)
  - Transfusion of emergency blood, due to actual or suspected haemorrhage or are high risk groups:
    - Multiple rib fractures
    - Penetrating wounds
    - More than one proximal long bone fracture
    - Amputation proximal to the wrist / ankle

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Respiratory rate (breaths/min)</th>
<th>Systolic BP (50th centile)</th>
<th>Systolic BP (5th centile)</th>
<th>Pulse (beats/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>30-40</td>
<td>80-90</td>
<td>65-75</td>
<td>110-160</td>
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<td>1-2</td>
<td>25-35</td>
<td>85-95</td>
<td>70-75</td>
<td>100-150</td>
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<td>2-5</td>
<td>25-30</td>
<td>85-100</td>
<td>70-80</td>
<td>95-140</td>
</tr>
<tr>
<td>5-12</td>
<td>20-25</td>
<td>90-110</td>
<td>80-90</td>
<td>80-120</td>
</tr>
<tr>
<td>&gt;12</td>
<td>15-20</td>
<td>100-120</td>
<td>90-105</td>
<td>60-100</td>
</tr>
</tbody>
</table>

**Administration:**

Presentation - Tranexamic Acid 100 mg in 1 ml (5 ml ampoules)

**Prescribing:** Dose: schedule based on CRASH2 trial.

**Loading dose:** prescribe on once only section of drug chart 15 mg/kg over 10 minutes (maximum 1 gram)

**Maintenance dose:** prescribe on the infusion section of drug chart (see example below) as tranexamic acid 1 gram, in 500ml sodium chloride 0.9% with glucose 5%. Infuse at 1ml/kg/hour, to give 2mg/kg/hour over 8 hours, or until bleeding stops. (maximum 1gram over 8 hours i.e. 62.5ml/hour)

*Dose reduction required in renal impairment.*

*See below in “Monitoring / other comments”*

Further doses can be given after the 8hr infusion if bleeding still persists, but this should only be considered after discussions between the patients responsible consultant and the haematology consultant.

**Storage**

Store at room temperature
**Preparation/ Dilution**

**Loading dose**: draw required dose via filter needle into 10ml syringe and dilute to 10ml using sodium chloride 0.9%.

**Maintenance dose**: draw 10ml tranexamic acid via filter needle into 10ml syringe. Change needle and add to 500ml bag of sodium chloride 0.9% with glucose 5%.

**Route of Administration**

Central or peripheral

**Rate of Administration**

**Loading dose** over 10 minutes

**Maintenance infusion** at rate of 2 mg/kg/hour, for 8hrs

**Stability**

Use immediately - assign 24 hour expiry to IV label for maintenance infusion.

**Flushes**

Sodium chloride 0.9%

**Common compatibilities at terminal Y-site**

Maintenance fluids containing sodium chloride/ glucose. Contact pharmacist for further advice.

**Monitoring/ other comments**

Monitor blood pressure- increased risk of hypotension with rapid injections. Contra-indicated in patients with arterial or venous thrombosis. Caution in patients with history of seizures. Increased risk of seizures in accumulation, therefore dose reduction in renal dysfunction recommended.

**Suggested dose reduction in renal impairment**: 

- mild renal impairment reduce infusion to 1.3 mg/kg/hour,
- moderate renal impairment 1mg/kg/hour,
- severe renal failure 0.5 mg/kg/hour.

**Extravasation Risk**

<table>
<thead>
<tr>
<th>Extreme of pH</th>
<th>Hyperosmolar</th>
<th>Vasoactive</th>
<th>Vesicant</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH 6.5-8</td>
<td>Unknown</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Links to other protocols/ guidelines

RCPCH Evidence Statement: Paediatric TXA for Major Trauma

*Please note that the RCPCH guidance suggests the maintenance fluids be reconstituted as a 500mg dose of TXA in 500mls fluid. BCH have opted for 1gram in 500mls fluid*

Infusion calculation equation

Pump rate in ml/hr = (Dose in mg/kg/hour) x weight
2mg/ml (Concentration in mg/ml)

Calculation example
  e.g. 25kg child presents in ED with major trauma with significant blood loss.
  Prescribe 15mg/kg = 375mg over 10 minutes on once only section of drug chart.
  Followed by tranexamic acid 1 gram in 500ml, infusion at rate of 25ml/hour - as shown below:

Administer as follows:

**Loading dose:** Draw up 3.8mls tranexamic acid into 10ml syringe and dilute to 10mls using sodium chloride 0.9%.

**Maintenance dose:** Draw 10ml tranexamic acid into 10ml syringe and transfer to 500ml bag of sodium chloride 0.9% with glucose 5%. Label as per Trust policy. Attach to patient and set pump to run at 25mls/hour (The volume to be infused would be 25mls/hr for 8hrs = 200mls)

Jehovah’s Witness and Blood Products

A child is defined as anyone under the age of 18. Anyone under the age of 18 must not be allowed to die as the result of a lack of blood transfusion and in common law, clinicians are open to prosecution if this occurs. Children aged 16 to 17 years have a legal right to consent to their own treatment, even if it is against the wishes of their parents. Furthermore, there is no necessity to seek consent from their parents regarding treatment. Conversely, a child under the age of 18 does not have the legal right to refuse treatment and lawful consent to life saving procedures can be given by the parents or by the courts.

If a child is under the age of 16, they can consent to treatment provided they are Gillick competent, hence must satisfy the following test:

1. Can the child understand the nature, purpose and hazards of the treatment?
2. Can the child make a value judgment and balance the risks and benefits?

If a child under the age of 16 is Gillick competent and agrees to a transfusion, this over-rides any parental objections. However, if the child is not Gillick competent and parental consent is not forthcoming, it may be necessary to obtain consent through the courts.
In emergency situations, such as patients fulfilling the criteria for massive transfusion protocol activation, blood transfusion should be given without waiting for a court order. In these circumstances, two doctors of consultant status should make a written, unambiguous entry in the patient’s notes that blood transfusion is essential to save life or prevent serious permanent harm. At the same time, the Trusts solicitors should be contacted in order to obtain a court order.

The 1989 Children's Act outlines who may have parental responsibility and this includes:

- The Mother
- The Father provided he is married to the mother when the child was born or has acquired legal responsibility by:
  1. Parental responsibility order made by the mother
  2. Parental responsibility order made by the court
  3. Jointly registering the birth of the child with the mother

- Legally appointed guardian – court appointed or appointed by parent in the event of their death
- A person in whose favour a court has made a residence order concerning the child
- A local authority designated in a care order in respect of the child (but not where the child is being looked after under section 20 of the Children Act, also known as being ‘accommodated’ or in ‘voluntary care’).
- A local authority or other authorised person who holds an emergency protection order in respect of the child
**CELOX Gauze / Granules**

Used in attempt to stop potentially lethal bleeding (kept in ED resus cupboard)

---

**Celox is suitable for:**
- Arterial & venous bleeds
- Bullet & knife wounds
- Blast & shrapnel wounds
- Wound packing

---

- Severeely bleeding wound identified
- Direct pressure and elevate when appropriate
- Indirect pressure when appropriate
- Apply tourniquet if limb wound still bleeding
- Ensure senior ED staff are aware and surgeons alerted to arrange definitive management of haemorrhage
- Catastrophic haemorrhage and direct surgical intervention to stop the bleeding immediately available
- Delay to surgical intervention for haemorrhage control
- CELOX usage

---

Formal wound assessment and surgical control of haemorrhage
Application of Celox products

Celox Gauze

Celox Granules
Reporting knife wounds

The police are responsible for assessing the risk posed by members of the public who are armed with knives. They need to consider:

- the risk of a further attack on the patient
- risks to staff, patients and visitors in the ED or hospital
- the risk of a further incident near to, or at, the site of the original incident.

For this reason, the police should be told whenever a person arrives at hospital with a wound inflicted in a violent attack with a knife, blade or other sharp instrument. Police should not be informed where the injury to the patient is accidental, or a result of self-harm. If you have responsibility for the patient, you should ensure that the police are contacted, but you may delegate this task to any member of staff. Identifying details, such as the patient’s name and address, should not usually be disclosed at the stage of initial contact with the police.

Make the care of your patient your first concern

When the police arrive, you should not allow them access to the patient if this will delay or hamper treatment or compromise the patient's recovery. If the patient's treatment and condition allow them to speak to the police, you or another member of the health care team should ask the patient whether they are willing to do so. You, the rest of the health care team and the police must abide by the patient’s decision.

Disclosing personal information without consent

Where it is probable that a crime has been committed, the police will seek further information. If the patient cannot give consent (because they are unconscious, for example), or refuses to disclose information or to allow health professionals to do so, information can still be disclosed if there are grounds for believing that this is justified in the public interest or disclosure is required by law. Disclosures in the public interest are justified where:

- failure to disclose information may put the patient, or someone else, at risk of death or serious harm.
- disclosure would be likely to assist in the prevention, detection or prosecution of a serious crime and failure to disclose would be prejudicial to those purposes.

If there is any doubt about whether disclosure is justified, the decision to disclose information without consent should be made by, or with the agreement of, the consultant in charge, or the Trust’s Caldicott Guardian. Wherever practicable, you should seek the patients consent to the disclosure or tell them that a disclosure has been made unless for example it may put you or others at risk of serious harm, or may be likely to undermine the purpose of the disclosure, by prejudicing the prevention, detection or prosecution of crime. The reasons for disclosure should be recorded in the patient's notes.
Stabilisation

Initial management of suspected cervical spine injuries

Indications for cervical spine immobilisation:

1. All patients with altered level of consciousness
2. Patients in whom the mechanism of the injury could have resulted in injury to the spine
3. All patients with signs and symptoms consistent with spinal cord injury:
   - History of transient paraesthesia, dysesthesia, shooting pains or subjective extremity paralysis
   - Complaints of neck pain or discomfort, or presence of muscle spasm
   - Limited range of motion or tenderness over the spin
   - Presence of sensory-motor deficits

Note: Cervical spine in an unconscious patient can only be confidently cleared after the patient regains consciousness. In doubtful situations it is mandatory to continue with cervical spine immobilisation until an expert consultation is available preferably after negative radiology and normal clinical examination.

Immobilisation of patients arriving by ambulance

If an injured child arrives by ambulance and immobilisation is inadequate, the following steps should be taken:

- DO NOT transfer the child from ambulance stretcher to ED trolley until immobilisation is adequate.
- Ensure adequate manual in-line stabilisation is provided
- Replace all soft (or makeshift) collars with rigid collars.
- Log roll patient and place vacu-mattress under them
- Apply sand bags / blocks and remove air from vacu-mattress
- Move patient to ED trolley

Note: once applied, cervical spine immobilisation may be removed only by the order of the TTL. If collar, sandbags and tape are removed for any other reason before C-spines are cleared, document the reason and duration. The time that the C-spine is cleared must also be documented.

Immobilisation of patient arriving by private vehicle:

If an injured child arrives by private vehicle, and the potential for spinal injury exists, the following procedure should apply under the direction of a trained doctor:

- Instruct the parents NOT to move the child
- A nurse and a doctor with a rigid collar, long backboard, sandbags and tape are needed.
• The doctor should enter the vehicle and provide manual in-line stabilisation, while the nurse applies the rigid collar
• **Whilst maintaining in-line stabilisation**, the patient is rotated around and moved to the long board. Sandbags or head blocks are applied.

*If parents are already carrying the child into ED, the following procedure should apply:* -

• Instruct the parents to remain still.
• The doctor should apply in-line stabilisation while the child is being held.
• The nurse should obtain a stretcher and equipment.
• The doctor should then co-ordinate movement of the child onto the Vacu-Mattress.
• Apply collar, and either sandbags or headblocks once the child is on the mattress.

**Note: a common sense approach is advocated in a fighting and uncooperative child**

*Full and correct immobilisation includes all of the following:* -

• Vacu-Mattress with torso and extremity restraints
• If child is more than 3 years of age, use hard collar re-enforced by blocks or sandbags with tape.
• If child is less than 3 years of age, blocks or sandbags and tape.
• Where above not available, manual in-line immobilisation must be used.

*Note: hard collar must be the correct size for the patient & soft collars are not acceptable*
**Initial management of suspected pelvic fractures**

*Beware! – paediatric patients are not always tachycardic at presentation. Apply pelvic splint if there is suspicion of potential injury.*

**The initial management aims to:**

- Splint the pelvis to provide tamponade and prevent movement.
- Detect the presence of a pelvic fracture with imaging.
- Differentiate between pelvic and intra-abdominal bleeding.

**The following is the Standard Operating Procedure:**

- Apply pelvic binder with history of blunt trauma and hypotensive (see below)
- Pelvic binder can be applied even if lateral compression injury is suspected.
- The Binder should be placed around the trochanters, not the iliac crests.
- If Binder applied pre-hospital leave it. Check position and x-ray.
- If hypotensive, begin fluid resuscitation
- Do NOT examine the pelvis for mechanical stability.
- Do NOT logroll the patient until the pelvis is cleared.
- Obtain an early pelvic x-ray (or immediate CT) to clear the pelvis.

If this x-ray is normal, the pelvis is cleared: remove binder and then repeat x-ray (an AP compression ‘open book’ injury can be perfectly reduced by the binder so that the plain x-ray and CT scan is normal. A check x-ray after removal of the binder will identify this problem). If there is haemodynamic instability, replace the binder.

**Application of the SAM Splint:**

This is a two-person technique and should be performed by people trained in the application of the splint

1. Unroll splint and place underneath the patients feet
2. Slide towards the patient’s head and if necessary, elevate buttocks to facilitate correct placement
3. The splint should be at the level of the greater trochanters and no higher.
4. One person holds the orange handle and the other tightens the splint until a click is heard.
5. The splint is fastened using the Velcro.
If a pelvic fracture is present:

- You can leave binder in place for up to 24 hours unless patient has severe neurological deficit (e.g. paraplegia).
- Examine carefully for open wounds, especially in the perineum.
- If there is an open wound, including vaginal lacerations, antibiotics must be administered. Unless contraindicated, Augmentin, Gentamycin and Metronidazole are recommended.
- How essential is the logroll?
- If unilateral pelvic injury: log-roll to opposite side
- If bilateral pelvic injury: avoid log-roll if at all possible.
- Female patient: catheterise if able. See catheterisation guidance below.
- Male patient: refer to catheterisation guidance below.

Catheterisation +/- contrast cystogram / urethrogram after pelvic fracture

In the absence of any concerning features, in particular blood at the meatus, or any history of haematuria since the accident, a single, gentle attempt at passing a urinary catheter may be undertaken. Sterile technique must be used and the procedure performed by an experienced surgeon or urologist: this is not the time to teach the technique.

- If clear urine drains, then all is good
- If there is any element of blood staining in the fluid draining from the catheter, then a contrast study (retrograde cystogram) is mandated

If there is any blood at the meatus prior to catheterisation, or any history of haematuria since accident, then a retrograde urethrogram is indicated before attempts at catheterisation.

- Urethrogram positive: call Consultant Urologist. Decisions now very difficult. If a suprapubic catheter is needed suggest discussion with the pelvic and acetabular surgeons as this will have major implications for any internal fixation.
- Urethrogram negative: catheterise. If haematuria present, perform a retrograde cystogram
**Initial management of open fractures**

*Based on BOAST 4*

**Wound management**

- Photograph wound
- Remove gross contamination e.g. leaves.
- Do **NOT** wash out wound at this stage
- Cover wound with saline soaked gauze
- Leave wound and dressing undisturbed
- Check tetanus status
- Give intravenous antibiotics:
  - Grade I or II: Augmentin
  - Grade III: Augmentin and Gentamicin
    (Farm / river, etc add Metronidazole)

**Fracture Management**

- Neurovascular exam and documentation
- Align and splint fracture
- Repeat neurovascular examination
- Xray
- Document all findings

**Definitive management**

- Discuss with ortho-plastics
- Timing depends on other injuries and available expertise
- Debridement and definitive fixation should be within 24 hours
- Definitive coverage should be within 72 hours
- Severely contaminated injuries, farm and aquatic remain a surgical emergency and must be debrided ASAP
**Spinal cord injuries**

Spinal cord injuries should be discussed (24/7) with the on-call team at Oswestry **within 4hrs** of identification. An initial management plan will be devised. Patients should subsequently have a follow-up referral via the national spinal injury database: [http://www.spinalcordinjury.nhs.uk](http://www.spinalcordinjury.nhs.uk)

If the patient is to remain at BCH, Oswestry will provide an outreach service.
Chest drain insertion

Chest drains should be inserted by adequately trained personnel to reduce the risk of complications, or adequately supervised by a member of trained personnel. Platelet count and clotting should be checked in non-emergency situations, and where possible, any coagulopathy or platelet defect should be corrected before chest drain insertion. Drains should be inserted at the optimum site suggested by ultrasound, but preferentially placed in the mid axillary line through the “safe triangle”. Seldinger Technique or Blunt dissection can be used for insertion. Neither substantial force nor a trocar should ever be used to insert a drain. A chest radiograph should be performed after insertion of a chest drain, and all chest tubes should be connected to a unidirectional flow drainage system (such as an underwater seal bottle) which must be kept below the level of the patient’s chest at all times.

Equipment

- Sterile gloves, gown and facemask.
- Skin antiseptic solution, e.g. iodine or chlorhexidine in alcohol
- Sterile drapes
- Gauze swabs
- A selection of syringes and needles (21–25 gauge)
- Local anaesthetic, e.g. lignocaine (lidocaine) 1% or 2%
- Scalpel and blade
- Suture
- Instrument for blunt dissection/ cut down set
- Chest tube / seldinger chestdrain set
- Connecting tubing
- Closed drainage system (including sterile water if underwater seal being used)
- Dressing

Patient Position and Insertion site

The preferred position for drain insertion is on the bed, slightly rotated, with the arm on the side of the lesion behind the patient’s head to expose the axillary area.

Insertion should be in the "safe triangle" illustrated in figure below. This is the triangle bordered by the anterior border of the latissimus dorsi, the lateral border of the pectoralis major muscle, a line superior to the horizontal level of the nipple, and an apex below the axilla.

When draining fluid Ultrasound should be used to guide thoracocentesis or drain placement-use a skin marking pencil if necessary
Aseptic Technique

Aseptic technique should be used for insertion of chest drain. 2% chlorhexidine (chlorprep) is recommended for skin preparation.

Insertion of Chest Drain

- Chest drain insertion should be performed without substantial force.

Insertion of a chest tube should never be performed with any substantial force since this risks sudden chest penetration and damage to essential intrathoracic structures. This can be avoided either by the use of a Seldinger technique or by blunt dissection through the chest wall and into the pleural space before catheter insertion. Which of these approaches is appropriate depends on the experience of the user. Blunt dissection is preferred for insertion of bigger drains.

Seldinger technique

Small bore chest tubes are usually inserted with the aid of a guidewire by a Seldinger technique. Blunt dissection is unnecessary as dilators are used in the insertion process. After infiltration with local anaesthesia, a needle and syringe are used to localise the position for insertion by the identification of air or pleural fluid. A guidewire is then passed down the hub of the needle, the needle is removed, and the tract enlarged using a dilator. A small bore tube can then be passed into the thoracic cavity along the wire. These have been successfully used for pneumothorax, effusions, or loculated empyemas.

Blunt dissection

The incision for insertion of the chest drain should be similar to the diameter of the tube being inserted. Once the anaesthetic has taken effect an incision is made. The incision should be made just above and parallel to a rib.

Many cases of damage to essential intrathoracic structures have been described following the use of trocars to insert large bore chest tubes.

Blunt dissection of the subcutaneous tissue and muscle into the pleural cavity has therefore become universal and is essential. Using a Spencer-Wells clamp or similar, a path is made through the chest wall by opening the clamp to separate the muscle fibres. For a large chest drain, similar in size to the finger, this track should be explored with a finger through into the
thoracic cavity to ensure there are no underlying organs that might be damaged at tube insertion. The creation of a patent track into the pleural cavity ensures that excessive force is not needed during drain insertion.

**Position of tube tip**

- The position of the tip of the chest tube should ideally be aimed apically for a pneumothorax or basally for fluid. However, any tube position can be effective at draining air or fluid and an effectively functioning drain should not be repositioned solely because of its radiographic position.

**Securing the drain**

Two sutures are usually inserted—the first to assist later closure of the wound after drain removal and the second, a stay suture, to secure the drain.

A transparent dressing allows the wound site to be inspected by nursing staff for leakage or infection. An omental tag of tape (as shown in the picture above) which allows the tube to lie a
little away from the chest wall to prevent tube kinking and tension at the insertion site

**After Care**

- A chest radiograph should be performed after insertion of a chest drain.
- All chest tubes should be connected to a unidirectional flow drainage system (such as an underwater seal bottle) which must be kept below the level of the patient’s chest at all times.
- Appropriately trained nursing staff must supervise the use of chest drain suction.
- Avoid taking too much fluid too quickly. The drain should be clamped for 1 hour once 10 ml/kg are initially removed.
- A bubbling chest drain should never be clamped.
- Please refer to nursing guidelines on care of intercostal drains.
Secondary survey

*This should include:*-

- Top to toe examination of the patient listing all injuries found and diagnoses confirmed by investigations to date.
- Listing all neurology – ideally before intubation and paralysing drugs administered.
- Examining fundi, pupils and tympanic membranes.
- Documenting a temperature – both core and peripheral in serious burns cases.
- Ensuring the back is examined with log roll, and PR whenever possible.
- Clear documentation if anything is *unable* to be done e.g. spinal clearance / logroll so this can be included in subsequent management plans when the clinical condition allows.

*Consider urinary catheter, arterial lines (and timing of), tetanus, and antibiotic cover.*

The ED SpR is responsible for the secondary survey of the limbs:-

They will:

- Evaluate each joint and long-bone for dislocation / stability / fracture.
- Undertake neurovascular examination of all limbs.
- Record presence or absence of key peripheral pulses & neurological findings.
- Assist with splinting fractures.
- Repeat neurovascular examination after splinting.
- Arrange appropriate x-rays *(peripheral x-rays must not delay trauma CT scan).*
- In some cases it may be best to delay x-rays until the patient is in theatre and good quality traction x-rays can be obtained.

If emergency fracture fixation or wound management is likely, warn the theatre coordinator as early as possible so that the theatre staff can start preparations.
Tetanus Prevention

Usual tetanus immunisation schedule

- Tetanus immunisation is given at:

<table>
<thead>
<tr>
<th>Age</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 months</td>
<td>Primary immunisation - 3 doses</td>
</tr>
<tr>
<td></td>
<td>As DTaP/IPV/Hib</td>
</tr>
<tr>
<td>3 months</td>
<td></td>
</tr>
<tr>
<td>4 months</td>
<td></td>
</tr>
<tr>
<td>3 years 4 months – 5 years</td>
<td>Booster as DTaP/IPV or dTaP/IPV</td>
</tr>
<tr>
<td>13 – 18 years</td>
<td>Booster as Td/IPV</td>
</tr>
</tbody>
</table>

Management of tetanus-prone wounds

- All wounds require thorough cleaning, whatever the tetanus status.

<table>
<thead>
<tr>
<th>IMMUNISATION STATUS</th>
<th>CLEAN WOUND</th>
<th>TETANUS-PRONE WOUND</th>
<th>Human Tetanus Immunoglobulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully immunised, i.e. has received a total of 5 doses of vaccine at appropriate intervals</td>
<td>None required</td>
<td>None required</td>
<td>Only if high risk</td>
</tr>
<tr>
<td>Primary immunisation complete, boosters incomplete but up to date</td>
<td>None required (unless next dose due soon and convenient to give now)</td>
<td>None required (unless next dose due soon and convenient to give now)</td>
<td>Only if high risk</td>
</tr>
<tr>
<td>Primary immunisation incomplete or boosters not up to date</td>
<td>A reinforcing dose of vaccine and further doses as required to complete the recommended schedule (to ensure future immunity)</td>
<td>A reinforcing dose of vaccine and further doses as required to complete the recommended schedule (to ensure future immunity)</td>
<td>Yes: one dose of human tetanus immunoglobulin in a different site</td>
</tr>
<tr>
<td>Not immunised or immunisation status not known or uncertain</td>
<td>An immediate dose of vaccine followed, if records confirm the need, by completion of a full 5-dose course to ensure future immunity</td>
<td>An immediate dose of vaccine followed, if records confirm the need, by completion of a full 5-dose course to ensure future immunity</td>
<td>Yes: one dose of human tetanus immunoglobulin in a different site</td>
</tr>
</tbody>
</table>
Tetanus-prone wounds include:

- Wounds or burns that require surgical intervention that is delayed for more than six hours.
- Wounds or burns that show a significant degree of devitalised tissue.
- Puncture-type injuries, particularly where there has been contact with soil or manure.
- Wounds containing foreign bodies.
- Open fractures.
- Wounds or burns in patients who have systemic sepsis.

High-risk is regarded as heavy contamination with material likely to contain tetanus spores and/or extensive devitalised tissue.

Immunosuppressed patients may not be adequately protected against tetanus, despite having been fully immunised – they should be managed as if they were incompletely immunised.

Which vaccine to use?

<table>
<thead>
<tr>
<th>Age</th>
<th>Components</th>
<th>Vaccine stocked in BCH</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary immunisation for children &lt; 10 years</td>
<td>DTaP/IPV/Hib</td>
<td>Pediacel or Infanrix-IPV+Hib</td>
<td>0.5 ml IM</td>
</tr>
<tr>
<td>Booster for children 3 – 10 years</td>
<td>dTaP/IPV</td>
<td>Repevax</td>
<td>0.5 ml IM</td>
</tr>
<tr>
<td>Primary immunisation for children ≥ 10 years</td>
<td>Td/IPV</td>
<td>Revaxis</td>
<td>0.5 ml IM</td>
</tr>
<tr>
<td>Booster for children ≥ 10 years</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Human tetanus immunoglobulin

- Standard dose: 250 units IM
- If > 24 hours since injury or heavy contamination or following burns: 500 units IM.
Paediatric Imaging

The Royal College of Radiologists published guidelines late 2014 on the imaging in paediatric trauma, and this is the network approved protocol. St Emlyn’s subsequently published a simple guide to the RCR guidelines. The following section is taken from both of these as a simplistic guide, and the full RCR guidelines can be read here.

In the acute paediatric trauma setting, there is currently no role for ultrasound outside of assisting in interventional procedures, and magnetic resonance imaging is only reserved for potential spinal cord injuries. Radiology has in-house access to 3 MRI scanners (two 1.5T and one 3.0T).

The most appropriate imaging modality will be discussed between the TTL, Radiology Consultant (plus specialty Consultants if appropriate), but the following can be read as a guide:

Head Injuries

CT is the primary investigation for most, but not all, head injuries, and fulfilling the criteria for a CT brain will not automatically indicate a CT of the cervical spine!

Discuss the care of all patients with new, ‘surgically significant’ abnormalities on imaging with a neurosurgeon. Regardless of imaging, other reasons for discussing a patient’s care plan with a neurosurgeon include:

- GCS <14
- Unexplained confusion for >4hrs
- Progressive, focal neurological signs
- Seizure, without full recovery
- Definite or suspected penetrating injury
- CSF leak

Cervical Spine

C-spine injuries are rare in paediatrics, and cervical CT irradiates the thyroid. You may want to consider x-ray if required. Imaging is not indicated on the basis of head injury alone. In the presence of neurological findings that may suggest a spinal injury, an MRI scan would be the imaging of choice.

Chest Injuries

In blunt chest trauma, a chest x-ray will identify (haemo)pneumothorax, rib fractures, major mediastinal abnormalities and diaphragmatic injuries. Further imaging may be required based on the chest x-ray findings, clinical assessment and mechanism of injury.

With penetrating chest injuries, contrast will be required to detect occult vascular injuries.
In conscious, haemodynamically stable patients with a normal plain film, chest CT’s are unlikely to change the clinical management.

Thoracic Spine

If there is high suspicion of thoracic spinal injury, plain films and MRI’s will be indicated

Abdomen

Where imaging is indicated, contrast CT is the modality of choice. There is no mechanism that mandates abdominal CT, but the following have been shown to be associated with intra-abdominal injury:

- Lap belt / handlebar injury
- Abdominal wall bruising
- Abdominal tenderness in conscious patients
- Abdominal distension
- Evidence of persisting hypovolaemia
- Blood via PR/NG routes

Limbs

Plain films are first line, although CT may be indicated for complex fractures

Pelvis

Pelvic fractures are rare in paediatric patients. Screening x-rays (as per the old ‘trauma’ series) as routine are not indicated. Imaging is only indicated if there is clinical concern (and the presence of a pre-hospital pelvic binder does not equal clinical concern)

Pelvic fractures are associated with multi-organ injuries, so if imaging is indicated, contrast CT of the abdomen and pelvis is the imaging of choice.

CT Reporting

The CT Radiology Consultant will give an initial verbal report real-time, with a provisional detailed report usually within the hour. Any CT not initially reported on by a Consultant will be validated within 12hrs.

Interventional Radiology

Interventional radiology is starting to play a role within paediatric trauma, and there have been a handful of cases where this intervention has come into its own. BCH currently employs an Interventional Radiology Consultant, and also has access to the wider-network on-call rota to ensure robust provision of service. The decision for contacting the Interventional Radiologist will
be made between the CT Radiology Consultant and the General Surgery Consultant

The IR suite is located within the main theatre block on the 2nd floor of the main hospital

**Intensive care**

The paediatric intensive care unit (PICU) at BCH is a 31 bedded unit, staffed by 18 consultants, middle grade doctors and Advance Nurse Practitioners. The Unit is able to provide all aspects of paediatric intensive care including ECLS and Burns. There is an active research group, and the unit forms part of the paediatric intensive care network.

The unit participates in the national PICANET audit, and the data shows it is the busiest unit when looking at admission figures.

The KIDS retrieval service is based on the BCH site and provides a consultant co-ordinated retrieval service for sick and injured children in the region. This includes the transfer in of children with major trauma who have stopped for initial management at other hospitals in the region. Transfers in are co-ordinated with KIDS working with the Regional Trauma Desk to ensure that the patients go direct to the correct destination in BCH (PICU, theatres). The KIDS service is also able to provide outreach support for adult intensive care units in the region in the event of them having to manage a child.

**Pain management**

There is a 7 day service run by 3 Consultant Anaesthetists and 5 Specialist Nurses. The pain team covers until 5pm during the week and until 1.30 and 12.30 weekends. In addition, there are pain workers on every ward and a quarterly report of their efficacy is undertaken. Outside the normal working hours of this service, pain management is provided by the on call anaesthetic consultants thus creating a 24/7 service.

Each patient referred to the pain service has a tailor made pain relief package to include techniques such as regional nerve blocks and epidurals. As a tertiary cardiothoracic surgery centre, the anaesthetists at BCH all have experience in the techniques that would be used in the event of a patient with multiple rib fractures, as they are similar to those used in several of the elective operative procedures (i.e. paravertebral block)
Definitive Care

Major trauma service

Due to the small number of paediatric major trauma cases seen at BCH, there is no definitive major trauma service that oversees all the patients. TARN data (Trauma Audit and Research Network) shows BCH submitting around 120 patients each year, of which 40% have an injury severity score over 15. The majority of those still have an isolated injury though, and indeed a previous audit of 2013/14 admissions showed that only 9% of BCH’s TARN submissions (12 patients in the year) had 2 or more injuries from different body regions, each with an AIS value ≥3:

Patients that are initially admitted to PICU are under the care of a Consultant Intensivist, and they are responsible for co-ordinating the acute care for the patient, whether that be an individual team for an isolated injury, or multiple teams for one of the small number of major poly-trauma patients.

These teams have daily reviews, and at the point of discharge from the unit, any poly-trauma patients will have their care transferred to the most appropriate specialty, with on-going input from any other specialties as required.

Patients that do not require admission to PICU will be admitted under the most appropriate specialty. As seen in the graph above though, over 90% of patients are covered by single specialties anyway, so this system works for the case-mix of patients at BCH.

The Trust has two trauma rehabilitation co-ordinators – Kay Newport and Karen Hodgkinson – who co-ordinate the ongoing care needs of the major trauma patients, whether that be expedititing therapies involvement, ensuring completion of rehabilitation prescriptions, or liaising with local trauma units to allow for care closer to home.
Formal Tertiary Survey

The recently redesigned trauma documentation pack now includes a protocol for secondary/tertiary survey. The new design has only been in operation for 6 months and the completion of the Tertiary survey has not been formally audited. However, this has been added to the Emergency Department audit programme for six monthly audits, the first of these due to be allocated to a new trainee in March 2015.

Neurosurgical trauma

BCH offer the full range of services required to care for neurosurgical trauma, with on-site neuroradiology, on-site neuro critical care, on-site 24/7 neurosurgical middle grades, and an on-call neurosurgical consultant available for advice 24/7 and the ability to be back on-site within 30mins of request.

Referrals from within the trauma networks will go either via the regional trauma desk, or the KIDS retrieval service. Either one will conference call the other in, and also the Consultant Neurosurgeon. A decision will be made about whether the patient requires transfer to BCH, and if they do, a decision will then be made about the most appropriate method of transfer (local ambulance with support of the enhanced medical team, or KIDS retrieving), depending on the time-critical nature of the injury.

Not all children with head injuries will require transfer to BCH. A previous audit of AIS3+ head injuries within the network between the 2013/14 financial year showed that:

- 80% were managed at BCH
- 8% were managed at Stoke MTC (on-site PICU and paediatrics)
- 4% were managed at Coventry MTC (on-site paediatrics)
- 8% were managed at a trauma unit

The Neurosurgical / KIDS teams continue to offer support to units where patients are not transferred.

All patients with intracranial haematomas (subdural, extradural, intracerebral, etc) are usually managed at BCH, whether surgery is required or not (an extension of the audit above showed that no patient remained at a trauma unit during this time with an AIS≥4 intracranial haematoma). Only around one-fifth of patients with an intracranial haematoma will have it neurosurgically removed. The overwhelming majority of paediatrics are managed conservatively. Every patient that does require surgery will either have it carried out by a consultant, or have a consultant supervising them.

Craniofacial Trauma

The Craniofacial Unit based at Birmingham Children’s Hospital is one of four nationally...
designated craniofacial centres, and manage patients with abnormalities of the skull and face, including as a result of trauma. A multidisciplinary team carries out this complex surgery, led by a plastic surgeon, a neurosurgeon and a maxillofacial surgeon supported by registrars and many other staff such as speech and language therapy, and ophthalmology.

**Spinal Injury Trauma**

Most, but not all spinal cord injuries will be identified during the resuscitation or stabilisation phase, but some may not be initially identified if a patient is intubated. If spinal cord injuries are subsequently suspected an MRI will be required, with any positive findings being discussed (24/7) with the on-call team at Oswestry **within 4hrs of identification**. An initial management plan will be devised. Patients should subsequently have a follow-up referral via the national spinal injury database: [http://www.spinalcordinjury.nhs.uk](http://www.spinalcordinjury.nhs.uk)

If the patient is to remain at BCH, Oswestry will provide an outreach service.
Musculoskeletal Trauma

Patients with isolated orthopaedic injuries are the largest group of trauma patients seen at BCH. They account for around 40% of our TARN submissions, and within this group, around three-quarters will have a fractured femur, with the remainder mainly being lower limb fractures.

Some of these lower limb fractures will be open, but very few (thankfully) are the more severe ‘Gustillo Anderson’ grades that TARN require for classification as a true BOAST4. Since the trauma system went live in April 2012 up until the end of December 14, BCH has seen less than 10 of these patients. There is always joint management of these patients between orthopaedics and plastics.

Pelvis injuries

The majority of paediatric pelvic fractures are managed conservatively, but a small number (predominantly older teenagers) will require operative intervention. There are arrangements with two of our adult MTC partners for patients that need to be transferred. There are surgeons available locally to come to BCH should a pelvis need fixing and the patient be too unstable to move (links with colleagues at the Royal Orthopaedic Hospital in Birmingham).

Hand Trauma & Brachial Plexus Injuries

Miss Lester is one of the Paediatric Plastic Surgeon based at the Birmingham Children’s Hospital. Always interested in hand surgery and with specialist training in this field, she set up what has now become The Birmingham Children’s Hand and Upper Limb Service. This is the largest service of its kind in the UK and is recognised as a world class unit for the management and research into children’s hand and upper limb conditions including hand injuries, complex upper limb trauma, birth injuries, brachial plexus injuries and congenital deformities in children.

Maxillofacial Trauma

BCH has 24/7 max-fax team coverage. Most of the acute trauma injuries this specialty this team deal with are fractures to orbits, zygomas and mandibles, often accompanying major intracranial injuries.

Specialist Burns Care

BCH is a Burns Centre that treats children of all ages who have suffered all types of burn injuries. The purpose-built centre opened in February 2007. It treats babies, children and young people up to the age of 16 from the East and West Midlands, although it can also take care for youngsters from across the UK. The Burns Centre is known for its excellent care, expert staff and superb facilities to treat all burn injuries, from minor to very serious.
It is a self-contained centre, which means that everything that patients with burn injuries need is there. There is an out-patients area for children who have minor injuries or have been allowed to go home but who need to return to have their dressings changed. They may also need to receive therapy, which helps recovery. This is also where you come to see the consultants when you have been discharged. The Centre has its own operating theatre; a high dependency unit, where a patient receives constant care from a nurse; an adolescent room, where older children can chill out, and a play room where there are lots of toys for younger children. There are also two assessment rooms, where children have their injuries assessed or their dressings changed. Lots of different dressings are used and the best one suitable for you will be used. One room contains special machinery called a Laser Doppler. This measures how deeply the burn has penetrated the skin. It does this by placing a camera over the burn and does not hurt at all.

If the burn injury is more serious, a patient may need to go to theatre for assessment application of a dressings or a skin graft. This is when a healthy piece of skin is taken from one part of the body and placed over the burn area. Splints, dressings or pressure garments may also have to be fitted over the wounds to enable the skin and tissue to repair properly. Patients can choose from a wide variety of colours. A pressure garment is a special piece of clothing – such as a vest, glove, sleeve or sock – that has to be worn 23 hours a day. It helps to reduce scarring, swelling and itching and helps to flatten any scars. There are many different colours to choose from.

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**Midlands Burn Network Flow Chart for Paediatric Burns**

- **Is the Total Body Surface Area (TBSA) Burnt > 5%**
  - YES: Discuss with and arrange transfer to the nearest Midland’s burn unit or centre. Nottingham 0115 969 1169. Leicester 0116 254 1414. Birmingham 0121 333 9999.
  - NO: Are any of the following present?
    - Full thickness area of >1% TBSA
    - Circumferential burns to chest or limbs that may require escharotomy
    - Significant burns to face, hands or perineum/genitalia
    - Any airway compromise or inhalation injury
    - Any additional trauma

- **Is the TBSA burnt >10%**
  - YES: Discuss with and arrange transfer to the nearest Midland’s burn centre. Birmingham 0121 333 9999.
  - NO: Are any of the following present?
    - Child has significant smoke inhalation and/or will need respiratory support for their burn injury?
    - Major trauma
    - A need for renal support

- **Is the child under 12 months?**
  - YES: Are any of the following present?
    - Full thickness burn
  - NO: Is there > 20% TBSA full thickness burn

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May 2009
**Burn Facility (BF)**  UHL (Leicester RI), NUH (City Hospital), BCH (Birmingham Children’s Hospital)
- No admission under 12 months
- Over 12 months < 1% TBSA Full thickness
- Over 12 months <5% TBSA

**Burn Unit (BU)**  NUH (City Hospital), and BCH (Birmingham Children’s Hospital)
- Under 12 months < 10% TBSA
- Over 12 months:
  - < 30% TBSA
  - < 20% TBSA (Deep dermal/FT)
  - No admission for children requiring ventilator support.
  - No admission for children with multiple injuries
  - (Children with TBSA between 20-30% to be discussed with BC)

**Burn Centre (BC)**  BCH (Birmingham Children’s Hospital)
- Under 12 months  > 10% TBSA
- Over 12 months
  - > 30% TBSA
  - > 20% TBSA (Deep dermal/FT)
- Children requiring ventilator support
- Children with Poly-trauma.

MOST MINOR BURNS ARE FOLLOWED UP IN ED, DISCUSS WITH SENIOR IF DOUBT

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**Nutritional Management Policy**

BCH have dieticians available 24/7 and they are involved early in the care of trauma patients to devise individualised nutritional plans.

Dieticians attend the multidisciplinary meetings on PICU and will liaise with the rehabilitation team during the rehabilitation phase of their treatment.
Rehabilitation

Trauma Rehabilitation Service

Please also see ‘major trauma services’ under ‘definitive care’, which outlines that BCH does not have an over-arching trauma service, but rather that patients are managed within the respective specialties appropriate for their injuries.

Patients who have sustained a brain or spinal cord injury are managed by the Neurological Rehabilitation Team led by Dr Martin Smith, Consultant Neurologist. His role includes;

- Lead clinician
- Weekly MDT
- Monthly case discussion with wider MDT including community services
- Discharge planning
- Facilitating patient led goal setting

Patients sustaining an orthopaedic, nerve or soft tissue injury will have their care overseen by the trauma and orthopaedic team. The lead clinician for musculoskeletal trauma is Mr James Philips, Orthopaedic Consultant. His role includes;

- Lead clinician
- Daily consultant led ward rounds
- Discharge planning
- Surgical management as required

Rehabilitation Coordinator Post

Birmingham Children’s Hospital has successfully recruited to the role of Trauma and Rehabilitation Coordinator. This role is completed by two band 7 Allied Health Professionals, Kay Newport and Karen Hodgkinson, their professional background is Physiotherapy. The role provides a service over 5 days (Monday to Friday) to facilitate coordination of patients admitted following major trauma and their on-going rehabilitation needs.

BCH also has an established post of a Therapy Coordinator. A band 5 therapy assistant coordinator; Richard O’Connell, is in post providing cover 5 days a week. This role identifies major trauma patients admitted to the trust and liaises with appropriate therapy teams to ensure appropriate rehabilitation and forward planning can commence at the point of admission.

The Physiotherapy service is able to provide assessment and treatment of major trauma patients 7 days a week in order to facilitate rapid discharge. Over the weekend this service is provided by the acute out-of-hours service. All staff who participate in this rota complete biannual neurological and orthopaedic physiotherapy training to ensure competence in this area.
Specialist Rehabilitation Service

Rehabilitation is available for all major trauma patients admitted to BCH. Rehabilitation is carried out throughout the hospital site on the ward most appropriate to meet the patient’s medical needs. All patients have access to specific equipment to support their rehabilitation and access to the therapy department facilities. This includes a gym, rehab kitchen, individual age appropriate treatment rooms, splinting and plaster rooms and associated equipment. Therapy equipment can be issued for use on the wards including, but not limited to, specialist seating and standing frames. There is also access to smaller equipment to facilitate the implementation of therapy programmes supported by parents and nursing staff.

There are two funded beds within the trust for neuro-rehabilitation. At any one time we have an average of six rehabilitation patients under our care. Families have weekly access to a support worker from the Child Brain Injury Trust to support their rehabilitation.

Rehabilitation of musculoskeletal patients takes place on the orthopaedic ward

All trauma patients regardless of mechanism of injury will be seen by a team of professionals from the following areas as required to meet the needs of the child and their family:

- Physiotherapy
- Occupational Therapy
- Speech and Language Therapy
- Orthotics
- Education
- Play Therapy
- Dietetics
- Psychology
- D/C coordinator

Physiotherapy

There are 3 distinct specialist teams to treat trauma patients depending on their need:

The **Musculoskeletal team** provides physiotherapy treatment to all musculoskeletal trauma patients including patients with bony injury, amputation, burns, muscular injury or peripheral nerve damage. Major trauma patients will be identified by the trauma coordinator and referred for physiotherapy management as appropriate to meet their needs.

The **Neurosciences team** provides physiotherapy treatment to all children who have sustained a neurological insult as a result of a major trauma. This would include acquired or traumatic brain injury and spinal cord injury.

The **Acute Respiratory** team provides physiotherapy management of children with a respiratory component to their injury, for example chest trauma, aspiration and those requiring a PIC stay.
This team also provides rehabilitation of those who sustain abdominal trauma if required. The staff structure is shown below:
Occupational Therapy

The acute occupational therapy team will manage trauma patients within BCH. Their role includes:

- Assessment and provision of equipment and/or guidance to prevent long term detrimental effects on the child’s development e.g. provision of seating, writing or communication aids
- Assessment and/or treatment to facilitate the child’s discharge home e.g. self-help skills and home adaptations. To include provision of equipment.
- Treatment to help restore or compensate for loss of function

The staffing structure is as below:
Speech and language Therapy

The acute speech and language therapy team will manage trauma patients within BCHNHSFT as required to meet their needs. Their role includes:

- Assessment of swallows to support altered diet and to influence the child’s medical management e.g. decision to tube feed.
- Assessment and provision of equipment to support eating and drinking.
- Assessment and treatment of communication difficulties.

Major trauma patients requiring speech and language therapy intervention would be managed by a member of the inpatient team. This team is responsible for all inpatients within BCHNHSFT regardless of diagnosis.

The staffing structure is as below:-

![Staffing Structure Diagram]

- Principal Speech and Language therapist (band 8a)
- Advanced Speech and Language therapists (band 7)
- Senior speech and language therapists (band 6)
- Therapy assistant
Referral to and on-going management of major trauma patients by the therapy teams are as per the following injury specific pathways:

**Acquired Brain Injury**

**Spinal Cord Injury**
Orthotics

The orthotic needs of major trauma patients at BCH are provided by Blatchford Clinical Services. They provide twice weekly input to inpatients and provide assessment and provision of appropriate orthotic devices.

Education

All school age children at BCH have access to education. This is provided by James Brindley School. Further information about the school can be at http://www.jamesbrindley.bham.sch.uk/

Children accessing education during their admission can be seen on the ward or at the onsite hospital school, which is equipped with a primary and secondary classroom. Education is provided by a specialist named teacher with skills specific to each ward.

Teachers are present at weekly neuro-rehabilitation meetings in order to engage with the MDT and support goal setting across all specialities.

Play Therapy

The Specialist Play Service consists of a team of Play Specialists, Youth Workers and Volunteers. They provide educational and recreational support for children, young people and their families throughout the Trust.

They offer a wide variety of play-orientated activities and information for patients and their families about their treatment.

The services work on a referral basis and supports patients and families throughout their stay in hospital.

Dietetics

The dietetics team provides a nutrition and dietetic service to all medical and surgical teams in the hospital. Daily work involves design, monitoring and teaching of individualised diet plans, including calculation of special formula feeds if needed.

Discharge Coordinator

The discharge coordinator is involved in all cases where it is identified that the discharge process may be complex or prolonged. The discharge coordinator attends the weekly neuro-rehabilitation meeting and relevant patient specific case discussions, to ascertain patient progress and update the MDT on issues or progress related to discharge.
Key Worker

Patients are allocated a named nurse on the ward at point of admission who will oversee their care throughout their hospital stay. Within therapy they are allocated a lead clinician at band 6 or above, to lead on the organisation and provision of the child’s therapy specific rehabilitation. Both of the above are clearly documented within the patient notes. Where possible the named nurse and lead therapist for each profession will attend the child’s MDT meetings.

Rehabilitation Prescription

All identified major trauma patients have a rehabilitation prescription completed within 72 hours of admission. This is a standard document used across all patients. Patients are identified daily via discussion with the bed managers in the Hospital Operations Centre to ensure all patients’ data is captured. A therapist appropriate to the specialty or the band 5 trauma coordinator will then visit the ward to review the medical notes of those children highlighted as potential major trauma patients. This allows these patients to be highlighted early in their stay, both to give maximal time to allow discharge planning to commence and also early completion of the appropriate paperwork.

BCH has a rehabilitation prescription document that is used for patients who have sustained a major trauma and whose rehabilitation requirements are not complex in nature. This allows for this document to be completed in a timely fashion and to be used as the child’s transfer document either to other services, outpatient therapy services and as a discharge summary. BCH has a further document that is used for patients whose rehabilitation requirements are more complex.

Rehabilitation for Traumatic Amputation

Rehabilitation of children who sustain a traumatic amputation will be via the musculoskeletal therapy teams. In addition this patient group have access to the specialist prosthetics service at West Midlands Rehabilitation Centre. This service provides outreach into BCH as required. The amputee service is led by Dr Jeff Lindsay, Consultant in Rehabilitation Medicine at the West Midlands Rehabilitation Centre.

Since becoming a major trauma centre we have not seen any traumatic amputations at BCH.

Analgesic management for this patient group would be via referral to the acute pain team. This team is made up of consultant anaesthetists and clinical nurse specialists who operate a 7 day service across the trust. There is no specific guideline for anaesthetic management of this group due to the rarity seen within the trust. Patients would be assessed and treated on a case by case basis.

Psychological support would be available for this patient group as per the standard referral system detailed within this document.
Facilities for Family/Carers

Families have access to a 60 bedded parent accommodation unit called Ronald McDonald House. This unit is located in close proximity to the hospital. Rooms are en-suite and have access to communal kitchens and day rooms. Parents can apply for a room depending on the child’s illness and length of stay.

On-site parent’s accommodation is also available within the BCH main hospital building. This unit is made up of 13 beds and again is allocated depending on child illness and length of stay. This unit also has en-suite rooms, communal kitchen and living space. If parents wish to remain at their child’s bedside, fold away beds are available in each bed space.

The wards are equipped with parent rooms with tea/ coffee making facilities, microwaves and fridges. These are accessible 24 hours per day to parents.

The hospital has a play centre which whilst providing for our hospital patients, also provides support through play for siblings and a variety of activities are offered. This allows siblings to access activities either independently to their sibling in hospital or alongside in specially tailored programs of activity that make use of both the inside and outside space available.

BCH is located within Birmingham city centre. Car parking is available to parents at a discounted rate during their stay at the hospital once the child has been an inpatient for 7 days or if the child requires an Intensive Care stay.

Information about public transport is available to all parents as this provides a quicker journey into the city as families may be a substantial distance from home.

Patient Information

BCH has a variety of patient information leaflets available to families specific to patient conditions. Many of these leaflets are available via the trust website or on the wards. The trust has a welcome booklet that is available to all families on admission outlining the facilities available at BCH. It also answers many frequently asked questions about a hospital admission.

The neuro-rehabilitation team has a specific patient information leaflet for their service which outlines the roles of the professionals who may be involved in their child’s care.

Referral Guidelines to Rehabilitation Services

Children sustaining major trauma who are admitted to either an adult MTC or local TU requiring rehabilitation can be referred to BCH for their on-going acute rehabilitation. There is an approved
network pathway in place to access this service. Patients will be admitted as a bed becomes available according to the needs of the child. Consultant approval will be required for all admissions so they child can be cared for by the appropriate medical team.

**Patient Transfer**

The majority of our patients will be admitted directly to BCH. The trust has a pathway for patients who require transfer into the trust which has been shared through our trauma network. The majority of patients requiring on-going rehabilitation remain at BCH for their inpatient stay, until they are able to access outpatient services from either their local community provider or as an outpatient at BCH. A small number of our patients access The Children’s Trust at Tadworth Court, through national commissioning. The latter is the only children’s specialist rehabilitation centre provision nationally and owing to its geographical location this is not always appropriate for our families even if the child meets the referral criteria.

The services available within the community vary depending on the child’s home address and the child will receive intervention depending on their need. There is a CCG agreement in place within the wider midlands region which enables an easier transition from the acute to community environment for a defined period of time.

There is not an agreed protocol to transfer patients to The Children’s Trust. As this falls within the realm of specialized commissioning, each case is presented on an individual basis.

**Network Care Closer to Home Policy**

Those patients that require care closer to home following admission will be arranged on a case by case basis. There is not a set protocol in place for this as it applies to a very small number of patients. We have seen an increase in numbers of patients being transferred over the last 3 years. Repatriation of patients is dependent on their individual needs and the availability of rehabilitation services locally. BCH recognise the importance of children being able to access the appropriate service but also locally, if able. To support this BCH is looking at a landscape mapping exercise to ensure accurate information of local therapy provision is available to support repatriation as able.

**Clinical Psychologist for Trauma Rehabilitation**

The psychology team at BCH allows access to services to improve the psychological well-being of the children and families served by the trust. The clinical lead is Gayle McKerracher, Consultant clinical Psychologist. Access to this service is on a referral basis via a standard referral form. This service is able to support both the child and their family during the inpatient stay or as an outpatient as required. The referrals are picked up by the duty psychologist if the child is an inpatient or if an outpatient they would be allocated based on the earliest available appointment.
24/7 Access to Psychiatric Advice

BCH specialist play, youth worker, learning disability nurses, paediatric psychology and liaison psychiatry services are all accessed through a single point of access in order to make BCH’s child and adolescent mental health service (CAMHS) services more streamlined and easier to access.

This access point provides:

- A single point of contact for primary care professionals when concerned about the mental health of a child /young person with contact available by phone/ fax or through a standard referral form available on the website.
- A team of clinicians who review and process referrals into CAMHS based on mental health risk using a stepped model of care for emergency urgent and routine referrals.
- An emergency assessment service for those most at risk from mental ill health
- A consultation service for referrers from 9am until 5pm, Monday to Friday (excluding Bank Holidays). Referrers will be offered advice and information regarding suitability of referrals.
- An information point regarding the nature of specialist child mental health services.

The BCH CAMHS service has its own designated website with further information:

https://www.lotsonyourmind.org.uk/professionals

The hospital also has access to a specialist unit based off site unit called Parkview. The therapy department at BCH provides the therapy input to this facility though a specialist CAMHS team within OT and through outreach from the Physiotherapy neurology team. This setup supports the maintenance of staff competency with this specialist group of patients and internal training sessions are completed though the therapies in-service training rota.

The BCH CAMHS service also provides for children as outpatients within Birmingham through the community CAMHS service.
Transfers

_Intra-hospital transfers_

Trauma is a team specialty and decisions on timing and order of surgery need to be made in consultation with other members of the trauma team, particularly the anaesthetist and critical care.

Transfer to, and resuscitation in, CT, theatre or later on in PICU should be performed as a team, with active input from the surgeons, anaesthetists and intensivists, all of whom have complementary skills in the early resuscitation of the multiply-injured patient.

Formal handover between team members following the SBAR format should be done at each opportunity – do not assume other team member’s knowledge of events. Ensure this is done when leaving each clinical area e.g. on leaving ED, in the operating theatre, and onto PICU or the ward etc.

On occasions, critical care will have insufficient staff or beds to allow continued resuscitation on PICU. In this situation, the senior clinicians will need to decide the safest environment to continue resuscitation: this may be in the Emergency Department, theatre or the theatre recovery area. This must not be allowed to compromise the care of the patient.

Ensure transfer is safe with all equipment and drugs needed (e.g., patient monitoring, Thomas bag, patient specific drugs, oxygen and suction). Lines and drains must be secured and all documentation complete. Handover to a lead specialist for ongoing care is vitally important. These patients will potentially be critically ill so transfer staffing should include:

- ED Nurse / ODP / PICU Tech Team nurse
- TTL and PICU Consultant
- Porter

Documentation to move with the patient from ED includes:

- A copy of the trauma chart
- Fluid prescription / drugs chart
- A copy of the ED notes
- Patients notes, or temporary folder
- Ambulance chart if brought in by ambulance
**Inter-hospital transfers**

For a paediatric patient(s) in a trauma unit (TU) or local emergency hospital (LEH) that requires paediatric MTC level of care for immediate intervention, there should be no delays to transfer. A principle of "call and send" will be used. The regional trauma desk will be the hub for communication via the KIDS office.

The TU / LEH will be responsible for ensuring that the paediatric patient(s) are safe to transfer. It will not be possible to ensure that all patients are completely stable as the intervention to achieve stability may also be the reason for the transfer.

As a basic principle, the TU / LEH should be satisfied that:

- The airway is safe for the duration of transfer or secured
- That life threatening chest injuries have been excluded or treated
- That appropriate haemorrhage control has been achieved
- That the cervical spine immobilisation is maintained.
- That an escort is provided who is clinically capable of dealing with the patient’s condition.
- That all relevant imaging is transferred electronically to the receiving MTC

The selected MTC is responsible for ensuring that the patient is received in an appropriate clinical area (as per discussion with BCH TTL and KIDS for paediatrics) and that the trauma team is alerted to the arrival of the patient.

BCH will:

- Be available to offer advice to the TU TTL if necessary or requested.
- Review the TU images on the Imaging Exchange Portal prior to patient arrival if possible.
- Notify relevant tertiary services as necessary.
- Assemble the trauma team

The Regional Trauma desk is responsible for coordinating the communication between MTC, TU and transporting ambulance provider. Specifically the RTD will:

- Take the call from the TU and note basic details of transfer
- Set up "conference call" with BCH TTL and KIDS, and monitor the call.
- Task appropriate vehicle to TU.
- Update MTC on departure of transport vehicle from TU and expected time of arrival
- Coordinate calls between vehicle and MTC TTL when advice or updated information needs to be passed.

Standards for service.

1. That from call to RTD to transfer commencing should be less than 30 minutes
2. That 90% patients are transferred to nearest MTC
3. That all patients are received in an MTC by a consultant led trauma team.

*A trauma unit should refer patients for hyper-acute transfer when the patient meets the criteria for needing immediate MTC level of care.*
**Pre transfer actions at TU**

1. Undertake full primary survey.
2. Secure airway if necessary
3. Radiological investigations as indicated
4. Decompress pneumothoraces or haemothoraces. Use transport type drains not under water seal.
5. Control haemorrhage
   5.1. Stop external bleeding
   5.2. Activate massive transfusion protocol if required
   5.3. If exsanguinating internal haemorrhage perform damage control laparotomy or definitive care
6. Apply pelvic binder if required
7. Splint femoral fractures with traction splint
   7.1. Immobilise all other fractures with splints or plaster.

Do not delay transfer to insert invasive monitoring, use non invasive methods.

**Escort**

If KIDS are not retrieving the paediatric patient, the appropriate escort should be determined by the TU TTL.

For intubated and ventilated patients this will normally be an anaesthetist or ITU doctor however there may be some centres that have advanced nurse practitioners providing this level of care. For non intubated patients the escort must be capable of dealing with the anticipated complications on route.

The ambulance service will not routinely return escorts to the referring TU. The MTC will arrange taxi transfers to return the escort and their equipment.

**Ambulance Transport**

West Midlands Ambulance Service (WMAS) will be the provider for most hyper acute transfers, (although for paediatric patients, KIDS may be the secondary provider). WMAS will provide a double manned ambulance from the emergency fleet. It will be equipped with a defibrillator and portable ventilator. The crew may not always contain a paramedic, if there is no paramedic the senior clinician on board will be an emergency medical technician (EMT). When a doctor escort is being provided by the TU it is not necessary to insist on a paramedic crew as the EMT will be more than capable of providing the support required.

*Further details can be found in appendix E, and in the network trauma handbook*
Appendix A – Pre-hospital Triage Tool

1. Measure vital signs
   - Respiratory Rate < 10 or > 29 /min
   - Systolic Blood Pressure < 90 mmHg (2 measurements)
   - Glasgow Coma Scale < 14

2. Assess anatomy of injury
   - Penetrating to neck / chest / abdomen
   - Suspected fractured pelvis
   - 2 or more long bone fractures
   - Crushed / de-gloved / mangled extremity
   - Amputation proximal to wrist / ankle
   - Open or depressed skull fracture
   - Sensory or motor deficit (new onset)

3. Assess mechanism of injury
   - Falls:
     - Fall > 6 m / 2 storeys in adult
     - Fall > 3 m / 2 times height in child
   - Motor vehicle
     - Ejection (partial or complete)
     - Intrusion > 30 cm at patient site
     - Death in same compartment
   - Motorcycle crash > 20 mph
   - Pedestrian / bicyclist versus motor vehicle thrown / run over / with significant impact
   - Entrapment

4. Special conditions
   - Age > 55
   - Children < 8 years old
   - Pregnancy > 20 weeks
   - Renal dialysis patients
   - Bleeding disorders / anticoagulants
   - Time critical extremity injury
   - Burns: circumferential or 20% (BSA)

   If any of the factors are present:
   - Activate a Major Trauma Alert
   - Transport to Major Trauma Centre
   - If all factors are absent, proceed to stage 3.

   If any of the factors are present contact:
   - EOC Trauma Desk for advice
   - If all factors are absent, proceed to stage 4.

Transport to nearest trauma unit.
## A.T.M.I.S.T Handover Tool

<table>
<thead>
<tr>
<th><strong>Age</strong></th>
<th>Age and sex of casualty (demographic).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td>Estimated Time of Arrival and the time of incident.</td>
</tr>
</tbody>
</table>
| **M.O.I** | Mechanism of incident. This should include:  
- The gross mechanism of injury (e.g. motor vehicle crash or stab wound to the chest) and,  
- Details of other factors known to be associated with major injuries e.g. entrapment, vehicle rollover, occupant ejected from vehicle. |
| **Injuries** | Seen or suspected. |
| **Signs** |  
- Vital signs including heart rate, blood pressure, respiratory rate, oxygen saturation and Glasgow Coma Score.  
- An indication as to whether the physiological state of the patient has improved or deteriorated since first seen. |
| **Treatment** | Treatment given. |
Appendix C – Alert Log

Date ____________________  Road □
Time ____________________  Air □

NON-TRAUMA ALERT

Age ______________
Time of arrival ____________ (estimated)

History

Prehospital findings

Signs  RR  ______________
SpO₂  ______________
HR  ______________
BP  ______________
GCS  ______________
Other  ______________

Treatment so far

2222 call?  Yes □ (time): ______ No □

TRAUMA ALERT

Age ____________
Time of arrival ____________ (estimated)

Mechanism

Injuries

Signs  RR  ______________
SpO₂  ______________
HR  ______________
BP  ______________
GCS  ______________
Other  ______________

Treatment so far

If ED Consultant not resident, inform them immediately (2222 to switchboard). ED Consultant may decide other specialties are required in addition to standard team, based on the alert info

Time ED Consultant informed ____________

Trauma Team call? Yes □ (time): ______ No □

Other specialties informed:
Team ______________ (time): ______
Team ______________ (time): ______

Update Information (time):
Appendix D – Flowchart for trauma alerts at BCH

Patient self presents with major trauma

WMAS Regional Trauma Desk

Alert Phone in BCH ED Resus

Details of Major Trauma Pt

Call ED consultant via 2222 immediately (24/7)

ED consultant in BCH

ED consultant off site

ED consultant may decide other specialties are required in addition to the standard team, based on the alert information

Call switchboard on 2222 and put out a trauma call, plus any other specialties required

Bleep 55122 and liaise with theatres re situation.

Consider the need for team 1 to be recalled back from home if 0000-0800

Patient stabilised in ED

CT scan

Ward, Theatre or PICU

KIDS Retrieval Team for secondary transfers
Appendix E - Midlands Trauma Networks Transfer Policy - January 2012

This policy relates to the transfer of Trauma patients, either as emergency or urgent transfers of critically ill patients (level 2 and 3), or non-urgent transfers for enhanced care or the repatriation of patients for continued care nearer to home.

Primary Transfers – from scene directly to appropriate level of care facility, usually to MTC or TU. Communication to the receiving hospital will be through the Regional Trauma Desk.

Secondary transfer – from existing care provider to enhanced, specialised or step-down care closer to home / rehabilitation care provider. E.g. TU to MTC, MTC to Specialised Rehabilitation, MTC back to TU, Specialised Rehabilitation onto ‘continued care closer to home’.

*No critically ill patient will be transferred without first being adequately resuscitated and stabilised.*

All relevant parties, including the relatives, must be informed that the transfer is taking place.

For secondary transfers, the patient is to be transferred in an appropriately equipped vehicle and accompanied by skilled and competent staff (Medical staff, Nurse Consultant, operating department practitioner, paramedic or Accident and Emergency nurse). All accompanying personnel should be familiar with the patient’s clinical condition, transfer procedure and associated equipment.

A critically ill patient should be transferred in line with the Midlands Critical Care Networks Transfer policy. 2 Midlands Trauma Networks – Transfer Policy *This policy should be used in conjunction with the Midlands Critical Care Networks Transfer Policy May 2011.* Longer and time critical journeys may require air transport. The decision to move a patient by air should take into consideration all the difficulties currently associated with this mode of transport.

**Transfer Checklist**

*Equipment:*

There should be a dedicated set of equipment available for transfer which should be stored near or on the critical care unit or Emergency Department. The staff accompanying the patient are responsible for checking the correct functioning of this equipment prior to departure. In particular, there should be sufficient battery power in any monitors and infusion pumps. Back-up equipment should be taken on longer journeys. A basic box of emergency drugs should also be available. The accompanying doctor should decide what other drugs and fluids, e.g. sedation and inotropes, should be taken in addition

*Preparation for Transfer:*

Meticulous preparation, resuscitation and stabilisation of the patient before transfer is the key to avoiding complications during the journey. The transfer personnel should fully familiarise themselves with the patient’s history, present condition and treatment up to the point of departure. Prior to departure they should make a full clinical assessment to ensure that the patient is ready for transfer.
In addition, the accompanying personnel should ensure that they are adequately prepared for the journey. Suitable clothing should be worn, refreshments must be available for longer journeys, mobile phones and money should be taken in case of emergency. They should also know the precise destination of the patient and have a named contact in the receiving unit. The team must contact the receiving hospital as they set out for confirmation that a bed is still available at the receiving unit. For enhanced care (TU to MTC) this should be communicated through the Trauma Desk.

**Monitoring during Transfer:**

During transfer, the standard of monitoring should reflect the patient’s condition and for critically ill patients this should remain as high as in the Resuscitation room or Critical Care Unit. End tidal carbon dioxide monitoring should be used with all ventilated patients.

**Paediatric Patients:**

The trauma desk should ring KIDS 0300 200 1100 to arrange any paediatric transfers. The normal receiving area will be the ED for primary transfers and for children secondary transfers will be to the PICU.

**Documentation:**

The network transfer form should always be used to record details of ALL transfers.
### BBCCCN/CNet/NWMCCN Transfer Form

#### Patient Details
- **Name:**
- **DOB:**
- **NHS Number:**
- **Postcode:**

#### Staff Arranging Transfer
- **Referring Doctor:**
- **Name:**
- **Specialty:**
- **Grade:**
- **Receiving Hospital:**
- **ITU Clinician:**
- **Grade:**
- **Specialist Clinician:**
- **Specialty:**

#### Escorting Personnel
- **Escort 1: Doctor / Nurse / ODP / Other:**
  - **Name:**
  - **GMC/NMC:**
  - **Grade:**
  - **Signed:**
- **Escort 2: Doctor / Nurse / ODP / Other:**
  - **Name:**
  - **GMC/NMC:**
  - **Grade:**
  - **Signed:**

#### Clinical Diagnosis/Patient History

#### Ambulance Details
- **Time ambulance booked:**
- **Time patient ready for transfer:**
- **Time ambulance arrived:**
- **Time of departure:**
- **Time of arrival at receiving unit:**

#### Transfer Details
- **Transferring Hospital:**
- **Transferring from:**
- **ICU / HDU / A&E / Theatre / Ward / Other:**
- **Specialty:**
- **Cardiac / Renal / Neuro / Resp / Liver / Other:**
- **Recipient Hospital:**
- **Recipient Unit:**
- **ICU / HDU / TH / WD / Other:**
- **Reason:**
- **Tertiary referral / No ICU bed / Repeat / Other:**
- **Date of Transfer:**
- **Time:**

#### Monitors
- **ECG:**
- **ETCO2:**
- **IBP:**
- **CVP:**
- **NBP:**
- **Other:**

#### Spinal Immobilisation?
- **Yes:**
- **No:**

#### Lines and Catheters
- **Site**
- **Insertion date**
- **Arterial Line:**
- **CVP:**
- **Cannula 1:**
- **2:**
- **NGT:**
- **Urinary Cath:**
- **Chest Drain:**
- **Other:**

#### Airway & Ventilation
- **Mechanical**
- **Spont**
- **Vent Mode:**
- **PEEP:**
- **ETT size:**
- **Tidal Vol:**
- **FiO2:**
- **Trachy:**
- **Size:**
- **Peak Press:**
- **Resp Rate:**

#### Start Time
- **Drugs & Fluids (ml/hr):**
- **Pupil L size/reaction:**
- **Pupil R size/reaction:**
- **BP = X:**
- **Pulse = X:**
- **BP = AV:**
- **Sao2 =**
- **ETCO2:**
- **CVP**

---

*White copy: File in patient notes, Blue copy: Post to Network Office, Yellow copy: File on receiving unit*
# KIDS Clinical Guideline:
## Checklist for transfer of children with neurosurgical emergency

<table>
<thead>
<tr>
<th>Checklist:</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Use this checklist to assist in ensuring adequate therapy and monitoring are in place prior to and during transfer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Identify and consult:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify acute neurosurgical emergency:</td>
</tr>
<tr>
<td>(e.g. Mode of injury or history, focal neurological deficits, reduced GCS, dilated/unequal pupils, bradycardia &amp; hypertension)</td>
</tr>
<tr>
<td>Urgent conference call with KIDS consultant and Neurosurgeon</td>
</tr>
<tr>
<td>If time-critical, likely to require primary transfer by referring team</td>
</tr>
<tr>
<td>If immediately life-threatening, may require primary transfer to neurosurgery theatre (theatre 1 at BCH) or local neurosurgical</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Airway and Breathing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral ETT, firmly taped, T2 on CXR</td>
</tr>
<tr>
<td>Cervical spine immobilisation if trauma</td>
</tr>
<tr>
<td>PaCO₂ 4.5-5.3 kPa</td>
</tr>
<tr>
<td>Orogastric tube on free drainage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Circulation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 peripheral iv lines</td>
</tr>
<tr>
<td>Request crossmatch (Aim Hb&gt;10gms)</td>
</tr>
<tr>
<td>Aim for normovolemia</td>
</tr>
<tr>
<td>Avoid hypotension</td>
</tr>
<tr>
<td>0.9% Saline maintenance +dextrose if hypoglycaemia</td>
</tr>
<tr>
<td>Volume expansion 0.9% Saline 10ml/kg boluses</td>
</tr>
<tr>
<td>Consider noradrenaline infusion to maintain BP (see KIDS drug calculator)</td>
</tr>
<tr>
<td>CVL and arterial line if sufficient time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disability and other management:</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 mins Neuro Obs</td>
</tr>
<tr>
<td>CT scan (discuss with Neurosurgeon/KIDS)</td>
</tr>
<tr>
<td>Normothermia (36-37°C)</td>
</tr>
<tr>
<td>Phenytoin 18 mg/kg over 20 mins if seizures</td>
</tr>
<tr>
<td>Maintain plasma Na &gt;140mmol</td>
</tr>
<tr>
<td>Hyperventilation therapy (discuss with Neurosurgeon/KIDS see KIDS drug calculator)</td>
</tr>
<tr>
<td>Secondary survey if trauma</td>
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</tbody>
</table>

## Preparing for transfer: |
<table>
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<tbody>
<tr>
<td>Adequate sedation and analgesia with morphine/midazolam infusion – see KIDS drug calculator for dosing</td>
</tr>
<tr>
<td>Muscle relaxant infusion – see KIDS drug calculator for dosing</td>
</tr>
<tr>
<td>Urinary catheterisation – especially if mannitol used</td>
</tr>
<tr>
<td>Strategy for managing raised ICP:</td>
</tr>
<tr>
<td>(discuss with Neurosurgeon/KIDS regarding sedation, pCO₂, ABP target for cerebral perfusion, hyperosmolar therapy)</td>
</tr>
<tr>
<td>Secure child to trolley (not on spinal board)</td>
</tr>
<tr>
<td>Connect long extension to allow additional drug and fluid administration en route</td>
</tr>
<tr>
<td>Sufficient portable oxygen for whole journey ≥2</td>
</tr>
<tr>
<td>Sufficient battery life on monitor and infusion pumps</td>
</tr>
<tr>
<td>Use ambulance oxygen gas and electricity supply where possible</td>
</tr>
<tr>
<td>Transfer documentation, radiology, blood results</td>
</tr>
<tr>
<td>Regular observations (at least once every 15mins) – including pupillary reactions, heart rate, blood pressure ETCO₂, SpO₂</td>
</tr>
<tr>
<td>Seat belts at all times</td>
</tr>
<tr>
<td>Travel safe – Lights/Sirens only when necessary to manage traffic congestion or unstable patient or time critical</td>
</tr>
</tbody>
</table>

## References: |
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>APLS 4th edition 2004</td>
</tr>
<tr>
<td>Joint statement from the Society of British Neurological Surgeons (SBNS) and the Royal College of Anaesthetists (RCOA) regarding the provision of emergency Paediatric Neurosurgical Services (document)</td>
</tr>
</tbody>
</table>
Appendix H – Paediatric Normal Values and Formulas

**Normal Values**

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Respiratory Rate</th>
<th>Heart Rate</th>
<th>Systolic B.P (50th centile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>30 - 40</td>
<td>110 - 160</td>
<td>80 - 90</td>
</tr>
<tr>
<td>1 – 2</td>
<td>25 - 35</td>
<td>100 - 150</td>
<td>85 - 95</td>
</tr>
<tr>
<td>2 – 5</td>
<td>25 - 30</td>
<td>95 - 140</td>
<td>85 - 100</td>
</tr>
<tr>
<td>5 – 12</td>
<td>20 - 25</td>
<td>80 - 120</td>
<td>90 - 110</td>
</tr>
<tr>
<td>&gt; 12</td>
<td>15 - 20</td>
<td>60 - 100</td>
<td>100 - 120</td>
</tr>
</tbody>
</table>

**Calculating Weights**

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Weight Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>Weight (in kg) = (0.5 x age in months) + 4</td>
</tr>
<tr>
<td>1 – 5</td>
<td>Weight (in kg) = (2 x age in years) + 8</td>
</tr>
<tr>
<td>6 – 12</td>
<td>Weight (in kg) = (3 x age in years) + 7</td>
</tr>
</tbody>
</table>

**Emergency Treatment Calculations (WETFAG)**

<table>
<thead>
<tr>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>T</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>G</td>
</tr>
</tbody>
</table>
Appendix I - Injury Severity Score & Abbreviated Injury Scale

Major Trauma is defined as injuries producing an Injury Severity Score (ISS) ≥16

The ISS is based on the Abbreviated Injury Scale (AIS).

Abbreviated Injury Scale (AIS)

The AIS is taken from a catalogue listing types of injury and describes the severity of injury to one defined body region:

1. Minor
2. Moderate
3. Serious
4. Severe
5. Critical
6. Maximal (lethal injury)

Injury Severity Score (ISS)

To calculate an ISS for an injured person, the body is divided into six regions. These body regions are:

1. Head and neck including cervical spine
2. Face, including facial skeleton
3. Thorax, thoracic spine and diaphragm
4. Abdomen, viscera and lumbar spine
5. Extremities including pelvic skeleton
6. External soft tissue

An ISS is then calculated according to ISS = A² + B² + C² where A, B, C are the AIS scores of the three most injured body regions.

The ISS takes scores from 0 to 75 (i.e. AIS scores of 5 for each category). If any of the three scores is a 6, the score is automatically set at 75. Since a score of 6 ("un survivable") indicates the futility of further medical care in preserving life.

Example:

<table>
<thead>
<tr>
<th>Region</th>
<th>Injury</th>
<th>AIS</th>
<th>AIS²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head/Neck</td>
<td>Single cerebral contusion</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Face</td>
<td>No injury</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chest</td>
<td>Flail chest</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Abdomen</td>
<td>1. Liver laceration</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>2. Completely shattered spleen</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Extremity</td>
<td>Fractured femur</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>External</td>
<td>No injury</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Injury Severity Score (ISS) = 50