All patients being admitted after assessment by the trauma team are to be admitted to the primary care of the Trauma Surgeon on call. There are no exceptions to this.

Subspecialty consultants may also be a secondary admitting doctor, but primary care should remain with the Trauma Surgeon. If the patient has single system injury (e.g. head, orthopaedic), primary care may be transferred to the subspecialty consultant when the tertiary survey has been completed and both the subspecialty consultant and Trauma Surgeon have agreed. Most often transfer will occur between 24 and 48 hours following admission to hospital. Once this occurs, a note must be made in the chart to confirm this and the ward clerk can then change the primary doctor in the hospital computers.

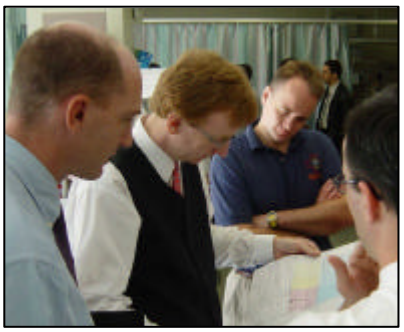
These requirements recognise that even injuries which appear uncomplicated and single-system may be otherwise, and that continuity of care and repeat examination along with tertiary survey are vital to consistent and better trauma patient care. Subspecialty consultants are able to care for patients very well, however, the trauma surgery team is able to offer a unique and general approach to the patient permitting improved patient care.

Handovers between registrars and teams must be thorough to ensure optimal care.

The team of the admitting Trauma Surgeon is responsible for the daily care and examination of the trauma patient. Any investigations must be viewed and documented in the patient progress notes before the end of the day. Responsibility for this may be delegated by the registrar of the admitting surgeon.

If the patient's clinical condition is unstable or rapidly evolving then the follow-up must change to keep up with this. All significant changes and results must be communicated to the admitting surgeon by the team registrar involved.

If a patient's primary care is to be transferred to a subspecialty consultant then the team of that subspecialty consultant assumes primary care and the Trauma Surgeon's team can "sign-off" on the patient. If however a problem arises or there is a question best suited to the trauma surgery team, then the team that admitted and cared initially for that patient is to be recontacted. Any new problems arising are NOT to be deferred to a new trauma surgical team or the team on call unless outside of normal hours or if the original Trauma Surgeon is on leave. This ensures adequate continuity of patient care. Admitted trauma patients are usually followed by the trauma surgery team for at least 48 hours from admission. Patients with multiple system injuries and those in the ICU should be followed longer to ensure all issues are addressed and complete patient care is achieved.



TERTIARY SURVEY

The tertiary survey is a complete head to toe examination of the patient and review of any investigations or imaging from the time of the patient's admission. This occurs following completion of most aspects of definitive care and should occur within 24 hours of patient admission. It is to be carried out by the registrar of the admitting Trauma Surgeon except when the patient is admitted to one of the critical care areas (ICU, CCU) in which case the tertiary survey is undertaken by the Trauma Fellow.

Any further studies or investigations mandated by the tertiary survey should be documented in the progress notes and the results similarly documented when completed.

At Liverpool Hospital it has been previously shown that unrecognised injuries are found in up to 65% of patients and these are clinically significant in 15%.[1] These injuries, although unlikely to result in mortality, can often lead to significant functional morbidity if left untreated. It is for these reasons that all trauma patients undergo a tertiary survey following admission.

It is important to remember that a tertiary survey in the first 24 hours can still miss injuries. Up to 40% of injuries are diagnosed in the two weeks following completion of the tertiary survey. Vigilance and careful re-examination is required to minimise the impact of these injuries and to effect treatment as early as possible.

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Clinical Pathways help to standardise care and ensure efficient and optimal patient care in certain common traumatic injuries.

These guidelines apply to all trauma patients who fit the criteria for admission into the clinical pathway. The clinical pathways have been based on extensive literature review[1,2,3,4,5,6], and have been designed to ensure common necessary elements of care are attended. They do not rule out need for clinical judgement, and are utilised only as a suggestion guide.

The five categories of clinical pathways are: -

Severe head injury – any patient with a Glasgow Coma Score of 8 or less on arrival to emergency or during resuscitation, unrelated to drugs or alcohol alone.

Fractured ribs – fracture to 1 or more ribs based on clinical or radiological findings (includes fractured sternum).

Fractured pelvis – any break in the structural continuity of the pelvic ring and / or the acetabulum.

Fractured femur – any break in the structural continuity of the femoral shaft.

Blunt abdominal trauma – blunt injury to any solid organ, hollow viscus or other abdominal structure.

Patients are to be enrolled in the appropriate pathway in Emergency by the surgical registrar, or as soon as the patient is recognised to have injuries consistent with admission criteria of the clinical pathway.

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THROMBOEMBOLISM AND TETANUS PROPHYLAXIS

PROBLEM

Incidence of proximal DVT without prophylaxis is 20%. 0.5 – 17% of patients with DVT's will develop a fatal pulmonary embolus.

Adequate prophylaxis reduces the incidence of DVT to 10% and the incidence of fatal pulmonary embolus to < 0.1%.

No prophylactic regime is 100% effective in preventing thromboembolic events.

RISK STRATIFICATION

Highest	spinal cord injuries
	spinal fractures
	lower extremity fractures*
	pelvic fractures*
	venous / arterial injuries*
	head injury*.

* The EAST (Eastern Association for the Surgery of Trauma) Group found no evidence of these specific groups of patients being high-risk, but most papers place these patients in the high-risk group.

High	Age > 60, major trauma patients.
Moderate	40 - 60 year old patients with trauma.
Low	Age < 40, minor injuries, patients likely to be mobilised early.

PROPHYLAXIS

High risk patients:
- Low molecular weight heparin (LMWH) enoxaparin.
- 30mg bd commencing within 12-36 hours of injury (or consider 40mg once daily in patients who are at increased risk of bleeding complications).*
- Elastic stocking(ES) / Intermittent pneumatic compressor (IPC) as soon as possible.
- No evidence that low dose unfractionated heparin is effective.

Moderate risk patients:
- Enoxaparin 30mg bd or heparin 5000 units s/c bd.*
- IPC or ES.

Low risk patients:
- Nil heparin or LMWH.

** 40mg once daily is used in most of Australasia and much of Europe.*

DELAY LMWH AND HEPARIN IN PATIENTS WITH:

- Intracerebral haemorrhage.
- Incomplete spinal cord injury with haematoma.
- Active bleeding.
- Coagulopathy
  [Liaise with primary team as to when it is safe to use LMWH or unfractionated heparin in these patients].

AVOID: ES + IPC in patients with peripheral vascular insufficiency or known DVT.

CAVAL FILTER

Consider prophylactic insertion if you are unable to anticoagulate after 36 hrs and patient has one or more of the following:

- Closed head injury.
- Incomplete spinal injury.
- Complex pelvic fracture.
- Long bone fractures.

Also consider use in patients with:

- Recurrent PE despite adequate anticoagulant.
- Proximal DVT with contraindication to anticoagulant.
- Proximal DVT with active bleeding.
- Failed anticoagulation.

TETANUS PROPHYLAXIS

ADULTS

TIME SINCE LAST TETANUS VACCINE	TYPE OF WOUND	ADT	TIG
< 5 years	all	-	-
5 - 10 years	clean minor wounds	-	-
5 – 10 years	all other wounds	Y	N
> 10 years	all wounds	Y	
Unknown or less than full series of 3 vaccines.			
	clean	Y	-
	all other	Y	Y

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REHABILITATION

Return of normal function to a patient following injury remains the goal of an optimally functioning trauma system. Rehabilitation is often thought of as a final step in care of injured patients yet it should really be considered as part of a continuum of care. In the acute phase of trauma patient care, rehabilitation is often a minor focus directed primarily towards preventing complications that may impair or inhibit return to normal day-to-day functioning. Once the risk to life has lessened, rehabilitation takes on an ever increasing and important role.

Early rehabilitation includes prevention or lessening of:

- Pressure area necrosis or skin breakdown.
- Muscle contractures (especially hands, arms and lower legs).
- Muscle atrophy from disuse.
- Inadequate nutrition.
- Thromboembolic complications.
- Delirium (especially in the elderly).

The potential for long-term impact of injury is most significant when injury affects the brain, spinal cord and extremities[1] and is less dependent on simple severity of overall injury. Early attention to aspects of care which decrease morbidity to each of these systems and subsequent early involvement of rehabilitation specialists are the best way of assuring an optimal outcome[2].

When to call the rehabilitation teams:

- When the patient requires in-hospital rehabilitation before discharge.
- To obtain consultation advice on management options for complicated patients requiring acute care and rehabilitation.

Liverpool Hospital has separate general rehabilitation and brain injury rehabilitation consultation services staffed by both specialists and registrars. These serve the inpatient population and have many links to the community that facilitate transition of the injured patient towards independent living. Additionally, Liverpool Hospital has an on-campus but separate unit for head injured patients, the Liverpool Hospital Brain Injury Rehabilitation Unit (BIRU).

How to contact the rehabilitation teams:

- Page the registrar directly for inpatient referral:
  General rehabilitation and aged care: pager 25233
  Brain injury unit: pager 25344.
  or
- Contact the general rehabilitation and aged care intake officer directly on extension 84762.
- Contact the brain injury unit directly on extension 85495.

There are three subspecialty populations of injured patients that are not kept at Liverpool beyond the early phase of care and these include:

- Spinal cord injury.
- Severe paediatric injury.
- Severe burn injury.

The immediate operative needs of these patients can be taken care of at Liverpool Hospital but these groups of patients require highly specialised units with specialised paramedical support teams for rehabilitation. These are located at other sites in greater metropolitan Sydney.

Spinal	**Royal North Shore Hospital and Prince of Wales Hospital.**
Paediatric	**Sydney Children's Hospital, Randwick and Children's Hospital, Westmead.**
Burns	**Royal North Shore Hospital, Concord Hospital and Children's Hospital, Westmead.** (To contact Burns services, please see page 297).

LIVERPOOL HOSPITAL BRAIN INJURY REHABILITATION UNIT (BIRU)

The beginnings of this highly specialised unit were at Lidcombe Hospital in the mid 1970's. The unit as part of the Liverpool Hospital campus moved to its new facility in 1995[3]. Its mission is to provide assessment, rehabilitation and a community support service for adults with traumatic brain injuries and their families. In addition they strive to educate, advocate and conduct research all of which is ultimately directed at minimising patient dependency and maximising function.

The BIRU has five service components. These are:

- 16 bed inpatient unit.
- 4 bed transitional living unit (TLU).
- Work assessment unit (WAU).
- Community outreach service.
- 4 bed respite and short-term accommodation service (Camden Respite House).

The inpatient ward and community service are co-located in one building on the grounds of Liverpool Hospital. The TLU is a modified house, less than a kilometer away from the hospital in a residential street. The WAU is located in a light industrial area close to the hospital and the respite house is a modified house a half-hour drive from Liverpool Hospital.

The support services available through the BIRU include:

- Medical management and specialised nursing staff.
- Physiotherapy, occupational therapy, speech therapy.
- Neuropsychology, clinical psychology.
- Recreation officer and social work.
- Individual and group-based living skills programs.
- Structured family program including relatives and carers groups.
- Recreational assessment for leisure activities, vocational assessment and retraining.
- Transitional living service, respite and short-term accommodation.
- Long-term case management, community development.
- Behavioural management, sexuality assessments and suicide intervention.
- Research, education, training and consultation.

REHABILITATION OF THE ELDERLY

Injury is less well-tolerated with increasing age. An elderly patient with significant injury is less likely to return to his / her previous level of functioning[4] however, independent living is most often still possible[5]. These patients are at high risk for in-hospital complications such as falls, pressure sores and skin breakdown as well as delirium. It is especially important with elderly patients that early assessment takes place by the rehabilitation and aged care team. Elderly patients often require extensive arrangements for out of hospital support and, if returning home, assessment of the home environment is required to ensure patient safety on discharge. Although all of the specific changes required are beyond the scope of this text, it is important that the correct team of carers is assembled to both assess and plan the patient's

discharge. It is best if the established rehabilitation and aged care team coordinates this aspect of care with their expert multidisciplinary team.

Liverpool Hospital has good rehabilitation services, and access to the Brain Injury Rehabilitation Unit. Early involvement of the rehabilitation and aged care team or brain injury team is important as is early attention to patient care details that can significantly impact patient morbidity during later phases of care.

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Thank you to Drs David Conforti and Adeline Hodgkinson for their assistance in reviewing this chapter.

TRAUMA ANAESTHESIA

Anaesthesia is an integral component of the surgical management of trauma patients. Anaesthetists are familiar with the principles of EMST and resuscitation; many have an active interest in the subspecialty of Trauma Anaesthesia. Early communication with and involvement of the Anaesthesia service facilitates early and appropriate anaesthesia care. Because anaesthetists commonly coordinate competing demands for operating time, clear information about the patient's condition and urgency priority classification are essential. Use the "MIST" mnemonic to transmit information to the anaesthetist.

AIRWAY MANAGEMENT

The trauma patient can present with particularly difficult airway problems. Frequently, rapid airway control is required to protect the airway from blood and gastric contents, and to ensure adequate ventilation. Difficult intubation may be anticipated in the following circumstances:

- Airway injury.
- Head and neck injuries.
- Obesity.
- "Bull neck".
- Reduced mouth opening / prominent teeth.
- Underslung jaw.

Although the majority of emergency intubations can be safely performed with a rapid sequence induction (RSI) of anaesthesia and in-line cervical spine stabilisation, anaesthetists contribute other advanced airway techniques and experience with:

- Fiber-optic intubation.
- Specialised laryngoscopes.
- Intubation aids (bougies, LMA introducer).
- Alternative airways (double lumen tubes).

Inadequate anaesthesia or analgesia during intubation can result in adverse haemodynamic responses, especially in the patient with a closed head injury.

If a difficult airway is anticipated based on pre-hospital information, contact the duty anaesthetist for immediate assistance in the resuscitation room.

INTRA-OPERATIVE RESUSCITATION

During operative treatment, resuscitation by the Anaesthetist continues and involves repeated assessment and reassessment of Airway, Breathing and Circulation. Anaesthetic requirements are highly dynamic and the vigilant anaesthetist must be alert for emerging or covert injuries. This is especially relevant when operative treatment is initiated before completion of the primary or secondary surveys. Of particular importance is the prevention of secondary neurological injury by ensuring adequate cerebral perfusion, and reducing cerebral metabolic requirements with anaesthesia. Invasive and non-invasive monitoring of patient physiology provides breath-to-breath and beat-to-beat information about the patient's condition as well as laboratory investigations. The management of pre-existing diseases, such as diabetes, COPD, and ischaemic heart disease, further complicate intra-operative priorities.

Pharmacological control is achieved through balanced selection of anaesthetic techniques:

- General anaesthesia (inhaled volatile; intravenous drugs).
- Local anaesthesia (neuro-axial, major plexus, nerve, field and infiltration blocks).
- Sedation.

Special care is required when sedation is administered to trauma patients, especially outside anaesthesia locations or critical care areas with patient monitoring. Altered pharmacological responses are common in trauma patients due to abnormal pharmacokinetics, changed drug

sensitivity or drug interactions. Unexpected responses to sedation can include loss of consciousness and cardio-respiratory arrest. Anaesthesia also involves careful administration of potent haemodynamic agents to control perfusion. These include pressor agents such as adrenaline, noradrenaline and metaraminol.

These agents are rarely indicated in the acute management of the hypotensive trauma patient. If the patient is hypotensive find and control the source of haemorrhage!

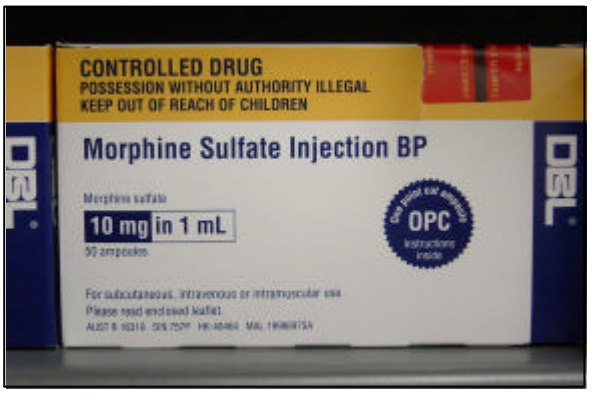
Physiological control involves the restoration or preservation of the body's homeostatic mechanisms. Seriously injured patients may have overwhelming disturbances which can interfere with surgical management. The multi-trauma patient is more likely to die from a triad of:

- coagulopathy
- hypothermia
- metabolic acidosis

than a failure to complete operative repairs. The anaesthetist has a primary role in treating and monitoring these complications during surgery. However, if the patient is to survive, the operation may need to be foreshortened so that transfer to the ICU can facilitate warming and correction of hypothermia and acidosis. A decision to limit surgery to "damage control" should be made early and should not wait for the patient to reach threshold values for core temperature, acidosis or transfusion volume. "Damage control surgery" refers to the principle that the first 'damage control' procedure aims to control haemorrhage, prevent contamination and to protect the patient from further injury. Once metabolic failure is controlled, definitive surgery can proceed. Clear communication and planning is required between surgeon, anaesthetist and intensivist to accomplish smooth transfers of care and appropriately timed surgery.

PAIN MANAGEMENT

Early initiation of pain management is essential to attenuate the stress response to trauma. Acute pain is ideally managed with multi-modal therapies including opioid agonists, anti-prostaglandins, and neural blockade. Effective acute pain management can reduce the risk of subsequent chronic pain syndromes.



SECTION 6

Patients will often be manged post-operatively with narcotic intravenous patient-controlled analgesia (PCA). Consider the use of thoracic epidurals in select patients to further optimise pain management, mobility and pulmonary toilet. Discuss these options with the treating anaesthetist, intensivist and acute pain service team.