NSW HEALTH

# Selected Specialty and Statewide Service Plans

**Number Six**

# NSW Trauma Services

**December 2009**

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# Abbreviations

| | |
|---|---|
| AHS | Area Health Service/s |
| AIS | Abbreviated Injury Score |
| AMRS | Aeromedical and Medical Retrieval Services |
| ASNSW | Ambulance Service of NSW |
| ESRG | Enhanced Service Related Group |
| ISS | Injury Severity Score |
| ITIM | Institute of Trauma and Injury Management |
| MTS | Major Trauma Service |
| NETS | Newborn and paediatric Emergency Transport Service |
| NRTAC | National Road Trauma Advisory Council |
| SBIS | Severe Burn Injury Service |
| SSCIS | State Spinal Cord Injury Service |
| RACS | Royal Australasian College of Surgeons |
| RLTC | Rapid Launch Trauma Coordinator |
| RTS | Regional Trauma Service |
| TNC | Trauma Nurse Coordinator |

# Executive summary

In Australia, injury remains a leading cause of death, illness, and disability.[1] While injury is generally associated with the younger age groups, actual death rates from trauma among the older population are proportionally greater than in younger age groups. Injury represents the major proportion of overall mortality and disability across all age groups.

The optimal management of the moderate or major trauma patient utilises significant health resources, particularly in terms of clinical infrastructure and expertise. Nationwide, it is estimated that approximately $3.4 billion (or 6% of total allocated expenditure) was spent on injuries in 2004/05.[2] In NSW, the total cost of direct health-system cost due to injuries has been estimated to be around $1.16 billion per year.[3]

Trauma Systems are developed to facilitate transfer and treatment of the injured patient at the appropriate hospital, resulting in optimal care for all trauma patients. The goals of a trauma care system are:

To decrease the incidence and severity of trauma through injury prevention;

To ensure optimal, equitable and accessible care for all persons sustaining trauma across the spectrum, from injury to rehabilitation; and

To promote quality and performance improvement of trauma care throughout the system.

Ongoing discussion and debate amongst trauma clinicians as to the most appropriate configuration for the adult trauma services in NSW has occurred for over a decade, and prompted a comprehensive review of the entire trauma system to be undertaken. The objective of the review was to ensure that NSW has, in place, a system which is appropriate to its needs; is able to provide a high standard of care; and, meet the needs of patients with injury occurring across all age groups and across NSW. A key driver for the review and development of the Plan was to ensure a sustainable, skilled trauma services workforce.

This Plan to reconfigure and further develop the NSW trauma system, has involved the collection, collation, analysis and modelling of trauma activity data and management processes. Together with an examination of the international literature, this informed the determination of the preferred trauma services model for NSW which resulted in the reconfiguration, concentration and enhancement of trauma services and networks. As a result of the continued lack of consensus, the decision making process regarding future configuration of services was extremely protracted.

1 Population Health Division. 2008. The health of the people of New South Wales - Report of the Chief Health Officer, Data Book – Injury & Poisoning. Sydney: NSW Department of Health, 2008.

2 Australian Institute of Health and Welfare 2009. Health expenditure Australia 2007–08. Health and Welfare Expenditure Series no. 37. Cat. no. HWE 46. Canberra: AIHW.

3 Potter Forbes M, Aisbett C, Injury costs: A valuation of the burden of injury in NSW 1998-1999, Sydney: NSW Injury Risk Management Research Centre, University of NSW, 2003.

A review of the trauma data reported to the NSW Institute of Trauma and Injury Management (ITIM) indicates that the NSW Trauma System is functioning effectively, as evidenced by:

- pre-hospital triage - in metropolitan areas the majority of patients are being transported directly to a major trauma service;
- pre-hospital treatment times - the average pre-hospital time is 56 minutes for 87% of patients arriving at a major trauma service; and,
- the relatively low in-hospital death rate.

However, although the system is operating effectively, it is acknowledged that there are improvements which can be made to ensure a sustainable trauma system workforce.

As part of this planning process, an extensive review of the literature was undertaken. While the literature does support the designation of hospitals to specialise in trauma, and the concentration of 'major' trauma patients to these hospitals, thereby increasing the volumes of trauma cases managed at these hospitals, there are widely varying views on what is the benchmark trauma caseload required to achieve improved outcomes and, as a result, the required number of major trauma services for NSW.

Trauma Services are a part of the critical care network which operates within the broader acute care system in NSW Health. The changes recommended to the configuration of the trauma system have taken into account the potential impact to all aspects of the health system including pre-hospital care; medical retrieval services; the acute in-hospital setting; rehabilitation; and, community based services. Similarly, appropriate consideration has been given to the interface between the metropolitan based major trauma services, regional trauma services, rural trauma referral networks and statewide specialty services, such as Severe Burn and Spinal Cord Injury.

The NSW Trauma Services Plan, to be implemented from 2010, is based on five integrated trauma service networks which incorporate major trauma services and regional trauma services across metropolitan and rural areas. The new service model for NSW aims to strengthen the overall management of trauma in NSW, including injury prevention, clinical services, rehabilitation, quality improvement and education and research.

The provision of six major trauma services, within the five networks, located at Liverpool, Royal Prince Alfred, Royal North Shore, St George, Westmead and John Hunter Hospitals, will provide:

- Strategic geographic cover for greater metropolitan Sydney, including the central business district, the airport and provides flexibility to respond to statewide demands;
- Well defined networks, including rural regional hospitals that support the transfer of patients to the major trauma service and back transfer for ongoing care and rehabilitation;
- A concentration of services that will provide core case numbers to promote enhancements and further improve well defined, comprehensive in-hospital trauma care, without overloading existing services and compromising access to these services for other patient groups;
- Concentrated ratios of activity to sustain a highly skilled workforce and train the future workforce;
- Appropriate pre hospital phase of care supported by Protocol T1;
- Clinical support, quality improvement, education and research within each network led by the major trauma service; and
- Alignment with critical care referral networks.

This Plan is founded on an inclusive trauma system that assures access for trauma patients consistent with the availability and effective use of health care resources, and clearly identifies the components of a system designed to meet the needs of all injured patients.

# 1 Introduction

The term 'trauma' refers to patients who have sustained physical injury. Injury has a major, but often preventable, impact on Australia's health, and is the most common cause of death in the first half of life, and leaves many with serious disability.

During 2005/06 there were 400,019 hospitalisations nationally due to injury, a rate of 1,815 per 100,000 population. This represented 5.5% of all hospitalisations in Australia. [4]

The hospitalisation rate for injury in NSW for 2006 was 2,130 per 100,000 population with 150,240 hospitalisations; 3,285 people died in NSW due to injury. Falls are the leading cause of injury-related hospitalisations in NSW, accounting for 38.3% of all such hospitalisations in NSW in the period 2004-05 to 2006-07. While death rates for injuries overall have decreased in recent years, hospitalisation rates have increased for injuries to motorcycle riders and fall-related injuries.[1] NSW Health is investing heavily in falls prevention strategies.

Rates of hospitalisation for injury vary by age group; the highest rates of hospitalisations are in people aged 65 years or older (most commonly due to falls) and those aged 15– 24 years (most commonly due to motor vehicle accidents and falls).[5]

Despite significant injury prevention efforts and trauma system development, injury continues to be a significant public health issue. While recovery from most minor injuries is, in effect, completed rapidly, more serious injuries often have long lasting consequences.

An effective trauma system needs to encompasses all phases of care, from injury prevention, and pre-hospital care, through to acute care and rehabilitation, as well as education and research activities. The aim of a trauma system is to provide a coordinated and systematic means of recognising patients who potentially may have suffered serious injury, and transferring these patients in a timely manner to definitive care, matching the needs of the injured to the appropriate level of care.

The NSW Trauma System is an important element of the broader spectrum of acute and critical care services, which are provided across the State. The key objective is timely access to definitive specialist trauma care. This objective drives the management of both adult and paediatric patients suffering severe trauma. Where possible, adult and paediatric severe trauma patients are to be taken directly to designated major trauma services in accordance with pre-hospital triage, clinical management and transport protocols which determine appropriate transport timeframes.

Based on the available clinical outcomes and performance measures, the NSW Trauma System is performing comparable to, and in some aspects better than, national and international standards. Despite this, it has been identified that there is scope for refinement through system-wide changes to further stream-line and improve the management of trauma patients in this State. A key driver for the reconfiguration of the NSW Trauma System is the availability of a suitably trained and experienced clinical workforce to provide expert definitive care. The reconfiguration of trauma services will enhance trauma-training and research opportunities and further develop a robust statewide trauma system.

4 Australian Institute of Health and Welfare 2008. Australia's Health 2008. AIHW Cat no. AUS 99 Canberra: AIHW.

5 Hayen A, Mitchell R, NSW Injury Profile: A Review of Injury Hospitalisations During 1989-1990 and 2003-2004, NSW Injury Risk management Research Centre, University of NSW, Sydney, ISBN 0-7334-2301-9, June 2006.

In addition to an extensive literature review of trauma service models, the development of this plan involved extensive consultation with clinicians and stakeholders across the system including the following key groups:

- Area Health Services (AHS) and the NSW Health Department
- Clinicians representing Trauma, Emergency, Intensive Care, Surgery, Radiology, Pathology, Allied Health and Rehabilitation Services;
- Critical Care Health Priority Taskforce
- Rural Health Priority Taskforce
- Ambulance Service of NSW (ASNSW)
- Medical Retrieval Services

In addition consultation was embarked on with other jurisdictions, and presentations were made by trauma clinicians from other states. Within the parameters of current best practice for major trauma; the size and population distribution of NSW; and, the current and future workforce challenges, there is broad support for a concentration of major trauma service resources.

Extensive planning for trauma and related services has been undertaken through the development of Area Healthcare Services Plans. The statewide trauma service planning process complemented the process, while ensuring that optimal trauma care is accessible to patients, regardless of their location when injured.

The aim of this Plan is to provide direction, and function as a communication tool, so that all components of the trauma system are striving to further reduce the impact of injury on the community.

## 1.1 Background

A formal trauma care system was first implemented in NSW in 1991. Additional elements of the trauma system were adopted in subsequent years, including the introduction of the Pre-Hospital Trauma Triage Protocol in metropolitan Sydney in 1992 and the Early Notification of Severe Trauma in rural areas in 1997.

The trauma system was reviewed in 1994 in response to a National Road Trauma Advisory Council (NRTAC) report published in 1993.[6] More recent developments include the establishment of the NSW Institute of Trauma and Injury Management (ITIM), the implementation of metropolitan trauma registries and trauma minimum dataset and the development of clinical guidelines for the delivery of optimal trauma care for adults.

Trauma Services were also included in reviews undertaken as part of the Government Action Plan for Health process in 2000. This review recommended a reduction in the number of Major Trauma Services in the greater Sydney metropolitan area from eight to five, specialist paediatric services would continue at the two specialist children's hospitals in Sydney (Sydney Children's Hospital Randwick and Children's Hospital at Westmead) and John Hunter Children's Hospital would be recognised as a paediatric trauma service. The recommendations regarding the redesignation of the adult services were not implemented due to a range of factors, including capacity in the system during this period, as a result of major rebuilding of hospitals during that time.

Since that time there has been ongoing discussion and debate amongst trauma clinicians as to the most appropriate configuration for the adult trauma services in NSW. This prompted a comprehensive review of the entire trauma system to be undertaken to ensure that NSW has in place a system which is appropriate to its needs, is able to provide a high standard of care and meet the needs of patients with injury occurring across all age groups and across NSW.

What has become apparent from the planning process is that there is no single international or national trauma service model which would be directly transferable to the geography and demography of NSW. The way forward has been to develop a model specifically suitable for NSW, informed by the literature, and taking into consideration elements of other trauma system models pertinent to the delivery of health services in NSW, including:

6 National Road Trauma Advisory Council (1993), Report of the Working Party on Trauma Systems, Commonwealth Department of Health, Housing, Local Government and Community Services, ISBN 0644296917.

The **geography** of greater metropolitan Sydney, which influences the movement of ambulances around the city and the **accessibility** of services. Sydney has a large geographic spread, resulting in some distance between the different parts of the city.

The road and transport system – the majority of the primary trauma cases will continue to be transported by road ambulance, therefore the road networks and traffic conditions and the impact on **transport distances and travelling time** need to be taken into account.

The recent review of rotary wing services (helicopters) factored in demand for the transport of primary and secondary trauma cases. It is envisaged that there will be enhanced capacity and responsiveness, however it is likely that road ambulance will remain the main means of transport around metropolitan Sydney.

The location of the hospital(s) and the **accessibility** of the service for ambulances, visitors and patients returning for outpatient and follow-up care.

The configuration which will allow maximum **flexibility** and **responsiveness** to residents requiring transfer to major trauma services. This is particularly pertinent to the rural areas where timely access to trauma services can be a challenge due to distance and travel time both to, and between hospitals.

The local **catchment population** and **referral population** for which the hospital provides a range of routine and specialty services, and the impact of expanding the trauma caseload on the ability of the hospital to continue to meet the community expectation to access these services locally. Projected increases to the catchment population due to population growth need to be appropriately incorporated, and have been considered in recent hospital redevelopments.

The local clinical interest and **support within a hospital** for the provision of trauma services. This will influence the overall response of the hospital to develop and maintain an expanded trauma service on an ongoing basis, including at times balancing competing demands for inpatients beds and access to in-hospital services, such as intensive care beds and operating theatre time.

The **capacity of the hospital(s)** to accommodate additional primary trauma caseload (and estimating what this additional caseload will be) as well as an increased number of transfers from rural and regional services due to an expanded referral network. Although there has been an expansion of critical care capacity over the past five years, tertiary hospitals in Sydney currently have little spare capacity to accommodate a significant additional caseload. The impact of the additional caseload needs to be evaluated, in particular the impact any increased major trauma caseload will have on acute inpatient beds, intensive care and high dependency services, diagnostic services, operating theatres as well as other clinical and specialty services.

The impact on the hospital to provide the long-term and ongoing care needs of the trauma patients as they return for follow-up procedures and on-going treatment, as well as ongoing outpatient care.

Access to **rehabilitation services** - the increased trauma caseload will also increase the demand for access to rehabilitation, the ability to transfer patients to a rehabilitation service in a timely manner will both improve patient outcomes and reduce bed block at the major trauma service.

The availability of a skilled and experienced multi-disciplinary team to provide and coordinate care for the major trauma patients including, specialist staff (medical, nursing and allied health) to provide comprehensive twenty-four hour coverage for the service, and the staffing requirements to manage an increased volume of major trauma cases.

Workforce development through **education and training** of specialist staff to expand the available specialist workforce. Currently in Australia there are no local medical trainees undertaking specialist training in the trauma discipline, all recent recruitments have been filled by overseas trained medical staff. The workforce issues, in particular medical workforce, needs to be addressed to ensure a viable workforce for the ongoing operation of the trauma system. While medical training is a specific issue, workforce issues are also pertinent to nursing and allied health disciplines which are also integral to the delivery of trauma care.

## 1.2 Scope of the NSW trauma services plan

The spectrum of trauma encompasses patients who have sustained minor injuries that can be treated at local emergency services, through to moderate and major (or serious trauma) which usually require hospital admission and access to specialised resources and which may result in a degree of short or long term functional disability.

'Minor' trauma refers to simpler injuries usually involving only a single part of the body, which can be well managed with less specialised resources in a variety of clinical settings.

'Major' trauma refers to patients with multiple injuries requiring complex multidisciplinary management or single system injuries of a potentially life-threatening nature requiring complex management at specifically designated and equipped health facilities.

Patients with major traumatic injuries are considered in terms of the Injury Severity Score (ISS) [7] with a score >15 recognised as an indicator of serious injury. The ISS is an international scoring system that calculates injury severity and predicts mortality. Patients with an ISS > 15 represent only about three percent of total trauma related admissions to NSW hospitals. Injury severity scoring is undertaken retrospectively, but within 24-48 hours after admission to allow for identification of all injuries.

The smaller, but more critical group of 'major' trauma patients is the patient group most in need of the highly specialised and expert services provided by a major trauma service. The designation of major trauma services improves quality of care as more seriously injured patients can be cared for by those who specialise in the care of trauma patients.

The NSW Trauma Services Plan is based on an inclusive trauma care system in which every facility with resources to care for the injured patient is incorporated. The roles range from resuscitating and transferring a seriously injured patient to the provision of specialised trauma care. In this system all levels of hospital are formally networked, with the structured use of retrieval services. This Plan identifies the principles and components of an inclusive trauma system and the model of care required for coordinated care of injured patients across the trauma continuum. The Plan does not intend to prescribe detailed solutions, however it will provide guidance and direction for comprehensive system development, and operational requirements.

7 Baker S.P, O'Neill B., Haddon W., Long W. B., The Injury Severity Score: A Method for Describing Patients with Multiple Injuries and Evaluating Emergency Care, Journal of Trauma, 1974, Vol 14, No., 3, pp 187 – 196.

# 2 Policy context

The outcome of effective health service planning is clarity of direction for service development and resource investment. This direction is one that should be evidence-based and reflect statewide service policies and Area population needs and priorities. Planning is undertaken through consumer, clinician and stakeholder consultation, and needs to acknowledge affordability and the workforce necessary to deliver the planned service. Therefore, planning at Area and Department levels must consistently be tested against the strategic direction of the system and the health needs of the population served.

## 2.1 The NSW state health plan – Towards 2010

The NSW State Health Plan addresses the challenges that lie ahead using the seven strategic directions identified during the consultation for the Future Directions for Health in NSW – Towards 2025. This approach has focused attention, at the highest level, on improving health, enabling the various streams of activity across a Health Service to be considered as a whole. Population health, acute health and community based care are each vital service elements and, with a number of others, must all be considered when planning for health services at national, statewide, supra-Area, Area, or local levels.

Health service planning is directed towards the ongoing achievement of the seven strategic goals of:

- Making prevention everybody's business
- Creating better experiences for people using health services
- Strengthen primary health and continuing care in the community
- Build regional and other partnerships for health
- Make smart choices about the costs and benefits of health services
- Build a sustainable health workforce
- Be ready for new risks and opportunities

The further development of clinical networks, greater emphasis on clinical collaboration, and the quality framework provide the policy context for this plan.

The NSW Trauma Services Plan has been developed in an environment of change and rapidly developing technology. The relationship between this plan and the goals of NSW Health are described below.

### 2.1.1 Making prevention everybody's business

Traumatic injury is a disease that can often be prevented or its impacts decreased by injury prevention efforts. Injury prevention is an essential component of the trauma system continuum of care designed to promote changes in health related behaviours that are conducive to reducing preventable trauma and improving outcomes for patients suffering traumatic injury.

The primary role of the trauma care system is to reduce death and disability amongst those who sustain serious injury. However, many injuries are preventable. Injury prevention aims to prevent the occurrence of serious injury, either by preventing events likely to cause injury (for example, motor vehicle crashes) or by reducing the likelihood that hazardous events will result in serious injury (for example, through the use of seat belts in motor vehicles).

### 2.1.2 Creating better experiences for people using health services

The reconfiguration and development of the NSW trauma system aims to ensure that all patients requiring trauma care in NSW hospitals have appropriate access to effective and safe care.

The trauma system model of care ensures the integrated provision of trauma care to facilitate seamless delivery of care during the pre-hospital, acute, rehabilitation and discharge phases. Focus is on the patient journey to ensure timely access to the most appropriate level of definitive trauma care and supported discharge to a lower level care when acute care is no longer needed.

The development and implementation of evidence-based statewide trauma clinical practice guidelines ensures a high standard of evidence based clinical management and continuity of care. This is supported through the provision of education and training for all clinicians caring for trauma patients across NSW.

These elements, when combined with the planning and coordination provided by the Critical Care Health Priority Taskforce, and the clinical, professional and system wide support provided by the ITIM enables effective and safe care to be provided to trauma patients in NSW.

### 2.1.3 Strengthen primary health and continuing care in the community

Changes to the configuration of the trauma system have taken into account the potential impact on all aspects of the health system including pre-hospital care, medical retrieval services, the acute in-hospital setting, rehabilitation and community based services. The NSW Trauma Services Plan is inclusive of all operational components, ranging from injury prevention activities to pre-hospital care, acute care facilities (designated trauma services), and rehabilitation. A developed trauma system facilitates effective transitional care for the patient across the trauma spectrum of care from acute care to rehabilitation and community based care.

### 2.1.4 Build regional and other partnerships for health

The NSW Trauma Services Plan has been developed based on five integrated trauma service networks which incorporate the six major trauma services and the regional trauma services in metropolitan and rural areas. The important role of the NSW Aeromedical and Medical Retrieval Service (AMRS), combined with interstate service agreements, service enhancements and networked trauma services promotes equity of access for residents of rural and remote areas and metropolitan NSW to major trauma services.

Trauma services in rural areas provide a clinical leadership role to rural hospitals within their network; they are also networked to a major trauma service within the greater metropolitan area strengthening the rural urban links. These networks are closely aligned to the critical care referral networks and consider the time critical nature of traumatic injuries.

### 2.1.5 Make smart choices about the costs and benefits of health services

To inform the determination of the preferred trauma services model for NSW and ensure an efficient use of health resources, consideration of the following issues informed the decision making process: the appropriate number of major trauma services; volume and quality relationships; pre-hospital triage and transport issues; and training and sustainability of the workforce. The project involved the collection, collation, analysis and modelling of trauma activity data, consultation with clinical experts, together with an examination of the international literature.

A key component of a mature trauma system is a quality performance improvement program with a process for multidisciplinary review and monitoring of outcomes and provision of care. Trauma system evaluation is important to ensure that system changes are consistent with this plan. This will be achieved through a statewide trauma registry and collection and monitoring of trauma system key performance indicators to monitor the implementation of the reconfiguration, concentration and enhancement of trauma services and networks.

### 2.1.6 Build a sustainable health workforce

The key impetus for the consolidation, streamlining and enhancement of trauma service provision across NSW was the need to ensure a sustainable skilled trauma services workforce to provide expert definitive trauma care. A key objective of reconfiguring and concentrating trauma services is to enhance trauma-training opportunities and develop robust highly skilled and appropriately resourced trauma services. The population and critical mass were key factors considered in relation to this issue.

The migration to a new trauma services model provides an opportunity to develop a comprehensive trauma training and accreditation program, which is underpinned by a centralised trauma training and research centre. A centralised statewide trauma-training program will be supported by a robust academic framework, clinical research and evidence based practice.

The development and support of the trauma specialty will provide the potential for advanced trauma practice roles in both rural and metropolitan areas supported by appropriate professional development opportunities.

### 2.1.7 Be ready for new risks and opportunities

The review and development of the NSW Trauma System has identified opportunities for collaboration and development of partnerships with other agencies to enhance the level of service to injured trauma patients. The reconfigured system will include new technology to establish a more comprehensive trauma registry; this will allow identification of changing injury profiles and provide data for collaborative research on trauma outcomes.

A robust trauma system has the capacity to respond to unexpected events such as a mass casualty disaster with the resources to provide coordinated care to seriously injured patients. The integration of trauma system planning with the State Disaster Plan, NSW HealthPlan and NSW Amplan supports rapid mobilisation and surge in capabilities when needed. The appropriate distribution of injured patients among available trauma facilities ensures that patients are afforded the best opportunity to minimise death and disability.

The seven strategic directions provide a sound foundation for this service plan to deliver the outcomes required for effective and efficient trauma care services.

# Trauma service planning 3

In determining whether change is required in NSW and examining the most appropriate trauma service model for NSW, the planning process has included a comprehensive literature review; an extensive consultation process with each of the major trauma services; and detailed analysis of available data from the Health Information Exchange (HIE), ITIM, the ASNSW, and AMRS.

A number of issues in relation to trauma service planning and trauma system design have been identified. The main areas of contention include the appropriate number and location of major trauma services; volume and quality relationships; pre-hospital triage and transport issues; and training and sustainability of the workforce.

## 3.1 Number of services required for NSW

There is consistent support throughout the literature for the concept of a regionalised trauma system, where patients with serious injury are cared for in hospitals with expertise in the management of trauma, known as major trauma services. The aim of concentration is to ensure that individual centres will receive sufficient major trauma caseload to warrant the infrastructure required to support the trauma service. Two meta-analyses of population-based studies evaluating trauma system performance demonstrated a 15 to 20% reduction in mortality in favour of the presence of trauma systems.[8] While there is evidence to support a trauma system, there is less evidence to guide the estimation of the required number of major trauma services for a given population or health system.

Whilst literature from overseas (in particular the United States) recommends a ratio approach, of one Major Trauma Service per million population, the differences in the population size and distribution, as well as patterns of trauma including incidence rates between the USA and NSW have also been considered in the validity of the translation of this approach to NSW.

## 3.2 Relationship between volume of trauma managed and patient outcome

The basic premise underlying the development of trauma systems is the concentration of the most severely injured patients into a limited number of specialist sites which have the expertise and experience to care for these patients and thus improve outcomes.

The literature is equivocal regarding the relationship between volume of major trauma cases managed at an individual site and patient outcome. There is agreement that patients should be concentrated into specialist centres but there is no consistency about what is an "optimal" volume of cases to ensure appropriate experience. It is often cited that increased trauma volumes at major trauma services will result in better patient outcomes; however this is not borne out by the published literature.

The literature both from Australia and overseas indicates varying recommendations of the numbers of major trauma patients (ISS > 15) which need to be managed at individual major trauma services on an annual basis. These vary from 250 (American College of Surgeons) up to 650 cases per annum.[9] Victoria, as part of a statewide review of trauma services determined that a minimum caseload of 200 major trauma cases per annum per major trauma service was an achievable benchmark for optimising patient outcomes and maintaining clinician skills.[10]

The literature indicates that volume is not a sole driver of improved patient outcomes. Effectiveness of a hospital and patient outcomes is also impacted by the presence of a dedicated in-hospital trauma service to manage this patient group. This service is responsible for establishing and maintaining in-hospital systems to manage the trauma patient. To establish such a service, an adequate volume of trauma patients would be required to make

8 Petchell J., (unpublished), Options Paper, NSW Trauma System, Background Paper for the NSW Health Care Advisory Council, November 2006.

9. Nathens A, Jurkovich G, Maier R, Relationship Between Trauma Center Volume and Outcomes, JAMA, Vol 285 (9), 7 March 2001, pp1164-1171.

10. Review of Trauma and Emergency Services – Victoria 1999 – Final Report of the Ministerial Taskforce on Trauma and Emergency Services and the Departmental Working Party on Emergency and Trauma Services.

this a viable service and warrant the resourcing required both in terms of workforce and finances.

While it has been hypothesised that higher volume centres are more likely to have relevant infrastructure and systems in place which ensure the provision of a comprehensive trauma service, it has also been demonstrated that, in lower volume centres which have a well-established trauma service, the outcomes are comparable to the higher volume centres. Another key consideration is the impact an increasing volume of trauma cases will have on the other specialty services provided by the hospital. This is highly relevant, as to be a major trauma service, a hospital needs to offer an array of high level, specialty services able to manage the severely injured patient, yet if the volumes of these patients are too high, it will impact on the ability of these specialty services to continue to provide services to other patient groups. This poses a risk to the ongoing viability of these services.

The challenge is to achieve a balance between the volume of trauma needed to develop a viable and effective in-hospital trauma service, and a volume not so high that it overwhelms the other specialty services upon which the trauma service is reliant to provide care and consultative services to the trauma patients.

A reduction in the number of major trauma services in NSW will ensure that all adult major trauma services will receive at least 250 cases with an ISS > 15 per annum, providing an adequate volume of seriously injured cases to enable ongoing development of an in-hospital trauma service.

## 3.3 Pre-hospital transport time

A key requirement of a trauma system is to deliver a patient to the appropriate level of trauma service in as timely a manner as possible, minimising the time from injury to when the patient can receive definitive trauma care; "the right patient, to the right hospital, in the right time". In the pre hospital environment the use of a pre-hospital trauma triage tool determines the appropriate hospital destination equipped with the resources to best meet the patient's needs. This approach may mean bypassing the closest hospital.

The accepted timeframe for this pre-hospital period has been an hour from injury to arrival at hospital, commonly referred to as 'the golden hour'. The total pre-hospital period is taken from the time of injury, and is comprised of the Ambulance response time (current benchmark 10 minutes), the time taken treating the patient at the scene of the accident (benchmark is up to 20 minutes), and the time to transport the patient to the hospital (the travel time, benchmark 30 minutes).

The premise is that it is preferable to travel further to deliver a patient to an appropriately equipped and experienced hospital (a major trauma service or regional trauma service) bypassing lower level hospitals, than taking a patient with major trauma to a hospital which is not equipped or experienced in managing these complex patients. Patients taken to a non-designated trauma service are delayed in transfer to a major trauma service for commencement of definitive trauma care. This delay can potentially impact on patient outcome.

Travel time for major trauma patients, from the time of injury to definitive trauma care, was a key consideration in determining the configuration of major trauma services for NSW. In the absence of strong evidence in the literature as to optimal pre-hospital time; the ideal should continue to be, to minimise the pre-hospital time for patients to arrive at an appropriate hospital able to assess, resuscitate and undertake definitive care. In an urban area this is a major trauma service, and in rural areas ideally this would be the regional trauma service.

In July 2008 the ASNSW implemented a revised Pre-Hospital Trauma Triage Tool – Protocol T1, which supports paramedics to extend travel time up to one hour to the highest level trauma service.

## 3.4 Workforce

The availability of a specialist and experienced workforce is the key to the provision of specialist trauma services. The workforce issues cross all of the disciplines involved with trauma care, but the medical workforce issues have been raised repeatedly during the planning process.

While trauma is often seen as a surgical specialty, in Australia the vast majority of cases are a result of blunt trauma and if surgery is required it will often be orthopaedic. The role of the trauma surgeon is frequently in the coordination of care, including clinical assessment and decision making for the trauma patient particularly in the initial phase of care. Both in NSW, and in the US, there are difficulties recruiting trainees and surgeons to specialise in trauma, in part because of the onerous nature of hours and on-call requirements. Like a number of clinical specialties, currently in NSW and across Australia, there are a limited number of surgeons who are specialist trauma surgeons. The majority are general surgeons, or surgeons with another specialty, who have an interest and commitment to trauma surgery. In Australia there are no local surgical trainees undertaking trauma training, and all recent recruits as trauma directors and trauma surgeons have come from overseas. The specialist trauma surgical workforce is at present limited and for most major trauma services the trauma roster is comprised of surgeons from a range of specialties providing coverage. While many of these surgeons are interested in participating in an on-call roster this is on the assumption that the requirements will not encroach on their usual area of practice.

A benefit of concentrating NSW trauma services into fewer sites is that this would concentrate the trauma patient load and provide an improved volume to support a networked trauma training program.

## 3.5 Trauma system performance indicators

It is important to be able to evaluate performance and identify, in a timely manner, areas which may require attention and possibly modification. Ongoing evaluation of the effectiveness of the trauma system is essential. Of particular importance is the monitoring of patient outcomes in terms of morbidity and functional outcome, this can provide a true indicator of the effectiveness of the trauma system. This information can be used to guide service improvement, policy and further planning and development of the trauma system.

While data for severely injured patients (ISS > 15) is captured through the NSW ITIM Trauma Minimum Dataset (TMDS), to date only limited performance indicators have been introduced to evaluate the functioning of specific components of the trauma system, such as time to definitive trauma care and trauma team activation. The TMDS is currently limited to patients with major injury who are admitted to major trauma services in NSW. Consequently, data is not collected about serious to critically injured people who are admitted to hospitals in rural areas and does not include the larger number of patients with less severe injuries (ISS < 15).

An ISS > 15 is the accepted benchmark for identifying major or serious trauma; and while ISS correlates well with the risk of mortality from trauma, it is not a good indicator for morbidity or the resources required to manage an injured patient. As ISS is the accepted international measure of injury severity it will need to continue to be applied, however, an ISS > 12 may be a better indicator for trauma patients who have sustained multiple injuries, requiring complex care and should be included for future data collection. Expansion of the data set to include rural patient data is also required to facilitate a more comprehensive data set for NSW. The implementation of a new Statewide Trauma Registry will enhance the capacity for trauma data collection across NSW.

## 3.6 Paediatric trauma service delivery issues

There are a number of issues specific to the provision of paediatric trauma services which require consideration to inform the development of the paediatric model of care for trauma services. These issues include determination of serious injury in children and where these children should receive their initial assessment and care.

The discussion of measures of injury severity and what is a relevant determinant of major injury needs to take account of the differences between adults and children. Children, particularly those aged less than twelve have different physiologic parameters and response to injury than adolescents and adults, making assessment, diagnosis, resuscitation and delivery of care quite different to that of an adult. There are lower rates of surgical intervention for injured children than for adult trauma cases, with children more likely to be medically managed in the first instance through close monitoring and observation, rather than immediate surgical intervention.

As with the adult population, the majority of trauma will have minor to moderate injury. At issue is the management of children with moderate to serious injury. These cases need to be managed in a higher level service with expertise in paediatric management. Lower volumes of paediatric trauma, particularly major trauma than adult trauma makes the acquisition and maintenance of the skills and expertise required to manage this patient group difficult, particularly for clinicians not working in an environment which cares for reasonable numbers of children on a routine basis. Compounding this is a declining availability of paediatric services and consequently access to specialist paediatric clinicians at a number of the adult major trauma services. As a result these services will need to be carefully monitored in order to ensure appropriate practice and outcomes.

# Trauma model of care 4

Trauma system development seeks to facilitate and coordinate a multidisciplinary system response to the injured patient from the time of injury through the provision of definitive care. The trauma model of care encompasses the following phases across the trauma continuum of care:

- Injury Prevention
- Pre-Hospital
- Acute Care
- Rehabilitation

When injury occurs, each phase of care, as represented in Figure 1 should occur seamlessly.

At the 'central core' of the trauma system are the clinical or operational components which must be established in order to provide timely patient care once an injury occurs. The administrative components of a trauma system comprise the framework within which care is given and which also promote continual development of the system.

## 4.1 Injury prevention

Injury prevention addresses the public health problem of trauma by reducing the number of new cases of injury, as well as by reducing the severity of those injuries that do occur.

Prevention of injury requires action by a wide range of organisations, and encompasses a wide range of activities, including legislative approaches, environmental and design modifications, education and awareness.

Prevention in the context of the trauma system aims to diminish the impact of injury, through actions to further reduce the severity of injury, and to optimise patient outcome. Examples of injury prevention activities of trauma systems include:

- Timely pre-hospital response, triage and transport protocols;
- Transport of the injured patient to a trauma service with the appropriate resources to meet the patients needs; and
- Provision of acute care services and rehabilitation

Data collected by the trauma service provides essential information for monitoring trends and patterns of injury, for defining subgroups of the population at high risk for injury and for developing and evaluating injury prevention programs. Injury prevention efforts are based on identification of specific injuries and risk factors in patients and the community.

The Major Trauma Service (MTS) has an integral role in coordinated and targeted injury prevention programs that focus on efforts to prevent, or diminish the impact of injury before, during, and after the injury. Clinicians have strong credibility with the public and messages given are (generally) highly effective. The NSW trauma networks will establish system-wide injury control links or coordinate with existing initiatives to facilitate consistent and coordinated community-wide injury prevention programs.

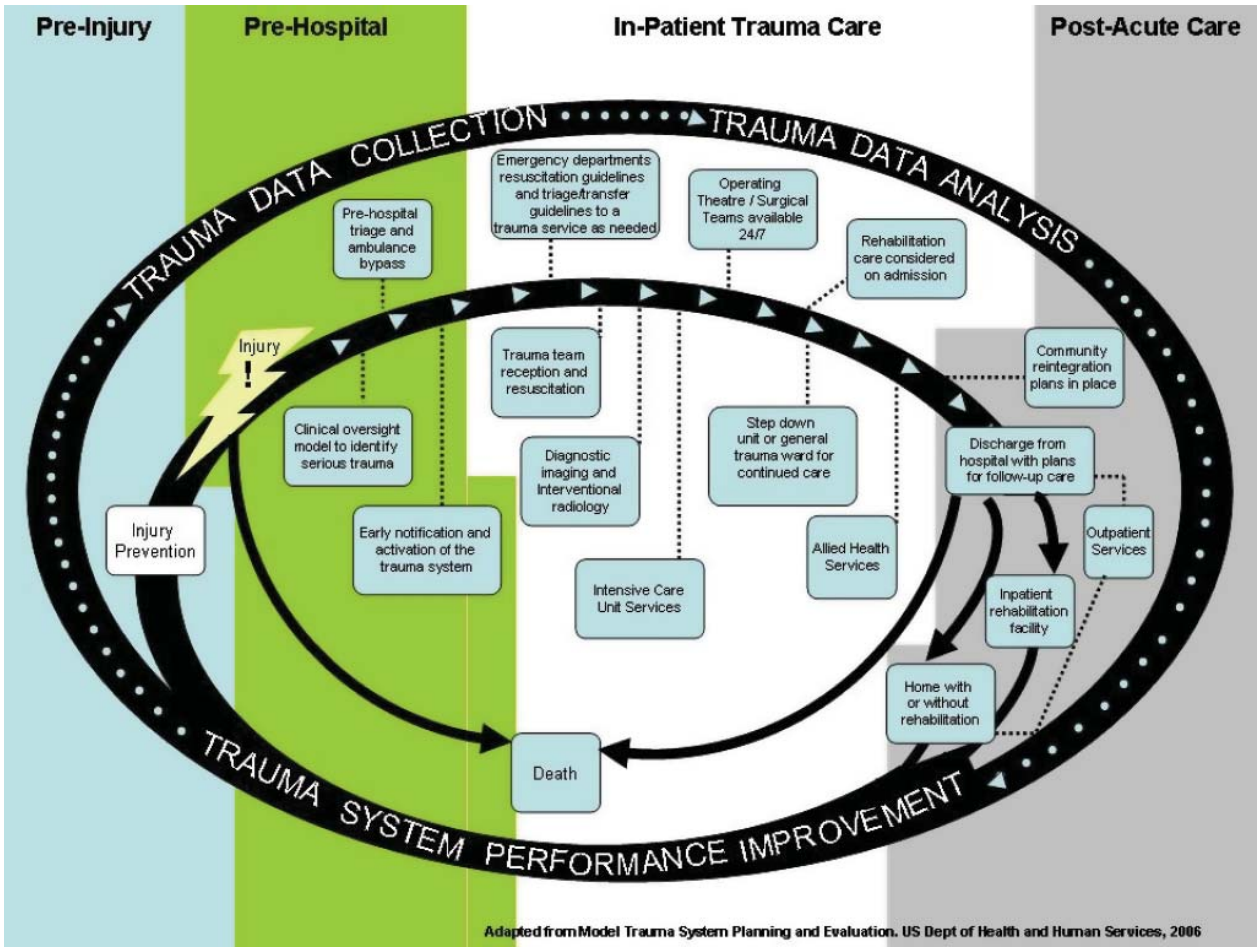
## 4.2 Pre-hospital management of major trauma

The pre-hospital phase of care is the period from the time of injury to arrival at a definitive care trauma hospital. This may include stabilisation and an interhospital transfer depending on where in NSW the injury occurred and whether there are sufficient resources locally to treat the injury.

An injured patient may be delivered to the trauma system in two ways:

- Non-ambulance arrival occurs when the patient arrives at a hospital outside of the ambulance/ emergency services arrangements. For example a patient may arrive at hospital by private vehicle;

Figure 1: Trauma Model of Care




Ambulance/helicopter arrival occurs after the patient has been subjected to a trauma triage process whereby a decision is reached which determines which hospital is the most appropriate for the patient. By preference this will be direct transport from the scene or by the most efficient transfer or retrieval means possible.

Pre-hospital trauma triage decisions are made using a number of criteria which include both physiological parameters, physical injuries and the accident mechanisms which carry a high risk of serious injury. The ASNSW trauma triage tool (Appendix 1) is a rapid and effective process for ascertaining patient risk from the mechanism, injuries and signs and symptoms (MIST), to determine the appropriate transport decision and destination.

A patient who is identified within the MIST criteria (Figure 2) either has, or has the potential for, serious injury and should therefore be transported to the appropriate highest level of trauma service within a one hour travel time.

If transport time is estimated to be greater than one hour, then medical advice is sought through the Medical Retrieval Consultant. The patient will either be transported for an extended period or transported to the nearest hospital. In this instance a decision can be made to activate a retrieval response to meet the Ambulance en route or at the hospital.

A trauma notification to the receiving hospital is conveyed using the MIST criteria. It is imperative that hospitals are aware of the extent of injury to a trauma patient and the estimated time of arrival to their facility. This allows for notification to assemble the appropriate personnel and equipment to best care for the injured patient. The use of radio or phone contact between the pre hospital personnel and Emergency Department (ED) staff prior to the patient arrival may be appropriate in some instances.

Figure 2: Ambulance Service of NSW Major Trauma Criteria

# Trauma Triage Tool — Major Trauma Criteria (MIST)

## M MECHANISM OF INJURY

**Blunt**

- Transport Incident:
  - — Death in same vehicle
  - — Intrusion into occupant compartment >30cm
  - — Steering wheel deformity
  - — Patient side impact
  - — Vehicle v pedestrian/cyclist/MBC
  - — Ejection from vehicle
  - — Entrapment with compression
- Focal blunt trauma to head or torso
- Falls >3m or paediatrics twice the child's height
- High voltage injury
- Crush injury excluding fingers/toes
- Any rapid deceleration mechanism that results in a large inertia change at impact

**Patients <16 & >65 years of age, Obstetric patients >20 weeks gestation, patients on anticoagulants and patients with pre-existing diseases are at greater risk and require a high index of suspicion for serious injury. If in doubt transport to Trauma Centre.**

**Penetrating** All penetrating injury (excluding isolated injury to hands or feet)

AND/OR

## I INJURIES

**Head:** Minor head injury with loss of consciousness or amnesic to event with:
- 2 or more vomits or a seizure
- on anticoagulants

Open, depressed skull # or signs of base of skull #.

**A decreased LOC is due to traumatic injury, until proven otherwise.**

**Face:** Injury with potential airway risk; severe haemorrhage.

**Neck:** Swelling, bruising, hoarseness or stridor.

**Chest:** Severe pain, paradoxical breathing, restraint abrasion/contusion.

**Abdomen:** Severe pain, rigidity, swelling, pelvic tenderness, restraint/abrasion/contusion.

**Limbs:** 2 or more proximal long bone #, amputation proximal to digits, ischaemia, degloving injury.

**Spinal/Back:** Visible deformity.

**Burns:** Partial or full thickness burns Adults > 20% Children >10%, or Burns involving head /neck/face/hands/feet/groin or inhalation injury.

All circumferential burns or burns in a patient with comorbidities or pregnancy.

AND/OR

## S SIGNS AND SYMPTOMS

**Airway:** at risk, hoarseness, stridor

**Breathing:** RR<10 or >29, SpO2 <90% on air, cyanosis or respiratory difficulty

**Circulation:** HR>120, SBP <90 or severe haemorrhage

**Disability:** GCS ≤13 or paralysis/sensory deficit

*Or*
*any worsening trend in ABCD*

**Paediatrics:**
Physiological changes are late indicators of serious injury in a child whom may lose 30% blood volume prior to ANY changes in vital signs. The following are a guide:

| | 1st Year | 1-5yrs | 6-12yrs |
|---|---|---|---|
| HR | >160 | >140 | >120 |
| SBP | <60 | <70 | <80 |
| RR | >60 | >35 | >30 |

## T TRANSPORT

**If patient meets Major Trauma Criteria they are to be transported to the highest level Trauma Centre within a 1 hour travel time or Aeromedical Retrieval Service advised.**

### 4.2.1 Retrieval

The activation of the retrieval system may occur at any stage of the pre-hospital phase by paramedics responding to the secene or by the Ambulance Operations Centre. The ASNSW provides a number of clinical oversight funtions, including Rapid Launch Trauma Coordination (RLTC) to identify patients who may need an ceromedical response, urgent transfer or retrieval. RLTC provides for the early identification of potential major trauma incidents and allows for a variety of actions, including activation of a local helicopter to the scene or notification of a local retrieval team to consider response to the nearest hospital.

In regard to medical retrieval services all patients assessed to be suffering major trauma are to be taken directly to the highest level trauma service (major or regional) within 1 hour travel time. There are four potential exceptions:

- In primary cases of an *isolated acute spinal injury in the greater Sydney metropolitan area, where a helicopter with accompanying doctor has responded,* then these patients may be transported directly to the relevant specialist spinal cord injury service.
- In primary cases of a combined severe *trauma and acute spinal cord injury in the greater Sydney metropolitan area, where a helicopter with accompanying doctor has responded,* then these patients may be transported directly to Royal North Shore Hospital if considered clinically appropriate.
- In primary cases of a *severe burn injury in the greater Sydney metropolitan area, where a helicopter with accompanying doctor has responded*, then these patients may be transported directly to the relevant specialist severe burn injury service.
- In primary cases of a *combined severe trauma and burn injury in the greater Sydney metropolitan area, where a helicopter with accompanying doctor has responded*, then these patients may be transported directly to Royal North Shore Hospital if considered clinically appropriate.

## 4.3 Acute hospital management

The in-hospital acute care phase of trauma focus is on the physiological stabilisation and treatment – surgical and non surgical – of traumatic injuries along with the prevention and treatment of complications, and establishment of early rehabilitation goals. Trauma resuscitation and management will be according to established trauma clinical practice guidelines.

### 4.3.1 Trauma team response

Prior to arrival at hospital a trauma team response should be activated at the receiving hospital following pre-hospital trauma notification. This facilitates a comprehensive time critical trauma response ensuring the trauma team is assembled and ready to assess and resuscitate the patient on arrival. Activation of the trauma team will occur based on documented trauma team activation criteria. The size and composition of the trauma team will vary with levels of trauma services and resources available.

The criteria for trauma team activation must be clearly defined by the Hospital Trauma Committee and evaluated as part of the trauma performance improvement program. A team response to a less severely injured patient would initially consist of ED Staff Specialist / Registrar and ED nurses, with additional resources called as appropriate.

The trauma team response may be unique to each individual service and is dependant on its role, and resources. However, the following information is provided to assist Areas in resourcing the trauma response to a severely injured patient at each of the levels of trauma services:

### Major Trauma Service Trauma Team Response

- ED Staff Specialist / Senior Registrar
- ED Nurses (x 3)
- Trauma CNC (in hours) / Clinical NUM (after hours)
- Surgical Registrar
- Anaesthetic registrar
- ICU Registrar
- Mobile Radiographer
- Wardsman / Porter
- Clerk
- Social Worker
- Other specialty registrars as required (eg orthopaedic, neurosurgical, vascular, plastics)

### Regional Trauma Service Trauma Team Response

- ED Staff Specialist / Registrar
- ED Registrar / Resident
- ED Nurses (x 2)
- Trauma CNC (in hours) / Clinical NUM (after hours)
- Surgical Registrar
- ICU Registrar
- Anaesthetic Registrar
- Radiology
- Blood Bank
- Social Work

### Local Hospital Trauma Team Response

While these hospitals may not have a dedicated trauma team an emergency response involving the following is recommended:

- ED Staff Specialist / Registrar
- ED Nurse

The importance of early notification to the MTS and initiation of transfer through AMRS to a higher level of care for those injured patients assessed as requiring higher level trauma care is emphasised.

## 4.4 Trauma service

The trauma service is a multidisciplinary team led by the Trauma Director who is responsible for the ongoing development, growth and oversight of the trauma program throughout the trauma network assuring transfer agreements are adhered to and maintaining collaborative relationships with referring facilities.

The Trauma Service provides expert care for injured patients, coordinating the care of multiple specialty teams and advocating for patients, both within the acute in hospital phase and during rehabilitative care. This entails the day-to day responsibility and coordination of services and systems necessary for a multidisciplinary approach to providing trauma care. Injury diagnosis, treatment and progress through the hospital are planned and monitored.

Trauma case management assures the implementation of day-to-day care of trauma patients and allows for monitoring of variations in patient management outside of specific critical paths and identifying opportunities for improvement.

## 4.5 Allied health

Allied health clinicians provide an essential multidisciplinary service to the injured patient, beginning during the acute phase of care and continuing through subsequent phases of care to recovery.

Interventions provided are dependent upon the needs of the individual patient. These clinicians address patient care issues which impact on outcome and often involve; assistance with breathing exercises; assisted and independent mobility strategies; positioning; turning; and bed exercises, as well as other interventions as required. They can also address the secondary problems associated with injury including pain assessment and the treatment of emotional and cognitive issues following trauma.

Their role within the Trauma Service is fundamental in meeting the complex needs of patients, who have had either single system or multiple injuries. As members of the multidisciplinary trauma service they have daily contact with both nursing and medical specialists, involved in the trauma patient's clinical management. This means that decision making regarding the exact needs of the patient can be decided, with all clinical and social aspects of care taken into consideration in the patient's management plan.

Particular problems which will influence a patient's mobility and the activities of daily living and psychosocial function, in the ongoing rehabilitation phase, are assessed specifically by the allied health clinicians. This assessment includes, appropriate review of the home setting so that the patient is able to return to the community, in a supported environment, so they can achieve an optimal outcome.

## 4.6 Rehabilitation and continuing care

The ultimate goal of trauma care is to restore the patient to pre injury status. Injured patients progress to recovery, rehabilitation and discharge in a timely fashion with appropriate referral to post acute care as required. The rehabilitation of the trauma patient and continual support of their family members is as important as any other system component. In many cases rehabilitation is the longest phase; however proper and early use of rehabilitation resources ensures the most rapid return of the patient to family, community, work force and society.

Early active involvement of rehabilitation services during the acute phase of care of the major trauma patient is an integral part of the proposed service model. The focus of the trauma system is on achieving good outcomes for patients as evidenced through low levels of morbidity and mortality. Improved functional outcomes will be achieved through the early involvement of allied health and rehabilitation services, and will also enable patients to be linked in early with appropriate levels of rehabilitation care.

Rehabilitation of injured patients should be heavily integrated into all phases of acute care and should begin on admission to hospital. Patients requiring rehabilitation should have a detailed evaluation by the rehabilitation team to set realistic goals and determine the potential for rehabilitation benefit. For major trauma patients, the rehabilitation service will provide a functional assessment and recommendations regarding short and long term rehabilitation needs within one week of the patient's admission to hospital or as soon as haemodynamically stable. All other patients managed by the trauma service should have referral to a rehabilitation service if their injuries are such that there is likely to be long term restriction of functioning.

Rehabilitation facilities and allied health services must be available during the acute phase of care, including intensive care. Rehabilitation of all functional deficits is not always simultaneous. Neurologic injuries should not preclude the therapy of other body systems; physiotherapy and occupational therapy can be provided in advance of return of significant neurologic function to reduce the complications associated with long term immobilisation. The major trauma service must have allocated allied health clinicians including physiotherapy, occupational therapy and social work as they are pivotal to the early phase of care and provide ongoing input to the passage of the patient throughout the acute treatment phase. Transfer agreements should exist between acute care and rehabilitation services. Policies for formal transfer into a rehabilitation facility and follow-up after discharge are to be a component of the major trauma service program.

# Current NSW trauma system 5

The NSW Trauma System is not a stand-alone system, but part of the spectrum of acute and critical care services and is consistent with the overall framework provided by the NSW Critical Care Plan - Metropolitan (1994) and the NSW Critical Care Plan – Rural (1998). The NSW Critical Care Referral Networks (adult) define the links between AHS and tertiary referral hospitals, taking into account the recent AHS reconfigurations and established clinical referral relationships.

The current trauma system is based on a networked system of hospitals, designated to provide different levels of trauma service in metropolitan, urban and rural settings. These service levels are described in Tables 1 and 2.

In rural areas, due to distance and travel times, trauma patients are frequently required to be transported to the nearest hospital for stabilisation, irrespective of the availability of trauma services at the hospital. The Early Notification of Severe Trauma in Rural NSW policy (NSW Health Policy Directive 2005_266) was developed to address this issue.

The rural AHS are also networked with a MTS. The current trauma networks operate in tandem with the Critical Care Adult Tertiary Referral Networks (NSW Health Policy Directive 2006_46) and the Child Health Networks. These networks are largely determined by the location of the Major Trauma Service and the imperative to achieve early clinical intervention for seriously injured patients.

**Table 1: Metropolitan trauma networks**

| Level | Description |
|---|---|
| Major Trauma Service | Supports all levels of trauma within their referral networks; and provides the full spectrum of care to manage major trauma patients from resuscitation through to rehabilitation and discharge. |
| Regional Trauma Service | Provide trauma services in urban areas, such as the Central Coast and Illawarra, where travel times are too great for patients to be transported direct to a major trauma service. Able to care for a defined group of seriously injured patients; and provide initial assessment and stabilisation, and initiate transfer to a major trauma service when a patient requires services not available at a regional service. |
| Urban Trauma Service | Hospitals serving local communities in urban areas. They manage patients with minor to moderate injury severity. As part of the Ambulance pre-hospital triage protocol (Protocol T1) major trauma cases are generally not transported to these hospitals. If required, they provide initial resuscitation and stabilisation for major trauma patients, prior to transfer to a major or regional trauma service. |

**Table 2: Rural trauma networks**

| Level | Description |
|---|---|
| Rural Regional Trauma Service | Rural hospitals providing care for a defined group of seriously injured patients in collaboration with the major trauma service in their network. They provide initial assessment, stabilisation and initiate transfer to a major trauma service when a patient requires services not available at the regional centre. These hospitals provide a referral service for trauma for hospitals within their rural network. |
| Rural Designated Protocol 4 (DP4) Trauma Service | These hospitals have 24 hour availability of a medical officer. They have the facility to provide emergency surgery and stabilisation. They provide early stabilisation of the seriously injured patient prior to transfer to a Rural Regional or major trauma service. |
| Rural Non-Designated Protocol 4 (DP4) Trauma Service | These are small hospitals or clinics in remote or rural parts of NSW that rarely receive seriously injured patients. They have no immediately available medical practitioner. They provide early triage, basic stabilisation, and early consultation and arrange transfer to a higher level of trauma service. |

## 5.1 Current trauma service provision

Trauma services are currently provided from the following hospitals.

**Table 3: Current NSW trauma service provision**

| Major trauma services | Regional trauma services | Rural regional trauma services |
|---|---|---|
| **Adult** | | |
| John Hunter | Gosford | Albury |
| Liverpool | Wollongong | Broken Hill |
| Nepean | | Coffs Harbour |
| Prince of Wales | | Dubbo |
| Royal North Shore | | Goulburn |
| Royal Prince Alfred | | Lismore |
| St George | | Orange |
| St Vincent's | | Port Macquarie |
| Westmead | | Tamworth |
| | | Wagga Wagga |
| **Paediatric** | | |
| Sydney Children's | | |
| Children's, Westmead | | |
| John Hunter Children's | | |

# Profile of major trauma in NSW

6

Trauma activity data has been extracted from two key sources, on a statewide basis using the NSW Health, Health Information Exchange (HIE), and for the severely injured major trauma patient group through the NSW ITIM Trauma Registry. Trauma admissions were identified within the HIE using the ICD-10-AM principal diagnosis and external cause of injury codes.

The analysis of trauma activity focuses on two trauma populations – all admissions for trauma (injury) and admissions with 'major' trauma, which includes patients with an ISS greater than fifteen (ISS > 15).

While the main focus of the trauma system planning is the moderately to severely injured (major trauma) patient group, it is important to consider this group as part of the overall caseload associated with injury related admissions to hospital in NSW and recognise that major trauma represents only a small percentage of the overall trauma group, as illustrated in Chart 1.

In 2004/05 there were 87,887 trauma related admissions in NSW, a 21% increase since 2000/01. Major trauma represents between 10.5 – 12 % of trauma admissions per annum and represents 15% of all trauma admissions to the major trauma services. Overall about 50% of major trauma admissions are managed in a major trauma service, with 30% in rural hospitals. In the metropolitan area about 80% of major trauma admissions are to major trauma services. There has been an increase in activity across all designations with the rural and regional trauma services having the largest increases.

## 6.1 Major trauma admissions

The NSW Trauma Registry data represents patients with an ISS > 15 who are admitted to the 12 major trauma services, as well as the two regional trauma centres (Gosford and Wollongong Hospitals) each calendar year. Since establishment in 2002, the trauma registry has recorded an average of approximately 2,200 people (per year) admitted to trauma services with major trauma (ISS>15).

Chart 2 demonstrates that the volume of deaths in this population has remained steady with a case fatality rate of 12.15% in 2007 (down from 12.6% in 2006). This is consistent with the Australasian death rate of 12%.[11]

### 6.1.2 Age

Injury is known to be highest in people aged 15-44 years (Chart 3) and a significant cause of morbidity and mortality among this age group. However, while the number of admissions for the younger age groups has remained relatively static, there has been an overall increase in the number of admissions for the older age groups. Apart from the higher number of co-morbidities among this patient group, they are also at risk of increased injury severity resulting from lesser mechanisms of injury, increased risk of complications in part due to their co morbidities as well as other age related factors, and generally have an increased average length of stay.

### 6.1.3 Mechanism of injury

Road trauma, falls and assaults are the most common mechanisms of injury recorded for major trauma. The most common mechanisms of injury are more likely to result in blunt trauma. Injuries associated with penetrating trauma account for just over one percent of admissions, and are concentrated in the 16-44 year age group. The NSW Trauma Registry records low to medium falls as the most frequently mechanism of injury for major trauma admissions, accounting for approximately a third of admissions in this major trauma group.

### 6.1.4 Procedures

The volume and type of procedures performed on trauma patients provides an indication of injury severity and resource requirements. Orthopaedic procedures are the most common principal procedure accounting for around half of all principal procedures. As this figure refers only to the principal procedure, it is likely that a much higher percentage of trauma admissions will have an orthopaedic procedure.

11 National Trauma Registry Consortium (Australia and New Zealand). 2008. The National Trauma Registry (Australia & New Zealand Report:2005. Herston: National Trauma Registry Consortium (Australia and New Zealand).

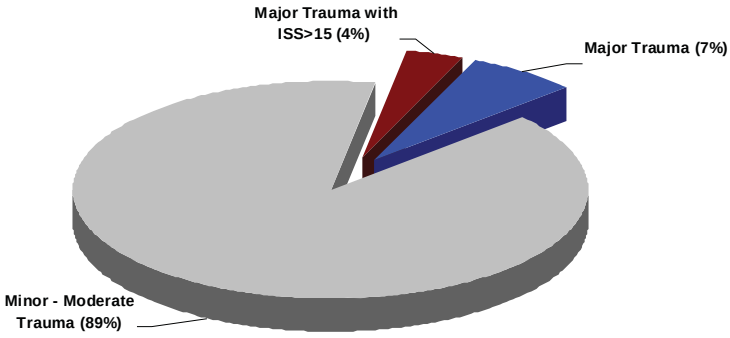
While a number of patients will have multiple procedures, the majority of these patients do not require multiple complex procedures such as craniotomy, laparotomy and thoracotomy. In 2004/05 of the 6,312 patients admitted with major trauma 5,198 had at least one procedure (82.4% of patients). Of these patients 1,974 (38%) had a radiological/imaging procedure as their principal procedure.

The more complex procedures are concentrated in the major trauma services reflecting both the higher severity of injury admitted to major trauma services as well as the concentration of tertiary level specialist services at these hospitals. Craniotomies are the most frequent of these surgical procedures performed. The number of laparotomies, in particular exploratory laparotomies has declined since the introduction and more widespread use of Focused Assessment with Sonography for Trauma (FAST) which is used to assess the abdomen for the presence of blood or free fluid. The number of thoracotomies and thoracic surgery performed has remained consistently low reflecting the low rates of penetrating trauma in NSW.

### 6.1.5 Intensive care services

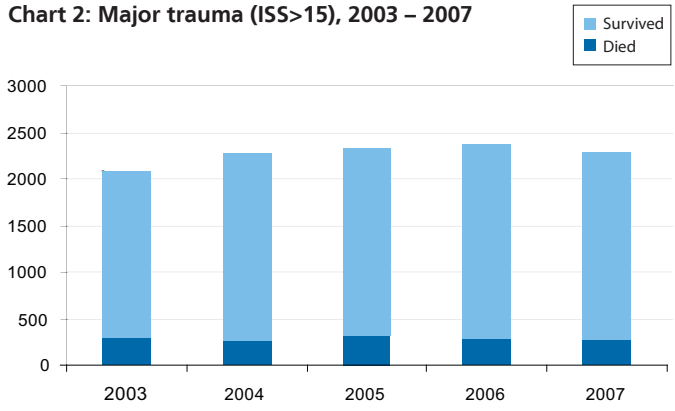
Due to the severity of their injuries, major trauma patients are often admitted to an intensive care unit. Data from NSW ITIM indicates that admission rates for major trauma patients with an ISS > 15 to Intensive Care Units average at about 44%, with an average length of stay of 7.5 days. These numbers reflect those patients admitted to intensive care for close monitoring or, in conjunction with intubation and ventilation. Within the data it is acknowledged that patients admitted to High Dependency Units that are embedded within some Intensive Care Units are included within the figures, therefore an admission rate of 44% is considered generous. The location, size and role level of Intensive Care and High Dependency services, and their capacity for growth, are key considerations in planning changes to the trauma system.

**Chart 1: Major trauma vs Minor trauma**



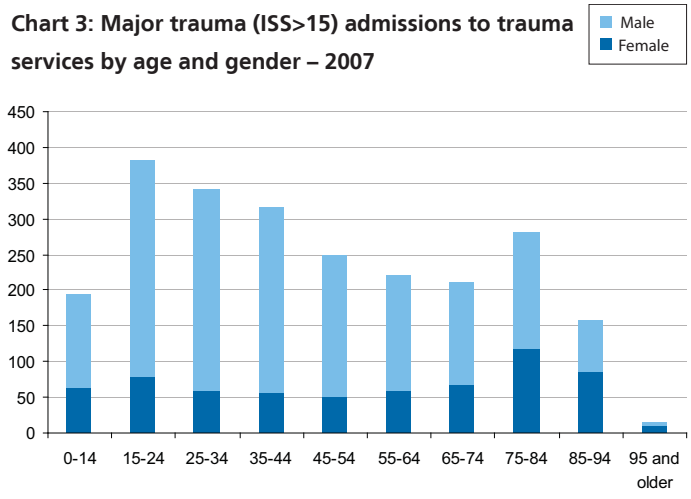

*Source: NSW HIE– Admitted Patient Data Collection, NSW ITIM Trauma registry – 2004/05 data*

**Chart 2: Major trauma (ISS>15), 2003 – 2007**




*Source: NSW ITIM Trauma Registry, 2009*

**Chart 3: Major trauma (ISS>15) admissions to trauma services by age and gender – 2007**




*Source: NSW ITIM Trauma Registry, 2009*

# Trauma system review 7

An effective trauma system needs to be responsive to changing models of care and developments in clinical practice; be able to incorporate into policy and planning, improved understanding of trauma care; ensure sustainability of the trauma services workforce; and, promote efficient and effective resource utilisation.

While there has been no consensus among the trauma clinicians regarding the preferred number of major trauma services to be located in Sydney, there has been broader agreement on the need to concentrate major trauma resources for NSW. Stakeholders also confirmed the following key issues that needed to be considered in the identification of a preferred option for the configuration of services for the next decade:

- Caseload, within the context of safety and quality outcomes;
- Pre-hospital care and transport, including travelling times;
- Workforce, with reference to senior trauma specialists and other key professional groups;
- Training and skill maintenance; and
- Related services, with particular reference to emergency, access to operative procedures and interventional radiology, acute care services, and rehabilitation.

## 7.1 Trauma service options

In 2005, the *"Draft Options Discussion Paper, NSW Trauma System 2011 and 2016, January 2006"*, was developed. The Options Paper identified key issues and developed five options for the configuration of major trauma services. The paper was distributed to clinicians and stakeholders for review and comment. The service configurations considered were:

- Option 1: Status Quo (base case option for comparison purposes);
- Option 2: Six major trauma services (five in Sydney and John Hunter Hospital);
- Option 3: Five major trauma services (four in Sydney and John Hunter Hospital);
- Option 4: Four major trauma services (three in Sydney and John Hunter Hospital); and
- Option 5: Three major trauma services (two in Sydney and John Hunter Hospital).

The subsequent analysis of commentary, detailed discussion with AHS, and clinicians resulted in *"The NSW Trauma System, Service Model for the Adult Major Trauma Services, Position Paper."* Based on the comments received, and following a consultation process with each of the major trauma services, the number of Options was refined to three:

- Option 1: Six major trauma services (five in Sydney and John Hunter Hospital);
- Option 2: Five major trauma services (four in Sydney and John Hunter Hospital); and
- Option 3: Three major trauma services – within this Option there are two possible configurations – Option 3a and Option 3b (two in Sydney and John Hunter Hospital).

When identifying the range of options particular recognition was given to the specific requirements of the Sydney central business district (CBD). While the resident population of the CBD is small in comparison to other areas, there is increasing urban consolidation which is increasing the resident population, in addition to the large daily influx of people for business and leisure activities. The transient population has been estimated at 750,000 per day. Also pertinent are the considerations relevant to providing an appropriate major disaster response.

Consideration was also given to the NSW Critical Care Referral Network. The current major trauma services provide referral network services along similar lines to the Critical Care Referral Network with the exception of trauma referrals from the North Coast AHS. These time critical trauma referrals are transported to John Hunter Hospital, in preference to the additional travel time that would be required to transport the patient to Royal North Shore Hospital.

The modelling which was undertaken and used to inform the decision making process is based on current available population, pre-hospital and inpatient data. Analysis and comparison was undertaken against pre hospital triage and transport issues; volume and quality relationships; and training and sustainability of the workforce.

Evaluation of the three options resulted in Option 1 being selected as the preferred adult trauma services model. This model comprises five adult major trauma services in greater metropolitan Sydney and one in Newcastle.

As the preferred service model, this model allows for some consolidation of trauma services without overwhelming any particular sites, and will cause minimal increase to pre hospital transport times.

Early in the planning process it was determined that the delivery of paediatric trauma services should be considered in its own right, with a view to ultimately integrating the service model into a statewide trauma system. Consideration of paediatric trauma service issues was initiated with the development of the *Paediatric Trauma Services in NSW, Background Paper, September 2006*, and followed by a meeting with representatives from the three children's hospitals and paediatric trauma clinicians.

The analysis undertaken and expert opinion indicated that the status quo should be maintained with the three children's hospitals continuing to provide specialist paediatric trauma services. A key issue to be resolved is the networking of trauma services and the protocols around bypassing adult major trauma services in favour of specialist paediatric services in metropolitan environments. Pre-hospital triage, clinical management and transport protocols provide the framework to ensure paediatric patients can access definitive trauma care in an appropriate time frame as specified in this NSW Trauma Services Plan.

The *Statewide Trauma Planning, Rural Discussion Document* was distributed to Rural AHS to facilitate a consultation process on proposed changes to Trauma Networks and to inform trauma planning. A series of consultations with rural clinicians and Hunter New England, Greater Southern, North Coast and Greater Western AHSs were undertaken.

In August 2007 the Health Care Advisory Council endorsed the configuration for the development of the NSW Trauma Service Plan based on five integrated trauma services networks which incorporate the six major trauma services and the regional trauma services in metropolitan and rural areas.

Recommendations from the *2008 Garling Special Commission of Inquiry; Acute Care in NSW Public Hospitals*, support a concentration and reduction of major trauma services, and suggest that NSW Health designates only three MTSs in the Sydney metropolitan area and one MTS for rural NSW located in Newcastle.

## 7.2 Pre-hospital management of serious trauma review

The purpose of the ASNSW Pre-Hospital Trauma Triage Protocol T1 (formally known as Protocol 4) is to provide a state-wide, structured protocol driven process for patients meeting the criteria defining serious trauma to receive an appropriate emergency response and transport to the appropriate level trauma facility within the least time interval possible.

The ASNSW has undertaken an evaluation and review of the pre-hospital management of serious trauma protocol. The review proposed the introduction of a program for the management of serious trauma based on the concept of a co-ordinated system approach, recognising that the entirety of the NSW trauma capacity forms a complex adaptive system with its own consequent challenges. Changes are aimed at improving the specificity and sensitivity of the triage tool to reduce the under- and over-triage rates.

The review process recommended the development of a Major Trauma program within Ambulance, aimed at further improving patient outcomes through initiating new protocols and guidelines for the pre hospital management of serious trauma, providing improved clinical oversight and earlier notification of medical retrieval services where required.

## 7.3 NSW Institute of Trauma and Injury Management (ITIM)

The NSW ITIM was established in 2002 to work in partnership with the NSW Department of Health, AHS and relevant clinical groups to provide clinical leadership in trauma care and to support the continuing development of trauma and injury management across NSW.

The Institute is sponsored and funded by NSW Health, and is responsible for:

- Developing and implementing system processes and clinical practice guidelines as standards for trauma care in NSW;
- Monitoring and reporting on the performance of individual Trauma Services to ensure that performance is consistent with the standard of care;
- Managing a state-wide clinical injury data collection process;
- Promoting and facilitating education in trauma care to meet the needs of health care providers in NSW; and
- Providing policy advice on areas for improvement within the trauma system, on the accreditation of trauma services in partnership with the professional colleges and the regionalisation of trauma services within NSW.

As a component of the trauma system planning process, a review of the operation and organisation of ITIM with respect to its role; structure; its operation as a statewide initiative; and its original terms of reference was undertaken.

Concurrent to this review the Motor Accidents Authority of NSW approached NSW Health regarding a proposal to establish partnership to undertake research and education to minimise the impact of traumatic injury and support better outcomes for injured people. The proposal was to provide a holistic approach to injury management with a multidisciplinary focus that extends across the continuum from injury and initial trauma management through to rehabilitation and community re-integration.

The development of collaborative partnerships with injury stakeholders offers a number of opportunities to build an improved critical mass for research and education across the spectrum of trauma prevention; care; and, rehabilitation.

# 8 Projected demand for major trauma services in NSW

## 8.1 Population projections

The Department of Planning prepare population projections for use by all NSW Government Departments.

Projections are based on demographic models that project births, deaths, internal migration and overseas migration. The models take into account the fact that these components of population change operate differently across regions and age groups.

In 2006 the population of NSW was 6.8 million. The population is projected to reach 7 million in 2011 and 8 million by 2021.

Population projections for NSW are shown in Table 4.

Population growth will impact on the number of injury related admissions even if incidence rates remain static. The largest projected population increases will be in the Sydney region, accounting for 75% of the State's growth, and increase its share of the State population from 63% (4.3 million) in 2006 to 64% (5.2 million) in 2021. Nearly all of the remaining 25% of the projected growth will occur in the coastal regions. Population growth for inland areas of the state will be modest or negligible.

All regions are projected to experience significant growth of their elderly population between 2006 and 2021, with the greatest increases in those aged 65 – 84 (50%) and 85 and over (70% increase).[12] The ageing of the population will have implications for the delivery of trauma services into the future, with the elderly being a more complex patient group due to associated co-morbidities.

Population changes are indicative of potential caseload increases, as the majority of trauma patients will have minor to moderate injury and will continue to be managed at the nearest hospital. The wide distribution of residents in regional and rural areas of the state in conjunction with the level of clinical services and availability of the required specialty services, in particular neurosurgery, preclude the establishment of a major trauma service in a regional area.

International population based studies estimate the rate of major trauma patients discharged to be 44 per 100,000 person-years and suggests the need for only one or two high level trauma centres per million population to achieve the appropriate concentration of severely injured patients in a limited number of special care facilities using appropriate triage criteria.

**Table 4: Estimated resident population and population projections to 2021**

| Year ending 30 June | Projected population | | | |
|---|---|---|---|---|
| | NSW | Rural | Greater metropolitan [B] | Sydney |
| 2006 [A] | 6,816,087 | 1,738,604 | 5,077,483 | 4,281,988 |
| **2011** | 7,207,641 | 1,806,582 | 5,401,060 | 4,564,237 |
| **2016** | 7,603,502 | 1,874,400 | 5,729,102 | 4,851,697 |
| **2021** | 8,008,299 | 1,939,621 | 6,068,678 | 5,150,685 |

A: Estimated Resident Population - Australian Bureau of Statistics as at June 2006

B: Includes Sydney, Wollongong & Newcastle

*Source: NSW Health Population Projection Series 1.2009, Dept. of Planning & Statewide Services Development Branch, NSW Health, March 2009.*

12 Department of Planning (2008) New South Wales State and Regional Population Projections 2006-2036:2008 Release. Department of Planning: Sydney.

Based on national and international reviews of service to population ratios the National Road Trauma Advisory Council (NRTAC) Report recommended the provision of a major trauma service per million population for NSW. A population base of this size is deemed to provide appropriate numbers of critically injured patients for the development and maintenance of clinical expertise in the management of seriously injured patients at each designated site.

Based on 2006 population projections the Sydney metropolitan area would require at least four major trauma services. This increases to five when the populations of Newcastle and Wollongong are included. In 2011 the NSW population is projected to reach 7.2 million which, according to the above benchmarks, would support the requirement of six or seven major trauma services for NSW. The Canberra Hospital, as a major trauma service, provides a trauma referral service for parts of the Greater Southern AHS, and is considered as one of the seven major trauma services required for NSW.

## 8.2 Major trauma activity

It is important to emphasise that the majority of injured patients will not be affected by changes to the trauma system and will appropriately continue to be treated at the nearest hospital. For the purposes of the modelling and projections the patient group of interest is patients with moderate to severe injury (major trauma), who require the expertise and facilities available at a major trauma service, as this is the patient group that will be impacted by changes to the configuration of major trauma services.

There is no trauma flag or indicator of injury severity in the HIE that can be used to accurately identify trauma related inpatient activity, also there are no discrete trauma Enhanced Service Related Groups (ESRG). Therefore identification of the 'major' trauma patient group has some limitations within the data available. The major trauma patient group was assembled through selecting specific trauma related Diagnosis Related Groups (DRG). In addition, individual International Classification of Diseases - 10th Revision (ICD10) diagnosis codes were selected based on diagnoses which were more likely to reflect moderate to severe injury and therefore the patient group which would more likely need to be treated at a major trauma service.

A full list of the individual diagnoses selected for major trauma has been included in Appendix 4.

It is recognised that while not all the patients in the selected diagnoses codes will have moderate to severe injuries, these diagnosis codes are more likely to reflect major trauma than minor injury. It is also recognised that not all these patients will require management in a major trauma service and could be managed at a larger metropolitan hospital or rural hospital. However in testing the validity of the ICD 10 selection it was found that in urban areas the majority of these cases are managed at the major trauma services and that the major procedures were concentrated in this group of patients.

Trauma ICD10 codes and DRGs are spread across ESRGs. The methodology required identification of ESRGs which are more likely to contain cases with major trauma (Table 5) and estimating the proportion of overall activity within an age group and ESRG that these cases represent and then applying these proportions to the modelling. This estimate is based on analysis of five years of worth of data from NSW public and private hospital activity.

**Table 5: ESRGs for major trauma**

| | |
|---|---|
| 429 | Other cardiothoracic surgery |
| 461 | Head injuries |
| 462 | Craniotomy |
| 549 | Other non-specialty surgery |
| 621 | Extensive burns |

Within each of these ESRGs, the proportion of overall activity that can be attributed to major trauma is assumed to remain constant for the projection period (2011/12 and 2016/17).

All modelling work has been undertaken using aIM2005, a software application that allows health service planners to model and project acute admitted demand and supply scenarios within a defined population catchment. aIM2005 produces projections at the lowest clinical level grouping of ESRGs. Modelling has been confined to the identified trauma ESRGs and day-only activity has been excluded from the analysis. The aIM2005 projections reflect future trauma activity on the basis of incidence observed for the five year period 2000-2005, in line with changes in demography and clinical trends distribution of activity to the existing major trauma hospitals on the basis of a demand-supply matrix for activity in 2003/04.

# Projected demand for major trauma services in NSW

**Table 6: Major trauma service activity ***

| | Actual | Projected | |
|---|---|---|---|
| | **2003/04** | **2011/12** | **2016/17** |
| **Separations** | 2,743 | 3,040 | 3,255 |
| **Bed days** | 26,317 | 37,853 | 40,490 |

*Source: aIM2005*

In the development of the "*The NSW Trauma System, Service Model for the Adult Major Trauma Services, Position Paper June 2007",* scenario modelling of the proposed options for reconfiguration of major trauma services was undertaken. The aIM 2005 methodology projections reflect a range of varying assumptions including the redistribution of major trauma activity in accordance with the future configuration of major trauma services.

The modelling "allows" activity to flow from particular regions to hospitals that are designated major trauma centres under the scenario. In each scenario it was assumed that all the activity (in the selected ESRGs) for a particular region (or regions) flows to a particular designated major trauma centre. The scenarios also included a rural component which is based on the assumption that activity from particular rural AHSs will flow to particular trauma centres.

Once the models were run, the "trauma fraction" for each of the ESRGs was applied uniformly across age-groups and sex for the total activity projected for 2011/12 and 2016/17. Projections are produced that show the projected volume of total activity (separations and bed days) by age-group and ESRG. The projected volume of trauma is derived by applying the incidence rate derived from analysis of five years of admitted patient data.

Table 7 shows the results of projection modelling for adult major trauma based on the future configuration of major trauma services.

The total volume of major trauma activity is projected to change, in line with changes in population and demographic changes. These changes in activity are considered in the normal processes of AHS service planning and development.

Changes in activity for Liverpool and Westmead Hospital will occur as a result of large projected increases in the population catchments of 17% for Liverpool and 19% for Westmead to 2016.

**Table 7: Major trauma service - Major trauma separations and bed days**

| **Major trauma service** | **Separations** | | | **Bed days** | | |
|---|---|---|---|---|---|---|
| | **2003/04 actual** | **2011/12 projected** | **2016/17 projected** | **2003/04 actual** | **2011/12 projected** | **2016/17 projected** |
| JHH | 332 | 369 | 398 | 3,068 | 4,315 | 4,561 |
| Liverpool | 320 | 376 | 416 | 3,165 | 4,770 | 5,372 |
| RNSH | 402 | 441 | 471 | 4,496 | 5,306 | 5,587 |
| RPA | 395 | 544 | 655 | 3,624 | 7,220 | 8,476 |
| St George | 270 | 341 | 357 | 2,597 | 4,192 | 4,525 |
| Westmead | 386 | 604 | 644 | 3,813 | 7,400 | 7,927 |
| **Total** | **2,105** | **2,675** | **2,941** | **20,763** | **33,203** | **36,448** |

*Source: aIM2005*

* Includes John Hunter, Liverpool, Nepean, Prince of Wales, Royal North Shore, Royal Prince Alfred, St George, St Vincent's and Westmead. The Children's Hospitals are not included in this data.

The reconfiguration of the major trauma services in the Sydney metropolitan area from eight to six will concentrate the redistributed trauma activity on the nearest remaining major trauma service, resulting in an increase in major trauma admissions at Royal Prince Alfred and St George Hospitals.

Royal North Shore, Westmead and St George Hospitals also have direct network responsibility for one of the three regional trauma services (Gosford, Nepean and Wollongong Hospitals), which will impact on the anticipated demand through referral workload. Patient flows to the major trauma services from the rural areas will be consistent with designated trauma referral networks. Some additional activity at Westmead as a result of the change in the trauma referral network for GWAHS may also occur.

While the reconfiguration of the trauma system is aiming to concentrate the major trauma cases in the designated major trauma services, there will continue to be inpatient trauma activity of the less severely injured patients across sites previously designated as a major trauma services, as indicated in Table 8.

### 8.2.1 Procedures

The impact on the individual trauma services of changes to the numbers of procedures performed will have some impact on the operating theatres, particularly their capacity to accommodate elective procedures, or to enable timely access of emergency procedures to operation. Trauma patients requiring surgery can present at any time of the day or night. Trauma services need to ensure availability of surgical specialties and anaesthesia with a dedicated theatre for emergency surgery.

Scenario modelling of operating theatres was completed with the NSW Health Operating Theatre projection Tool v1.11, which uses significant factors affecting surgical demand and operating theatre capacity to produce an estimate of operating theatre requirements. The operating theatre model utilised the above aIM2005 projections as a basis to forecast the impact of the reconfiguration of major trauma services on theatre requirements at the major trauma services. An 'acute surgical theatre' type was used in the theatre modelling with availability of 365 days per year for 15 hours per day (0800 – 2300).

The projection models the theatre volume and requirements under the assumptions of major trauma cases flowing to trauma services as indicated in the modelling of separations and bed days as shown in Table 7.

Table 9 shows the results of the theatre modelling and provides an indication of theatre requirements for patients with moderate to severe trauma under the future configuration of six adult major trauma services. The modelling produced an estimate of 1,383 cases of moderate to severe trauma requiring an operating theatre in 2003-04, which represents 66% of separations as per Table 7.

Data from the NSW ITIM suggests that approximately a third of major trauma cases undergo an operative procedure in the first 24 hours of admission to a major trauma service. This suggests that the projection is conservative, tending to slightly over estimate theatre requirements for moderate to severe trauma.

**Table 8: Other sites - Trauma separations and bed days**

| Hospital | Separations | | | Bed days | | |
|---|---|---|---|---|---|---|
| | 2003/04 actual | 2011/12 projected | 2016/17 projected | 2003/04 actual | 2011/12 projected | 2016/17 projected |
| Nepean | 209 | 55 | 59 | 1,512 | 688 | 739 |
| Prince of Wales | 221 | 187 | 127 | 2,170 | 2,644 | 1918 |
| St Vincent's | 208 | 123 | 128 | 1,872 | 1,318 | 1384 |
| **Total** | **638** | **365** | **314** | **5,554** | **4,650** | **4042** |

*Source: aIM2005*

**Table 9: Moderate to severe trauma cases requiring theatre and theatre requirements**

| Major trauma services | Cases for theatre | | | Theatre requirements | | |
|---|---|---|---|---|---|---|
| | 2003/04 actual | 2011/12 projected | 2016/17 projected | 2003/04 actual | 2011/12 projected | 2016/17 projected |
| JHH | 206 | 272 | 300 | 0.2 | 0.3 | 0.3 |
| Liverpool | 216 | 267 | 299 | 0.2 | 0.3 | 0.3 |
| RNSH | 223 | 269 | 296 | 0.2 | 0.3 | 0.3 |
| RPA | 285 | 467 | 495 | 0.3 | 0.5 | 0.5 |
| St George | 189 | 282 | 306 | 0.2 | 0.3 | 0.3 |
| Westmead | 264 | 310 | 338 | 0.3 | 0.3 | 0.3 |
| **Total** | **1,383** | **1,867** | **2,034** | **1.4** | **1.9** | **2.1** |

*Source: NSW Health Operating Theatre projection tool VI.II*

### 8.2.2 Intensive care

Intensive Care Unit (ICU) stay could not be used as an indicator of injury severity due to problems with the capture and accuracy of this data currently in the HIE. Data from NSW ITIM indicates that admission rates for major trauma patients to ICU have averaged at approximately 44% over the past five years with an average length of stay of 7.5 days.

Using an admission rate to ICU of 44% and the projections of major trauma admissions detailed in Table 7, the following ICU admissions are projected for the Major Trauma Services.

**Table 10: Major trauma ICU admission**

| Major trauma services | Admission to ICU | | |
|---|---|---|---|
| | 2003/04 actual | 2011/12 projected | 2016/17 projected |
| JHH | 146 | 162 | 175 |
| Liverpool | 141 | 165 | 183 |
| RNSH | 177 | 194 | 207 |
| RPA | 174 | 239 | 288 |
| St George | 119 | 150 | 157 |
| Westmead | 170 | 266 | 283 |
| **Total** | **927** | **1,176** | **1,293** |

# Future NSW trauma system 9

Within NSW Health there are defined lines of responsibility for care of the injured patient within the trauma system, across the trauma care continuum, from injury prevention to rehabilitation. NSW Health oversees the planning and coordination of the state trauma system. This is achieved through a partnership between Strategic Development Division, the Centre for Health Protection, the Chief Health Officer and the NSW ITIM. The services are governed and operated by the AHSs.

## 9.1 Injury prevention

It is recognised that the prevention of injury plays the most significant role in minimising the impact of the disease of injury on NSW residents. Injury prevention addresses the public health problem of trauma by reducing the number of new cases of injury, as well as by reducing the severity of those injuries that do occur.

No one sector has control over the multiple settings and causes of injuries. Therefore, it is imperative that effective partnerships are formed and maintained with all stakeholders (community, government, non-government and private sector) who have existing or potential passive and active roles to play in promoting safe behaviours and reducing injury exposure and risk conditions/ environments.

Injury prevention efforts are based on identification of specific injuries and risk factors in patients and the community. Collaboration with existing injury prevention stakeholders at Area and State level will create a systematic approach for activities, program development, and the provision of information to the community.

## 9.2 Pre-hospital

### 9.2.1 Ambulance Service of NSW (ASNSW) major trauma program

The ASNSW provides the pre-hospital component of care to the injured patient. Ambulance Stations are located at strategic points across the State to facilitate a rapid response time so that the injured patient can be delivered to definitive care in the shortest period of time possible. The accurate identification of patients with serious injury and their timely arrival at an appropriate hospital are crucial to the effectiveness of the trauma system.

#### Protocol T1

All trauma patients attended by the ASNSW are assessed according to the ASNSW Protocol T1 Pre-hospital Management of Major Trauma which is based on the MIST criteria to trigger a systemwide response to a patient suffering major trauma and a maximum sixty minute travel time to definitive care if required and clinically appropriate.

#### Rapid Launch Trauma Coordinator (RLTC)

The RLTC facilitates the early identification of and capacity to allocate primary medical responses to potential major trauma incidents, and activate early transfer or retrieval arrangements.

### 9.2.2 Retrieval services

There are two specialist medical retrieval services, which undertake the majority of retrievals across the State. Medical retrieval teams are provided by the:

- Aeromedical and Medical Retrieval Service (AMRS); and the
- Newborn and paediatric Emergency Transport Service (NETS)

These statewide services, in conjunction with regional retrieval services, undertake retrievals from all rural and metropolitan areas. Medical retrieval teams comprise a combination of medical, nursing and/or paramedic staff and are transported by road ambulance, helicopters and the fixed wing, Air Ambulance fleet.

The AMRS have an integral role in the coordination of retrieval of adult patients to higher levels of service (secondary transfers) as well as tasking the primary medical response to the scene of an accident (primary response).

The Medical Retrieval Consultant provides clinical oversight and assists paramedics with pre-hospital clinical decisions and authorises extended transport times.

To contact Aeromedical and Medical Retrieval Services (AMRS)

**1800 650 004**

In addition, some Regional Retrieval Services provide a local contact number that is available within that Critical Care Network. Either the local contact number or 1800 650 004 can be used.

For transfer of children 15 years and under to a paediatric major trauma service the Neonatal and paediatric Emergency Transport Service (NETS) provide statewide coordination of neonatal and paediatric retrieval.

Contact NSW Neonatal and paediatric Emergency Transport Services (NETS) on

**1300 36 2500**

for children aged 15 years and under.

#### Head Injury Retrieval Trial (HIRT)

In 2005, CareFlight obtained funding from the Insurance Australia Group (IAG) to perform a clinical trial to be conducted across the Greater Sydney Metropolitan Region which aims to demonstrate improvement in patient outcomes by delivering physician management to patients suffering severe head injury within 15 minutes of the "000" call to the ASNSW.

The trial commenced in May 2005 and continues, as at 2009. The objective of this initiative is to reduce the long term cost of injury and improve recovery outcomes for people with severe head injuries.

**Table 11: NSW Trauma service designation**

| Major trauma services | Regional trauma services |
|---|---|
| **Adult** | Gosford |
| John Hunter | Wollongong |
| Liverpool | Nepean |
| Royal North Shore | Coffs Harbour |
| Royal Prince Alfred | Lismore |
| St George | Orange |
| Westmead | Port Macquarie |
| **Paediatric** | Tamworth |
| Sydney Children's | Tweed Heads |
| Children's, Westmead | Wagga Wagga |
| John Hunter Children's | |

## 9.3 Designated trauma services

A trauma service represents a multidisciplinary structure of care for injured patients and includes staff and resources necessary to ensure the appropriate and efficient provision of trauma care. This includes access to relevant subspecialties and coordinated multidisciplinary care.

The NSW Trauma System is comprised of the following levels of service:

- Major Trauma Services (MTS)
- Regional Trauma Services (RTS)
- Local hospitals

The maps on the following pages show trauma service locations for NSW.

In rural areas, where travel times are too great for patients to be transported direct to a RTS rural hospitals will provide initial assessment and resuscitation; and limited stabilisation prior to early transfer to the appropriate RTS or MTS. Due to geographical location it is recognised that Bega, Broken Hill, Dubbo, and Griffith Hospitals will receive major trauma. In these cases early activation of a trauma retrieval response will occur to facilitate patient transfer to a higher level trauma service.

Canberra Hospital is formally acknowledged as a MTS within the NSW Trauma Network as it provides a trauma tertiary referral role to the GSAHS.

Trauma Services will meet requirements, as defined by the NSW Health Guide to the Role Delineation of Health Services to ensure consistency with NSW Health Policy framework clinical services planning guidelines. Where relevant, the equivalent Royal Australasian College of Surgeons Trauma Verification classification system is included (Appendix 2).

The statewide specialty services for Spinal Cord Injury and Severe Burn Injury are also integral components of the Trauma System.

| Statewide specialty service | Hospitals |
|---|---|
| Severe Burn Injury Service | Concord |
| | Children's, Westmead |
| | Royal North Shore |
| Spinal Cord Injury Service | Prince of Wales |
| | Children's, Westmead |
| | Royal North Shore |
| | Sydney Children's |

**Figure 3: NSW trauma services**

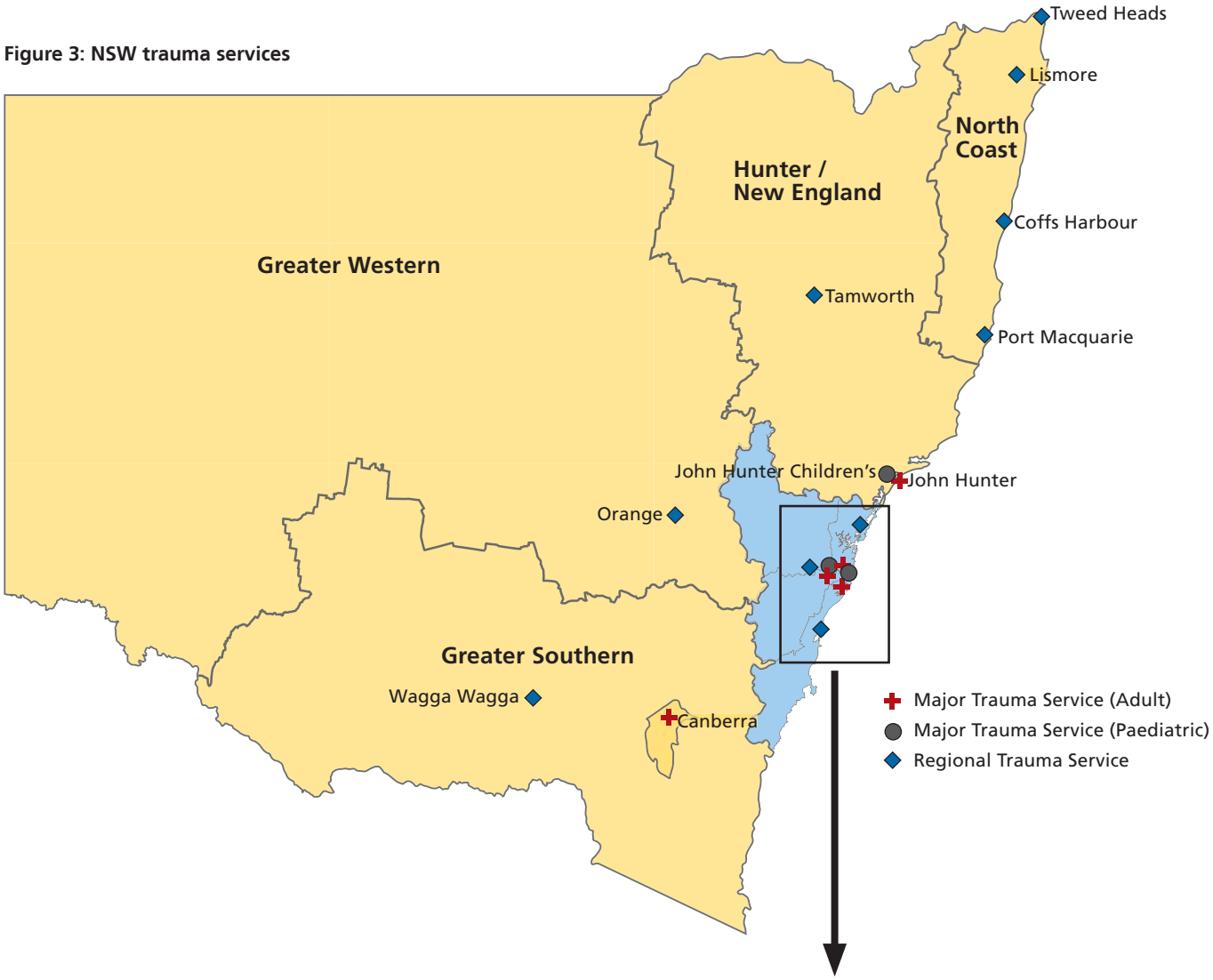



**Figure 4: Metropolitan trauma services**

### 9.3.1 Major trauma service (MTS)

A MTS (adult or paediatric) can provide the full spectrum of care for major and moderately injured patients, across the trauma care continuum from initial resuscitation through to rehabilitation and discharge. Such a hospital provides a full range of specialist services delineated as Level 6 (NSW Health, Guide to the Role Delineation of Health Services, 2002).

A MTS acts as the principal hospital for reception of inter-hospital transfer of major trauma patients. Within each network, the MTS will have responsibility for patients referred within the network, the provision of education, clinical support and workforce development.

A MTS will have:

- a time critical trauma team response;
- coordinated care of the injured patient across the trauma care continuum;
- a surgical trauma admitting service (bed card);
- case management to all major trauma patients, who require complex multidisciplinary care;
- a trauma monitoring and performance improvement program; and
- documented protocols (routinely updated) relating to the management of trauma.

A MTS has all surgical specialties, including interventional radiology, required for the care of seriously injured trauma patients available 24 hours day. A MTS shall have an operating theatre that is available for trauma patients at all times. All surgical sub specialties are essential including prompt availability of neurosurgery; cardiothoracic; orthopaedics; and plastics.

In addition to the provision of complex clinical care to injured patients the MTS will provide clinical leadership, education, research and performance improvement throughout their defined trauma networks to promote a cooperative and collaborative working environment among the clinical disciplines involved in trauma care.

The multidisciplinary activities of the MTS are led by the Trauma Director and the Trauma Nurse Coordinator. This entails the day-to-day responsibility and coordination of services and systems necessary for a multidisciplinary approach to providing trauma care. A recommended staffing infrastructure for the trauma service is provided in Table 12.

It is also essential that the trauma service has established links with Rehabilitation Services within the hospital. The inclusion of a Trauma Fellow to the staff complement is seen as essential to support a robust trauma training education and research program.

**Table 12: Major trauma service infrastructure**

| **Role** | **MTS (Adults)** | **MTS (Paediatrics)** |
|---|---|---|
| Trauma Director | Full time | Part time |
| Trauma Nurse Coordinator / Trauma CNC | Full time | Part time |
| Trauma Registry Manager | Full time | Part time |
| Trauma Case Manager (CNS) | Full time | Part time |
| Area Trauma Coordinator (CNC) | Full time | |

*Generic descriptions for these roles are provided in Appendix 3.*

### 9.3.2 Regional trauma services (RTS)

A RTS can provide a high level of care to the injured patient. Definitive trauma care can be provided to a limited number of major trauma patients in collaboration with the major trauma service; and can provide all aspects of care to people with moderate and minor trauma. These hospitals provide trauma services to supplement the clinical activities of the MTS in population dense areas and in areas where travel times are too great for patients to be transported direct to a major trauma service. They provide initial assessment, stabilisation and definitive care and initiate transfer to the major trauma service when a patient requires services not available at the regional centre.

To provide this level of service the RTS requires:

- 24 hour access to medical and nursing staff with appropriate skills and expertise to assess, resuscitate and manage patients with major trauma;
- access to diagnostic services – radiology, CT scanning, and pathology;
- access to an operating theatre if required; and
- access to ICU and inpatient beds if required.

There will be varying capacity amongst rural RTS for the provision of emergency surgery, although a surgeon and anaesthetist must be available for all major traumas.

Each RTS will be networked to a MTS, and will have established transfer agreements for the transfer of major trauma patients. In the rural areas the RTS provide a referral service for trauma from hospitals within their rural network.

A recommended staffing infrastructure for a RTS is provided in Table 13. Within the rural areas the Trauma Director and Trauma Nurse Coordinator will provide leadership and clinical support for hospitals within their rural referral networks.

### 9.3.4 Local hospitals

These hospitals also play a part in the trauma system, but are not designated trauma services. These may be tertiary hospitals, while others are hospitals serving predominantly local communities in metropolitan or rural areas. As part of the Ambulance Protocol T1 these hospitals will be bypassed for major trauma. However, they will continue to receive minor to moderate trauma cases.

## 9.4 Statewide specialist services

The trauma system and trauma services are networked with the State Spinal Cord Injury Service (SSCIS) and the Severe Burn Injury Service (SBIS) for clinical support and to ensure timely access to these services for patients requiring these specialised type of services. These networks are largely determined by the location of the clinical super-specialty services, and in some cases, the imperative to achieve early clinical intervention, such as for those patients with major trauma.

### 9.4.1 NSW Severe Burn Injury Service (SBIS)

The NSW SBIS is located over three campuses, at the Royal North Shore and Concord Hospitals and the Children's Hospital at Westmead. The NSW SBIS coordinates and provides management of people who have sustained a severe burn injury.

Trauma patients with a severe burn injury should be referred to the Severe Burn Injury Service as per the NSW Health Burn Transfer Guidelines 2008 (GL 2008_ 012). For adult patients with severe burns requiring transfer, AMRS should be contacted early to facilitate clinical advice, receiving hospital acceptance and timely transfer. For paediatric patients with severe burns, contact NETS.

**Table 13: Regional trauma service infrastructure**

| Role | RTS |
|---|---|
| Trauma Director | Part time |
| Trauma Nurse Coordinator / Trauma CNC | Full time |
| Trauma Registry Manager | Part time |
| *Generic descriptions for these roles are provided in Appendix 3* | |

### 9.4.2 NSW State Spinal Cord Injury Service (SSCIS)

The SSCIS for adults is located at the Royal North Shore and Prince of Wales Hospitals. Children requiring care for acute spinal cord injury are cared for at the Children's Hospital Westmead and the Sydney Children's Hospital. The SSCIS is responsible for the management of patients who have sustained a spinal cord injury where there is persistent neurological deficit arising from either a traumatic or non-traumatic but non-progressive cause who require specialised SCI services.

For adult patients with spinal cord injury requiring transfer, AMRS should be contacted early to facilitate clinical advice, receiving hospital acceptance and timely transfer. For paediatric patients with spinal cord injury, contact NETS.

Regional and major trauma services will have established protocols for the stabilisation and initial management of spinal cord injury which are aligned with the SSCIS. Early notification of spinal cord injured patients to the SSCIS will facilitate transfer of the patient to a designated Spinal Cord Injury unit, and assist with the development a collaborative management plan prior to transfer.

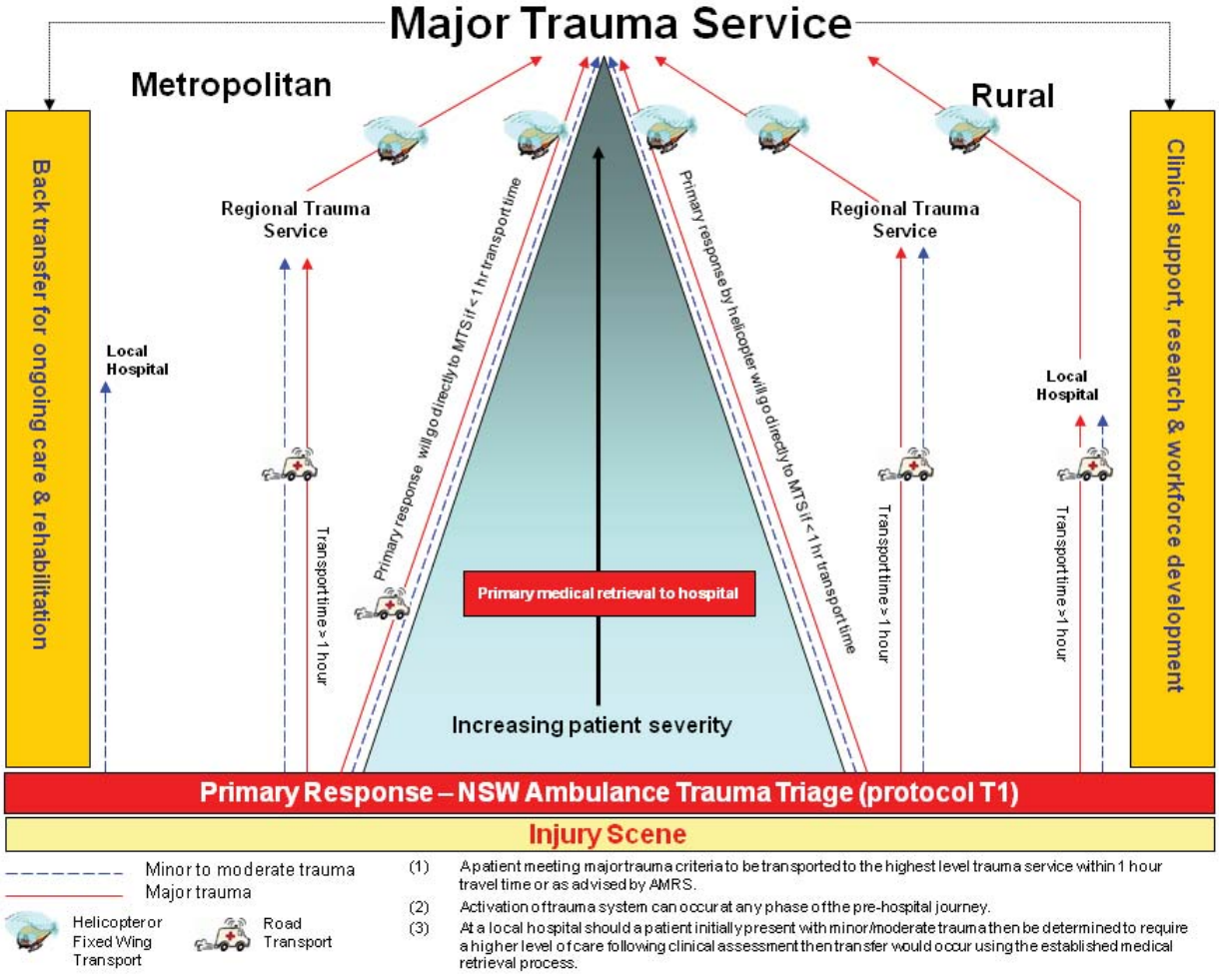
## 9.5 NSW trauma services model

It is the goal of the NSW Trauma Services Plan to integrate all hospital facilities into an inclusive trauma network in order to provide definitive trauma care to all injured patients throughout NSW. Patients with minor to moderate injuries will continue to be managed at the nearest appropriate facility (local hospital), while patients with more serious injuries require management at a higher level of care necessitating their transfer to a RTS or MTS.

The appropriate identification of patients with serious injury and their timely arrival at an appropriate hospital are crucial to the effectiveness of the trauma system. The NSW trauma system is underpinned by the pre-hospital management of major trauma program undertaken by the ASNSW to identify the most appropriate trauma care requirements for the patient and transport the patient to the appropriate level of service. All trauma patients attended by the ASNSW are assessed according to Protocol T1:Pre-hospital Management of Major Trauma. (Appendix 1) This protocol includes support for paramedics to transport patients meeting major trauma criteria to the highest level trauma service within a one hour travel time. This travel time can be potentially extended upon discussion with the duty AMRS Consultant, if it is in the best interests of the patient. The premise of minimising the time the patient spends in the pre-hospital environment is one of the main drivers of trauma systems.

Figure 5 details an integrated, comprehensive, trauma service model for NSW. The model is comprised of defined networks with the MTS at the apex of well defined intra-Area and inter-Area networks with overall responsibility to ensure the delivery of a high standard of trauma care to all trauma patients within their networks. Within each network, the MTS will have responsibility

Figure 5: NSW Trauma services model



for patients referred within the network, the provision of education, clinical support and workforce development. The aim is to have a consistent approach to the initial management of the major trauma patient.

All major trauma patients are to be transported to a major trauma service for assessment, resuscitation and initiation of definitive trauma care. The networked MTS will have responsibility for patients within their network requiring higher levels of specialised trauma care. Furthermore the major trauma service will have responsibility for maintaining oversight and coordination of trauma care within their networks to ensure the delivery of a high standard of care to all trauma patients and not just those with serious injuries (major trauma).

In instances where patients with moderate to severe trauma who either self-present, present by private transport or are transported to a RTS or local hospital, these hospitals will advise the MTS of the patient's arrival, and a decision can then be made as to the appropriate action, whether the patient should be retrieved to the MTS, and advice can be given as to resuscitation and care of the patient.
A mechanism should also be in place to provide feedback to the individual hospital regarding patient care and outcome. Hospitals within the network are to be included on relevant trauma committees and care review committees (such as Morbidity & Mortality review committees).

An integral part of the model is the effective back-transfer of patients, in the post acute phases, to a hospital in closer proximity to their area of residence. This frees up the high level acute care beds and also enables patients to continue their care closer to their family and local community. Similarly, there will be patients transferred to MTS, who in retrospect do not require such resources and can be transferred back to their nearest hospital when appropriate. Within a trauma network there is scope for developing the roles for individual non-major trauma service hospitals to provide specialist and tertiary care.

## 9.6 Interhospital trauma transfer

The decision to transfer trauma patients to a higher level of care is made on clinical grounds, and not the availability of resources such as beds at the major trauma service. All hospitals shall have transfer agreements within their networks for the identification and transfer of trauma patients as necessary. The following criteria suggest the necessity for early transfer; however, these criteria may vary dependent on the level of clinical services available at individual hospitals.

**Transfer criteria***

| |
|---|
| Penetrating injury or open skull fracture. |
| GCS <14 or lateralising signs |
| Intracranial haemorrhage |
| Spinal Cord Injury |
| Unstable vertebral injury |
| Torn thoracic aorta or great vessel. |
| Chest injuries requiring prolonged ventilation. |
| Unstable pelvic fractures. |
| Fracture dislocation with loss of distal pulses |
| Significant abdominal vascular injury |
| Multiple system injuries requiring specialist care at a higher level centre |
| Severe burn |

* Adapted from American College of Surgeons, 2006

Once the need for transfer is recognised, arrangements should be expedited and not delayed for diagnostic procedures that have no impact on resuscitation or the transfer process and do not change the immediate plan of care. The retrieval of patients will be coordinated through AMRS or NETS.

The destination of the secondary transport cases, which are cases requiring transfer to a higher level trauma service, will be the responsibility of the networked major trauma service.

The Critical Care Resource System (CCRS) is utilised to support networking and secondary transfers.

The MTS has responsibility for all trauma patients requiring a higher level of care and/or specialised services from within their network. Availability of an ICU, HDU or ward bed at the receiving MTS does not affect the acceptance of trauma patients for definitive care. Relevant staff at each MTS must be made aware of their responsibilities in this respect.

Each MTS must have a single published contact point for referrals, and a second tier AHS officer will be required to oversight this arrangement.

## 9.7 Major trauma networks

### 9.7.1 Adults

Trauma networks are closely aligned with the NSW Critical Care Tertiary Referral Networks for adults and are largely determined by the location of the MTS and the imperative to achieve early clinical intervention for seriously injured patients in accordance with Protocol T1. Details of the MTS, their networked RTS and AHS networks are outlined in Table 14.

### 9.7.2 Paediatrics

The majority of paediatric trauma cases presenting to hospital EDs will have minor to moderate injury and will continue to be managed appropriately at the nearest hospital. However, a small number of cases are time-critical and need access to specialist trauma care in as timely manner as possible

The agreed principal of care is that all children with major trauma should be managed at a paediatric MTS. Children aged from 0-15 fitting criteria as per the pre-hospital 'MIST' protocol T1 (with due consideration given to paediatric physiological differences) should be considered for transfer to a paediatric MTS capable of providing specialised acute, diagnostic and definitive care

When direct transport to a paediatric MTS is not possible the child should be transported to the highest level trauma service in accordance with Protocol T1 for initial assessment, stabilisation and appropriate transfer. It may be necessary for children to be transferred to a paediatric MTS to receive appropriate diagnostics, definitive care and long term follow up as indicated by their clinical status. However, when children are managed in primarily adult-focused institutions, the minimum level of diagnostics services for children should mirror those available for adults, with a caveat in place to ensure that results are reviewed by accredited paediatric clinicians.

The role of the paediatric MTS in supporting the hospitals within its clinical networks is essential. It is important that there are adequate skill levels among staff in the ED, trauma services and other key areas, as injured children will continue to present to these services.

A back transfer pathway back to the referring institution once the patient's condition has stabilised will ensure appropriate use of resources.

**Table 14 : NSW trauma services network – Adult**

| Major Trauma Service | Regional Trauma Service | Referring Area Health Services (AHS) |
|---|---|---|
| John Hunter | Coffs Harbour<br>Lismore [1]<br>Port Macquarie<br>Tamworth<br>Tweed Heads [1] | Hunter New England AHS<br>North Coast AHS |
| Royal North Shore | Gosford | Northern Sydney Central Coast AHS |
| Liverpool | N/A | Sydney South West AHS |
| Royal Prince Alfred | N/A | Sydney South West AHS |
| St George | Wollongong<br>Wagga Wagga | South Eastern Sydney/Illawarra AHS<br>Greater Southern AHS [2,3] |
| Westmead | Nepean<br>Orange | Sydney West AHS<br>Greater Western AHS [4] |

1. Owing to proximity, NCAHS maintains a clinical referral network with Queensland.
2. Owing to proximity, Albury also maintains a clinical referral network with Victoria.
3. The Canberra Hospital maintains a referral network for the following hospitals: Batemans Bay, Batlow, Bega, Bombala, Boorowa, Braidwood, Cooma, Delegate, Moruya, Pambula, Queanbeyan, Tumut, Yass and Young.
4. Owing to proximity, Broken Hill also maintains a referral network with South Australia.

## 9.8 Cross border patient flow

For those health facilities in close proximity to inter-state borders, the flow of trauma patients requiring higher levels of care, or specialist services, may be to a facility situated in another state. It is recognised that due to geography and close proximity of the ACT, the Canberra Hospital has an integral role in management of trauma patients from rural areas of NSW and as such is recognised as part of the trauma system network.

Formalisation of these cross-border networking arrangements is required to ensure timely retrieval of patients and linkage with the referral service for clinical support and feedback; as well as access to the interstate retrieval services, if required. Also important, is to formalise networks to enable patients to be back transferred for ongoing care, and to improve processes to enable these patients to be linked in with ongoing care and rehabilitation services available. This will be the responsibility of the relevant AHS, in conjunction with the NSW Department of Health.

## 9.9 Trauma system response to a mass casualty incident

It is recognised that, in a disaster, casualties will be directed to the nearest hospitals for treatment, regardless of that hospital's trauma status according to the State Disaster Plan. However, the trauma system is a significant resource in support of a response to a disaster or mass casualty incident involving large numbers of injured patients. Reasons for trauma consideration in triage and destination are that:

- Patients are afforded the best opportunity to minimise death and disability;
- Patients are taken to the facility with the appropriate resources to care for their injuries;
- There is appropriate distribution of patients among the available facilities; and
- There is appropriate use of air versus ground versus other modes of transportation.

The trauma system provides a foundation on which to build a response model for mass casualty response; and is able to provide the necessary surge in numbers of patients that a facility can manage. Surge capacity is expanding the capability and capacity of the existing health care system for an increase in patients, for disaster response.

Within NSW, disaster casualties are triaged into one of four categories. This triage in the field is utilised to determine treatment and transport priorities. The challenge is to identify those patients who warrant the resource of a major trauma centre to ensure that resources are utilised appropriately. A sudden influx of patients will create a significant demand on resources such as operating theatres, diagnostic imaging, and intensive care and requires an immediate presence of surgeons and other specialists with an expertise in the area of trauma management.

A systematic method of distributing casualties among available hospitals must occur according to injury severity and urgency, and with the aim of avoiding overload at any single facility. The even and rotational distribution of mass casualties to trauma centres will be achieved through the implementation of a 'Carousel System'; initially up to ten seriously injured patients will be sent to each trauma centre.[13]

The NSW Health / Ambulance Service Counter Disaster Unit (CDU) is responsible for health disaster planning and response to ensure NSW Health is prepared to respond effectively to major health emergencies and disasters as well as support the health aspects of major events within NSW.

13 Ambulance Service of NSW (2005). State Major Incident Disaster Plan (AMPLAN).

# 10 Trauma system monitoring

Measuring the effectiveness of the trauma system and the quality of care delivered is integral to evaluating the operation of the system and identifying areas for change. Quality management programs are necessary to ensure that the standard of care is met in caring for injured patients. A quality performance improvement program with a process for multidisciplinary review and monitoring of outcomes and provision of care will be maintained. The goal of this program is to monitor the process and outcome of trauma patient care. The NSW Trauma Services model of care facilitates trauma data injury surveillance, monitoring and a performance improvement program.

The NSW ITIM in partnership with NSW Health coordinates monitoring of the quality of trauma care to ensure that trauma system components are operating in an organised and coordinated manner that improves overall trauma patient outcomes. This process will provide for the collection and analysis of data on the trauma system from injury through to rehabilitation and discharge. This information can be used to guide service improvement, policy and further planning and development of the trauma system.

## 10.1 Pre-hospital

The pre-hospital component of trauma system care is monitored and evaluated by the ASNSW to promote clinical excellence in the pre hospital management of injured patients.

In addition to reporting responsibilities to NSW Health for agreed KPI targets related to trauma, the implementation of the revised triage tool Pre-Hospital Management of Major Trauma will require monitoring for compliance.

Integration between pre-hospital and designated trauma services is necessary to facilitate identification and communication of overall system issues to be targeted by quality improvement processes.

Pre-hospital and functional outcomes will be tracked and used in a total quality management initiative to improve policies, procedures, and processes throughout the trauma continuum. Information will be used to develop performance standards and measure system performance against similar systems (benchmarking).

## 10.2 Trauma services

As part of the performance improvement program trauma services have a responsibility to monitor in hospital patient care. This includes collection and evaluation of key performance indicators and other data that relates to trauma system management within the trauma network.

This is achieved through the following components of a performance improvement program:

- Participation in the NSW Statewide Trauma Registry
- Morbidity and Mortality reviews
- Multidisciplinary Trauma Committee
- Concurrent patient care review
- Investigation / reporting of unusual events
- Monitoring of standardised Key Performance Indicators
- Maintain records of action plans with documentation of "loop closure".

Major and Regional Trauma Services will have a process to monitor the quality of care for all trauma patients with the ability to undertake a concurrent and retrospective peer review process and a trauma registry to provide the data base for review.

MTS, in collaboration with the NSW ITIM, have the additional challenge of engaging other facilities within their trauma network in the performance improvement process for an inclusive trauma system. Meaningful participation in State and Area trauma system planning, development, and operation is essential. This is facilitated through both Area and Hospital Trauma Committees.

### 10.2.1 Data collection

It is important to be able to evaluate performance and identify, in a timely manner, areas which may require attention and possibly modification. Ongoing evaluation of the effectiveness of the system is essential. As part of the performance improvement program trauma services have a responsibility to monitor in hospital patient care. This includes collection and evaluation of key performance indicators and other data that relates to trauma system management within the trauma network. Key areas supported by data include patient management at a hospital level (using real-time data), system performance monitoring and adverse incidents, trauma system review and planning, trauma research activities, injury prevention activities, health provider education activities, and trauma centre verification.

All major, regional and paediatric trauma services will be required to maintain a trauma registry and submit data to the NSW ITIM in accordance with the NSW TMDS. This currently includes all trauma admissions with ISS > 15 or ICU Admission or death (Excluding fractured neck of femur death). The TMDS contains simple, non-identifiable information about each injured person, the nature and location of the incident resulting in injury, the main injuries sustained; and details of treatments and services provided to each person. (Appendix 5)

### 10.2.2 Trauma registries

Trauma registry activities support trauma services and statewide trauma activities. Trauma registry activities, be it at hospital, state or national level include data collection, data entry, data quality processes, data storage, security and privacy, and data retrieval. It is critical that standards are implemented universally and evenly across hospital trauma registries to ensure the highest quality of aggregated statewide data. The provision of accurate and current trauma registry data can be used to foster trauma related research, injury prevention initiatives and relevant health planning and policy.

All trauma data in NSW will be held in the NSW Statewide Trauma Registry; a single, centralised trauma database designed to meet data needs of trauma services; and ensure consistent, reliable, and comparable data between trauma services. Data from the trauma registry will be used at a statewide level for system performance monitoring, trauma system review and planning, injury prevention activities with a range of agencies, and health provider education activities.

NSW ITIM will provide secure statewide registry accessible to all trauma services through the NSW Health intranet. Trauma Services will maintain data in the registry to meet the requirements of the NSW TMDS. To facilitate timely reporting from the statewide trauma registry, data must be submitted by trauma services in a regular manner, allowing time to complete and compile the required data.

Standards pertaining to trauma registry software, data definitions and related information management and information technology standards will be managed and maintained by NSW ITIM in collaboration with Health Technology at NSW Health, and trauma practitioners and trauma registry managers in the NSW trauma network.

### 10.2.3 Trauma scoring

Abbreviated Injury Scoring (AIS) and the Injury Severity Score (ISS) are key standards which provide the common means for identifying patients within a group of trauma patients in a hospital, whose details are submitted for inclusion in the statewide trauma registry. All people involved in trauma registry activities must be accredited in the use of AIS and calculation of ISS scores, in particular those with access to record level or case level data in the registry (entering, editing or viewing) Accredited AIS courses within Australia are provided through the NSW ITIM by an Association for the Advancement of Automotive Medicine (AAAM) Certified AIS Coding Specialist.

## 10.3 Key performance indicators

Monitoring is best achieved through measuring aspects of the system and performance against Key Performance Indicators (KPIs). In addition to the Trauma Minimum Data Set, the statewide trauma registry also records mandated KPI's submitted by trauma services on a regular basis.

Statewide level system KPI's are currently reported through NSW ITIM to the Critical Care Health Priority Taskforce and include:

- Time to definitive trauma care.
- Activation of trauma call at Trauma Service on patients arrival.

The time taken to definitive care is a value calculated from the time of injury to the date and time of admission to the trauma service where definitive care is provided to the patient. This time can be related to factors such as mechanism of injury and injury severity, and can reflect the effectiveness and compliance with trauma bypass and transfer protocols.

It is recommended that ITIM progressively expand the range of indicators it monitors and reports on. Trauma Service KPI's will focus on key areas of the system, and while some of these will be relevant for ongoing collection, others will vary focusing on specific areas for a period of time (eg. trauma team notification times, missed injuries, unplanned readmission to ICU). RTSs should focus on indicators or aspects of care that are relevant to their setting such as time spent in resuscitation and time elapsed before decision to transfer.

As part of the role in the monitoring and reporting on the performance and the provision of policy advice on areas for improvement within the trauma system, the development of performance monitoring of individual trauma services will include monitoring a range of processes and outcomes across the continuum of trauma care; to ensure that trauma system performance complies with the trauma system model of care as outlined in the NSW Trauma Services Plan.

This may also involve the development of formalised links with the Bureau of Health Information, to be established in response to the Special Commission of Inquiry into Acute Care Services in NSW Public Hospitals.

## 10.4 Trauma verification

The trauma verification program is designed to assist trauma services in the evaluation and improvement of trauma care and provide objective, external review of capability and performance. Trauma verification is aimed at improving the quality of care and does not designate which hospitals receive major trauma.

The verification process is a multidisciplinary inter-collegiate process, developed through the Royal Australasian College of Surgeons (RACS); and is carried out by a peer review of the hospital by a multidisciplinary team of highly experienced trauma clinicians. Key recommendations from the verification process are provided to NSW Health and AHS.

# Trauma training education and research

# 11

Innovative and concerted efforts are needed in the recruitment, retention and education of qualified personnel through the trauma care system. The availability of a specialist and experienced workforce is the key to the provision of specialist trauma services.

A centralised statewide trauma-training program would incorporate all MTS and selected regional and quaternary services, and would be supported by a robust academic framework, clinical research and evidence based practice. The NSW ITIM will support each of the MTS and associated clinical networks to develop a comprehensive training, education and research framework consistent with the requirements of the Royal Australasian College of Surgeons (RACS) Trauma Verification criteria.

Formalised links to academic and research institutes, such as The George Institute for International Health George Institute (USYD) and the Injury Risk Management Research Centre (UNSW) are required to strengthen ITIMs research capability.

## 11.1 Trauma surgery training

A key driver for the consolidation, streamlining and enhancement of trauma service provision across NSW are the training, accreditation and skill maintenance of trauma clinicians in particular trauma surgical trainees. The specialist trauma surgical workforce is at present limited and in most trauma services the trauma roster is comprised of surgeons from a range of specialties providing coverage. With a limited number of surgeons who are specialist trauma surgeons currently in NSW and across Australia, and no local surgical trainees undertaking trauma training, the present practice model of trauma care is not sustainable.

Changing injury patterns, improvements in technology and the use of interventional radiology, see the role of the trauma surgeon frequently in the coordination of care for the trauma patient particularly in the initial phase of care. While trauma is seen as a surgical specialty, injuries are rarely system specific. Patients with multi system injuries may require care from a number of disciplines; there is a need for a leader to coordinate and plan that care. This migration to a new trauma services model provides an opportunity to redefine trauma training to meet the needs of future surgical trainees in trauma.

### 11.1.1 Surgical Education and Training program (SET)

RACS in collaboration with the Specialist Associations and Societies provides surgical training across nine surgical disciplines: cardiothoracic, general, neurosurgery, orthopaedic, otolaryngology head and neck, paediatric, plastic and reconstructive, urology and vascular.

The management of the majority of trauma patients, who have minor to moderate injury, is covered by the SET program and specialist surgical curricula, as many of the programs have a trauma component within them. The following courses have been nominated as part of the SET training for all specialties to facilitate better understanding of the overall trauma care and priorities of the multiply injured trauma patient:

- Australian and New Zealand Surgical Skills Education and Training (Asset);
- Care of the Critically Ill Surgical Patient (CCrISP); and
- Early Management of Severe Trauma (EMST)

These courses provide a base in the care of the critically ill or injured trauma patient.

At an appropriate level of training Definitive Surgical Trauma Care (DSTC) provides a limited but important experience in advanced surgical decision making and operative technique in the management of serious and multi-system injury. Currently, this sort of experience is, at best, only learned by trainees who work in centres with advanced trauma surgery training programs, and even then by chance depending on the sorts of patients admitted when on-call.

Patients suffering major trauma and multi-system injury are those that will benefit directly in having their care coordinated by a trauma specialist, however the system that exists to manage these patients at a high level benefits all patients – even those suffering less severe injury.

### 11.1.2 Trauma Specialist training pathways

On completion of the SET program individuals with a particular interest in trauma surgery specialty training may wish to pursue a specialist trauma surgery fellowship.

It is recommended that this fellowship consists of a two year program that would provide a coherent understanding of, and clinical experience in, all aspects of trauma care and leadership which would be expected in a busy clinical and academic teaching hospital. The goal of the fellowship is to produce both clinical and academic leaders in trauma surgery. This incorporates important concepts in system design, quality assurance and research. It is essential that the program emphasises surgery experience within the specialty background of the fellow and an understanding of other subspecialty trauma related surgery.

Appointment at a hospital with significant acute trauma loads would allow for operating theatre time in their primary specialty. (eg general, neurosurgery, orthopaedic, vascular etc)

The trauma fellows become proficient in the evaluation of seriously injured trauma patients; the initiation of appropriate and complete diagnostic and treatment plans; and providing leadership which facilitates interaction within the entire multidisciplinary trauma team and with the patients and their families. The fellow has full responsibility as trauma team leader, gaining a broad range of experience in the management of blunt and penetrating trauma, and the use of diagnostic modalities. Emergency surgical call and trauma call are mandatory components of the training curriculum.

The program includes rotations in trauma surgery (resuscitative and post op management of complex surgical illness related to general surgery and trauma); electives in critical care (management of complex critical illness); and emergency and elective surgical experience in trauma related surgical subspecialties. Suggested clinical rotations include cardiothoracic surgery, neurological surgery, orthopaedic surgery, and vascular/interventional radiology. Flexibility in the timing of these rotations, and the structure of the training should be utilised to optimise the training with the fellow's future career goals in mind.

International or interstate experience is optional with a 6-12 month period spent in a busy, reputable Major Trauma Service to broaden the perspective of the Fellow.

Administratively the trauma fellows are expected to gain a comprehensive understanding of the trauma system and the importance of continuous performance monitoring. This incorporates an understanding and a working knowledge of the major issues in trauma care and health care administration. These non-procedural elements have significant importance to the leadership of regional trauma systems, and allow individuals to progress on to assume leadership positions at State and National levels.

In addition to the opportunity to gain critical surgical decision making experience in the management of the multiply-injured trauma patient, the trauma fellowship also involves research and education.

Conduct, publication and presentation (state or national scientific meetings) of research or other projects will be expected. Research towards gaining a Higher Degree in surgery (or related discipline) will be strongly encouraged. Teaching contributes to the educational process, and therefore should be a regular part of the training program. The trauma fellow should be involved in the instruction of surgical residents, and medical students, as well as nurses and other allied health professionals.

Recruitment of Fellows would be undertaken under the auspices of the MTS in partnership with the NSW ITIM and RACS.

## 11.2 Nursing

Currently within the tertiary education sector trauma is not recognised as a specialty within its own right and is embedded in the domain of emergency/critical care/acute care programs. There is a need for the establishment of partnerships between MTS with tertiary education providers to promote the specialisation of trauma. The academic components of the programs can be provided by the universities and the clinical components coordinated across the major trauma services, regional trauma service and specialist services such as spinal and burns. This should include coordinated clinical rotations across the spectrum of trauma care: emergency, ICU, acute care areas, operating suite, and rehabilitation.

## 11.3 Allied health

Specific trauma education needs for allied health professionals will be met through collaboration between NSW ITIM and Professional Associations.

## 11.4 Continuing education

Recruitment and retention of qualified trauma care clinicians across all components of the trauma system require a substantial investment in resources. Where appropriate, continuing education programs should be aligned to quality management activities.

Examples of courses that have been established by professional organisations as important for trauma care include:

- Pre Hospital Trauma Course (PHTC)
- Pre Hospital Trauma Life Support (PHTLS)
- International Trauma Life Support (ITLS)
- Early Management of Severe Trauma (EMST)
- Care of the Critically Ill Surgical Patient (CCrISP)
- Definitive Surgical Trauma Care (DSTC)
- Definitive Perioperative Nursing Trauma Care (DPNTC)
- Paediatric Life Support (PLS)
- Advanced Paediatric Life Support (APLS)
- Course in Advanced Trauma Nursing (CATN)
- Trauma Nursing Core Course (TNCC)
- Trauma Nursing Program (TNP)
- Trauma Outcome and Performance Improvement Course (TOPIC)
- Emergency Management of Severe Burns (EMSB)

These courses offer excellent opportunities to augment basic training with special emphasis on trauma and specialty care. Participation by the MTS in the above trauma specific courses at instructor level is encouraged.

Educational programs are particularly important in facilities that do not receive a high volume of trauma patients. A coordinated trauma education program aimed at skill development and maintenance needs to be implemented and available to staff on a regular basis.

## 11.5 Trauma team training

The concept of a trauma team has evolved to address the unique challenges that severely injured patients present. The use of skilled clinicians to participate in trauma reception and resuscitation can improve the process and outcome of trauma care.

Effective trauma team training provides a context in which both clinical and team concepts/ skills can be taught, practiced and developed. The experiential learning and ability to safely rehearse critical events gives the participant the ability to review their own and the team's performance, with transformational learning often occurring.

In 2006 a program was developed by the Sydney Clinical Skills and Simulation Centre (previously known as Sydney Medical Simulation Centre) on behalf of, and in collaboration with NSW ITIM. The program specifically aims to improve teamwork within trauma teams through:

1. Exposing trauma teams to simulated cases of serious trauma and provide them with an opportunity to rehearse early management of these cases focusing on their response and interaction as a team, not as individuals.
2. Instructing teams in the specific behavioural skills and attitudes relevant to effective trauma teamwork including: team leadership/followship; principles of "crisis management"; team communication; negotiation and conflict resolution; safety culture.

3. Revising general principles of trauma management according to recognized best practices in NSW, incorporating the Trauma Clinical Practice Guidelines.
4. Revising specific management of key trauma conditions including head injury, major haemorrhage and multi-trauma.

Courses have been conducted for the metropolitan AHS with plans to expand access to training across the state through the provision of training off site in rural AHS and the development of a CD/video based resource to support clinical staff in the metropolitan and rural hospitals.

## 11.6 Trauma research

Research is necessary to guarantee the ongoing evaluation and improvement of the trauma system and trauma patient outcome. As research identifies practices to further enhance the continuum of care for the injured, the system continues to evolve and improve. Research should be organised to address fundamental and major issues of injury in its broadest sense affecting injury surveillance and epidemiology, prevention, definitive trauma care and rehabilitation. Validation of individual trauma care system components is necessary to ensure system efficiency. Information related to the complete cycle of trauma-from prevention to post-hospital care-will be collected, analysed, and made available to facilitate improvements in injury prevention, response times, patient care, and rehabilitation. Information systems should be usable for multi-centre studies.

A MTS is responsible for the provision of a trauma research program designed to expand the knowledge base applicable to the care of the injured patient, and the infrastructure of the state trauma system. Research projects should be designed with the objective of enhancing the trauma system's ability to resuscitate, stabilise and treat the patients' needs. The inclusion of a Trauma Fellow to the staff complement of the trauma service is seen as essential to support a robust research program.

Academic units are well placed to help clinicians look after their patients through epidemiological expertise and the assisting in the development of prospective studies. The development of active partnerships between ITIM and academic institutions that are engaged in clinical, biomedical and population health research relevant to trauma will stimulate scholarship in trauma research and stimulate critical links between researchers and clinicians.

# Resource requirements for future service

12

The initial concentration of adult MTSs in the greater metropolitan area from eight to six will have a varied impact across the system. This section details the estimated impact and the resource implications. The upgrade of the NSW trauma system in accordance with this Plan will require a strategic approach and include the following key strategies:

- Continued development of prehospital services including the Ambulance Major Trauma Program and the Rapid Launch Trauma Coordination oversight model.
- Enhancement of infrastructure and workforce to support the increased major trauma workload as a result of the reconfiguration of services.
- Ongoing development of Trauma Services in the designated Major Trauma Services and support for trauma coordination in Regional Trauma Services through Trauma Directors, Trauma Fellows, Trauma Nurse Coordinators, Trauma Registry Managers, and Trauma Case Managers.
- Enhance the role of NSW ITIM as the hub for trauma and rehabilitation related education, research and clinical standards.

## 12.1 Pre-hospital

The principles of the outlined NSW Trauma System are to minimise the time to **definitive trauma care** by clinically based triage by the ASNSW paramedics to a major trauma service.

A standard protocol for pre-hospital care, and transport of patients to an appropriate level trauma service is imperative to ensure reliable and consistent entry into the trauma system. The ASNSW has completed a comprehensive review of the Pre Hospital Trauma Triage and transfer process, which has resulted in the development of the Ambulance Major Trauma Program.

The Ambulance Major Trauma Program includes new protocols and guidelines for the pre hospital management of serious trauma, providing clinical oversight and an informed system for trauma management.

The Ambulance Major Trauma Program comprises an evidence based Trauma Triage Tool, and Clinical Trauma Protocol T1. Protocol T1 underpins the successful reconfiguration of the trauma services, and is one aspect of ASNSW responsibilities for the management of trauma patients in the out of hospital environment, which includes the spectrum of clinical, operational and retrieval parameters.

On release of the NSW Trauma Services Plan Protocol T1 will be amended to incorporate NSW Health Referral Matrix Guidelines in accordance with the new trauma service model and designation of major trauma services.

Reconfiguration of the major trauma system will result in an increase in the volume of major trauma cases transported to Royal Prince Alfred and St George Hospitals. There is minimal, if any, impact on the volume of primary trauma cases transported to the other major trauma services anticipated with this change.

Trauma designation within the rural areas will incorporate RTSs and local hospitals. The development of the ASNSW Major Trauma Program and the associated Protocol, now T1, supports a shift away from the DP4 system previously detailed within the 'Early Notification of Severe Trauma in Rural NSW policy. To facilitate the early identification of trauma cases and early response the rapid launch trauma coordination model allows for monitoring of ambulance calls across the state identifying those that need an early upgraded response.

The Ambulance Major Trauma Program will require substantial support in both implementation and monitoring to determine the effectiveness of improvements to the ASNSW response to and management of major trauma. Trauma support roles within the ASNSW have existed on a temporary basis since 2004 and have evolved over time into both a liaison role between Ambulance and Major Trauma Services; and higher level quality improvement functions including the review of the Pre Hospital Management of Major Trauma Protocol – T1.

## 12.2 NSW trauma services

Increases in activity projected for NSW Major Trauma Services will primarily be due to population and demographic changes and are considered in the normal processes of AHS planning and development.

The concentration and reconfiguration of major trauma services will immediately impact on Royal Prince Alfred Hospital with an increase in ED trauma presentations expected in accordance with the redistribution of the current major trauma caseload at St Vincent's Hospital and part of the major trauma workload from Prince of Wales Hospital. While not all of these cases will require admission, an increase in the potential major trauma caseload transported to Royal Prince Alfred Hospital will impact on the ED resources. A small shift in patient destination at the periphery of the Royal Prince Alfred catchment area may result in small increases in patient numbers to St George Hospital.

There will be minimal impact on the trauma referral networks, particularly from rural areas. However, it is acknowledged that changes in the Greater Western AHS referral network may result in some additional activity at Westmead.

Nepean, Gosford and Wollongong Hospitals will continue to operate as RTSs providing services to their local community and networked to a major trauma service for patients requiring a higher level of care. These centres will experience growth due to population changes and will need to be more formally integrated with their trauma networks and be actively supported by the MTSs.

Other designated regional trauma services in rural areas will operate within a robust clinical, professional and educational network. The MTS will take a lead role in the establishment of clinical networks to provide a mechanism for the exchange of information between clinicians and for quality improvement activities.

Major trauma services for paediatrics will continue to be provided by the three children's hospitals: Children's Hospital, Westmead, John Hunter Children's Hospital and Sydney Children's Hospital. The role of the paediatric MTS in the further development of clinical networks is important not only to facilitate the exchange of information but also to support ongoing education and quality improvement needs.

### 12.2.1 Trauma service resources

Over recent years, the trauma system, overall has received enhancement funding to support the major and greater metropolitan regional trauma services, promoting the establishment of core staff consisting of a Trauma Director, Trauma Fellow, Trauma Nurse Coordinator (CNC), Regional / Area Trauma Coordinator (CNC) and Trauma Data Manager to facilitate the management of trauma services within AHS. The Trauma Case Manager role has also been established at a number of major trauma services, and is recommended for each of the major trauma services. In the paediatric major trauma services, a full time trauma nurse coordinator / trauma case manager or combination is recommended dependent on trauma caseload.

Trauma Service infrastructure within rural Areas is reliant on the existing critical care networks and medical retrieval processes. In May 2007 a Rural Trauma Clinical Nurse Consultant (CNC) role was established as a 2 year pilot project at Tamworth Base Hospital covering the northern region of the Hunter New England AHS. This role is focused on the evaluation of the clinical care of patients who have sustained severe injury and have required the activation of the trauma system at local or State level. This project has provided the basis for the development of a process to be adapted in other rural areas to provide data, monitoring of patient outcomes and trauma system function.

Ongoing development of the MTSs will require the establishment of formalised links with Rehabilitation Services and Allied Health; trauma fellowship programs and an increased focus on education and injury prevention.

The establishment of additional positions in Trauma Services will be considered over the next five years, as resources allow.

## 12.3 Statewide institute for trauma and injury

The key functions of the Institute will span across the trauma continuum of care from prevention to rehabilitation and include:

- Trauma Information and Data Management
- Injury Research
- Trauma Clinical Standards
- Trauma Education

The Institute may initially be established as a virtual Institute with formalised links to MTS, academic institutions and other specialty clinical groups. The development of links and partnerships with key organisations involved in injury prevention, education, research and clinical care and with other relevant stakeholder agencies fosters a whole of government approach to trauma and injury management in NSW.

### 12.3.1 Trauma information and data management

There are a number of facets to the management of injury ranging from injury prevention, pre-hospital phase, the acute in-hospital phase of care through to rehabilitation. Each of these facets can impact on the outcome of the injury both in terms of mortality and morbidity for the patient. To identify injury risk factors and outcomes across the trauma continuum there is a need to encourage data linkage and integration between databases. This includes rehabilitation data and research studies established to determine the effect on the rehabilitation process on improving or maintaining long term functional outcome of the severely injured trauma patient.

The further development of NSW ITIM will include expansion of a comprehensive state-wide clinical injury dataset which captures data across the trauma continuum and supports comprehensive performance monitoring and reporting. Trauma data collection will be expanded to include all trauma admissions with an ISS > 12, to provide data on a more relevant patient group for evaluation of the trauma system and major trauma caseload. In addition rehabilitation data should contribute to the trauma system data and research studies established to determine the effect of the rehabilitation process on improving or maintaining long term functional outcome of the severely injured trauma patient.

In 2009 NSW ITIM, supported by NSW Health Technology, implemented a new Statewide Trauma Registry; a modified version of the Collector © trauma registry built by Digital Innovation (USA) to replace existing trauma registries across NSW as the single central repository of trauma data in the state.

### 12.3.2 Injury research

To date there has been minimal focus on research into trauma rehabilitation and outcomes of trauma care. Having a research group with a focus on these aspects could provide an opportunity to conduct research into morbidity and essentially the effectiveness of trauma care. This will include:

- Identification of research questions, monitoring research effort and stimulating strategic research scholarship in trauma prevention, care and outcomes; and
- Development of funding options and attracting funds from external sources to assist with trauma research and education and generally to support the development of the trauma system in NSW.

### 12.3.3 Trauma clinical standards

NSW ITIM is responsible for coordinating the development, implementation and maintenance of trauma clinical practice guidelines. In 2006 the following evidence based statewide guidelines were released:

- Management of Hypovolaemic Shock in the Trauma Patient
- The Management of Haemodynamically Unstable Patients with a Pelvic Fracture
- Emergency Airway Management in the Trauma Patient
- Initial Management of Closed Head Injury in Adults

In addition to the development of a supplement to the Initial Management of Closed Head Injury in Adults guideline, ITIM are currently developing the following clinical guidelines:

- Maxillo-Facial Trauma
- Anterior Abdominal Stab Wounds
- Compartment Syndrome in the Limbs
- Thromboembolism Prophylaxis in Trauma

### 12.3.4 Trauma education

Education has been a major role for ITIM working in partnership with providers to deliver trauma education programs, seminars and clinical workshops throughout NSW for doctors, nurses, paramedics and allied health clinicians.

Assumption by ITIM of a leadership, facilitation, monitoring and evaluation role would be more likely to ensure a sustainable education program. It is recommended that ITIM develop a strategic framework for trauma education in NSW and then support and monitor its implementation.

This may include a role in the establishment of a formalised trauma training fellowship in collaboration with the RACS and potentially other colleges, coordinated across the major and regional trauma services.

# Conclusion

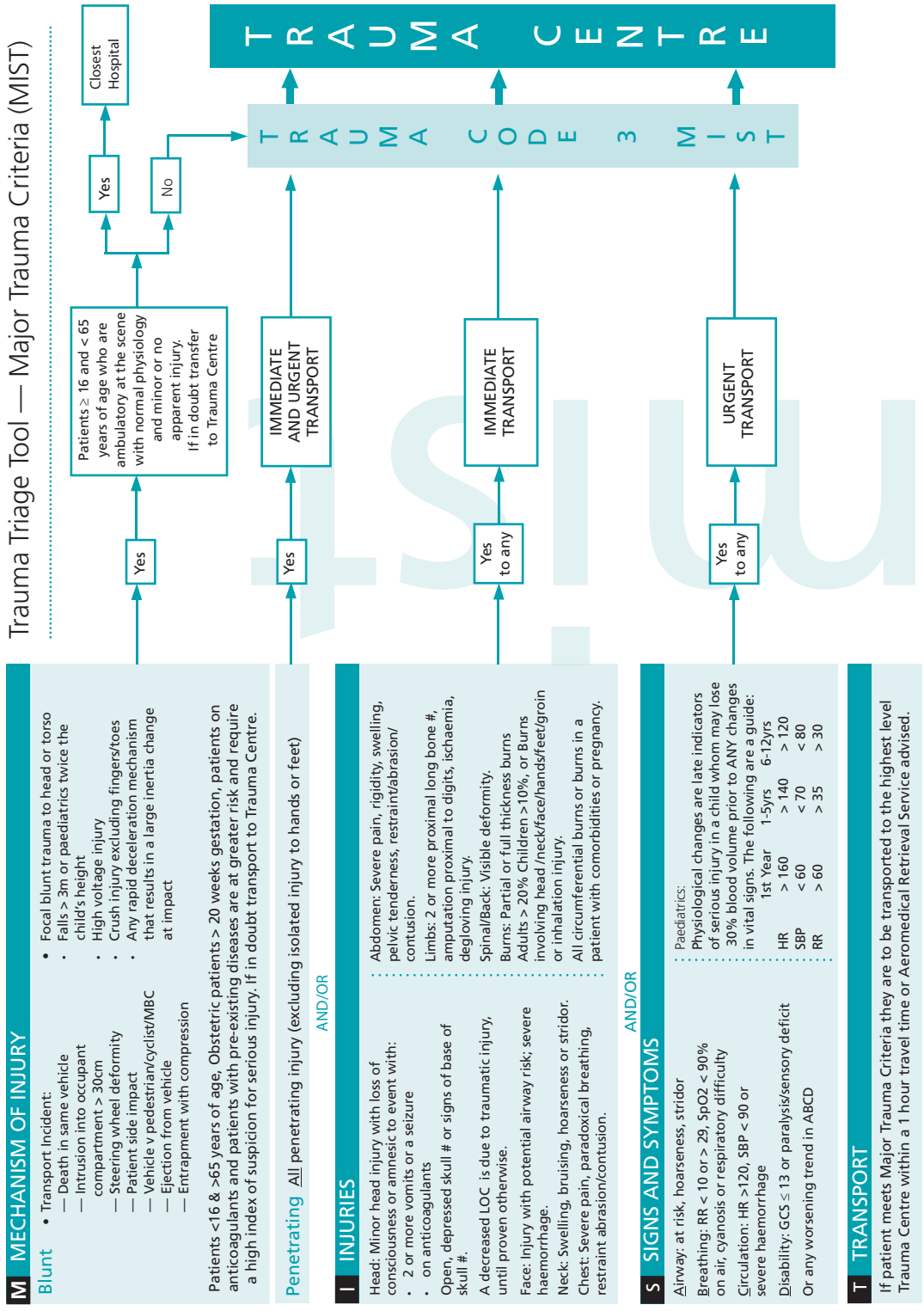
The trauma planning process has included a comprehensive review of the entire trauma system. Extensive consultation was undertaken throughout the system with wide spread support gained for the Health Care Advisory Council (HCAC) endorsed reconfiguration.

To meet current and future demands, continued improvements are required to ensure a sustainable, strategically located trauma system. This Plan recommends a trauma services model comprising five integrated trauma service networks incorporating the designation of six adult major trauma services and three paediatric major trauma services.

Each of these services will be networked with the remainder of the trauma system, comprised of regional trauma services and local hospitals in metropolitan and rural areas. This approach will provide the best possible health service for trauma patients across NSW.

Appendix 1

# ASNSW Major Trauma Triage Tool



Appendix 2

# NSW trauma services – trauma designation and role delineation

| Hospital | Trauma designation | NSW health role delineation | | | Comments |
|---|---|---|---|---|---|
| | | Emergency | Operating theatres | ICU | |
| Liverpool | Major (Adult) | 6 | 6 | 6 | |
| Royal North Shore | Major (Adult) | 6 | 6 | 6 | Specialist Service for Spinal Cord Injury and Severe Burn Injury |
| Royal Prince Alfred | Major (Adult) | 6 | 6 | 6 | |
| Westmead | Major (Adult) | 6 | 6 | 6 | |
| St George | Major (Adult) | 6 | 6 | 6 | |
| John Hunter | Major (Adult) | 6 | 6 | 6 | |
| John Hunter Children's | Major (Paediatric) | 6 | 6 | 6 | |
| Sydney Children's | Major (Paediatric) | 6 | 6 | 6 | |
| Children's Westmead | Major (Paediatric) | 6 | 6 | 6 | Specialist Service for Paediatric Severe Burn Injury |
| Coffs Harbour | Regional | 5 | 6 | 5 | |
| Gosford | Regional | 5 | 6 | 5 | |
| Lismore | Regional | 5 | 6 | 5 | |
| Nepean | Regional | 5 | 6 | 6 | |
| Orange | Regional | 4 | 5 | 5 | |
| Port Macquarie | Regional | 5 | 6 | 5 | |
| Tamworth | Regional | 5 | 6 | 5 | |
| Tweed Heads | Regional | 5 | 6 | 5 | |
| Wollongong | Regional | 6 | 6 | 6 | |
| Wagga Wagga | Regional | 5 | 6 | 5 | |

Appendix 3

# Trauma service position roles and responsibilities

## Trauma director

The Trauma Director provides the leadership required for a Trauma Service to function within the individual hospital and wider AHS. The Trauma Director's role includes the development, implementation and evaluation of trauma system protocols which meet the needs of the trauma patient from pre-hospital through to rehabilitation.

The tasks, which accompany this function, include:

- Clinical leadership in the treatment of patients with multiple serious injuries
- Coordinating the care of the patient between multiple services and specialties
- Participation in the emergency on call roster for the relevant sub specialty and trauma
- Supervision and delegation of appropriate duties to the Trauma Fellow
- Leading the weekly multi-disciplinary rounds of trauma patients
- Coordinating, participating and chairing the hospital Trauma Committee and Area Trauma Committee
- Critical review of complications and deaths in the Trauma Service as chair of the Trauma Morbidity and Mortality Committee
- Trauma education including orientation of hospital and area network personnel involved in the management of the trauma patient; instructor / director for EMST; and conduct of regular educational sessions for members of the multi-disciplinary team
- Implementation and responsibility for the Trauma Team/Surgical roster
- Assisting the Trauma Coordinator and the multi-disciplinary Trauma Committee with the development of policies and procedures
- Participating in trauma prevention research in partnership with the area injury prevention unit
- Performing relevant clinical research relating specifically to the evaluation and management of trauma patients

## Trauma nurse coordinator

The Trauma Nurse Coordinator, in close collaboration with the Trauma Director and departmental managers, is responsible for monitoring and coordinating all operational issues that are involved in the multidisciplinary team approach to quality care of the trauma patient from pre-hospital to rehabilitation. Areas of responsibility include evaluating patient care, identifying system problems, making recommendations for improvement, and coordinating continuing educational trauma related activities for the hospital. The Trauma Nurse Coordinator functions as a liaison for trauma care by maintaining effective lines of communication to the wider AHS and community.

The tasks, which accompany this function, include:

- Participating in daily patient rounds with the specialty team and or the Trauma Director/Trauma Fellow
- Communication with medical, nursing and allied health staff and the provision of regular feedback
- Ensuring that all appropriate teams are aware of the patient's admission
- Attending Trauma Team calls to review team performance and response
- Identification of trauma systems related issues and directs information to the Trauma Director and relevant committees ensuring loop closure
- Review of patients' charts and evaluate for potential care issues; refers to the Trauma Director and appropriate specialty managers as required
- Data collection and supervision of trauma registry entry ensuring registry confidentiality
- Participating in injury prevention activities
- Working with the Trauma Director/Registry Manager to analyse tabulated data to determine if trends are occurring
- Coordination of educational activities necessary to meet the objectives of the Trauma Service
- Conduct of regular Trauma Review meetings

- Participating in orientation, in-service and mentor programs for nursing, medical and allied health staff at hospital and area level
- Identification of specific trauma research areas of interest; and participate in collaborative research as a member of a multidisciplinary team or principal investigator of a designated study.

## Trauma registry manager

The Trauma Registry Manager is responsible for the maintaining the hospital Trauma Registry and quality assurance issues related to the Trauma Registry together with data validation. The role includes the supervision of the trauma data collection process in liaison with the Trauma Nurse Coordinator and the provision of reports to relevant groups both within the hospital and appropriate bodies outside the hospital. The Trauma Registry Manager is responsible for entering data into the registry while ensuring accuracy and confidentiality in handling of all trauma registry related matters. The Trauma Registry Manager is an integral part of the trauma team, and should participate in regular team activities such as meetings and reviews.

The tasks which accompany this function, include:

- Submission of the TMDS to the NSW ITIM on a regular basis
- Database management, including data audits for data validity and integrity
- Performance indicator (QA/KPI) monitoring and reporting
- Data abstraction and analysis as required

## Trauma case manager

The Trauma Case Manager provides case management services to an assigned caseload of patients with multiply injuries and other trauma patients at high risk of complications and poor outcome. They visit the patient daily, review patient progress and ensure an optimal management plan; providing education and support regarding discharge options. He/she will facilitate communication and information sharing, both written and verbal, to enhance patient outcomes. The Trauma Nurse Case Manager will assist with data collection for the Trauma Registry.

The tasks which accompany this function, include:

- Daily ward round and review of patient progress
- Fostering collaboration and communication between the multidisciplinary team
- Provision of continuity of care and advocacy for trauma patients
- Data collection for the trauma registry
- Provision of trauma related education within the hospital

# Appendix 3

## Area trauma nurse coordinator

The role of the Area Trauma Nurse Coordinator supports the MTS to improve trauma care through injury prevention, education programs and support to other hospitals within the Area Trauma network. This includes participation in continuous quality improvement activities within the MTS and with referring facilities.

As a resource of the MTS the Area Trauma CNC provides an expert consultancy service to all hospitals within the AHS so that clinical staff have a sound knowledge in all aspects of trauma services.

The tasks which accompany this function include:

- Provision of clinical leadership and advice on the management of trauma within the hospitals within the Area Trauma network
- Monitoring of trauma transport / retrieval decisions within the Area Trauma network
- Responsibility for the planning, development, implementation and evaluation of trauma management education sessions, programs and courses within the Area Trauma network
- Specified data collection relating to severely injured patients within the Area Trauma network
- Liaison with other relevant service providers/ organisations at a local, AHS and State level to promote a cohesive approach to the management of critically injured patients
- Collaboration with existing injury prevention programs to enhance the community's knowledge and awareness

## Trauma fellow

The key role of the Trauma Fellow is to facilitate the day to day management of the seriously ill trauma patient. In addition to the opportunity to gain critical surgical decision making experience in the management of the multiply-injured trauma patient, the trauma fellowship also includes research and education.

The tasks which accompany this function include:

- Attending Trauma Team activation's during working hours and after hours in a sustainable roster, and ensure that the patient progresses to definitive care
- Operate on trauma patients based on specialty (eg general, orthopaedic) background
- Assist (perform parts of procedure under supervision) in operations of trauma patients without specialty boundaries
- Daily round and review of patient progress, and attendance to weekly multidisciplinary rounds
- Communicating with specialty teams and services informing the Trauma Director of any clinical problems that are unresolved
- Participating in the after hours on call emergency roster
- Participating in an organised teaching program with networked hospitals, including the instruction of surgical residents, medical students, nurses and other allied health professionals
- Conduct, publish and present research in trauma related areas

Appendix 4

# Major trauma diagnosis codes

The following diagnosis codes were selected as representing cases more likely to have sustained major trauma.

*Source: The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM). Fifth Edition – July 2006.*

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| Abdominal Procedures for Multiple Significant Trauma | Capsule tears of spleen, without major disruption of parenchyma |
| | Complete disruption of kidney parenchyma |
| | Contusion and haematoma of kidney |
| | Flail chest |
| | Fracture of lumbar vertebra, L2 level |
| | Injury of cauda equina |
| | Injury of descending [left] colon |
| | Injury of diaphragm |
| | Injury of other and multiple parts of small intestine |
| | Injury of other intra-abdominal organs |
| | Injury of peritoneum |
| | Injury of retroperitoneum |
| | Injury of small intestine, part unspecified |
| | Injury of spleen, unspecified |
| | Injury of stomach |
| | Injury of tail of pancreas |
| | Injury of thoracic aorta |
| | Injury of transverse colon |
| | Laceration of liver, unspecified |
| | Laceration of lung |
| | Laceration of spleen extending into parenchyma |
| | Loss of consciousness of unspecified duration |
| | Massive parenchymal disruption of spleen |
| | Moderate laceration of liver |
| | Multiple rib fractures, involving three ribs |
| | Open wound of front wall of thorax |
| | Other and multiple pelvic fractures |
| | Other injury of spleen |
| | Rupture of bladder |
| | Traumatic haemopneumothorax |
| Burns, Transferred to Another Acute Care Facility < 5 Days | Burn of respiratory tract, part unspecified |
| | Burn of unspecified thickness of head and neck |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Burns of multiple regions, at least one burn of full thickness mentioned |
| | Full thickness burn of abdominal wall |
| | Full thickness burn of ankle and foot |
| | Full thickness burn of back [any part] |
| | Full thickness burn of chest wall, excluding breast and nipple thorax [external] |
| | Full thickness burn of forearm and elbow |
| | Full thickness burn of head and neck |
| | Full thickness burn of hip and lower limb, except ankle and foot |
| | Full thickness burn of wrist and hand |
| | Partial thickness [blisters, epidermal loss] burn of abdominal wall |
| | Partial thickness [blisters, epidermal loss] burn of ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of arm (upper) and shoulder region |
| | Partial thickness [blisters, epidermal loss] burn of back [any part] |
| | Partial thickness [blisters, epidermal loss] burn of chest wall, excluding breast and nipple thorax [external] |
| | Partial thickness [blisters, epidermal loss] burn of forearm and elbow |
| | Partial thickness [blisters, epidermal loss] burn of genitalia [external] |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| | Partial thickness [blisters, epidermal loss] burn of hip and lower limb, except ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of wrist and hand |
| Craniotomy W Catastrophic CC | Epidural haemorrhage |
| | Focal cerebral contusion |
| | Focal cerebral haematoma |
| | Fracture of base of skull |
| | Fracture of vault of skull |
| | Intracerebral haemorrhage, unspecified |
| | Multiple intracerebral and cerebellar haematomas |
| | Other intracerebral haemorrhage |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Craniotomy W Severe or Moderate CC | Epidural haemorrhage |
| | Fracture of base of skull |
| | Fracture of vault of skull |
| | Multiple intracerebral and cerebellar haematomas |
| | Other diffuse cerebral and cerebellar injury |
| | Other intracranial injuries |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Craniotomy W/O CC | Epidural haemorrhage |
| | Focal cerebral contusion |
| | Fracture of base of skull |
| | Fracture of vault of skull |
| | Fractures of other skull and facial bones |
| | Multiple intracerebral and cerebellar haematomas |
| | Other intracranial injuries |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Disorders of Liver Excep Malig, Cirrhosis, Alcoholic Hepatitis W/O Cat/Sev CC | Contusion and haematoma of liver |
| | Injury of liver, unspecified |
| | Laceration of liver, unspecified |
| | Major laceration of liver |
| | Minor laceration of liver |
| | Moderate laceration of liver |
| | Other injury of liver |
| Disorders of Liver Except Malig, Cirrhosis, Alcoholic Hepatitis W Cat/Sev CC | Contusion and haematoma of liver |
| | Injury of liver, unspecified |
| | Minor laceration of liver |
| | Moderate laceration of liver |
| Extensive O.R. Procedure Unrelated to Principal Diagnosis | Epidural haemorrhage |
| | Focal cerebral haematoma |
| | Fracture of base of skull |
| | Fracture of lumbar vertebra, L2 level |
| | Fracture of lumbar vertebra, L4 level |
| | Fracture of malar and maxillary bones |
| | Fracture of pelvis, part unspecified |
| | Fracture of thoracic vertebra, T7 and T8 level |
| | Fracture of vault of skull |
| | Fractures of other skull and facial bones |
| | Full thickness burn of ankle and foot |
| | Full thickness burn of head and neck |
| | Full thickness burn of hip and lower limb, except ankle and foot |
| | Injury of brachial artery |
| | Injury of thoracic aorta |
| | Intracerebral haemorrhage in hemisphere, subcortical |
| | Loss of consciousness of unspecified duration |
| | Multiple intracerebral and cerebellar haematomas |
| | Multiple rib fractures involving four or more ribs |
| | Multiple rib fractures, involving three ribs |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| | Traumatic haemopneumothorax |
| | Traumatic pneumothorax |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Extracranial Vascular Procedures W Catastrophic or Severe CC | Fracture of base of skull |
| | Injury of other cranial nerves |
| Extracranial Vascular Procedures W/O Catastrophic or Severe CC | Injury of brachial plexus |
| | Loss of consciousness of unspecified duration |
| Fractures of Pelvis and Femoral Neck W Catastrophic CC | Fracture of ilium |
| | Other and multiple pelvic fractures |
| Fractures of Pelvis and Femoral Neck W Severe CC | Fracture of ilium |
| | Fracture of ischium |
| | Fracture of pelvis, part unspecified |
| | Other and multiple pelvic fractures |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| Fractures of Pelvis and Femoral Neck W/O Catastrophic or Severe CC | Fracture of ilium |
| | Fracture of ischium |
| | Fracture of pelvis, part unspecified |
| | Other and multiple pelvic fractures |
| Head and Neck Procedures W CC | Fracture of malar and maxillary bones |
| Hip, Femur and Limb Procs for Multiple Significant Trauma, incl Implantation | Fracture of base of skull |
| | Fracture of ilium |
| | Injury of internal carotid artery |
| | Injury of liver, unspecified |
| | Injury of popliteal artery |
| | Massive parenchymal disruption of spleen |
| | Moderate laceration of liver |
| | Multiple intracerebral and cerebellar haematomas |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Injuries Age < 65 | Avulsion of scalp |
| | Crushed chest |
| | Crushing injuries involving multiple regions of lower limb(s) |
| | Crushing injuries involving thorax with abdomen, lower back and pelvis |
| | Crushing injury of other and unspecified parts of abdomen, lower back and pelvis |
| | Injuries of intrathoracic organs with intra-abdominal and pelvic organs |
| | Injury of brachial artery |
| | Injury of external jugular vein |
| | Injury of femoral vein at hip and thigh level |
| | Injury of internal carotid artery |
| | Injury of other blood vessels at abdomen, lower back and pelvis level |
| | Injury of popliteal vein |
| | Injury of radial artery at forearm level |
| | Injury of radial artery at wrist and hand level |
| | Injury of thoracic aorta |
| | Injury of ulnar artery at forearm level |
| | Injury of unspecified blood vessel at abdomen, lower back and pelvis level |
| | Injury of unspecified intrathoracic organ |
| | Multiple injuries of head |
| | Multiple injuries of neck |
| | Multiple open wounds of head |
| | Open wound of abdominal wall |
| | Open wound of back wall of thorax |
| | Open wound of front wall of thorax |
| | Open wound of lower back and pelvis |
| | Open wound of neck, part unspecified |
| | Open wound of other and unspecified parts of abdomen |
| | Open wound of other and unspecified parts of pelvic girdle |
| | Open wound of other parts of neck |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Open wound of thorax, part unspecified |
| | Open wound of trunk, level unspecified |
| | Open wounds involving head with neck |
| | Open wounds involving multiple regions of upper limb(s) with lower limb(s) |
| | Other multiple injuries of abdomen, lower back and pelvis |
| | Other specified injuries involving multiple body regions |
| | Other specified injuries of abdomen, lower back and pelvis |
| | Other specified injuries of head |
| | Other specified injuries of neck |
| | Other specified injuries of thorax |
| | Traumatic amputation of hand at wrist level |
| | Unspecified multiple injuries |
| Injuries Age>64 W CC | Injury of unspecified blood vessel at abdomen, lower back and pelvis level |
| | Injury of unspecified intrathoracic organ |
| | Multiple open wounds of head |
| | Multiple open wounds of neck |
| | Open wound of abdominal wall |
| | Open wound of back wall of thorax |
| | Open wound of front wall of thorax |
| | Open wound of neck, part unspecified |
| | Open wound of other and unspecified parts of abdomen |
| | Open wound of other parts of neck |
| | Open wound of thorax, part unspecified |
| | Open wounds involving multiple regions of upper limb(s) with lower limb(s) |
| | Other multiple injuries of abdomen, lower back and pelvis |
| | Other specified injuries of abdomen, lower back and pelvis |
| | Other specified injuries of head |
| | Other specified injuries of neck |
| | Other specified injuries of thorax |
| Injuries Age>64 W/O CC | Multiple open wounds of head |
| | Open wound of back wall of thorax |
| | Open wound of lower back and pelvis |
| | Open wound of neck, part unspecified |
| | Open wound of other parts of neck |
| | Open wound of thorax, part unspecified |
| | Open wounds involving head with neck |
| | Open wounds involving other combinations of body regions |
| | Other multiple injuries of abdomen, lower back and pelvis |
| | Other specified injuries involving multiple body regions |
| | Other specified injuries of abdomen, lower back and pelvis |
| | Other specified injuries of head |
| | Other specified injuries of neck |
| | Other specified injuries of thorax |
| Intracranial Injury | Diffuse cerebellar contusions |
| | Diffuse cerebral and cerebellar brain injury, unspecified |
| | Diffuse cerebral contusions |
| | Epidural haemorrhage |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Focal cerebellar contusion |
| | Focal cerebellar haematoma |
| | Focal cerebral and cerebellar injury, unspecified |
| | Focal cerebral contusion |
| | Focal cerebral haematoma |
| | Intracranial injury, unspecified |
| | Multiple intracerebral and cerebellar haematomas |
| | Other diffuse cerebral and cerebellar injury |
| | Other focal cerebral and cerebellar injury |
| | Other intracranial injuries |
| | Traumatic cerebral oedema |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Intubation Age<16 | Focal cerebral haematoma |
| | Fracture of base of skull |
| | Fracture of malar and maxillary bones |
| | Fracture of vault of skull |
| | Intracranial injury, unspecified |
| | Loss of consciousness of unspecified duration |
| | Multiple intracerebral and cerebellar haematomas |
| Kidney, Ureter & Major Bladder Procedures for Non-Neoplasm W/O Cat or Sev CC | Laceration of kidney |
| Major Chest Procedures W Catastrophic CC | Contusion and haematoma of lung |
| | Injury of diaphragm |
| | Multiple rib fractures involving four or more ribs |
| | Traumatic haemopneumothorax |
| | Traumatic pneumothorax |
| Major Chest Procedures W/O Catastrophic CC | Contusion and haematoma of lung |
| | Injury of diaphragm |
| | Injury of pleura |
| | Laceration of lung |
| | Traumatic haemopneumothorax |
| | Traumatic haemothorax |
| | Traumatic pneumothorax |
| Major Chest Trauma (Age<70 W CC) or (Age>69 W/O CC) | Dislocation of other and unspecified parts of thorax |
| | Flail chest |
| | Injury of diaphragm |
| | Laceration of lung |
| | Multiple rib fractures involving four or more ribs |
| | Multiple rib fractures, involving three ribs |
| | Multiple rib fractures, unspecified |
| Major Chest Trauma Age<70 W/O CC | Dislocation of other and unspecified parts of thorax |
| | Flail chest |
| | Injury of diaphragm |
| | Laceration of lung |
| | Multiple rib fractures involving four or more ribs |
| | Multiple rib fractures, involving three ribs |
| | Multiple rib fractures, unspecified |
| | Open wound of trachea |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| Major Chest Trauma Age>69 W CC | Flail chest |
| | Multiple rib fractures involving four or more ribs |
| | Multiple rib fractures, involving three ribs |
| | Multiple rib fractures, unspecified |
| Maxillo-Facial Surgery | Fracture of skull and facial bones, part unspecified |
| | Fracture of third cervical vertebra |
| Multiple Trauma Without Significant Procedures | Capsule tears of spleen, without major disruption of parenchyma |
| | Central cord syndrome (incomplete cord injury) of cervical spinal cord |
| | Complete disruption of kidney parenchyma |
| | Complete lesion of thoracic spinal cord |
| | Concussion and oedema of cervical spinal cord |
| | Concussion and oedema of thoracic spinal cord |
| | Contusion and haematoma of kidney |
| | Contusion and haematoma of liver |
| | Contusion and haematoma of lung |
| | Contusion of heart |
| | Crushing injuries involving head with neck |
| | Dislocation of C1/C2 cervical vertebrae |
| | Dislocation of C3/C4 cervical vertebrae |
| | Dislocation of C6/C7 cervical vertebrae |
| | Epidural haemorrhage |
| | Flail chest |
| | Focal cerebral contusion |
| | Focal cerebral haematoma |
| | Fracture of base of skull |
| | Fracture of first cervical vertebra |
| | Fracture of ilium |
| | Fracture of lumbar vertebra, L1 level |
| | Fracture of malar and maxillary bones |
| | Fracture of pelvis, part unspecified |
| | Fracture of sacrum |
| | Fracture of second cervical vertebra |
| | Fracture of seventh cervical vertebra |
| | Fracture of sixth cervical vertebra |
| | Fracture of third cervical vertebra |
| | Fracture of vault of skull |
| | Incomplete cord syndrome of thoracic spinal cord |
| | Injuries of brain and cranial nerves with injuries of nerves and spinal cord at neck level |
| | Injury of body of pancreas |
| | Injury of diaphragm |
| | Injury of liver, unspecified |
| | Injury of other pelvic organ |
| | Injury of other specified intrathoracic organs and structures |
| | Injury of pancreas, part unspecified |
| | Injury of peritoneum |
| | Injury of retroperitoneum |
| | Injury of spleen, unspecified |
| | Injury of thoracic spinal cord unspecified |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Laceration of kidney |
| | Laceration of liver, unspecified |
| | Laceration of spleen extending into parenchyma |
| | Massive parenchymal disruption of spleen |
| | Minor laceration of liver |
| | Moderate laceration of liver |
| | Multiple fractures of lumbar spine with pelvis |
| | Multiple intracerebral and cerebellar haematomas |
| | Multiple rib fractures involving four or more ribs |
| | Multiple rib fractures, involving three ribs |
| | Multiple rib fractures, unspecified |
| | Other and multiple pelvic fractures |
| | Other injury of spleen |
| | Other specified injuries of head |
| | Traumatic haemopneumothorax |
| | Traumatic haemothorax |
| | Traumatic pneumothorax |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Multiple Trauma, Died or Transf to Another Acute Care Facility, LOS<5 Days | Complete disruption of kidney parenchyma |
| | Contusion and haematoma of liver |
| | Contusion and haematoma of lung |
| | Epidural haemorrhage |
| | Flail chest |
| | Focal cerebellar haematoma |
| | Focal cerebral haematoma |
| | Fracture of base of skull |
| | Fracture of first cervical vertebra |
| | Fracture of pelvis, part unspecified |
| | Fracture of skull and facial bones, part unspecified |
| | Fracture of third cervical vertebra |
| | Fracture of thoracic vertebra, T5 and T6 level |
| | Fracture of thoracic vertebra, T9 and T10 level |
| | Fracture of vault of skull |
| | Fractures of other skull and facial bones |
| | Injury of body of pancreas |
| | Injury of colon, part unspecified |
| | Injury of innominate or subclavian vein |
| | Injury of mesentery |
| | Injury of radial artery at forearm level |
| | Injury of retroperitoneum |
| | Injury of spleen, unspecified |
| | Laceration of heart without penetration into heart chamber |
| | Laceration of lung |
| | Loss of consciousness of moderate duration [30 minutes to 24 hours] |
| | Loss of consciousness of unspecified duration |
| | Major laceration of liver |
| | Massive parenchymal disruption of spleen |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Multiple intracerebral and cerebellar haematomas |
| | Multiple rib fractures involving four or more ribs |
| | Multiple rib fractures, unspecified |
| | Other and multiple pelvic fractures |
| | Other diffuse cerebral and cerebellar injury |
| | Other dislocation of cervical vertebrae |
| | Other injuries of heart |
| | Other injury of lumbar spinal cord [conus medullaris] |
| | Other intracranial injuries |
| | Traumatic cerebral oedema |
| | Traumatic haemopneumothorax |
| | Traumatic pneumothorax |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Other Burns Age<65 W/O Catastr or Severe CC W/O Complicating Diagnosis/Proc | Burn of respiratory tract, part unspecified |
| | Burn of unspecified body region, unspecified thickness |
| | Burn of unspecified thickness of back [any part] |
| | Burn of unspecified thickness of head and neck |
| | Burn of unspecified thickness of hip and lower limb, except ankle and foot |
| | Burn of unspecified thickness of other sites of trunk |
| | Burn of unspecified thickness of shoulder and upper limb, except wrist and hand, unspecified site |
| | Burns of multiple regions, no more than partial thickness burns mentioned |
| | Partial thickness [blisters, epidermal loss] burn of abdominal wall |
| | Partial thickness [blisters, epidermal loss] burn of ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of arm (upper) and shoulder region |
| | Partial thickness [blisters, epidermal loss] burn of back [any part] |
| | Partial thickness [blisters, epidermal loss] burn of breast |
| | Partial thickness [blisters, epidermal loss] burn of chest wall, excluding breast and nipple thorax [external] |
| | Partial thickness [blisters, epidermal loss] burn of forearm and elbow |
| | Partial thickness [blisters, epidermal loss] burn of genitalia [external] |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| | Partial thickness [blisters, epidermal loss] burn of hip and lower limb, except ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of other sites of trunk |
| | Partial thickness [blisters, epidermal loss] burn of shoulder and upper limb, except wrist and hand, unspecified site |
| | Partial thickness [blisters, epidermal loss] burn of trunk, unspecified site |
| | Partial thickness [blisters, epidermal loss] burn of wrist and hand |
| Other Burns Age>64 or W Catastr or Severe CC or W Complicating Diagnosis/Proc | Burn of unspecified thickness of back [any part] |
| | Burn of unspecified thickness of head and neck |
| | Burn of unspecified thickness of hip and lower limb, except ankle and foot |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Partial thickness [blisters, epidermal loss] burn of abdominal wall |
| | Partial thickness [blisters, epidermal loss] burn of ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of arm (upper) and shoulder region |
| | Partial thickness [blisters, epidermal loss] burn of back [any part] |
| | Partial thickness [blisters, epidermal loss] burn of breast |
| | Partial thickness [blisters, epidermal loss] burn of chest wall, excluding breast and nipple thorax [external] |
| | Partial thickness [blisters, epidermal loss] burn of forearm and elbow |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| | Partial thickness [blisters, epidermal loss] burn of hip and lower limb, except ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of other sites of trunk |
| | Partial thickness [blisters, epidermal loss] burn of wrist and hand |
| Other Burns W Skin Graft Age<65 W/O Cat or Sev CC W/O Complicg Diagnosis/Proc | Burn of unspecified thickness of hip and lower limb, except ankle and foot |
| | Full thickness burn of abdominal wall |
| | Full thickness burn of ankle and foot |
| | Full thickness burn of arm (upper) and shoulder region |
| | Full thickness burn of back [any part] |
| | Full thickness burn of chest wall, excluding breast and nipple thorax [external] |
| | Full thickness burn of forearm and elbow |
| | Full thickness burn of head and neck |
| | Full thickness burn of hip and lower limb, except ankle and foot |
| | Full thickness burn of other sites of trunk |
| | Full thickness burn of wrist and hand |
| | Partial thickness [blisters, epidermal loss] burn of ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of arm (upper) and shoulder region |
| | Partial thickness [blisters, epidermal loss] burn of back [any part] |
| | Partial thickness [blisters, epidermal loss] burn of chest wall, excluding breast and nipple thorax [external] |
| | Partial thickness [blisters, epidermal loss] burn of forearm and elbow |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| | Partial thickness [blisters, epidermal loss] burn of hip and lower limb, except ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of shoulder and upper limb, except wrist and hand, unspecified site |
| | Partial thickness [blisters, epidermal loss] burn of wrist and hand |
| Other Burns W Skin Graft Age>64 or W Cat/Sev CC or W Complicg Diagnosis/Proc | Burn of unspecified thickness of back [any part] |
| | Burn of unspecified thickness of hip and lower limb, except ankle and foot |
| | Full thickness burn of abdominal wall |
| | Full thickness burn of ankle and foot |
| | Full thickness burn of arm (upper) and shoulder region |
| | Full thickness burn of back [any part] |
| | Full thickness burn of chest wall, excluding breast and nipple thorax [external] |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Full thickness burn of forearm and elbow |
| | Full thickness burn of head and neck |
| | Full thickness burn of hip and lower limb, except ankle and foot |
| | Full thickness burn of other sites of trunk |
| | Full thickness burn of shoulder and upper limb, except wrist and hand, upper limb, unspecified site |
| | Full thickness burn of wrist and hand |
| | Partial thickness [blisters, epidermal loss] burn of ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of arm (upper) and shoulder region |
| | Partial thickness [blisters, epidermal loss] burn of back [any part] |
| | Partial thickness [blisters, epidermal loss] burn of forearm and elbow |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| | Partial thickness [blisters, epidermal loss] burn of hip and lower limb, except ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of trunk, unspecified site |
| Other Cardiothoracic Procedures W/O Pump | Laceration of heart with penetration into heart chamber |
| | Laceration of heart without penetration into heart chamber |
| Other Digestive System O.R. Procedures W Catastr or Severe CC or W Malignancy | Injury of mesentery |
| | Injury of peritoneum |
| | Injury of stomach |
| Other Digestive System O.R. Procedures W/O Catastr or Sev CC W/O Malignancy | Injury of mesentery |
| | Injury of other and multiple parts of small intestine |
| | Injury of peritoneum |
| | Injury of unspecified intra-abdominal organ |
| Other Head Injury | Loss of consciousness of moderate duration [30 minutes to 24 hours] |
| | Loss of consciousness of prolonged duration [more than 24 hours] with return to pre-existing conscious level |
| | Loss of consciousness of unspecified duration |
| Other Hepatobiliary and Pancreas O.R. Procedures | Contusion and haematoma of liver |
| | Laceration of liver, unspecified |
| Other Hip and Femur Procedures Age<55 W/O Catastrophic or Severe CC | Dislocation of other and unspecified parts of lumbar spine and pelvis |
| | Other and multiple pelvic fractures |
| Other Hip and Femur Procedures Age>54 W/O Catastrophic or Severe CC | Multiple fractures of femur |
| Other Hip and Femur Procedures W Catastrophic or Severe CC | Fracture of ilium |
| | Fracture of second cervical vertebra |
| | Other and multiple pelvic fractures |
| Other Kidney and Urinary Tract Diagnoses W Catastrophic CC | Contusion and haematoma of kidney |
| | Injury of retroperitoneum |
| Other Kidney and Urinary Tract Diagnoses W Severe CC | Contusion and haematoma of kidney |
| | Foreign body in bladder |
| | Injury of retroperitoneum |
| | Laceration of kidney |
| Other Kidney and Urinary Tract Diagnoses W/O Catastrophic or Severe CC | Complete disruption of kidney parenchyma |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Contusion and haematoma of kidney |
| | Foreign body in bladder |
| | Injury of retroperitoneum |
| | Laceration of kidney |
| | Rupture of bladder |
| Other O.R. Procedure of Blood & Blood Forming Organs W Catastr or Severe CC | Capsule tears of spleen, without major disruption of parenchyma |
| Other O.R. Procedure of Blood & Blood Forming Organs W/O Catastr or Severe CC | Injury of spleen, unspecified |
| Other O.R. Procedures for Multiple Significant Trauma | Complete lesion of thoracic spinal cord |
| | Contusion and haematoma of liver |
| | Dislocation of C3/C4 cervical vertebrae |
| | Dislocation of C5/C6 cervical vertebrae |
| | Flail chest |
| | Fracture of base of skull |
| | Fracture of fifth cervical vertebra |
| | Fracture of lumbar vertebra, L1 level |
| | Fracture of lumbar vertebra, L2 level |
| | Fracture of lumbar vertebra, L3 level |
| | Fracture of second cervical vertebra |
| | Fracture of seventh cervical vertebra |
| | Fracture of thoracic vertebra, T3 and T4 level |
| | Fracture of vault of skull |
| | Injury of (anterior)(posterior) tibial artery |
| | Injury of diaphragm |
| | Injury of liver, unspecified |
| | Injury of retroperitoneum |
| | Injury of thoracic aorta |
| | Injury of thoracic spinal cord unspecified |
| | Laceration of liver, unspecified |
| | Laceration of spleen extending into parenchyma |
| | Multiple fractures of lumbar spine with pelvis |
| | Multiple rib fractures involving four or more ribs |
| | Other and multiple pelvic fractures |
| | Other incomplete cord syndrome of cervical spinal cord |
| | Other injury of lumbar spinal cord [conus medullaris] |
| | Other intracranial injuries |
| | Traumatic amputation of upper limb, level unspecified |
| | Traumatic haemopneumothorax |
| | Traumatic haemothorax |
| | Traumatic pneumothorax |
| | Traumatic subarachnoid haemorrhage |
| Other O.R. Procedures for Other Burns | Burn of partial thicknes, body region unspecified |
| | Full thickness burn of ankle and foot |
| | Full thickness burn of back [any part] |
| | Full thickness burn of forearm and elbow |
| | Full thickness burn of genitalia [external] |
| | Full thickness burn of hip and lower limb, except ankle and foot |
| | Full thickness burn of wrist and hand |
| | Partial thickness [blisters, epidermal loss] burn of abdominal wall |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Partial thickness [blisters, epidermal loss] burn of ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of back [any part] |
| | Partial thickness [blisters, epidermal loss] burn of chest wall, excluding breast and nipple thorax [external] |
| | Partial thickness [blisters, epidermal loss] burn of forearm and elbow |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| | Partial thickness [blisters, epidermal loss] burn of hip and lower limb, except ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of wrist and hand |
| Other Procedures for Other Injuries W Catastrophic or Severe CC | Injury of brachial artery |
| | Injury of external jugular vein |
| | Injury of femoral artery |
| | Injury of femoral vein at hip and thigh level |
| | Injury of internal carotid artery |
| | Injury of other blood vessels at neck level |
| | Injury of radial artery at forearm level |
| | Injury of radial artery at wrist and hand level |
| | Injury of thoracic aorta |
| | Injury of unspecified blood vessel of thorax |
| | Open wound of abdominal wall |
| | Open wound of front wall of thorax |
| | Open wound of lower back and pelvis |
| | Open wound of neck, part unspecified |
| | Open wound of other and unspecified parts of abdomen |
| | Open wound of other parts of neck |
| | Open wound of other parts of thorax |
| | Open wound of trunk, level unspecified |
| | Other specified injuries of abdomen, lower back and pelvis |
| Other Procedures for Other Injuries W/O Catastrophic or Severe CC | Injury of brachial artery |
| | Injury of femoral artery |
| | Injury of iliac blood vessels |
| | Injury of internal jugular vein |
| | Injury of other blood vessels at abdomen, lower back and pelvis level |
| | Injury of other blood vessels at neck level |
| | Injury of portal or splenic vein |
| | Injury of radial artery at forearm level |
| | Injury of radial artery at wrist and hand level |
| | Injury of renal blood vessels |
| | Injury of ulnar artery at forearm level |
| | Injury of vertebral artery |
| | Multiple open wounds of head |
| | Open wound of abdominal wall |
| | Open wound of back wall of thorax |
| | Open wound of front wall of thorax |
| | Open wound of lower back and pelvis |
| | Open wound of neck, part unspecified |
| | Open wound of other and unspecified parts of abdomen |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Open wound of other parts of neck |
| | Open wound of other parts of thorax |
| | Open wounds involving head with neck |
| | Other specified injuries of abdomen, lower back and pelvis |
| | Traumatic amputation at level between elbow and wrist |
| Pancreas, Liver and Shunt Procedures W Catastrophic CC | Contusion and haematoma of liver |
| | Injury of other and multiple parts of pancreas |
| | Laceration of liver, unspecified |
| Pancreas, Liver and Shunt Procedures W Severe or Moderate CC | Injury of liver, unspecified |
| | Laceration of liver, unspecified |
| | Other injury of liver |
| Pancreas, Liver and Shunt Procedures W/O CC | Moderate laceration of liver |
| Peripheral and Cranial Nerve & Other Nervous System Procedures W CC | Epidural haemorrhage |
| | Fracture of base of skull |
| | Fracture of vault of skull |
| | Loss of consciousness of moderate duration [30 minutes to 24 hours] |
| | Multiple fractures involving skull and facial bones |
| | Other intracranial injuries |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Peripheral and Cranial Nerve & Other Nervous System Procedures W/O CC | Diffuse cerebral contusions |
| | Fracture of base of skull |
| | Fracture of vault of skull |
| | Fractures of other skull and facial bones |
| | Injury of brachial plexus |
| | Injury of optic nerve and pathways |
| | Multiple intracerebral and cerebellar haematomas |
| Pneumothorax | Pneumothorax, unspecified |
| | Traumatic haemopneumothorax |
| | Traumatic haemothorax |
| | Traumatic pneumothorax |
| | Traumatic subcutaneous emphysema |
| Severe Burns | Burns of multiple regions, at least one burn of full thickness mentioned |
| | Full thickness burn of abdominal wall |
| | Full thickness burn of ankle and foot |
| | Full thickness burn of arm (upper) and shoulder region |
| | Full thickness burn of back [any part] |
| | Full thickness burn of chest wall, excluding breast and nipple thorax [external] |
| | Full thickness burn of forearm and elbow |
| | Full thickness burn of head and neck |
| | Full thickness burn of hip and lower limb, except ankle and foot |
| | Full thickness burn of shoulder and upper limb, except wrist and hand, upper limb, unspecified site |
| | Full thickness burn of trunk, unspecified site |
| | Full thickness burn of wrist and hand |
| | Partial thickness [blisters, epidermal loss] burn of abdominal wall |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Partial thickness [blisters, epidermal loss] burn of ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of back [any part] |
| | Partial thickness [blisters, epidermal loss] burn of chest wall, excluding breast and nipple thorax [external] |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| | Partial thickness [blisters, epidermal loss] burn of hip and lower limb, except ankle and foot |
| | Partial thickness [blisters, epidermal loss] burn of wrist and hand |
| Severe Full Thickness Burns | Burn of unspecified thickness of head and neck |
| | Burns of multiple regions, at least one burn of full thickness mentioned |
| | Full thickness burn of abdominal wall |
| | Full thickness burn of arm (upper) and shoulder region |
| | Full thickness burn of back [any part] |
| | Full thickness burn of breast |
| | Full thickness burn of chest wall, excluding breast and nipple thorax [external] |
| | Full thickness burn of forearm and elbow |
| | Full thickness burn of head and neck |
| | Full thickness burn of hip and lower limb, except ankle and foot |
| | Full thickness burn of wrist and hand |
| | Partial thickness [blisters, epidermal loss] burn of back [any part] |
| | Partial thickness [blisters, epidermal loss] burn of head and neck |
| Skull Fractures | Fracture of base of skull |
| | Fracture of vault of skull |
| | Fractures of other skull and facial bones |
| | Multiple fractures involving skull and facial bones |
| Spinal Cord Conditions W or W/O O.R. Procedures W Catastrophic or Severe CC | Central cord syndrome (incomplete cord injury) of cervical spinal cord |
| | Complete lesion of cervical spinal cord |
| | Complete lesion of thoracic spinal cord |
| | Concussion and oedema of cervical spinal cord |
| | Incomplete cord syndrome of thoracic spinal cord |
| | Injury of cervical spinal cord, unspecified |
| | Injury of thoracic spinal cord unspecified |
| | Other incomplete cord syndrome of cervical spinal cord |
| | Other injury of lumbar spinal cord [conus medullaris] |
| Spinal Cord Conditions W or W/O O.R. Procedures W/O Catastrophic or Severe CC | Central cord syndrome (incomplete cord injury) of cervical spinal cord |
| | Complete lesion of thoracic spinal cord |
| | Concussion and oedema of cervical spinal cord |
| | Concussion and oedema of thoracic spinal cord |
| | Functional spinal cord injury, C4 |
| | Functional spinal cord injury, L1 |
| | Functional spinal cord injury, L3 |
| | Incomplete cord syndrome of thoracic spinal cord |
| | Injuries of nerves and spinal cord involving other multiple body regions |
| | Injury of cauda equina |
| | Injury of cervical spinal cord, unspecified |
| | Injury of spinal cord, level unspecified |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Injury of thoracic spinal cord unspecified |
| | Other incomplete cord syndrome of cervical spinal cord |
| | Other injury of lumbar spinal cord [conus medullaris] |
| Spinal Fusion W Catastrophic or Severe CC | Dislocation of C3/C4 cervical vertebrae |
| | Dislocation of C5/C6 cervical vertebrae |
| | Dislocation of C6/C7 cervical vertebrae |
| | Fracture of fifth cervical vertebra |
| | Fracture of first cervical vertebra |
| | Fracture of lumbar vertebra, L1 level |
| | Fracture of lumbar vertebra, L2 level |
| | Fracture of lumbar vertebra, L3 level |
| | Fracture of lumbar vertebra, L4 level |
| | Fracture of second cervical vertebra |
| | Fracture of seventh cervical vertebra |
| | Fracture of sixth cervical vertebra |
| | Fracture of thoracic vertebra, T1 and T2 level |
| | Fracture of thoracic vertebra, T11 and T12 level |
| | Fracture of thoracic vertebra, T5 and T6 level |
| | Fracture of thoracic vertebra, T7 and T8 level |
| | Multiple fractures of thoracic spine |
| | Traumatic spondylopathy, cervical region |
| Spinal Fusion W/O Catastrophic or Severe CC | Dislocation of C2/C3 cervical vertebrae |
| | Dislocation of C4/C5 cervical vertebrae |
| | Dislocation of C5/C6 cervical vertebrae |
| | Dislocation of C6/C7 cervical vertebrae |
| | Fracture of fifth cervical vertebra |
| | Fracture of lumbar vertebra, L1 level |
| | Fracture of lumbar vertebra, L2 level |
| | Fracture of lumbar vertebra, L3 level |
| | Fracture of lumbar vertebra, L4 level |
| | Fracture of second cervical vertebra |
| | Fracture of seventh cervical vertebra |
| | Fracture of sixth cervical vertebra |
| | Fracture of thoracic vertebra, T11 and T12 level |
| Spinal Procedures W Catastrophic or Severe CC | Fracture of base of skull |
| | Loss of consciousness of unspecified duration |
| Splenectomy | Capsule tears of spleen, without major disruption of parenchyma |
| | Injury of spleen, unspecified |
| | Laceration of spleen extending into parenchyma |
| | Massive parenchymal disruption of spleen |
| | Other injury of spleen |
| Tracheostomy Any Age, Any Condition | Burn involving larynx and trachea with lung |
| | Burn of larynx and trachea |
| | Burn of oesophagus |
| | Complete lesion of cervical spinal cord |
| | Contusion and haematoma of lung |
| | Diffuse cerebral contusions |
| | Dislocation of C2/C3 cervical vertebrae |
| | Epidural haemorrhage |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Flail chest |
| | Focal cerebellar contusion |
| | Focal cerebral contusion |
| | Focal cerebral haematoma |
| | Fracture of base of skull |
| | Fracture of ilium |
| | Fracture of malar and maxillary bones |
| | Fracture of other parts of neck |
| | Fracture of second cervical vertebra |
| | Fracture of seventh cervical vertebra |
| | Fracture of sixth cervical vertebra |
| | Fracture of skull and facial bones, part unspecified |
| | Fracture of third cervical vertebra |
| | Fracture of thoracic vertebra, T11 and T12 level |
| | Fracture of thoracic vertebra, T9 and T10 level |
| | Fracture of vault of skull |
| | Fractures of other skull and facial bones |
| | Injury of cervical spinal cord, unspecified |
| | Injury of internal carotid artery |
| | Injury of thoracic aorta |
| | Loss of consciousness of unspecified duration |
| | Massive parenchymal disruption of spleen |
| | Moderate laceration of liver |
| | Multiple fractures involving skull and facial bones |
| | Multiple intracerebral and cerebellar haematomas |
| | Multiple rib fractures involving four or more ribs |
| | Open wound of other parts of neck |
| | Open wound of trachea |
| | Other diffuse cerebral and cerebellar injury |
| | Other focal cerebral and cerebellar injury |
| | Other incomplete cord syndrome of cervical spinal cord |
| | Other injury of spleen |
| | Other intracranial injuries |
| | Other specified sepsis |
| | Traumatic haemopneumothorax |
| | Traumatic haemothorax |
| | Traumatic pneumothorax |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |
| Ungroupable | Fracture of vault of skull |
| Ventilation or Craniotomy Procs for Multiple Significant Trauma | Capsule tears of spleen, without major disruption of parenchyma |
| | Central cord syndrome (incomplete cord injury) of cervical spinal cord |
| | Complete disruption of kidney parenchyma |
| | Complete lesion of cervical spinal cord |
| | Complete lesion of thoracic spinal cord |
| | Contusion and haematoma of lung |
| | Diffuse cerebellar contusions |
| | Diffuse cerebral and cerebellar brain injury, unspecified |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Diffuse cerebral contusions |
| | Dislocation of C1/C2 cervical vertebrae |
| | Epidural haemorrhage |
| | Flail chest |
| | Focal cerebral contusion |
| | Focal cerebral haematoma |
| | Fracture of base of skull |
| | Fracture of first cervical vertebra |
| | Fracture of lumbar vertebra, L1 level |
| | Fracture of malar and maxillary bones |
| | Fracture of sacrum |
| | Fracture of second cervical vertebra |
| | Fracture of sixth cervical vertebra |
| | Fracture of skull and facial bones, part unspecified |
| | Fracture of thoracic vertebra, T5 and T6 level |
| | Fracture of thoracic vertebra, T7 and T8 level |
| | Fracture of vault of skull |
| | Fractures of other skull and facial bones |
| | Functional spinal cord injury, T6/T7 |
| | Injury of ascending [right] colon |
| | Injury of brachial artery |
| | Injury of coeliac or mesenteric artery |
| | Injury of diaphragm |
| | Injury of iliac blood vessels |
| | Injury of liver, unspecified |
| | Injury of mesentery |
| | Injury of other and multiple parts of small intestine |
| | Injury of portal or splenic vein |
| | Injury of retroperitoneum |
| | Injury of sigmoid colon |
| | Injury of small intestine, part unspecified |
| | Injury of spleen, unspecified |
| | Injury of thoracic aorta |
| | Injury of thoracic spinal cord unspecified |
| | Injury of unspecified intra-abdominal organ |
| | Intracranial injury, unspecified |
| | Laceration of kidney |
| | Laceration of liver, unspecified |
| | Laceration of spleen extending into parenchyma |
| | Major laceration of liver |
| | Massive parenchymal disruption of spleen |
| | Moderate laceration of liver |
| | Multiple fractures of thoracic spine |
| | Multiple intracerebral and cerebellar haematomas |
| | Multiple rib fractures involving four or more ribs |
| | Multiple rib fractures, involving three ribs |
| | Multiple rib fractures, unspecified |
| | Other and multiple pelvic fractures |
| | Other and unspecified injuries of lung |

# Appendix 4

| DRG name | Diag name (ICD -10 Diagnosis) |
|---|---|
| | Other diffuse cerebral and cerebellar injury |
| | Other dislocation of cervical vertebrae |
| | Other incomplete cord syndrome of cervical spinal cord |
| | Other injury of lumbar spinal cord [conus medullaris] |
| | Other intracranial injuries |
| | Rupture of bladder |
| | Traumatic amputation at level between knee and ankle |
| | Traumatic amputation of both legs [any level] |
| | Traumatic cerebral oedema |
| | Traumatic haemopneumothorax |
| | Traumatic pneumothorax |
| | Traumatic subarachnoid haemorrhage |
| | Traumatic subdural haemorrhage |

Appendix 5

# NSW trauma minimum data set (TMDS)

| Data element |
|---|
| Hospital name (recording facility name) |
| System access |
| Gender |
| Age |
| Residential postcode |
| Injury location postcode |
| Date and time of injury |
| Mechanism of injury |
| Primary injury type (blunt/penetrating) |
| Height of fall |
| Place of injury |
| Activity when injured |
| AIS body regions |
| AIS injury code and severity score |
| ISS |
| Hospital admission date and time |
| Transport provider agency |
| Mode of arrival |
| Transferred from |
| Operating procedures at referring hospital |
| Trauma response (NSW ITIM KPI) |
| ED departure date/time |
| Operating procedure in first 24 hours |
| Operating procedure start date/time |
| Intensive care length of stay |
| Total ventilator days |
| Hospital length of stay |
| Discharge/death date/time |
| Discharged to |
| Transferred to |
| Transfer reason |

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