MAJOR TRAUMA DATA REVIEW:

MODELLING THE

IMPACT OF THE TRAUMA

TRIAGE GUIDELINES

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Executive Summary

The review of the major trauma data was undertaken to estimate the potential impact of introducing the Metropolitan Trauma Triage Guidelines. It was anticipated that this would shed further light on the number and level of major trauma patients who require treatment at a Major Trauma Service and those who can appropriately be treated at other levels of trauma service. This will allow for a better understanding of the overall impact of the introduction of the Guidelines on the wider acute system as well as on the Major Trauma Services.

The major findings of this review were:

1. The number of major trauma patients in Victoria for the period 1 April 2000 to 31 March 2001 was between 1,627 and 1,952. It is likely that the true figure was approximately 1,700 patients.

2. The number of major trauma patients has remained stable since the Monash University study of 1997-98 data.

3. Over 96% of major trauma patients received definitive treatment at a Major Trauma Service, a Metropolitan Trauma Service or a Regional Trauma Service.

4. Over 49% of major trauma patients were recorded on the Victorian Admitted Episode Database (VAED) as having a Diagnostic Related Group (DRG) associated with a head or brain injury. The four DRG groups "Head/Brain", "Multiple Trauma", "Chest Injury" and "Spinal Cord Injury" accounted for 76% of major trauma patients. As these categories appear to warrant definitive care at a Major Trauma Service there may not be the flexibility to prioritise certain categories of patients to a Major Trauma Service based on the injured body part.

5. The impact of the introduction of the Metropolitan trauma Triage Guidelines will re-direct **145–185** major trauma patients *per annum* to The Alfred and **116–145** major trauma patients *per annum* to the Royal Melbourne Hospital. There will be a consequent reduction in the number of major trauma patients requiring definitive care at other major metropolitan hospitals.

6. The introduction of the Metropolitan Trauma Triage Guidelines will decrease the number of hours in Metropolitan Trauma Services Intensive Care Units (ICU) by 18,950 hours. There will be an increase in ICU hours at The Alfred of 9,650 hours and at the Royal Melbourne Hospital of 9,300 hours.

7. There were issues concerning the accuracy and quality of the data recorded on the VAED.

Purpose Of The Review

Primary Research Question

The primary research question is:

WHAT WILL BE THE CHANGE IN THE NUMBER OF ADULT MAJOR TRAUMA PATIENTS DIRECTLY TRIAGED TO A MAJOR TRAUMA SERVICE FOLLOWING THE INTRODUCTION OF THE METROPOLITAN TRAUMA TRIAGE GUIDELINES?

Secondary Research Questions

1. What is the true number of major and minor trauma patients who received treatment in Victorian hospitals during the period 1 April 2000 – 31 March 2001?

2. How many major trauma patients received treatment at a MTS and how many at other levels of trauma service?

3. What are the demographic characteristics of the major trauma population?

Background

The Review of Trauma and Emergency Services

The Ministerial Taskforce report *Review of Trauma and Emergency Services – Victoria 1999* (the *ROTES* report) established a framework for the treatment and care of major trauma patients. The development of an integrated system was seen to be necessary following research into trauma in Victoria which found that 30 - 40% of major trauma related deaths were potentially preventible[1]. The international literature shows that patient outcomes are improved when major trauma patients receive their definitive treatment at a Major Trauma Service (MTS).

The *ROTES* report makes 16 recommendations regarding the triage and transfer of trauma patients (Recommendations 3.1 – 3.16). Of particular note are Recommendations 3.2 to 3.6 which establish the level of trauma service to which major trauma patients should be triaged. These Recommendations are set out below:

Recommendation 3.2
Triage to a Major Trauma Service where a major trauma patient is less than 30 minutes transport time from a Major Trauma Service.

Recommendation 3.3
Triage to the highest designated trauma service accessible in 30 minutes where a major trauma patient is more than 30 minutes transport time from a Major Trauma Service.

Recommendation 3.4
Triage to a designated trauma service accessible in the least amount of time in isolated rural areas that are more than 30 minutes from any trauma service.

Recommendation 3.5
Where a patient is triaged initially to a non-Major Trauma Service for initial stabilisation, early liaison with the Major Trauma Service occur and consideration be given to appropriate medical retrieval or interhospital transfer to a Major Trauma Service.

Recommendation 3.6
Where a major trauma patient appears to be in an "immediately life-threatening situation" during transport, the patient be diverted to the nearest designated trauma service for stabilisation, with subsequent transport to a Major Trauma Service at the earliest appropriate time.

[1] Danne, P. et al (1998) "The Major Trauma Management Study: an analysis of the efficacy of current trauma care", *Aust. N.Z. J. Surg*. 68: 50-57.

McDermott, F.T. Cordner, S.M. Tremayne, A.B. (1996) "Evaluation of medical management and preventability of death in 137 road traffic fatalities in Victoria, Australia", *J Trauma*, 41: 83-90.

State Trauma Committee

The State Trauma Committee (STC), established as a result of the *ROTES* report, identified that the introduction of Trauma Triage and Transfer Guidelines will increase the proportion of major trauma patients treated at a MTS and will be a key development in the implementation of the trauma system. The introduction of the Guidelines would initially be achieved by having ambulance services triage all adult major trauma patients directly to an adult MTS (The Alfred and the Royal Melbourne Hospital) when the travel time is less than 30 minutes. The Royal Children's Hospital (RCH) has been designated as the paediatric MTS for Victoria and all paediatric major trauma patients should be referred to the RCH to receive definitive care.

Changes to the way in which adult major trauma patients are triaged and transferred would be made incrementally. The introduction of metropolitan triage Guidelines would be followed by:

- The introduction of rural/regional triage Guidelines;
- The introduction of metropolitan transfer Guidelines; and
- The introduction of rural/regional transfer Guidelines.

Trauma Triage Guidelines

Introduction of the metropolitan triage Guidelines would potentially increase numbers of patients admitted to the two adult MTSs, and decrease major trauma admissions to other hospitals. Overall, there could be efficiencies and improved patient outcomes resulting from the reduction of inter-hospital transfers, as patients will be triaged directly to definitive care.

During the lead up to the introduction of metropolitan triage Guidelines, concerns were raised by a number of trauma stakeholders regarding the timing and associated issues in the implementation of the Guidelines. The two adult MTSs reported some uneasiness about the potential impact of any increased demand on their services.

Trauma Data Review

In the light of these concerns, the Department of Human Services (DHS) made the decision to delay the introduction of the Trauma Triage and Transfer Guidelines while the available trauma data is reviewed. It is anticipated that reviewing the data will shed further light on the number and level of major trauma patients who require treatment at a MTS and those who can appropriately be treated at other levels of trauma service. This will allow for a better understanding of the overall impact of the introduction of the Guidelines on the wider acute system as well as on the MTSs.

Some further work may be necessary to align the various stages of the trauma transfer and triage Guidelines with the capacity of the MTSs. While this may require some evaluation of the priorities in the treatment of major trauma patients, it will not change the fundamental approach of the *ROTES* report which sees MTSs as centres of excellence in the management of trauma and defines a role for other levels of services in the management of trauma in Victoria.

Methodology

Data Review Method

The review of the data relied on an interactive process whereby the project team engaged in ongoing consultation with relevant clinicians and researchers in the trauma field. This allowed for constant evaluation of the data analysis process and ongoing confirmation of the methodology.

Analysis of the trauma data was initially based on a previous trauma study undertaken by the Department of Epidemiology and Preventive Medicine, Monash University[2] to estimate the impact of trauma triage and transfer Guidelines on ambulance services.

The project team discussed the methodology with the following people:

- Professor Peter Cameron, Director of Emergency Medicine, Royal Melbourne Hospital (RMH);
- Mr Chris Atkin, Acting Director of Trauma at The Alfred;
- Dr Karen Smith, Senior Research Officer, Monash University;
- Associate Professor Peter Danne, Director of Trauma, RMH;
- Dr Jamie Cooper, Head, Trauma Intensive Care, The Alfred;
- Dr Craig White, Executive Director, Clinical Services, Austin & Repatriation Medical Centre;
- Ms Paula Morrissey, Senior Project Officer, Acute Health, DHS
- Ms Susan McLellan, Trauma Co-ordinator, Royal Melbourne Hospital;
- Ms Cindy Barry, Trauma Co-ordinator, Royal Melbourne Hospital; and
- Ms Louise Niggemeyer, Trauma Co-ordinator, The Alfred

The methodology was also confirmed by the Monitoring and Evaluation Subcommittee of the STC.

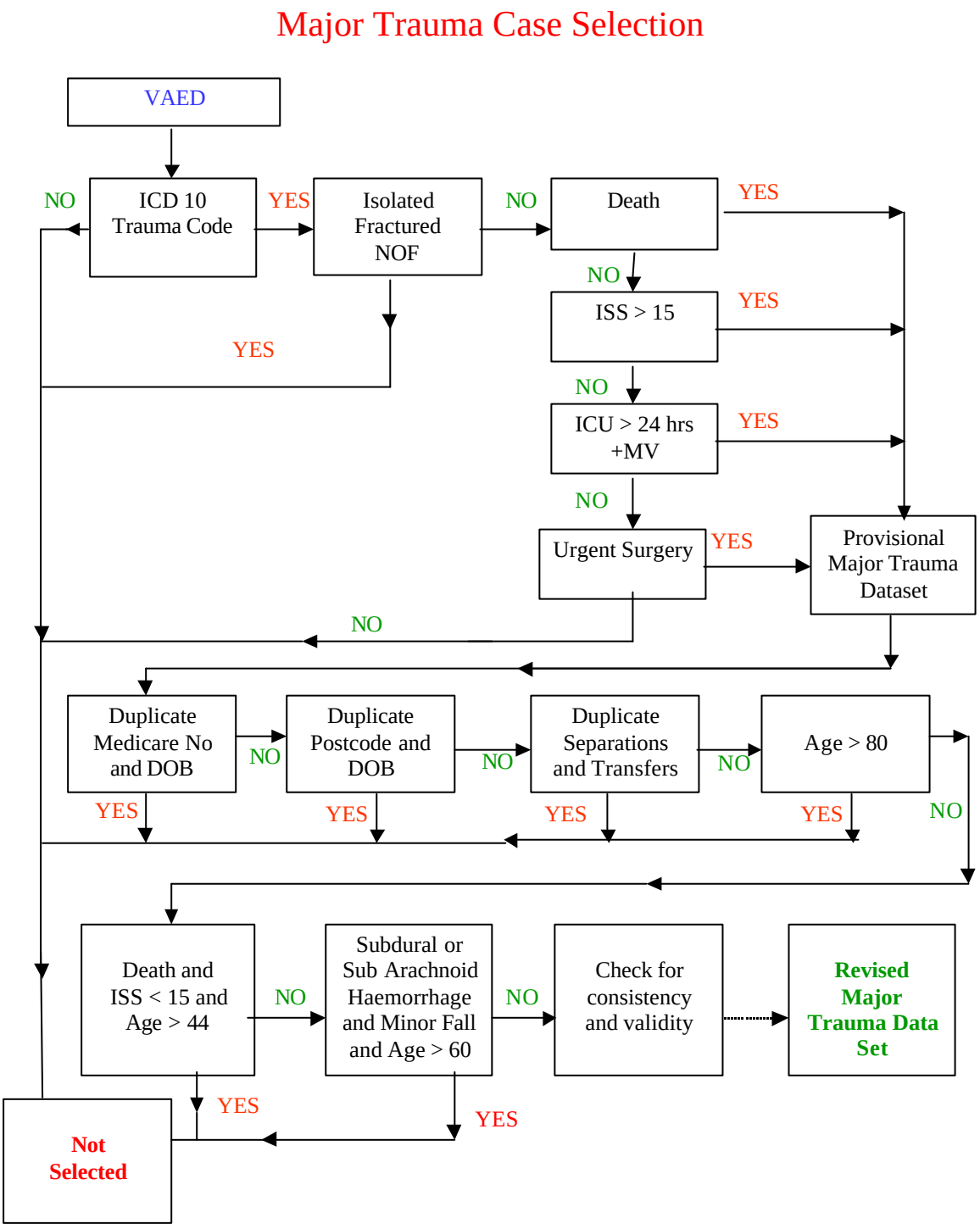
Case Selection Algorithm

In order to identify those major trauma patients whose triage destination would change following the introduction of the metropolitan triage Guidelines, it was first necessary to identify the true major trauma dataset. Previous attempts at quantifying the number of major trauma patients had encountered significant difficulties due to a number of factors including:

- Data quality issues;
- Variations in the definition of major trauma;
- Difficulties in identifying duplicate hospital separations by the same patient;
- Errors in calculation of Injury Severity Scores; and
- Inclusion in the major trauma dataset of patients with minor injuries and chronic underlying medical problems.

[2] An Estimate of the Impact of Trauma Triage and Transfer Guidelines on the Resources of Ambulance Services Victoria, June 2000, Department of Epidemiology and Preventive Medicine, Monash University.

The following Case Selection Algorithm was developed to address these issues and guide the data analysis process.



Case Selection Process

The analysis of the trauma dataset was conducted by examining individual separation records for all public hospitals throughout Victoria for the period 1 April 2000 to 31 March 2001. The variables utilised in the data analysis included:

- Hospital name;
- Admission date;
- Separation date;
- Gender;
- UR number;
- Medicare number;
- Date of birth;
- Postcode of residence;
- Admission source;
- Separation type;
- 12 ICD 9 diagnosis codes;
- 12 ICD 9 procedure codes;
- Country of birth;
- Number of hours in ICU;
- Number of hours mechanically ventilated;
- 12 ICD 10 diagnosis codes;
- 12 ICD 10 procedure codes;
- Patient type (for funding purposes);
- Admission type;
- WIES cost;
- DRG type;
- Clinical speciality;
- TAC/Workcover compensable.

Selecting Trauma Cases

The Victorian Admitted Episode Database (VAED) was examined for hospital separations with an ICD 10 trauma code (International Statistical Classification of Diseases and Related Health Problems, 10th Revision). This provided a provisional dataset including all major and minor trauma hospital separations.

ICD 10 Trauma Codes used to identify trauma are:

- Injuries to head;
- Injuries to neck;
- Injuries to thorax;
- Injuries to abdomen, lower back, lumbar spine and pelvis;
- Injuries to shoulder and upper arm;
- Injuries to elbow and forearm;
- Injuries to wrist and hand;
- Injuries to hip and thigh;
- Injuries to knee and lower leg;

- Injuries to ankle and foot;
- Injuries involving multiple body regions;
- Injuries to unspecified parts of trunk, limb or body region;
- Effects of foreign body entering through natural orifice;
- Burns.

Excluded from these codes are:
- Fractured Neck of femur where age > 65;
- Superficial injuries.

This provides a provisional dataset of major and minor trauma cases.

Selecting the Provisional Major Trauma Dataset

A provisional dataset identifying only major trauma cases was then established by examining all cases with a principle ICD 10 trauma code to determine how many met the definition utilised in the *ROTES* report for major trauma. This was established by the *ROTES* Taskforce as involving the presence of at least one of the following:
- Death after injury.
- Admission to an Intensive Care Unit for more than 24 hours, requiring mechanical ventilation.
- Serious injury to two or more body systems (excluding integumentary).
- Injury Severity Score (ISS)> 15.
- Urgent surgery for intracranial, intrathoracic, or intraabdominal injury, or for fixation of pelvic or spinal fractures.

A hierarchical approach for case selection was utilised in order to avoid double counting of major trauma cases.

Identifying Trauma Deaths

Patients who died following injury were identified from the VAED as those whose separation type was "D" which indicates death. Major trauma patients who die may fall into two additional categories. Those who are transported from the scene of the accident directly to the Coroner's Office and those who are transported by ambulance and either die in the ambulance or in the Emergency Department without being admitted.

While all groups will be included in future major trauma datasets, the latter two have not been included in this study. The first group, those transported directly to the Coroner's Office will have no affect on hospital resources and are therefore unrelated to the primary research question.

The second group, those who die in the Emergency Department or ambulance, have not been included due to methodological difficulties in identifying trauma patients and due to the immediate life threatening situation rendering it unlikely that the patient would be triaged to anywhere other than the closest Emergency Department.

Identifying Trauma Separations with ISS Greater than 15

The Collector software program was used to calculate Injury Severity Scores (ISS) (John Hopkins University and Tri-Analytics Inc 1998). This program uses "input from injury coding experts and artificial intelligence to translate ICD codes into AIS – 90 codes and severity scores" (ICDMAP – 90 software user's guide).

Identifying Trauma Separations with ICU for More than 24 Hours and Mechanical Ventilation

The VAED records the number of hours of during which a patient was admitted to an ICU and also records the number of hours during which mechanical ventilation was used. It was assumed that all mechanical ventilation occurred in the ICU.

Identifying Trauma Patients Requiring Urgent Surgery

Patients who required urgent surgery following injury for intra-cranial, intra-thoracic, or intra-abdominal injury, or for fixation of pelvic or spinal fractures were identified through the relevant ICD codes recorded in the VAED. A list of the relevant codes is contained at Appendix 1.

Separations that fall into one or more of the above categories were then included in the provisional major trauma dataset.

Exclusions from the Provisional Major Trauma Dataset

The provisional major trauma dataset was inflated due to two main factors:

- The same patient incurring multiple separations; and
- The inclusion in the dataset of patients who experienced only minor trauma but had significant underlying medical conditions.

In order to exclude these separations the following filters were applied to the dataset.

Duplicate Medicare Number and Date of Birth

Records were compared using Medicare Number and Date of Birth to identify any duplicate patients in the dataset. It should be noted that for 42% of the data the Medicare number is missing, reflecting the emergency nature of the treatment. Where two or more separations had identical Medicare numbers and Dates of Birth a hierarchy of priority was applied. The record relating to the highest level of trauma service was retained and admissions to lower levels of trauma services were excluded.

Duplicate Postcode and Date of Birth

A similar method was used to examine records for duplicate Postcode and Date of Birth to identify and exclude multiple separations. Records were also matched to demonstrate contiguous periods of hospital admissions.

Duplicate Separations and Transfers

The VAED identifies the admission source and the separation type for all separations. All separations whose separation type was "T" which indicates "separation and transfer to other acute hospital/extended care/rehabilitation/geriatric centre" were matched against separations whose admission source was "T" which indicates "transfer from acute hospital/extended care/rehabilitation/geriatric centre". Logically, where a separation type is transfer to another hospital, there should be a corresponding record where the admission source is transfer from another hospital.

The data was analysed using this criteria in order to assess the ability of the "Duplicate Medicare Number/Date of Birth" filter and "Duplicate Postcode and Date of Birth" filter to identify all multiple separations.

Age 80 and Over

The 80 years and over age group is proportionally over represented in the dataset. It has been speculated that the death rate for trauma is higher in older patients, due to co-morbidities rather than the injury itself. However, the counter arguments[3] are that a disproportionate rate of significant injuries occur in this age group due to a number of factors including:

- Decreased motor skill coordination may lead to involvement in motor vehicle and pedestrian injuries;
- Increased vulnerability may contribute to a disproportionate number of assaults;
- Deterioration in physical and sensory abilities may lead to increased potential for falls and other injuries;
- Increased incidence of burns in house fires particularly in relation to inattentive smoking;
- A reluctance to adapt behaviour to changing levels of physical ability leading to high risk activities such as cleaning house gutters or pruning trees;
- The prevalence of prescribed medication in this age group may contribute to dizziness and lack of coordination leading to increased injury by falls and motor vehicle accidents.

In order to test whether the group is "genuinely" over-represented in the dataset, cases were individually examined to determine the mechanism of injury. It was anticipated that if the group is "genuinely" over-represented in the dataset, there would be a higher proportion of mechanisms such as assault, motor vehicle accident and fall from height. If the group is over-represented due to underlying medical conditions it was anticipated that there would be a higher proportion of mechanisms such as fall, trip or stumble at same level.

It was decided that if the over-representation was due to underlying medical conditions, then all separations where the age is 80 years and over would be excluded. To compensate for those cases that may have been truly due to major trauma, 2.9% would be added to the final major trauma dataset. This is the proportion of the

[3] Stevens, J.A. and Thomas, T.A. (1996) "Major Causes of Unintentional Injuries among Older Persons – an Annotated Bibliography" National Centre for Injury Prevention and Control, Atlanta, Georgia.

Victorian population that the Australian Bureau of Statistics determined was aged 80 years or above in 2000.

Death and ISS Under 15 and Age Over 44

In previous studies (Department of Epidemiology and Preventive Medicine, Monash University, June 2000), it was found that less than 20% of cases where the outcome was death and the patient had an ISS < 15 were due to major trauma. Investigation of the few major trauma cases in the Monash University sub-set indicated that 88% of these patients were aged 45 years or below. Consequently, in line with the methodology employed in the Monash report, individual analysis was conducted of cases where separation type was death and an ISS < 15 was calculated. If the results indicated that less than 20% of the deaths were due to mechanisms associated with major trauma then this group would be excluded from the dataset.

If the results indicated that more than 20% of the deaths were due to major trauma then cases would be examined on an individual basis to determine whether they should remain or be excluded from the dataset.

Subdural or Sub Arachnoid Haemorrhage and Minor Fall and Age Over 60

Head injuries attract an automatic ISS of over 15, defining the case as major trauma, however the actual injury and subsequent treatment may not be defined as truly being major trauma. Previous studies have examined each case where the primary diagnosis was subdural or subarachnoid haemorrhage and the patient was aged over 60. It was found in the Monash University study that 96% of these cases were not major trauma.

It was decided to remove those cases where the patient was over 60 and the primary diagnosis was Subdural or Sub Arachnoid Haemorrhage due to a minor fall or fall from the same level.

Consistency and Internal Validity

The methodology included a final check of the data for internal consistency or any anomalies by analysis of randomly selected individual cases.

Revised Major Trauma Dataset

Following the methodology outlined above a Revised Major Trauma Dataset was identified.

Findings

Selecting Trauma Cases

Using the methodology described above, the VAED was examined for separations with a primary ICD 10 Diagnosis Code of major or minor trauma. There were 44,486 such separations for the period 1 April 2000 – 31 March 2001.

Selecting the Provisional Major Trauma Dataset

Of the 44,486 separations, the following numbers of patients were identified as meeting each criteria for major trauma:

Death	330
ISS > 15	1,613
ICU > 24 hours and Mechanical Ventilation	192
Urgent Surgery	303
TOTAL	**2,438**

This a hierarchical selection process and once a separation is identified as major trauma it is no longer applied against the remaining criteria.

The total number of separations included in the Provisional Major Trauma Dataset is **2,438**.

Exclusions from the Provisional Major Trauma Dataset

Duplicate Separations

After using the strategies outlined above to remove multiple separations by the same patient, 214 separations were removed giving a revised dataset of **2,224** patients.

Age 80 and Over

The strategy to address the issue of possible over-representation of this age group in the dataset was to determine whether the mechanism of injury was related to major trauma. The results indicated that the following mechanisms of injury were included in the 279 patients aged 80 and over:

Assault	2
Bitten by dog	1
Burns	4
Fall – same level	82
Fall – different level	39
Fall – from playground equipment	1
Fall – unspecified	102
Foreign body through eye or orifice	2
Medical injury	1
Motor Vehicle/Bike/Pedestrian Injury	39
Struck by object	1
Not recorded	5
TOTAL	**279**

It would appear from the mechanisms of injury that 95 patients (35% of the group aged > 80 years) were "genuine" major traumas (assault, bite, burn, fall - different level, foreign body, medical injury, motor vehicle/bike/pedestrian, fall from playground equipment and struck by object). The remaining 82 patients who fell at the same level and 102 patients where the fall was unspecified account for the remaining 65% of the dataset.

The methodology stipulates that all patients aged 80 years or over should be excluded from the provisional dataset if less than 20% were "genuine" major traumas. On the basis that at least 35% of the group had a mechanism of injury consistent with major trauma there was insufficient evidence to demonstrate that the entire group should be excluded from the dataset.

It was decided to only exclude from the dataset the 184 patients who were aged 80 and over and had a minor fall.

This gave a dataset of **2,040** patients.

Death and ISS Under 15 and Age Over 44

The strategy for dealing with patients where the outcome was death and the patient had an ISS < 15 was that the entire group would be removed if individual patient analysis indicated that less than 20% of the deaths were due to major trauma.

Analysis of the dataset indicated that the mechanisms of injury for the 93 patients were:

Means	**Number**	**Percent**
Assault	4	4
Bitten or struck by dog	1	1
Burns	7	8
Contact with powered lawnmower	1	1
Exposure to unspecified factor	4	4
Fall - different level	17	18
Fall - same level	11	12
Fall - unspecified	15	16
Foreign body through eye or orifice	1	1
Harm by sharp object	1	1
Motor Vehicle/Bike/Pedestrian Injury	23	25
Other specified events undetermined intent	1	1
Overexertion strenuous repetitive movement	3	3
Poisoning	2	2
Strike against/bump into other person	1	1
Striking against/struck by other objects	1	1
TOTAL	**93**	**100%**

The categories where there was some doubt about whether the mechanism was indicative of major trauma were deemed to be "Exposure to unspecified factor", "Fall–same level", "Fall–unspecified", "Other specified events undetermined intent" and "Overexertion strenuous repetitive movement". On the basis that the remaining 64% of patients had a mechanism of injury consistent with major trauma it was

determined that the entire group could not be removed from the revised major trauma dataset.

It was determined through examination of individual cases that 26 patients whose mechanism of injury was either "fall-same level" or "unspecified fall" would be removed from the dataset.

This gave a dataset of **2,014** patients.

Subdural or Sub Arachnoid Haemorrhage and Minor Fall and Age Over 60

Analysis of the dataset revealed 62 patients where the patient was over 60 and the primary diagnosis was Subdural or Sub Arachnoid Haemorrhage following a minor fall or fall from the same level. These patients were removed from the dataset.

This gave a dataset of **1,952** patients.

Length of Stay Between 1 and 3 Days

Review of the data at this stage indicated a number of major trauma patients whose length of stay was between one and three days. It would appear to be inconsistent for major trauma patients to have such a relatively brief period of hospitalisation. After excluding patients who died, who were transferred to another hospital or who voluntarily discharged themselves, there remained 291 major trauma patients with a length of stay of one to three days and a separation to home.

After also excluding patients whose admission source was from another hospital there were 248 patients who were admitted from the Emergency Department and who were discharged home within three days. Individual analysis of a selection of these patients revealed a number of possible reasons for this apparent inconsistency:

- Incorrect data entry of admission dates, separation dates or separation details;
- Over-coding on the VAED of injury severity resulting in minor trauma patients appearing to be major trauma patients;
- Errors in the computer software resulting in misleading calculation of ISS scores;
- The existence of an underlying chronic medical condition which, together with a minor injury, elevates the status to that of a major trauma patient; and
- A number of major trauma patients, particularly those with minor head injuries, who after appropriate evaluation and monitoring are discharged within three days.

Due to the complex reasons outlined above and apparent errors in data recording, it was decided to run maximum and minimum datasets from this point in the methodology. The maximum dataset contains all patients including those whose length of stay is within three days. The minimum dataset excludes patients with a length of stay within three days who were admitted through the emergency department and where the separation was not death, transfer or voluntary discharge.

This gave a minimum dataset of **1,704** patients.

Elective and Pre-Booked Patients

A further issue was the internal inconsistency of patient records where the admission source as recorded on the VAED was either "L" for "Waiting list" (12 cases) or "Z" for "other formal admissions (including private booked patients)" (65 cases). Examination of individual patient records did not reveal whether the apparent error was due to incorrect recording of the admission source or the incorrect re-recording of previous trauma injury codes at subsequent admissions.

It was decided to retain these patients in the maximum dataset and exclude them from the minimum dataset.

This gave a minimum dataset of **1,627** patients.

Revised Major Trauma Dataset

Applying the methodology outlined above resulted in the identification of a Revised Major Trauma Dataset of **1,627 to 1,952** patients.

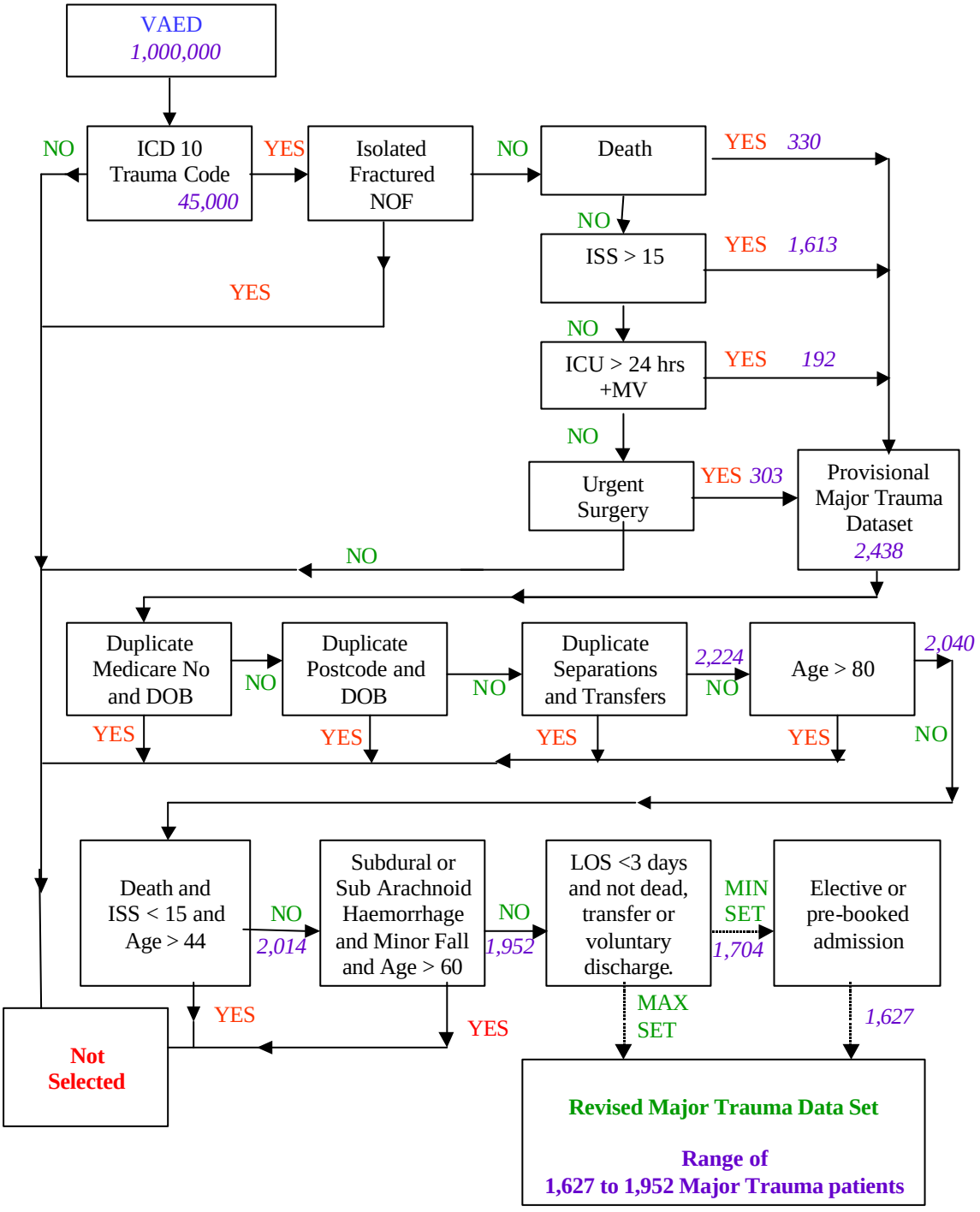
Examination of a selection of the patients within the range (ie patients whose length of stay was 1-3 days or who were planned admissions) by trauma clinicians indicated that the majority of the patients were not genuine major trauma patients. This would indicate that the true number of major trauma patients is liable to be below the mid-point of the range.

For practical purposes the number of major trauma patients using the definition in the *ROTES* report is approximately **1,700** patients per annum.

A flow chart and table providing summary statistics are set out on the subsequent pages.

In comparison to the 1997-98 data analysed during the Monash University study, the number of major trauma patients has remained static over the three year period. The Monash University study used the more restricted definition of major trauma being injured patients who either die or have an ISS over 15. Using the same definition the 2000-01 minimum dataset would contain 1,244 patients compared to the Monash University figure of 1,232 cases.

Major Trauma Case Selection



Summary of case selection

CRITERIA	ADDITIONS	EXCLUSIONS	TOTALS
VAED Separations			**1,000,000**
ICD 10 Primary Diagnosis Major & Minor Trauma			**44,486**
Death	330		
ISS > 15	1,613		
ICU > 24 hours & mechanical ventilation	192		
Urgent Surgery	303		
Provisional Major Trauma Dataset			**2,438**
Same patient but duplicate separation		214	
Aged > 80 years		184	
Death & ISS< 15 & aged > 44 years		26	
Subdural or Subarachnoid Haemorrhage & Minor Fall & aged > 60 years		62	
Length of stay within 3 days		248	
Elective and Pre-Booked patients		77	
Revised Major Trauma Dataset			**1,627 to 1,952**

Establishing the Impact of the Introduction of the Metropolitan Trauma Triage Guidelines

The implementation of the Metropolitan Trauma Triage Guidelines will ensure that patients classified as meeting the Metropolitan Ambulance Service's Time Critical Guidelines for major trauma will be triaged to the highest designated trauma service accessible in 30 minutes.

The primary issue is to quantify the impact on The Alfred and Royal Melbourne Hospital of the introduction of the adult metropolitan trauma triage Guidelines.

The following filters were applied to the Revised Major Trauma Dataset in order to assess the change in destination of patients following the introduction of the Guidelines.

Revised Major Trauma Dataset

The methodology set out below (and depicted diagrammatically at the end of this section) was developed to assist in the process of quantifying the potential impact on the MTSs and other hospitals once the Metropolitan Trauma Triage Guidelines are introduced.

The Revised Major Trauma Dataset of **1,627 to 1,952** patients was taken as a starting point.

Definitive Care at Metropolitan Hospital

Patients who did not receive definitive care at a metropolitan hospital were excluded from the dataset as the introduction of the Guidelines in the metropolitan area would not change the destination decision at the triage point.

This gave a dataset of **1,407 – 1,641** patients.

Major Trauma Service Patients

Patients who received definitive trauma care at a MTS were removed from the dataset. Their trauma destination would remain the same following the introduction of the Guideline and there would be no additional burden on the MTSs.

This gave a dataset of **617 - 756** patients.

Age 15 and Below

Major trauma patients aged less than 16 years should receive definitive care at the Royal Children's Hospital. Children were excluded from the database on the basis that there would be no impact on The Alfred or the Royal Melbourne Hospital.

This gave a dataset of **578 – 705** patients.

Isolated Spinal Cord Injury

On the advice of clinicians and ambulance services, the dataset was examined for major trauma patients whose injury would clearly be classified as Isolated Spinal Cord Injury (ISCI). The Trauma Triage Guidelines indicate that injuries that are established at the triage point as ISCI should be transported directly to the Austin and Repatriation Medical Centre for definitive management.

This gave a dataset of **547 - 672** patients.

Isolated Single Limb Amputation

On the advice of clinicians and ambulance services, the dataset was examined for major trauma patients whose injury would clearly be classified as Isolated Single Limb Amputations (ISLA). The Trauma Triage Guidelines indicate that injuries that are established at the triage point as ISLA should be transported directly to St Vincent's Hospital for definitive management. As there would be no impact on The Alfred and Royal Melbourne Hospital patients with ISLA were removed from the dataset.

No such patients were found within the dataset.

The dataset of **547 - 672** patients remained the same.

Rural to Metropolitan Hospital Transfer

A small number of major trauma patients were initially triaged to a rural or interstate hospital and subsequently transferred to a non-MTS metropolitan hospital. These were removed from the dataset as their hospital destination would remain unchanged until the introduction of the Rural Transfer Guidelines (a later step in the Trauma Triage and Transfer Guidelines process).

This gave a dataset of **519 - 648** patients.

Transfer from a MTS

There were six patients whose admission source was a transfer from a MTS to a lower level of trauma service. Under the hierarchical selection process for removal of duplicate separations the non-MTS separation should have been removed and the MTS separation retained. The six patients identified were found to have been separated from an MTS in the time period prior to that under examination so were only recorded as major trauma for their separation from the non-MTS hospital. As these patients would have no further impact on The Alfred or Royal Melbourne Hospital they were removed from the dataset.

This gave a dataset of **514 – 642** patients.

Arrival at Hospital by other than Ambulance

The VAED dataset does not include means of arrival at hospital. It was known however that a small number of major trauma patients arrive at the Emergency Department by means other than ambulance – for example, by private vehicle or transported by police. Hospital level data on modes of arrival maintained by the two adult MTSs indicated that for the relevant period 5% of major trauma patients arrived by other than ambulance.

As the introduction of the Guidelines would not alter the destination of these patients 5% of cases were removed.

This gave a dataset of **488 – 610** patients.

Time from Triage Point to Adult MTS

Ambulance services will triage a major trauma patient to a MTS when that hospital is within 30 minutes travel time. Location of injury is not recorded on the VAED and the current review did not have the capacity to make judgements about whether individual injuries had occurred within 30 minutes of either The Alfred or the RMH. Cross analysis with ambulance services data was problematic in the absence of a common identifier.

After consultation with clinicians and authors of previous studies it was decided to use the distribution of injury locations contained in the Monash University study of ambulance services to predict the number of additional cases that would be triaged to an adult MTS. Trends in the location of injury are likely to have remained relatively unchanged since the previous study was conducted, although individual cases will of course differ.

The table overleaf sets out the distribution of patients following the introduction of the adult metropolitan trauma triage Guidelines.

Percentage of Major Trauma Patients where the injury occurs within 30 minutes of a MTS

Hospital	Triage to Alfred	Triage to RMH
Angliss	8%	0%
ARMC	40%	38%
Box Hill	68%	10%
Dandenong	49%	1%
Maroondah	9%	0%
MMC Clayton	67%	0%
Mornington Peninsula (Frankston)	9%	0%
Northern	0%	55%
Rosebud	100%	0%
Sandringham	40%	0%
St Vincent's	18%	64%
Werribee Mercy	0%	20%
Western	0%	72%

The use of this methodology allowed for the identification of **145 – 185** additional major trauma patients triaged to The Alfred and **116 - 145** additional patients to the Royal Melbourne Hospital.

Trauma Overtriage

It is widely recognised in the international literature that some level of overtriage – ranging from 50% to 300% - must occur to ensure that an optimal number of major trauma patients receive definitive care at the highest level of trauma service. It was accepted in the *ROTES* report that an overtriage rate of 50% was beneficial in facilitating the treatment of major trauma patients at MTSs. After consultation with clinicians and researchers it was determined that the overtriage rate of 50% used in the Monash University report on ambulance services should also be adopted for the current review. The overtriage patients would of course be minor trauma patients who would subsequently place a relatively minor burden on MTS resources.

Implications for the adult Major Trauma Services

Using the modelling described above, the impact on the adult MTSs of the introduction of the metropolitan trauma triage Guidelines will be:

The Alfred – an additional **145 – 185** major trauma patients and **72 – 92** minor trauma patients per year. This approximates to 3–4 major and 1–2 minor trauma patients each week.

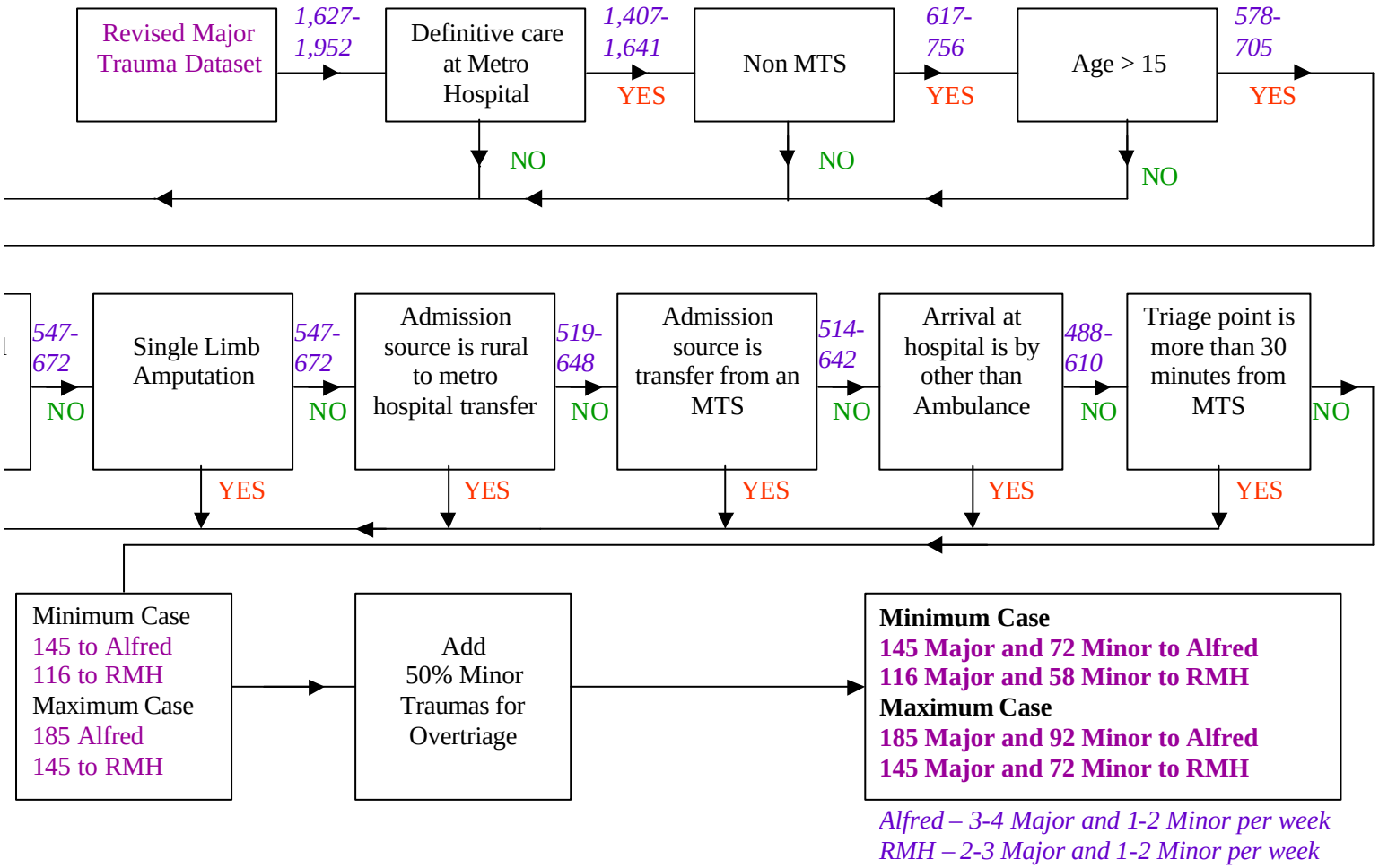
Royal Melbourne Hospital – an additional **116 – 145** major trauma patients and **58 – 72** minor trauma patients per year. This approximates to 2–3 major and 1–2 minor trauma patients each week.

ICU Hours

Utilising the same triage distribution pattern for hours spent in intensive care, the redistribution of ICU hours for the minimum and maximum datasets after the introduction of the metropolitan trauma triage guidelines will be:

Hospital	**Reduction in ICU Hours p.a.**
Austin	5,112 - 5,295
Box Hill Hospital	994 - 994
Dandenong Hospital	3,962 - 4,419
Frankston Hospital	69 - 72
Maroondah Hospital	55 - 55
Monash Medical Centre [Clayton]	1,495 - 1,579
Northern Hospital	1,710 - 1,710
St Vincent's Hospital	1,544 - 1,649
Western Hospital [Footscray]	3,580 - 3,598
TOTAL	**18,522 - 19,372**
	Increase in ICU Hours p.a.
Alfred	9,330 - 9,981
Royal Melbourne	9,192 - 9,391
TOTAL	**18,522 - 19,372**

Metropolitan Trauma Triage Algorithm



Alfred – 3-4 Major and 1-2 Minor per week
RMH – 2-3 Major and 1-2 Minor per week

Distribution of definitive care of major trauma patients

A secondary research question was –

> *How many major trauma patients received treatment at a MTS and how many at other levels of trauma service?*

The distribution of definitive treatment provided to major trauma patients for the minimum dataset of 1,627 patients for the period 1 April 2000 – 31 March 2001 was:

	Alfred	**RMH**	**RCH**	**Other**	**Total**
Number	517	177	96	837	1,627
Percentage of total	32%	11%	6%	51%	100%

Analysis of definitive treatment at the different levels of trauma services indicate that the majority of major trauma patients received definitive treatment at a Major Trauma Service (49%), a Metropolitan Trauma Service (37%) or a Regional Trauma Service (11%). Together these categories account for over 96% of definitive treatment.

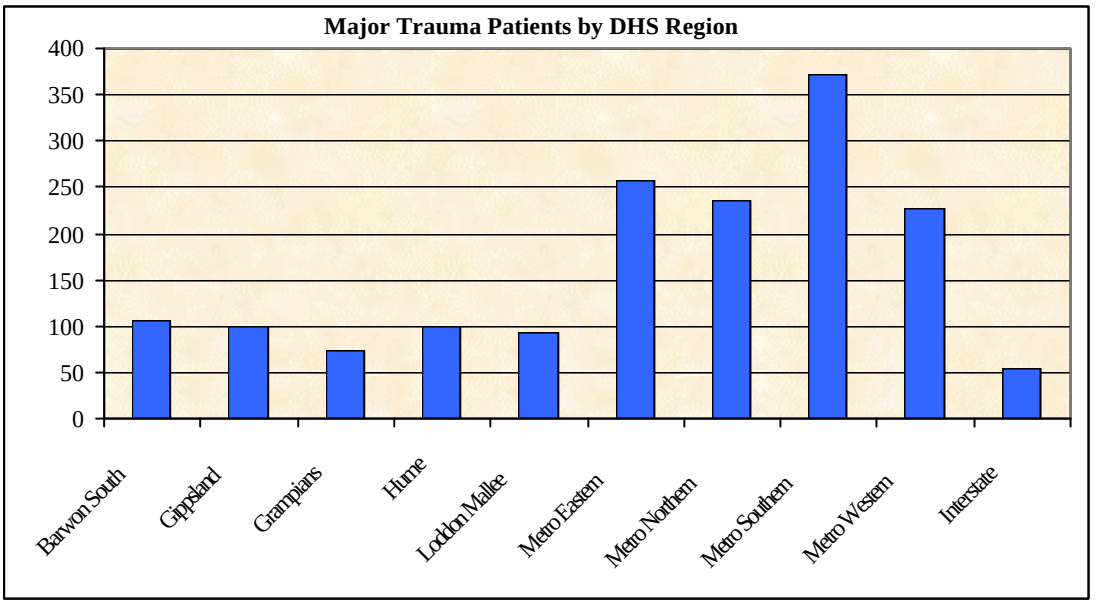
Trauma Designation	**Number**	**Percent**
Metropolitan		
MTS	790	48.56%
MeTS	598	36.75%
PCS (Metro)	20	1.23%
Total Metro	*1,408*	*86.54%*
Regional		
RTS	180	11.06%
UCS	34	2.09%
PCS (Regional)	2	0.12%
Total Regional	*216*	*13.27%*
Not recorded	2	0.12%
Not specified	1	0.06%
Grand Total	*1,627*	*100.00%*

The distribution of definitive care across all public hospitals is shown on the next page:

Public Hospital	Number	Percent
Alfred, The	517	31.8%
Royal Melbourne Hospital	177	10.9%
Austin [Heidelberg/Repat]	136	8.3%
Royal Children's Hospital [Parkville]	96	5.9%
St Vincent's Hospital (Melbourne) Ltd [Fitzroy]	94	5.8%
Dandenong Hospital	89	5.5%
Western Hospital [Footscray]	82	5.0%
Monash Medical Centre [Clayton]	71	4.4%
Frankston Hospital	43	2.6%
Geelong Hospital	38	2.3%
Northern Hospital, The [Epping]	34	2.1%
Box Hill Hospital	31	1.9%
Ballarat Health Services [Base Campus]	27	1.7%
Bendigo Hospital, The	23	1.4%
Goulburn Valley Health [Shepparton]	23	1.4%
Wangaratta District Base Hospital	19	1.2%
Maroondah Hospital [East Ringwood]	18	1.1%
New Latrobe Regional Hospital [Traralgon]	14	0.9%
New Mildura Base Hospital	12	0.7%
South West Healthcare [Warnambool]	12	0.7%
Central Gippsland Health Service [Sale]	9	0.6%
Mercy Public Hospitals Inc [Werribee]	9	0.6%
Wimmera Base Hospital [Horsham]	7	0.4%
Angliss Health Services [Upper Ferntree Gully]	6	0.4%
Mildura Base Hospital (includes Red Cliffs)	5	0.3%
Wodonga Regional Health Service	4	0.2%
Bairnsdale Regional Health Service	3	0.2%
Echuca Regional Health	3	0.2%
Hamilton Base Hospital	3	0.2%
Swan Hill District Hospital [Swan Hill]	2	0.1%
West Gippsland Healthcare Group [Warragul]	2	0.1%
Alexandra District Hospital	1	0.1%
Alpine Health [Mount Beauty]	1	0.1%
Beechworth Hospital, The	1	0.1%
Benalla & District Memorial Hospital	1	0.1%
Colac Community Health Services [Colac]	1	0.1%
Far East Gippsland Health & Support Service [Orbost]	1	0.1%
Kingston Centre [Cheltenham]	1	0.1%
Mansfield District Hospital	1	0.1%
Melbourne Extended Care and Rehabilitation Service	1	0.1%
Numurkah & District Health Service	1	0.1%
Portland & District Hospital	1	0.1%
Rochester & Elmore District Health Service	1	0.1%
Rosebud Hospital	1	0.1%
Royal Victorian Eye & Ear Hospital, The	1	0.1%
Sandringham & District Memorial Hospital	1	0.1%
Williamstown Hospital	1	0.1%
Not recorded	2	0.1%
Grand Total	**1,627**	**100.0%**

The previous table indicates a concentration of definitive treatment at relatively few public hospitals with over 86% of major trauma patients receiving definitive care at one of 12 hospitals.

The distribution of major trauma patients across Department of Human Services regions is depicted diagrammatically as follows:



The distribution of ***minor*** trauma patients receiving definitive treatment at a Major Trauma Service was:

	Alfred	**RMH**	**RCH**	**Non MTS**	**Total**
Minor Trauma	2,523	2,235	1,721	35,569	**42,048**
% of minor trauma	6%	5%	4%	85%	**100%**

The trauma workload at each MTS is distributed between minor and major trauma. This is depicted in the following table:

	Alfred	**RMH**	**RCH**	**Non MTS**
Major Trauma	17.0%	9.3%	4.1%	2.3%
Minor Trauma	83.0%	90.7%	95.9%	97.7%
Total	**100%**	**100%**	**100%**	**100%**

Demographics of the Major Trauma Dataset

A further secondary research question was:

> *What are the demographic characteristics of the major trauma population?*

Gender

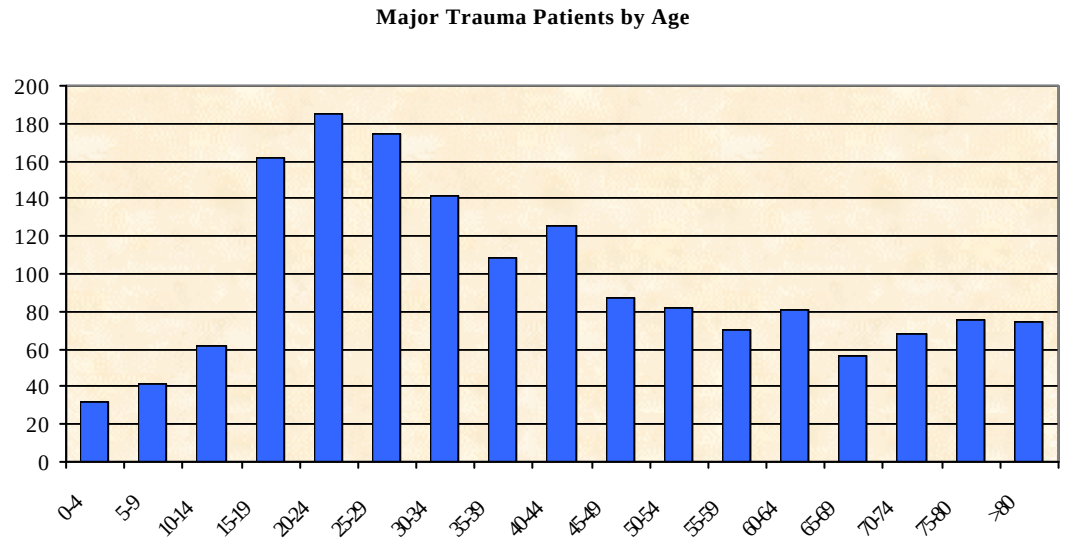
Results for a cross tabulation of gender are consistent with international literature and previous Victorian studies that the incidence of major trauma is significantly higher among males than females. This has generally been associated with increased risk taking behaviour among males and a larger section of the heavy industrial workforce being male.

Male	1,194	(73.3%)
Female	433	(26.6%)
Total	**1,627**	**(100.0%)**

The proportion of males to females in the major trauma dataset has remained unchanged since the 1997-98 Monash University review which also found that 73% of major trauma patients were male and 27% were female.

Age

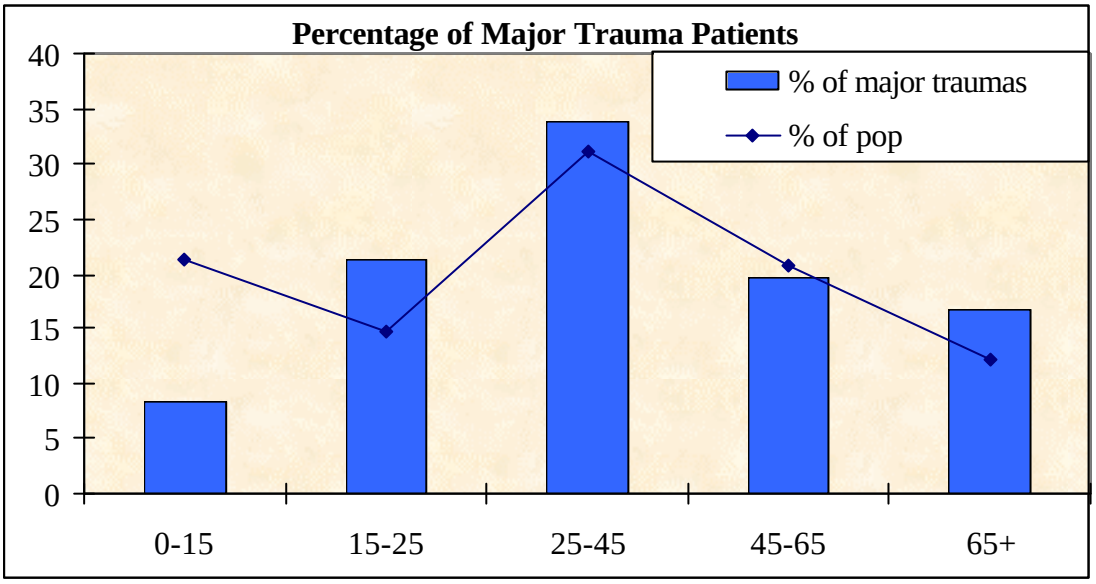
Analysis of the distribution of major trauma patients by age indicates that the incidence of major trauma rises rapidly in the 15-19 year old age group, peaking within the 20-24 year age group and then declining until it plateaus from the age of 50 onwards.



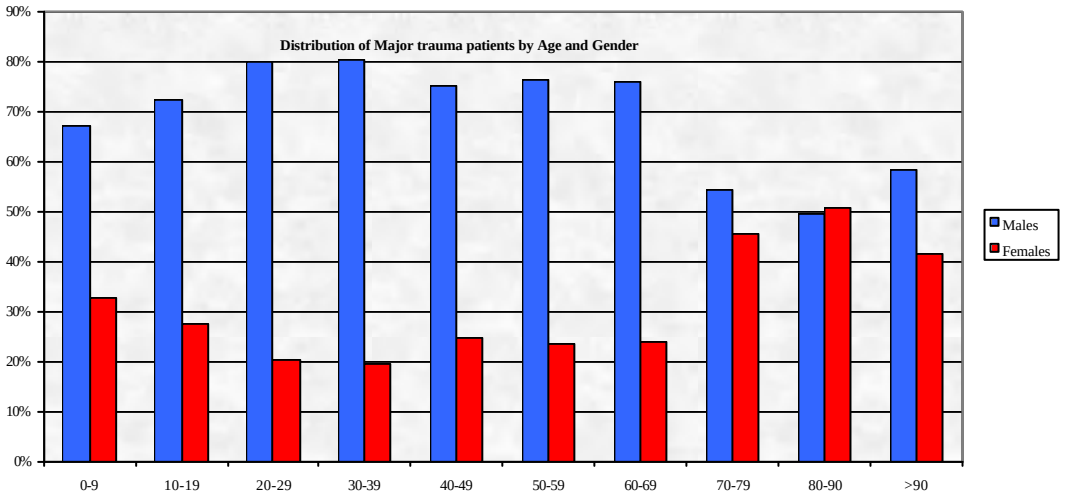
The table below compares the percentage of major trauma patients within certain age categories against the proportion of the Victorian population within the same age category (ABS 1996 data).

The 0-15 age group is under-represented in the dataset, possibly reflecting the lower opportunity for this age group to be involved in major trauma. The 15-25 age group however is over-represented in the dataset reflecting the risk taking behaviour of this age group.

The over 65 age group is similarly over-represented perhaps reflecting the issues related to ageing discussed in the methodology section of this report.



Perhaps, surprisingly for the very young at least, males are at least twice as likely to be in the major trauma dataset for all age groups from 0 years up to 70 years. It is only after the age of 80 that males and females are more evenly distributed in the dataset.



Mechanism of Injury

Analysis of the mechanism of injury for major trauma patients indicates that the majority of injuries occur as a result of road traffic accidents (56%), which, with falls from different level (13%) and assaults (11%) together account for 80% of the dataset.

Mechanism of Injury	**No.**	**% of total**
Motor vehicle/bike/pedestrian	906	55.69%
Fall - different level	211	12.97%
Assault	183	11.25%
Fall - same level	73	4.49%
Fall - unspecified	50	3.07%
Struck by object	44	2.70%
Exposure to unspecified factor	23	1.41%
Burn	21	1.29%
Sharp object	20	1.23%
Machinery or tool	14	0.86%
Bitten	12	0.74%
Explosion	12	0.74%
Boating accident	7	0.43%
Foreign body enter skin or natural orifice	7	0.43%
Firearm	6	0.37%
Train accident	6	0.37%
Diving accident	5	0.31%
Medical procedure	5	0.31%
Flying accident	4	0.25%
Overexertion strenuous repetitive movement	4	0.25%
Poisoning	4	0.25%
Electric shock	2	0.12%
Strangulation	2	0.12%
Avalanche	1	0.06%
Crush	1	0.06%
Not recorded	4	0.25%
Grand Total	**1,627**	**100%**

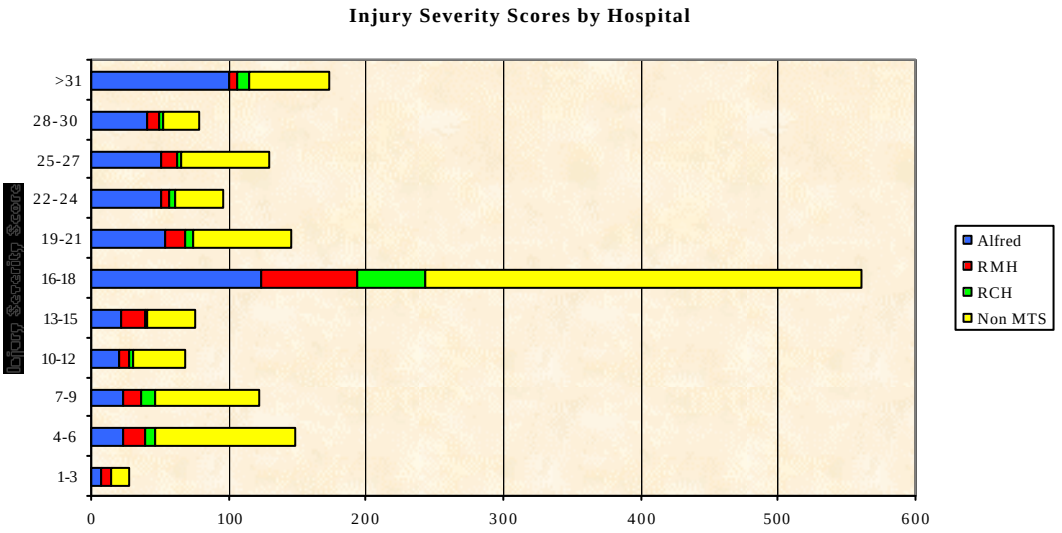
Injury to Body Region

The Diagnostic Related Groups (DRG) recorded on the VAED indicate that the most common principle body injury site is the head and brain (49%). The four DRG groups Head/brain, Multiple Trauma, Chest and Spinal Cord together account for over 76% of the dataset.

Body Region	Number	Percent
Head/brain	804	49.42%
Multiple trauma	219	13.46%
Chest	149	9.16%
Hip/leg	87	5.35%
Spinal cord	68	4.18%
Stomach	58	3.56%
Skin	54	3.32%
Bowel	43	2.64%
Soft tissue	26	1.60%
Pancreas/liver/spleen	23	1.41%
Arm	21	1.29%
Kidney/bladder	16	0.98%
OR procedure - NOS	13	0.80%
Leg and arm	10	0.61%
Cardiothoracic	4	0.25%
Rectal	4	0.25%
Neonatal	2	0.12%
Not specified	26	1.60%
Total	**1,627**	**100.00%**

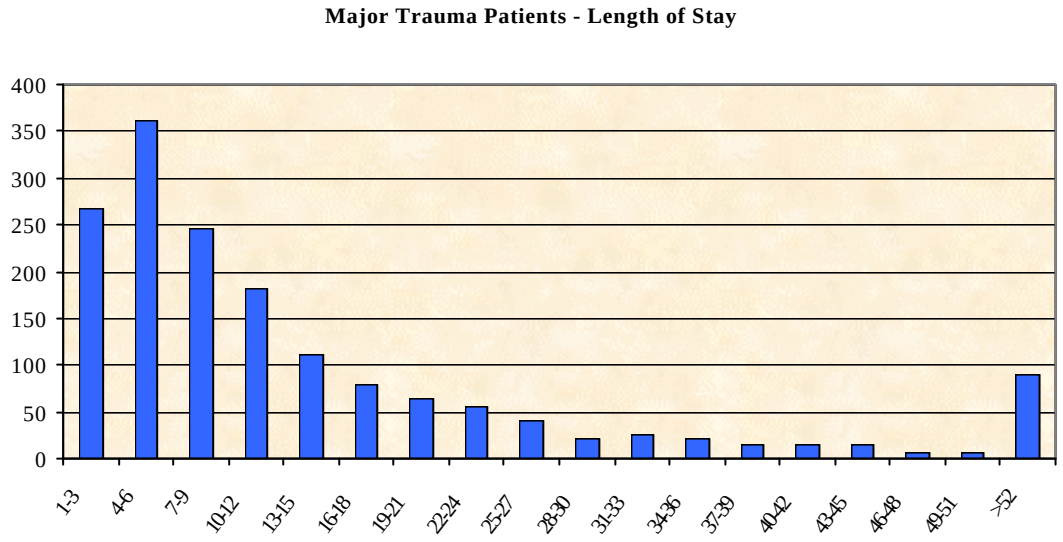
Injury Severity Score

Injury Severity Scores across the dataset indicate that a large proportion of patients have an injury severity score within the 16-18 range. This may be a reflection of the large number of head injuries (49% of the major trauma dataset) which generally score 16 on the ISS scale.



Length of Stay

Most major trauma patients have a length of stay of 4-6 days within each hospital. As the VAED is not structured to give patient information it was problematic to add consecutive separations to give a total hospital length of stay. These figures therefore only indicate the length of stay at the hospital where the patient received definitive treatment.



The average length of stay across the minimum major trauma dataset was 17 days for the separation during which definitive care was provided.

Transport Accident Commission

	Alfred	RMH	RCH	Non MTS	Total
TAC	303	82	36	329	750
Workcover	45	5		35	85
Other	169	90	60	473	792
Total	**517**	**177**	**96**	**837**	**1,627**

Over 31% of patients within the major trauma dataset are recorded as being Transport Accident Commission (TAC) compensable.

The proportion of TAC to non-TAC major trauma patients at each of the Major Trauma Services is:

	Alfred	RMH	RCH	Non MTS	% of dataset
TAC	59%	46%	38%	39%	46%
Workcover	9%	3%		4%	5%
Other	33%	51%	63%	57%	49%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Conclusion

The number of major trauma patients remained stable over the three year period from 1997-98 to 2000-01. The number of major trauma patients for the period under review, 1 April 2000 – 21 March 2001, was approximately 1,700.

The review of trauma data was requested in order to clarify the potential impact on adult Major Trauma Services of the introduction of the Metropolitan Trauma Triage Guidelines. The data analysis shows that there will be some shift in patient numbers with 3–4 additional major trauma patients receiving definitive care at The Alfred each week and 2–3 at the Royal Melbourne Hospital. There will of course be a consequent reduction in numbers of major trauma patients receiving care at other levels of metropolitan trauma services.

The Diagnostic Related Groups for major trauma recorded on the VAED indicate that the most common principle body injury site is the head and brain (49%). Head and brain injuries, together with multiple trauma and major injuries to the chest or spinal cord constitute 76% of the major trauma dataset. Due to the large proportion of patients who have an injury in one or more of these body sites, any attempt to prioritise certain major trauma patients to MTSs based on this criteria may be problematic.

Analysis of the data also revealed that over 96% of patients received definitive care at a Major Trauma Service, Metropolitan Service or Regional Trauma Service. Less than 4% of major trauma patients received definitive care at an Urgent Care Service or a Primary Care Services.

References

Cameron, P. Dziukas, L. Hadj, A. Clark, P. and Hooper, S. “Patterns of Injury from Major Trauma in Victoria”, (1993).

Danne, P. Brazenor, G. Cade, R. Crossley, P. Fitzgerald, M. Gregory, P. Kowal, D. Lovell, L. Morley, P. Smith, M. Taylor, R. and Walker, S. (1998) “The Major Trauma Management Study: an analysis of the efficacy of current trauma care”, *Aust. N.Z. J. Surg*. 68: 50-57.

Department of Epidemiology and Preventive Medicine, Monash University, (June 2000) “An Estimate of the Impact of Trauma Triage and Transfer Guidelines on the Resources of Ambulance Services Victoria”.

McDermott, F.T. Cordner, S.M. Tremayne, A.B. (1996) “Evaluation of medical management and preventability of death in 137 road traffic fatalities in Victoria, Australia”, *J Trauma*, 41: 83-90.

“Review of Trauma and Emergency Services – Victoria 1999”, Department of Human Services, Victoria.

Stevens, J.A. and Thomas, T.A. (1996) “Major Causes of Unintentional Injuries among Older Persons – an Annotated Bibliography” National Centre for Injury Prevention and Control, Atlanta, Georgia.

Appendix 1

Urgent Surgery for Intracranial, Intrathoracic or Intra-abdominal Injury or for Fixation of Pelvic or Spinal Fractures

unspec = unspecified
unqual = unqualified

Site	ICD-9-CM Dx	ICD-9-AM Proc
Intracranial	854.0/.1 *Intracranial injury other/unspec*	01.01-01.8 *Incision, excision of skull, brain, cerbral meninges* 02.01 *Opening cranial suture* 02.03-02.99 (Remaining from) *Other operations on skull, brain, cerebral meninges* 04.0-04.7 *Operations on cranial nerves*
	851 *Cerebral laceration, contusion*	
	852 *Subarachnoid, subdural and extradural haemorrhage following injury*	
	853 *Other/unspec intracranial haemorrhage following injury*	
Skull fracture	800-801 *Fracture vault/base of skull*	02.02 *Elevation of skull fracture fragments*
	803-804 *Other/unqual skull fractures* and *Multiple fractures involding skull or face with other bones*	76.01-76.99 *Operations on facial bones and joint*
Intrathoracic All: *Internal injury*	862.8 *Multiple and unspec intrathoracic organs, without mention open wound into cavity*	42.01-42.9 *Operations on oesophagus*
	862.9 *Multiple and unspec intrathoracic organs with open wound into cavity*	
	862.0 *Diaphragm, without mention open wound into cavity*	34.82 *Suture laceration of diaphragm* 34.84 *Other repair of diaphragm*
	862.1 *Diaphragm, with open wound into cavity*	
	861.00/.01/.02/.03 *Heart, without mention open wound into thorax*	35.00-38.99 *Operations on heart*
	861.10/.11/.12/.13 *Heart, with open wound into thorax*	
	861.20/.21/.22 *Lung, without mention open wound into thorax*	32.01-33.09 *Excision of lung and bronchus* and *Other operations on lung and bronchus*
	861.30/.31/.32 *Lung, with open wound into thorax*	
	862.29/.21/.22 *Other spec intrathoracic organs, without mention open wound into cavity*	34.01-34.79 34.91-34.99 *Operations on chest wall, pleura, mediastinum*
	862.39/.31/.32 *Other spec intrathoracic organs, with open wound into cavity*	

Site	ICD-9-CM Dx	ICD-9-AM Proc
	860.2 *Haemothorax without mention open wound into thorax*	32.3 segmental resection lung 32.4 -32.5 pneumonectomy 33.22/33.23 bronchoscopy 33.41 suture laceration bronchus 33.43 closure laceration lung 34.01 incision chest wall 34.02 exploratory thoracotomy 34.04 insertion intercostal catheter 34.09 other incision pleura 34.1 incision mediastinum
	860.3 *Haemothorax with open wound into thorax*	as for 860.2 34.82 suture laceration diaphragm
	860.5 *Pneumohaemothorax with open wound into thorax*	as for 860.2 34.82 suture laceration diaphragm
	860.0 *Pneumothorax without mention open wound into thorax*	33.41 suture laceration bronchus 33.43 closure laceration lung 34.01 incision chest wall 34.04 insertion intercostal catheter 34.09 other incision pleura
	860.4 *Pneumohaemothorax without mention open wound into thorax*	as for 860.2 34.82 suture laceration diaphragm
	860.1 *Pneumothorax without mention open wound into thorax*	33.41 suture laceration bronchus 33.43 closure laceration lung 34.01 incision chest wall 34.04 insertion intercostal catheter 34.09 other incision pleura
	901 *Injury to blood vessels of thorax*	39.0-39.99 *Other operations on vessels*
Intra-abdominal	868.00-09 *Injury to other intra-abdominal organs without mention open wound into cavity*	07.44 *Repair adrenal gland* 51.01-51.99 *Operations on gall bladder, biliary tract* 54.0-54.90 *Other operations on abdominal region*
	868.10-19 *Injury to other intra-abdominal organs with open wound into cavity*	
	863 *Injury to gastrointestinal tract with/without open wound*	43.0-49.99 *Operations on stomach, gastrointestinal tract*
	864 *Injury to liver, with/without open wound*	50.0-50.9 *Operations on liver*
	865 *Injury to spleen, with/without open wound*	41.1-41.2 *Operations on spleen* 41.41-41.5 41.95 41.99
	867? *Injury to pelvic organs, with/without open wound*	55.01-71.9 *Operations on urinary system, male, female genital organs*
	902 *Injury to blood vessels abdomen, pelvis*	(See Injury to blood vessels of thorax)
Pelvic fracture	808.0x-808.5x *Fracture pelvis, specified site, open/closed*	('Other' includes pelvis) 79.09 *Closed reduction fracture without fixation, other specified bone* 79.19 *Closed reduction fracture with fixation, other specified bone* 79.29 *Open reduction fracture without fixation, other specified bone* 79.39 *Open reduction fracture with fixation, other specified bone*
	808.8 *Fracture pelvis, unspec site, closed*	
	808.9 *Fracture pelvis, unspec site, open*	

Site	ICD-9-CM Dx	ICD-9-AM Proc
Trunk fracture	809.0/.1 *Fracture bones of trunk, closed/open (Ill-defined* and *multiple bones of trunk)*	34.71 suture laceration chest wall 78.1 application external fixation device (4th digit subclassification =1 for scapula, clavicle, thorax) 78.2 78.4 other repair bone(4th digit subclassification =1 for scapula, clavicle, thorax) codes as for spinal fracture
Spinal fracture	805 *Fracture vertebral column without mention spinal cord injury*	03.53 (included below)
	806 *Fracture vertebral column with spinal cord injury*	03.01-03.99 *Operations on spinal cord and spinal canal structures*