Special Focus Report - Burns
1 July 2001 – 31 March 2009

Victorian State Trauma Outcome Registry and Monitoring Group (VSTORM)

SPECIAL FOCUS ON BURNS

ABOUT THIS REPORT

For the purposes of generating this report, only data received by the Registry by the 14th August 2009 has been included.

Most of the data is presented across the whole trauma system and corresponds to patient level data. When the data is stratified across the trauma service levels, this is presented either on the basis of episodes of care, or according to information from either the first or definitive hospital of care, as indicated.

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The Victorian State Trauma Registry is a Department of Health and TAC Health Research funded and approved initiative.

EXECUTIVE SUMMARY SPECIAL FOCUS - BURNS

- The rate of major trauma burns cases rose significantly in 2007-08, and 2008-09, compared to 2001-02. The number of fire, flames or smoke cases varied per quarter from four in January-March 2005 to 20 in January-March 2009, with the latter incorporating “Black Saturday”.

- 52.9% (n=276) of cases sustained a TBSA of 20% or more with no other injuries (AIS severity>1). For the remaining cases, the reason for inclusion on the registry was other injuries (23.5%), death (2.5%) and ICU admission requiring mechanical ventilation (20.3%.) This compares with 3.7% deaths and 6.4% ICU admissions requiring mechanical ventilation for the wider major trauma population.

- The vast majority of patients are going to major trauma centres with specialist burns units. 98.2% (n=271) of patients with TBSA of 20% or more and no other injuries received definitive care at a designated burns unit. This is considerably greater than the 82.2% in the wider major trauma patient population. The percentage of cases definitively managed at a specialist burns unit has remained stable since 2001-02.

- Only half (n=263, 50.4%) of the major trauma cases involving burns were transported directly from the scene to the definitive hospital of care which is considerably less than the wider major trauma patient population of 67.2%. However the median (IQR) transfer time was 3.8 (2.9-6.0) hours, substantially shorter than the median transfer time of 6 hours for the wider major trauma patient population.

- The median (IQR) length of stay at the definitive hospital was 22.9 days for all patients, 21.7 days for adult cases, and 32.0 days for paediatric cases. This is noticeably longer than the median of 7.6 days reported for all Victorian major trauma cases in the 2006-07 year.

- The in-hospital death rate was 17.4% (n=91) for all cases, compared with 12.8% in the wider major trauma population. For patients with TBSA of 20% or more and no other injuries the in-hospital death rate was 22.5% (n=62).

- Of the 75.9% of patients working prior to injury, 66.2% had returned to work by 6-months, however 50.0% of cases with a TBSA of 30-39% had returned to work, and only 26.7% of cases with a TBSA ≥ 40% had returned to work by 6-months. The percentage of cases reporting pain at 6-months was 42.7%, with 18.3% reporting persistent moderate to severe pain.

SPECIAL FOCUS THIS ISSUE

BURNS IN VICTORIA

Major trauma involving burns – July 2001 to March 2009

Case selection

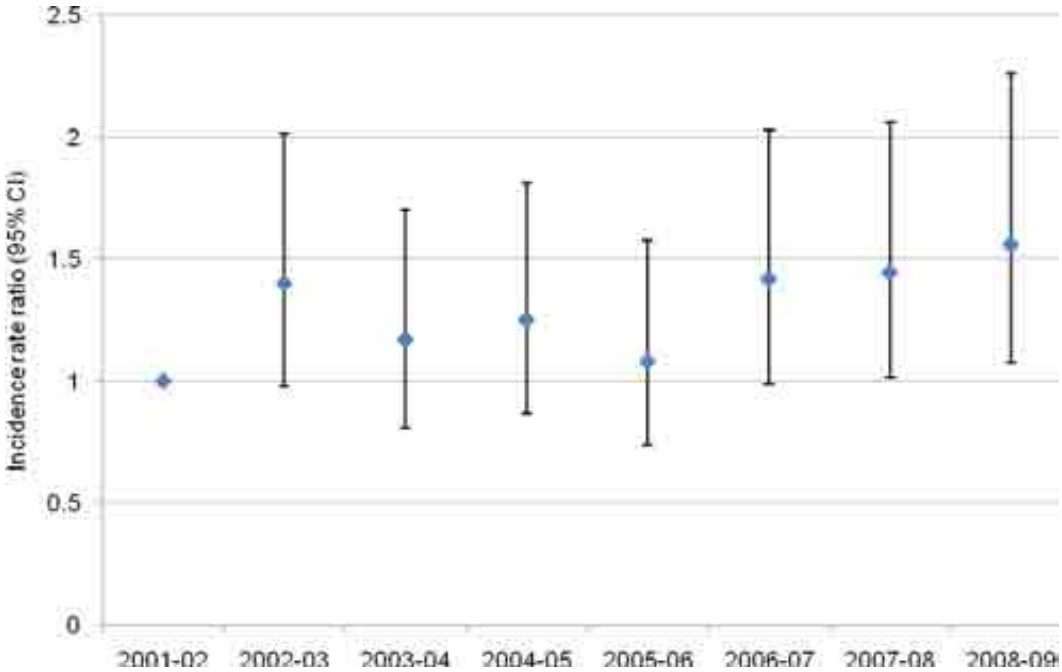
All major trauma cases in Victoria captured by the Victorian State Trauma Registry (VSTR) with a date of injury between July 2001 and March 2009 (inclusive) meeting the following inclusion criteria were extracted for analysis:

i. Abbreviated Injury Scale (AIS) coded burn, inhalation or electrical injury (912000.1-919404.5) and/or
ii. Cause of injury coded as fire/flames/smoke, scalds, contact burn, or electricity.

Incidence

There were 522 cases who met the inclusion criteria over this period; 50 in 2001-02, 71 in 2002-03, 60 in 2003-04, 65 in 2004-05, 57 in 2005-06, 76 in 2006-07, 79 in 2007-08, and 64 in the 9 months to date of the 2008-09 year. Using Victorian population data as the denominator, and a Poisson regression model, there has been an increase in the rate of hospitalised major trauma burns cases since 2001-02 (IRR 1.04, 95% CI: 1.00, 1.08, p=0.029). Figure 1 shows the rate of major trauma burns cases rose significantly in 2007-08, and 2008-09, compared to 2001-02 (Figure 1).

Figure 1: Incidence of hospitalised major trauma burns injury cases in Victoria (2001-08)



Mechanism and intent of injury

The majority (64.6%) of cases were due to fire, flames or smoke, followed by scalds (10.2%), motorcycle crashes (7.1%), motor vehicle crashes (6.9%), contact burns (5.6%), and electricity (2.3%). The remaining 18 cases were attributed to a fall (n=4), cutting/piercing object (n=2), struck by or collision with an object/person (n=4) or an "other" specified cause (n=8). Five of the eight "other" cases were the result of explosions related to homemade bombs, rockets or fireworks.

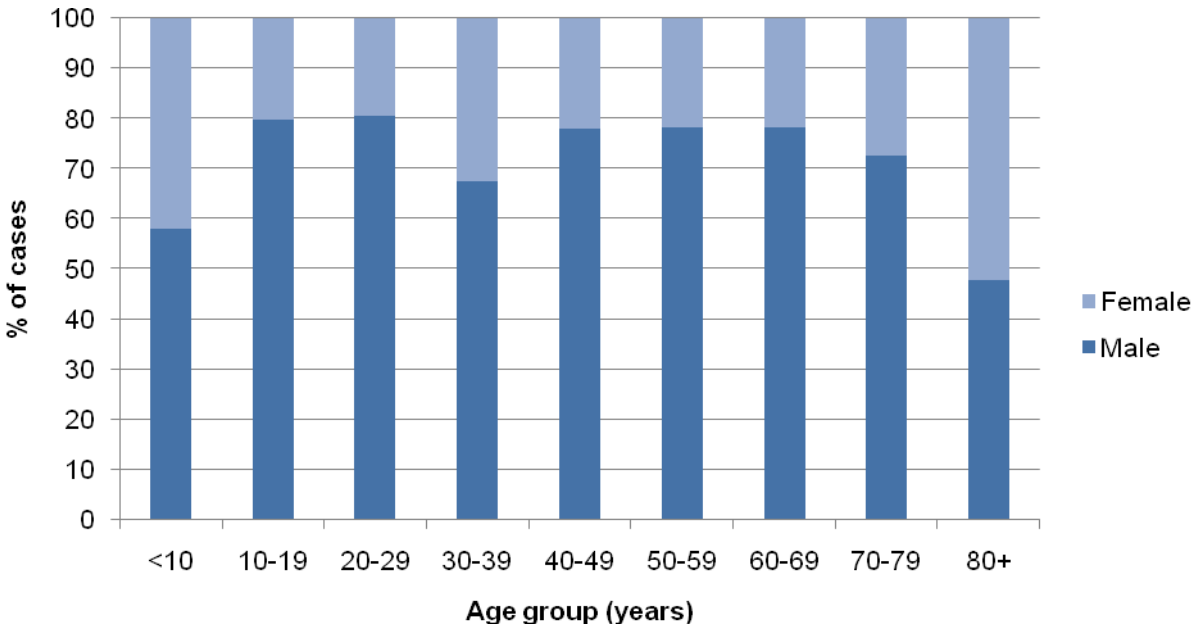
The number of fire, flames or smoke cases varied per quarter from four in January-March 2005 to 20 in January-March 2009, with the latter incorporating "Black Saturday". However, there was no association between year and mechanism of injury (X^2_{35}=37.7, p=0.347).

The majority of cases were the result of unintentional events (86.9%), while intentional self-harm and assault accounted for 10.6% and 2.5% of cases, respectively. The intent was undetermined for 24 cases. Overall the profile of intent is similar to the broader major trauma population.

Patient demographics

Overall, the majority of major trauma cases involving burns or inhalation injury were male (73.8%) and the mean (SD) age of cases was 38.2 (21.3) years, ranging from 0-101 years. There was an association between age and gender (X^2_8=20.6, p=0.008). Figure 2 shows the gender distribution of cases across the age groups. Males represented the lowest proportion of cases in children less than 10 years (58.1%) and adults aged 80 years and over (47.8%).

Figure 2: Gender distribution of major trauma cases involving burns by age group (2001-2009)



There was an association between age and mechanism of injury (X^2_{40}=136.0, p<0.001). In children less than 10 years of age, scalds were the predominant mechanism, accounting for 51.2% of cases followed by fire, flames and smoke (34.9%). Scalds were also common in adults aged 80 years and over, accounting for 21.7% of cases. For all other age groups, scalds represented less than 10% of cases. Fire, flames or smoke accounted for 77.0% of 50-59 year olds, 78.4% of 60-69 year olds, and 81.8% of 70-79 year olds. Motor vehicle and motorcycle crashes as a cause of injury were most common in youths (10-19 years) and young adults (20-29 years), accounting for 21.9% and 23.7% of cases, respectively.

Profile of cases

The AIS classification system categorises the percentage total body surface area (% TBSA) burned into <10%, 10-19%, 20-29%, 30-39%, 40-89% and ≥ 90%. For 491 of the 522 cases (94.1%), the % TBSA was recorded. Of the remaining 31 cases, three had sustained a high voltage electrical injury (2 with associated cardiac arrest), 19 had a recorded inhalation injury but no external injury, the % TBSA was not specified for 7 cases, and AIS data were missing for the remaining 2 cases due to death shortly after arrival at hospital. The percentage of cases according to % TBSA and presence of other injuries (defined as AIS severity>1) is shown in Table 1. 52.9% (n=276) of cases sustained a TBSA of 20% or more with no other injuries (AIS severity>1). Where the % TBSA was <20% and serious injury to another body region was absent, the reason for inclusion on the registry was death (17.4%) or ICU admission requiring mechanical ventilation (20.3%.) This compares with 12.8% and 5.6% respectively for the wider major trauma population.

Table 1: Profile of cases by % TBSA

% TBSA		n (% within TBSA group)
<10%	No other injuries	50 (54.4)
	Serious injury to other body region	42 (45.6)
10-19%	No other injuries	80 (83.3)
	Serious injury to other body region	16 (16.7)
20-29%	No other injuries	97 (93.3)
	Serious injury to other body region	7 (6.7)
30-39%	No other injuries	75 (90.4)
	Serious injury to other body region	8 (9.6)
40-89%	No other injuries	84 (88.4)
	Serious injury to other body region	11 (11.6)
≥ 90%	No other injuries	20 (95.2)
	Serious injury to other body region	1 (4.8)

The percentage of cases with a documented inhalation injury was 44.3% (n=231), and 93.1% were admitted to an ICU. Table 2 shows the breakdown of the severity of inhalation injuries according to the AIS classification system.

Table 2: Profile of cases with an inhalation injury (n=231)

Severity of inhalation injury		n (%)
Moderate	Inhalation injury not further specified, or documented absence of carbonaceous deposits, erythema, oedema, bronchorrhea or obstruction	83 (35.9)
Serious	Inhalation injury with minor or patchy areas of erythema, carbonaceous deposits in proximal or distal bronchi	95 (41.1)
Severe	Inhalation injury with moderate degree of erythema, carbonaceous deposits, bronchorrhea with or without compromise of the bronchi	38 (16.5)
Critical	Inhalation injury with severe inflammation with friability, copious carbonaceous deposits, bronchorrhea, and/or bronchial obstruction	13 (5.6)
Maximum	Inhalation injury with mucosal sloughing, necrosis, and/or endoluminal obliteration	2 (0.9)

Management in the trauma system

The mode of transport from the scene of injury to hospital was predominantly by road ambulance (n=315, 64.4%) followed by air ambulance (fixed and rotor wing, n=109, 22.3%). Of the remaining 65 cases, 59 were transported to hospital in a private car, 2 by the police, 2 were transferred in by interstate ambulance services, and 1 by a private ambulance. Intubation at the scene was performed for 11.5% of cases transported by ambulance.

Only half (n=263, 50.4%) of the major trauma cases involving burns were transferred directly from the scene to the definitive hospital of care, with 48.1% (n=251) requiring one inter-hospital transfer, and 1.5% (n=8) requiring two inter-hospital transfers, to reach the definitive care hospital. The odds of transfer were double for paediatric patients (OR2.07, 95% CI: 1.16-3.72) when compared to adult patients (≥ 15 years) which is consistent with the wider major trauma population. Motor vehicle cases were less likely (OR 0.34, 95% CI: 0.16, 0.72) to be transferred than cases resulting from fire, flames or smoke, despite there being no association between ISS and transfer status in this patient group (p=0.208). Adult patients transferred directly from the scene had a higher mean pulse rate (t=2.37, p=0.018), systolic blood pressure (t=2.79, p=0.006), and respiratory rate (t=2.36, p=0.019) on arrival at the definitive hospital of care, but there was no difference in the temperature on arrival between transferred and not transferred patients (t=-0.17, p=0.861). The percentage of hypothermic (<35°C), and hypotensive (SBP<100mmHg), patients who were transferred was comparable to those transported directly to the definitive hospital from the scene; 20% vs. 19% and 9.6% vs. 10.0%, respectively.

While there has been a significant increase in direct transfers to hospital from the scene for all major trauma cases from 62.4 per cent in 2001-02 to 70.0 per cent in 2007-08 there was no association between transfer status and year (X^2_7=8.7, p=0.273) in major trauma cases involving burns, indicating no change in the pattern of transport over time. The median (IQR) transfer time was 3.8 (2.9-6.0) hours, substantially shorter than the median transfer time of 6 hours for the wider major trauma patient population.

The trauma triage guidelines state transfer to a major trauma service if there is suspicion of an inhalation injury, and/or an estimated TBSA >20%, but does not specify transfer to a designated burns unit. The definitive hospital of care was a designated burns unit for 92.1% (n=481) of case; n=420 to The Alfred and n=61 to the Royal Children's Hospital (RCH). The percentage of cases definitively managed at a burns unit has remained stable since 2001-02 (X^2_7=8.9, p=0.264). Where cases were not definitively managed at a designated burns unit, almost half (n=20, 48.8%) were definitively managed at the Royal Melbourne Hospital with 12.2% (n=5) managed at Austin Health and 7.3% (n=3) managed at the Northern Hospital. Of the 24 cases with a documented % TBSA not managed at a designated burns unit, only 6 had a %TBSA ≥ 20% and 3 of these 6 cases were deaths (2 within 10 minutes of arrival at hospital and one 8 days post-admission). All cases definitively managed at RMH had a %TBSA less than 20%, 75.0% had other serious injuries, and 30.0% had a documented inhalation injury. Where no other injuries (AIS severity>1) were sustained and a TBSA of 20% or more was reported, a designated burns unit was the definitive hospital of care for 98.2% (n=271) of cases.

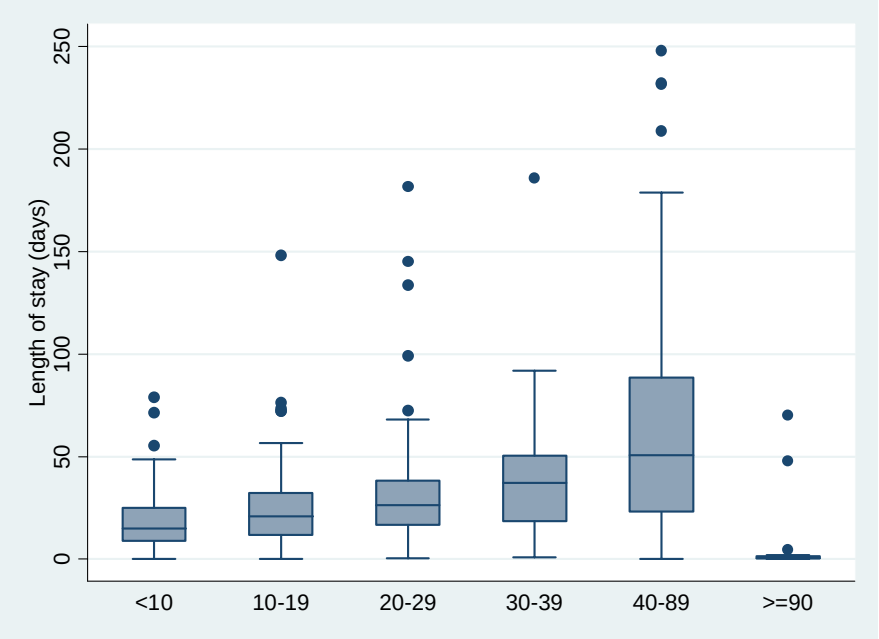
In-hospital outcomes

An ICU admission was required for 75.5% (n=348) of burns-related major trauma cases with a median (IQR) length of stay in ICU of 8 (3-17) days. The percentage of adult cases requiring ICU admission was 76.7% with a median (IQR) length of ICU stay of 8 (3-17) days, and 65.5% of paediatric cases were admitted to ICU for a median (IQR) length of stay of 6.5 (2-16) days. There was no association between year and ICU admission for burns-related major trauma cases (X^2_7=8.6, p=0.286). Where no other injuries (AIS severity>1) were sustained and a TBSA of 20% or more was reported, 65.2% (n=180) of cases required an ICU admission with a median (IQR) length of stay in ICU of 12 (3-25) days.

The median (IQR) length of stay at the definitive hospital was 22.9 (10.9-43.4) days for all patients, 21.7 (10.3-41.9) days for adult cases, and 32.0 (15.4-52.8) for paediatric cases, noticeably longer than the median of 7.6 days reported for all Victorian major trauma cases in the 2006-07 year. Where no other injuries (AIS severity>1) were sustained and a TBSA of 20% or more was reported, the median (IQR) length of stay at the definitive hospital was greater at 29.5 (14.9-50.5) days for all patients.

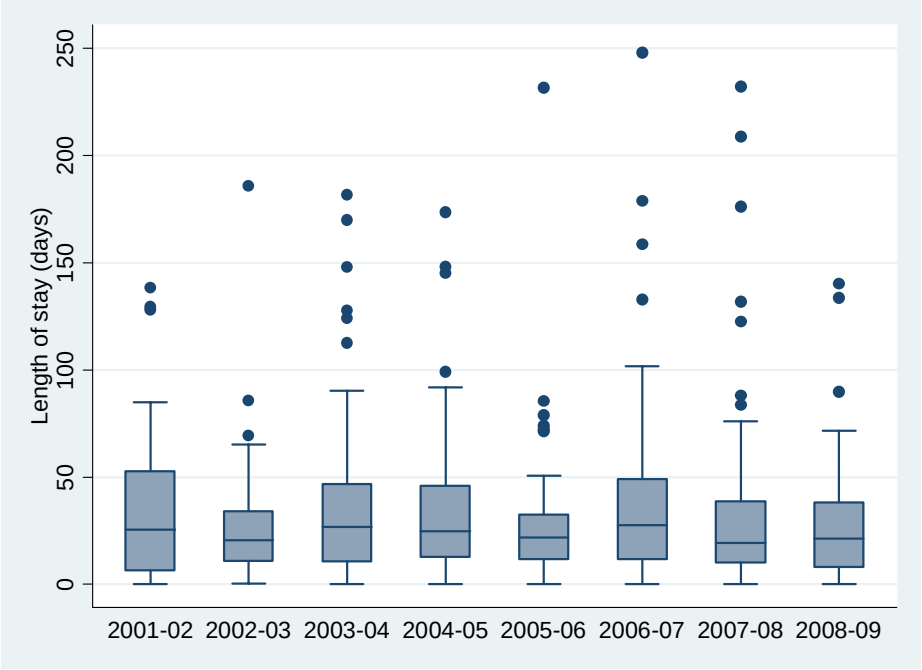
Figure 3 shows the length of stay in each % TBSA group, indicating an increase in median length of stay with severity, except for the ≥ 90% group where early fatality was high.

Figure 3: Length of stay at the definitive hospital by % TBSA



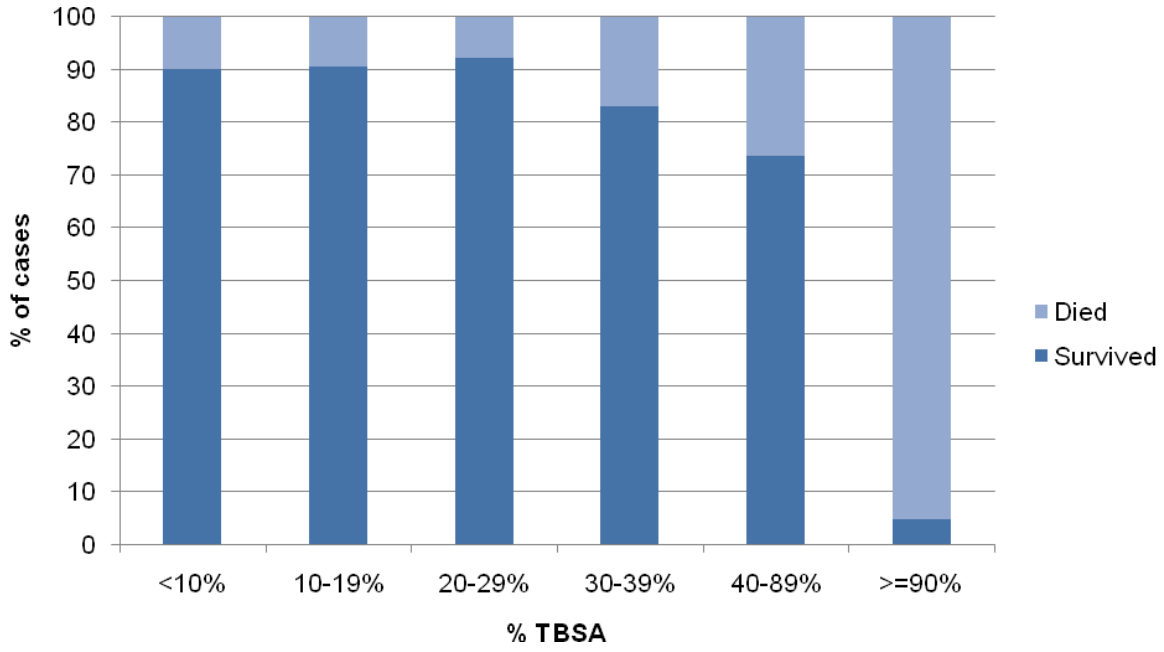
While the median length of stay for major trauma patients has reduced significantly for the broad major trauma population in Victoria since 2001-02, there has been no change in the length of stay for burns-related major trauma over time (X^2_7=5.0, p=0.665). The distribution of length of hospital stay by year is shown in Figure 4.

Figure 4: Length of stay at the definitive hospital by year



The in-hospital death rate was 17.4% (n=91) for all cases, with all but one death occurring in adults (≥ 15 years). Less than 10% of cases with a TBSA <30% died in-hospital while 95.2% of cases with a TBSA ≥ 90% died in-hospital, most shortly after arrival at the definitive hospital of care.

Figure 5: Percentage of in-hospital deaths according to % TBSA - 6-month outcomes



Where no other injuries were sustained (AIS severity>1) and a TBSA of 20% or more was reported, the in-hospital death rate was 22.5% (n=62).

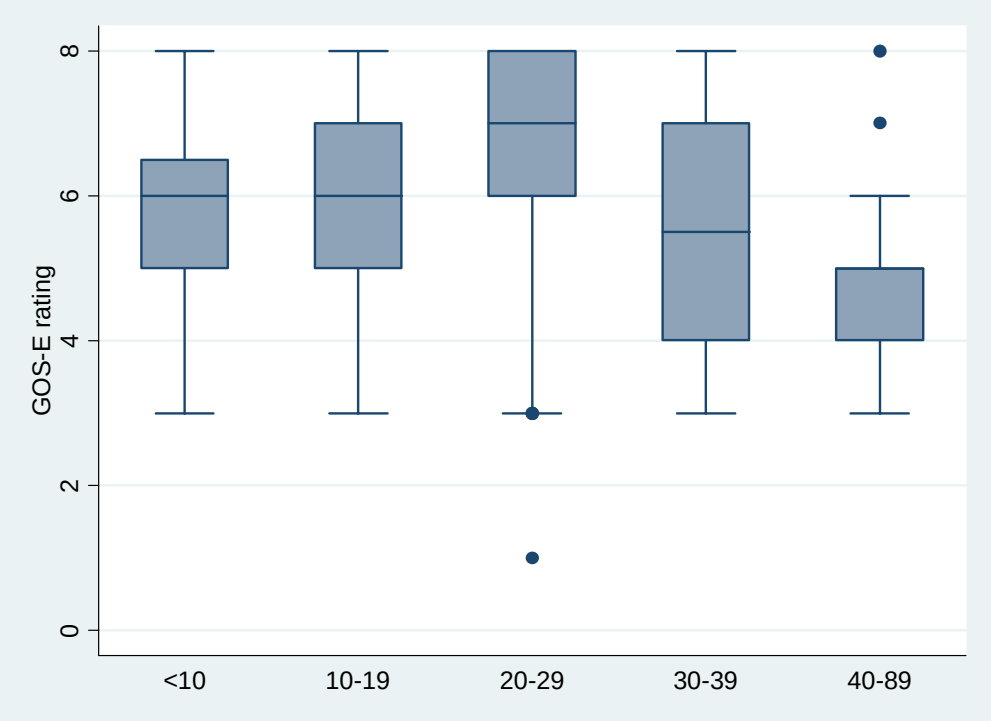
The VSTR has been following-up all adult major trauma patients who survived to hospital discharge, with a date of injury from October 2006, using functional, health status and pain measures, providing 21 months of six-month post-injury data for reporting. There were 127 adult burns-related major trauma cases who survived to discharge with a date of injury from October 2006 to September 2008. Eighty-one per cent of these 127 cases were successfully followed-up six months following injury, which is slightly lower than the 6-month follow-up rate for all major trauma patients.

There was no association between age (t=-0.9, p=.370), sex (X^2_1=0.03, p=0.873), mechanism of injury (X^2_5=4.2, p=0.521), injury intent (X^2_1=0.71, p=0.701), or injury severity (ISS) (z=-1.21, p=0.226) and responder status at 6-months, indicating that the profile of patients successfully followed-up was representative of the burns-related major trauma population.

There was only one post-discharge death among the 103 cases with a known 6-month outcome. The percentage of patients living independently 6-months following burns-related major trauma was 78.6%, with 17.5% experiencing a complete return to pre-injury function and participation according to the GOS-E scale. Figure 6 shows the distribution of GOS-E scores according to % TBSA category, with worse functional outcome associated with greater % TBSA

Of the 75.9% of patients working prior to injury, 66.2% had returned to work by 6-months, however 50.0% of cases with a TBSA of 30-39% had returned to work, and only 26.7% (4/15) of cases with a TBSA ≥ 40% had returned to work by 6-months. The percentage of cases reporting pain at 6-months was 42.7%, with 18.3% reporting persistent moderate to severe pain.

Figure 6: Distribution of functional outcome (GOS-E) scores at 6-months by % TBSA category



Conclusion

The vast majority of patients are going to specialist burns units. Mortality and functional outcomes are significantly worse for those patients with burns to greater than 40 percent of their body.

There needs to be a better mechanism for classifying burns injuries to include the combination of inhalation and percentage of burns to the body. The establishment of a National Burns Registry will assist with more standardised documentation and benchmarking of industries.

The length of stay data for this group of patients shows that they stay noticeably longer than other trauma patients and are a significant drain on hospital resources.

THE VSTORM GROUP

The Victorian State Trauma Outcome Registry and Monitoring (VSTORM) group, based at the Department of Epidemiology and Preventive Medicine at Monash University, coordinate the Victorian State Trauma Registry.

The VSTORM Chief Investigators are:

- Professor Peter Cameron (Head of the Victorian State Trauma Registry, Monash University)
- Professor John McNeil (Head of Department of Epidemiology and Preventive Medicine, Monash University)
- Dr Belinda Gabbe (NH&MRC Population Health Research Fellow, Department of Epidemiology and Preventive Medicine, Monash University)

Members of the VSTORM Steering Committee, all of whom have expertise in epidemiology, trauma management or related areas, are:

- Chair: Professor Rodney Judson (Director of Trauma, The Royal Melbourne Hospital)
- Professor Peter Cameron (Head, VSTORM)
- Ms Bernadette McDonald (Acting Assistant Director, Access and Metropolitan Performance, Department of Human Services)
- Ms Diane Gill (Executive Officer, Royal Melbourne Hospital)
- Dr Marcus Kennedy (Director, Adult Retrieval Victoria)
- Dr Fergus Kerr (Director of Emergency Medicine, Austin Health)
- Dr Russell Gruen (Trauma Surgeon, Royal Melbourne Hosptial)
- Dr Simon Young (Director of Emergency Medicine, The Royal Children's Hospital)
- Dr Sol Zalstein (Director, Emergency, Bendigo Health Care Group)
- Dr Jennie Ponsford (Director, Monash-Epworth Rehabilitation Research Centre.)
- Dr Bruce Bartley (Emergency Department, The Geelong Hospital)
- A/Prof Tony Walker (Executive General Manager, Quality and Education Services, Ambulance Victoria)
- Mr Alex Currell (General Manager, Strategic Planning, Ambulance Victoria)
- Mr Alex Collie (Director, Victorian Neurotrauma Initiative)

DEFINITIONS OF MAJOR AND POTENTIALLY MAJOR TRAUMA

The Registry has a particular focus on patients who meet the ROTES definition of major trauma. However, in order to ensure complete capture of all Victorian trauma patients fitting the ROTES major trauma definition a wider definition has been adopted for VSTORM. This means that the VSTORM database encompasses a broader spectrum of patients with both potentially major and major trauma.

ROTES major trauma definition
ALL trauma patients with injury as principal diagnosis IRRESPECTIVE OF AGE who meet ANY of the following criteria
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

Source: (Ministerial Taskforce on Trauma and Emergency Services and the Department of Human Services Working Party on Emergency and Trauma Services, 1999)

To ensure the capture of all major trauma cases fitting the ROTES major trauma definition, the extra criteria for the VSTORM screening definition include patients with injury as principal diagnosis:

- Whose length of stay is 3 days or more;
- Who are transferred to, or received from, another hospital for further emergency care or admission to a high dependency area.

The formal VSTORM inclusion and exclusion criteria are shown below.

VSTORM major and potentially major trauma screening inclusion criteria

ALL trauma patients with injury as the principal diagnosis IRRESPECTIVE OF AGE who meet ANY of the following criteria

1. Death after injury.
2. All patients admitted to an Intensive Care or High Dependency Area >24HRS and who have mechanical ventilation after admission.
3. Significant injury to 2 or more ISS body regions or ISS>15. AIS>2 in 2 body regions
4. Urgent surgery for intracranial, intrathoracic, or intraabdominal injury, or for fixation of pelvic or spinal fractures.
5. Electrical injuries, drowning, asphyxia included if admitted to an Intensive Care Unit and have mechanical ventilation > 24 hours (or death after injury).
6. All patients transferred to or received from another hospital for further emergency care or admission to a high dependency area - Unless meets exclusion criteria.
   NB: For patients received from another hospital they must meet any of criterion
   1 – 5 or have combined LOS of 3 or more days, as per criterion 7.
7. Length of stay is 3 days or more, the exception being transfers out of hospital. This includes combined length of stay for transfers from another hospital. - Unless meets exclusion criteria

VSTORM major and potentially major trauma screening exclusion criteria

ALL trauma patients with injury as principal diagnosis who meet any one of the following criteria

1. Isolated # NOF.
2. Isolated upper limb joint dislocation, shoulder girdle dislocation (unless associated with vascular compromise) and toe/foot/knee joint dislocation – *Unless meets inclusion criteria 1,2 or 4*
3. Isolated closed, limb fractures only. (e.g. # femur, Colles # etc) – *Unless meets inclusion criteria 1, 2 or 4*
4. Isolated injuries distal to wrist and ankle only. (e.g. Finger amputations) – *Unless meets inclusion criteria 1, 2 or 4*
5. Soft tissue injuries only. (e.g. tendon and nerve injury and uncomplicated skin injuries) – *Unless meets inclusion criteria 1, 2 or 4*
6. Less than 10% burns only – *Unless meets inclusion criteria 1, 2 or 4*
7. Isolated eyeball injuries

Electrocution, Drowning, Asphyxia (Unless these are associated with other injuries or death or patient receives mechanical ventilation for greater than 24 hours)

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