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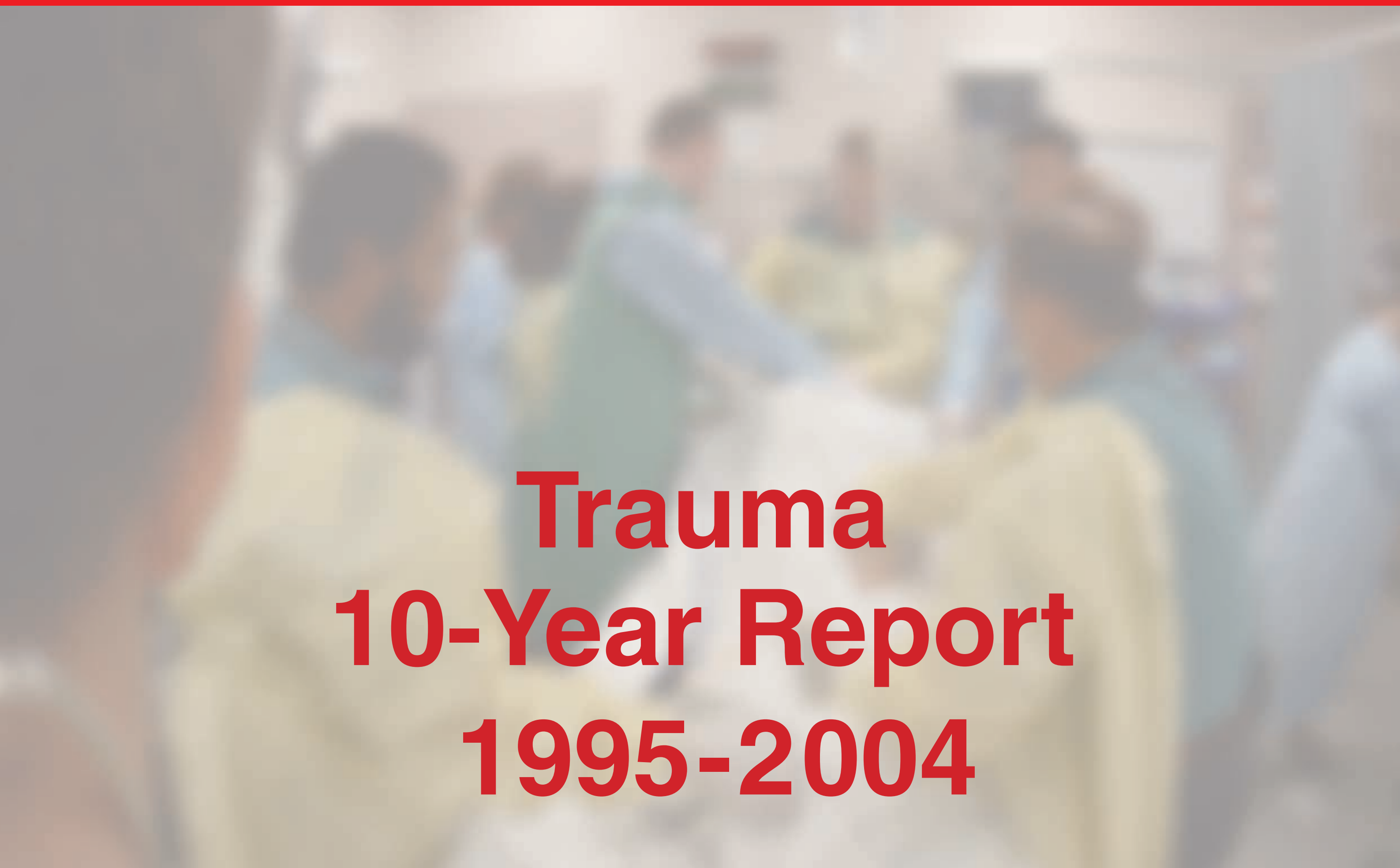
South Western Sydney Regional Trauma Registry



Trauma
10-Year Report
1995-2004

Liverpool Hospital Trauma Department

South Western Sydney Regional Trauma Registry 10-Year Report 1995-2004

South Western Sydney Regional Trauma Registry 10-Year Report 1995-2004 ISBN 978 1 74079 073 4 / 1 74079 073 1

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Acknowledgements

- Liverpool Hospital and the Sydney South West Area Health Service for their support over the last decade
- The NSW Institute of Trauma and Injury Management (ITIM) for their support in the final publication of this report
- The University of NSW for their ongoing support

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Special thanks

- Thelma Allen, Sonia Gagliardi and Charmaine Miranda for secretarial support
- Andrea Delprado, Nevenka Francis and Sally Horder for their assistance in the final production of this report
- The NSW Ambulance Service for their untiring efforts to obtain high quality pre-hospital information, with particular thanks to Paul Smith
- Clinical Information Department staff at each SWSAHS hospital, who ensure patients records are available for viewing
- Switchboard operators at Liverpool Hospital, who keep a diligent record of trauma hotline calls (for the inter-hospital transfer system)
- NRMA Careflight and Westpac Lifesaver medical retrieval services for provision of pre-hospital data and Careflight photos in this report
- Clerical and nursing staff at Liverpool Hospital Emergency Department, for promoting a system to improve the capture of these records
- SWSAHS Information Services Department for PC support and assistance, with particular thanks to Oleg Gluschenko
- The medical, nursing and allied health staff who directly or indirectly contribute to registry data on a daily basis
- Finally, to all our trauma patients here in south west Sydney and around the world, may their lives and the lives of their friends, family and future trauma patients be better because of this work.

Editorial comments

Liverpool Hospital Trauma Department staff, March 2006

Front row L-R: Virginia Tai (fifth year medical student), Wei Chong Chua (Trauma Research Fellow from Singapore), Nevenka Francis (Area Trauma Coordinator), Tassanee Iemsomboon (Visiting Nurse from Thailand), Ziggy Yeh (Resident Medical Officer), Katherine Brown (Data Manager)

2nd row L-R: Sharon Wood (Secretary), Sonia Gagliardi (Secretary), Sally Horder (Case Manager), Erica Caldwell (Liverpool Trauma Coordinator), Bastiaan Punt (David Sloane Trauma Fellow)

3rd row L-R: James Chau (Surgical Registrar, RACS), Michael Sugrue (Director), Scott D'Amours (Deputy Director)

Absent: Thelma Allen, Charmaine Miranda

The Trauma Department was founded in 1989 by Dr David Sloane in conjunction with Maria Seger, Trauma Nurse Coordinator. Both have passed away, and no doubt they would have enjoyed the fruits of their founding vision. In his time as Professor of Surgery, Stephen Deane was a great advocate of data collection and analysis.

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Forward

It is a great pleasure to welcome you to the third significant report from the South Western Sydney Area Health Service Regional Trauma Registry since its inception in 1995. Trauma and injury have claimed many lives, injured many people and stressed the social fabric of our society. The economic cost of trauma and injury care is immense, and whilst south-western Sydney is geographically one of the larger metropolitan regions within greater metropolitan Sydney, it is but one small area from a global perspective on trauma. It is within our region however, that the vision, commitment and support of individuals have come together to produce one of the most comprehensive sets of trauma data to be published to date.

This report outlines the overall pattern and epidemiology of injury in the region focusing on the entire spectrum of care, the type of injuries seen, management, diagnosis and work up. There are special sections on injury severity scores, outcomes, performance and complications. The report itself is a combination of a tremendous effort by Erica Caldwell (six years), Elizabeth Halcomb (two years), Russell Smith (six months) and our current Data Manager, Katherine Brown (two years). A special thank you must go to the Motor Accidents Authority who provided a grant of $50,000 in 1996, South Western Sydney Area Health Service, and now Sydney South West Area Health Service for their continued support affording us the vision to provide data. Data gives the power, the power to change, innovate and move forward and ultimately make a contribution to safer and better trauma patient care.

This registry has the capacity to provide information that will allow us to pose questions about care and facilitate change. The large number of patients within the database now affords us the opportunity to make meaningful conclusions and recommendations. This report will complement existing worldwide registries allowing comparison at a global level. It will provide confidence for our National Trauma Registry in the hope that in the future a comprehensive regional trauma registry such as this will be available at a national level facilitating our patients, their families, relatives and friends in helping to reduce the cost of our trauma care delivery.

Finally before concluding, I must acknowledge that comprehensive reports such as these are produced only with the commitment of the entire staff of our trauma department both clinical and administrative, coupled with inputs from our colleagues in urban and rural hospitals. As a major trauma service we must serve our colleagues and our aim is always to provide a comprehensive system for the area, its population and those providing care to injured patients.

May this report stimulate you to question or change your practice and in doing so help the patients of the future.

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Acknowledgement

The South Western Sydney Regional Trauma Registry would like to acknowledge the continued support of the Hospital and Area Health Service over the decade of this major undertaking. During this time there has been a firm commitment to the ongoing development and enhancement of the trauma service at a time of increasing resource limitations. The commitment and willingness to allow analysis of data and outcomes is commendable.

Particular thanks goes to the current General Manager, Dr Teresa Anderson, and the current Chief Executive Officer, Mr Mike Wallace. Without their facilitation none of this would have been possible.

Executive Summary and Recommendations

1.1 Executive Summary and Recommendation

Trauma is a major burden on health care in south-western Sydney. This 10-year report provides an opportunity to define a comprehensive set of benchmarks in contemporary trauma care. This data will assist in the understanding and planning of future trauma care not only in Sydney South West but nationally.

The data in the registry report, because of its power, will help improve the process of trauma care. Utilising the data to drive change within the clinical environment will lead to a reduction in costs as well as increasing efficiency across the trauma system. Improvements in care need to translate into measurable outcomes, not just in terms of reducing mortality but also impacting on functional outcomes.

This ten year report should be used as a benchmark for comparison of trauma care not just in Australia but worldwide. It is one of the most comprehensive sets of trauma data to be published.

1.2 Recommendations

1 Data registry linkages nationally and internationally

Linkages between trauma data sets in Australia needs to occur. This will optimise access to information and increase the depth and power of registry reports.

The ability of Sydney South West and Liverpool Hospital to produce comprehensive meaningful trauma data will add vigour to the efforts of the recently established National Trauma Registry Consortium (NTRC). The NTRC is supported by the Royal Australasian College of Surgeons (RACS), the Australasian Trauma Society and the Centre of National Research on Disability (CONROD), where the secretariat is hosted. Registries require funding and we estimate that each patient entry in the South Western Sydney Area Health Service Regional Trauma Registry costs approximately 15 AUD. It is important that federal and state leaders in health make a firm commitment to the analysis and reporting of trauma data at a national level. This process needs to be transparent and without prejudice. Data from the pre-hospital, acute care, rehabilitation and insurance environments should be matched in linked data sets to facilitate its use in directing improvements in trauma care. This will benefit patients, clinicians, administrators and corporate Australia. These linkages will allow greater coordination of initiatives across the trauma care continuum, particularly liaison with health promotion / injury prevention and rehabilitation programs.

2 Coordinated approach to elderly trauma care

Within the Area Health Service trauma patient numbers have increased steadily to a recent plateau. The most striking pattern identified in this report is the increase in elderly patients admitted following injury.

Planning for trauma care will need to include greater care for elderly, especially following falls.

This includes increased non-operative management and critical care. Integration of geriatric medicine and allied health with a special focus on elderly trauma is required to achieve better outcomes for this group of patients, who often have complex requirements in care as well as their injury-related ones. Outcome data needs to be analysed at a national level to evaluate strategies implemented to address this rapidly growing issue.

3 Collaborative approach to trauma care in the young.

The report has identified that despite active injury prevention programs, there appears to have been little change in risk-taking behaviour. This is particularly evident in the prevalence of injury amongst young males. New and innovative programs should be developed that continue to target this group.

4 Major multidisciplinary investigations into falls required

The registry report has identified that falls account for 39.5% of all traumatic hospital admissions. Given the wealth of information recently published on falls prevention programs, the implementation of these programs should be evaluated by the use of the registry to monitor for decreasing frequency and severity. This will be a major intervention to reduce the burden of elderly fall injuries, especially on our hospitals.

5 Measures to control guns and violent crime should continue

Interpersonal violence, particularly gun related and stabbings, is decreasing. The introduction of gun control measures may have had an impact on this reduction.

6 New initiatives to evaluate drug and alcohol abuse are required

While the registry did not objectively test all admissions, it was clear from the data that there is a major problem with substance use in those aged between 15 and 50 years. Research in this area should be a priority in order to determine the exact prevalence of the problem and to guide targeted prevention strategies.

7 Greater adoption of evidence-based practice is required to optimise patient care

This is evident throughout the report. For example, within the pre-hospital environment, the data demonstrates a change in the pattern of pre-hospital fluid administration that is in line with the increasing evidence of the need for haemorrhage control and permissive hypotension rather than over-aggressive fluid resuscitation. In addition the complete cessation of the use of the MAST suit bears testament to the value of education. Trauma registry data will allow outcome analysis of treatment and procedural change. It will allow the evaluation of the translation of evidence into practice through outcome monitoring.

8 Expediting definitive care of the bleeding trauma patient needs urgent attention

Three phases of time-critical care can be described in the bleeding trauma patient. Phase 1 is the pre-hospital or scene time. Phase 2 is the emergency department resuscitation time and phase 3 is the operating theatre time. This concept could be called the "triple scene time" in the bleeding patient.

This report has identified that phase 1, pre-hospital scene time, in the non-entrapped patient is too long and appears to be increasing. The phase 2 'ED or second scene' time is longer than 45 minutes in 35% of patients. The phase 3 'OT or third scene' has not been captured in this data set, however increasing reports in the literature describing damage control surgery techniques emphasize the importance of reducing the amount of time spent in the operating theatre prior to transferring the patient to the ICU for stabilisation. The recording of patient temperature as a measure of the need for stabilisation and rewarming could be improved. Greater analysis of the processes of trauma care in these time critical areas is required.

9 Implement trauma systems that facilitate consistent delivery of trauma care 24 hours a day 7 days a week. Establish trauma-admitting units at the major trauma centres staffed by clinicians specifically interested and educated in trauma care.

It is clear, from the pattern of injury data presented in Chapter 6 and the outcome data presented in Chapters 8 and 10, that clinical care can vary not only from year to year, but also from day to day. Often this variability may be dependent on the seniority and experience of the clinicians involved. Consistent trauma care is more likely to be provided by trauma surgeons who are up to date on current trends in management and who are experienced clinicians, rather than by those who have little or no interest in trauma. This is evidenced by such performance indicators as therapeutic laparotomy rates.

Major Trauma Services should ensure the engagement of appropriately trained, experienced and interested trauma surgeons and actively monitor the appropriate performance indicators to determine consistent and safe delivery of trauma care.

10 Concentrate resources for Trauma Care delivery to improve outcomes

Despite the large numbers reported it has taken a decade of dedication to reach the power required to make robust recommendations. Concentration of trauma treatment resources initially into four adult major trauma centres in metropolitan Sydney, with a progressive reduction to two major trauma centres over the next five years is recommended. This will establish an environment of trauma admitting units working with a dedicated multidisciplinary team to improve outcomes.

11 Refine the indicators of quality trauma care

Many of the indicators used to monitor the process and delivery of care no longer serve a useful function. With newer trends in care evolving, the system must have flexibility to change.

Indicators such as those relating to pre-hospital fluid administration will be dropped. Indicators relating to time of definitive trauma operation will be added along with indicators to monitor damage control surgery and anaesthesia. This report should be used to determine those indicators that no longer adequately reflect system and clinical performance.

12 New collaborative approach to trauma data collection and analysis

This data set, at a cost of approximately 15 AUD per patient record, needs to be properly funded. Collaboration with the insurance industry and other funders of trauma care is essential. New partnership arrangements between government and industry are required to sustain appropriate funding levels. Initiatives need to come from both State and Federal levels. In addition, the professional colleges and societies need to combine their resolve and initiate the processes needed to make these changes.

13 Expansion of the registry as a research tool for all trauma researchers

Nearly 80% of the 100 or so recent trauma publications from the Trauma Department at Liverpool Hospital utilised data sourced from the registry. Of particular note was the ability to use the data to drive clinical change through the introduction of new practice guidelines. The introduction of clinical practice guidelines relating to the management of haemodynamically unstable patients with pelvic fractures has resulted in a reduction in mortality for this group of patients from 35% to under 10%! The strength of the trauma registry has enabled us to identify clinical problems, develop solutions, implement the solutions and evaluate their effectiveness. This example clearly demonstrates the power and cost effectiveness of a robust trauma data set such as the South Western Sydney Area Health Service Trauma Registry.

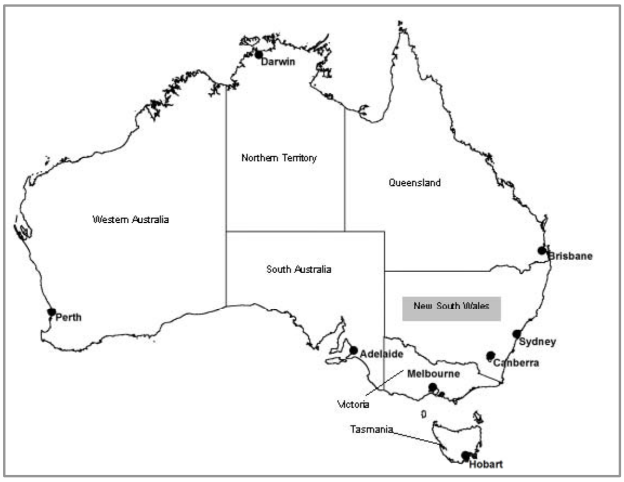
1 Introduction

1.1 Background

New South Wales (NSW) is the most populated state in Australia, with an estimated resident population of 6.73 million people as at 30 June 2004. (1) Sydney is the capital city of NSW, and has an estimated resident population of 4.25 million people (30 September 2005). (2) In NSW there are currently six adult major trauma services (MTS) and three paediatric major trauma services. All but one adult and one paediatric service are located within the Sydney metropolitan region.

In NSW, public health services are grouped into Area Health Services (AHS) according to pre-determined geographical boundaries. Liverpool Hospital is the adult major trauma service for the South Western Sydney Area Health Service (SWSAHS). The hospital is located approximately 35km south-west of the Sydney central business district, and is the major trauma service for residents of south western Sydney.

Figure 1.1: Map of Australia*. The state of New South Wales is highlighted in grey.



*Map outline © C2005 Commonwealth of Australia, Geosciences Australia, Geocat 61756 (http://www.ga.gov.au)

1.2 South Western Sydney Area Health Service

SWSAHS provides hospital and community based health services for over 750000 residents of the local government areas (LGA) of Bankstown, Camden, Campbelltown, Fairfield, Liverpool, Wingecarribee and Wollondilly. These seven regions cover an area of 6237km^2. Settlement varies from dense residential and commercial development to scattered rural townships with some parts of the region being quite isolated. (3)

According to the South Western Sydney Area Health Service 2003/04 Annual Report, (3) more than one-third of the residents of SWSAHS were born overseas in a non-English speaking country, and 44% of residents speak languages other than English at home. The most common non-English languages spoken are Arabic, Vietnamese, Italian and Cantonese.

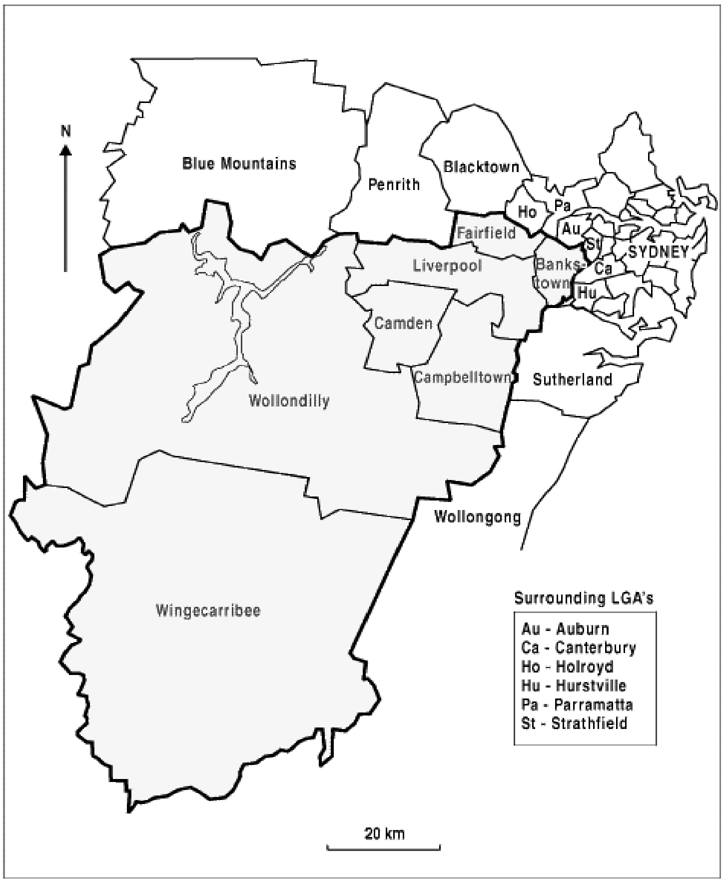
People of Aboriginal and Torres Strait Islander descent account for 1.3% of SWSAHS residents. South western Sydney has a higher than average unemployment rate: 8.6% compared with 7% in NSW. The proportion of residents in public housing is almost double that for the rest of the State of NSW: 8.8% compared with 4.9%. (3) Table 1 presents the most recent available data for selected population characteristics for each LGA within south western Sydney.

Table 1.1: Population characteristics of south-western Sydney by local government area, 2001 census (1)

Local Government Area	Population	% Aboriginal identified	% Language other than English spoken at home	Projected Population 2016
Bankstown	172030	0.76	46.2	180060
Fairfield	189020	0.59	66.0	191460
Liverpool	159070	1.28	43.7	225590
Campbelltown	150160	2.40	19.4	179280
Camden	45450	1.16	8.5	83030
Wollondilly	38460	1.50	5.1	47840
Wingecarribee	42760	1.16	4.2	51740
Total	796950	1.21	38.9	959000

Figure 1.2: Sydney metropolitan Area Health Services, Sydney, NSW, 1995-2004

Figure 1.3: Map of Sydney metropolitan region highlighting SWSAHS (in grey)



1.3 The new Sydney South West Area Health Service

Due to recent NSW HEALTH mergers, SWSAHS has combined with the Central Sydney Area Health Service (CSAHS) as of 1st January 2005, to become the Sydney South West Area Health Service (SSWAHS). This report spans the ten year period 1995-2004 prior to the amalgamation, therefore the correct term for that time period, SWSAHS, has been used throughout the report.

1.4 SWSAHS hospitals

The SWSAHS trauma network consists of Liverpool, Bankstown, Campbelltown, Fairfield, Camden and Bowral hospitals. Liverpool Hospital is the designated major trauma service. The designated urban trauma services (UTS) are Bankstown, Campbelltown, Fairfield and Camden hospitals. Bowral Hospital is the sole rural trauma service (rural TS) in south western Sydney.

A formal system of pre-hospital trauma triage was introduced by the Ambulance Service of New South Wales in 1992. This system provides guidelines and protocols for ambulance officers, including Protocol 4, [Appendix 1] a triage tool which determines transport decisions and allows seriously injured patients to bypass a nearer urban hospital and be delivered directly to a major trauma service.

Liverpool Hospital is a 650 bed tertiary referral and teaching hospital, located approximately 35km south-west of the Sydney central business district, and is one of the principal teaching hospitals of the University of NSW, Sydney, Australia. The hospital has been operating continuously since its opening as a hospital for soldiers and convicts. Liverpool Hospital had 57966 inpatient separations during the 2004-2005 financial year. [4-6]

The Trauma Department at Liverpool Hospital facilitates the care of patients across all disciplines. There is however no current admitting trauma surgical unit. Patients are admitted under the on-call surgical team of the day. Liverpool Hospital was the first hospital in Australasia to successfully undergo verification of its Trauma Service by the Royal Australasian College of Surgeons multidisciplinary verification program in 2002.

Bankstown Lidcombe Hospital is a 454 bed metropolitan hospital, located approximately 20km south-west of the Sydney central business district. [4-6] It serves a local population of approximately 165000 residents. The hospital is approximately 15 minutes drive from Liverpool.

Campbelltown and Camden Hospitals are situated within the Macarthur Health Service, located approximately 61km south-west of the Sydney central business district. They serve the approximately 234070 residents who reside in Campbelltown, Camden and Wollondilly local government areas. Macarthur Health Service is approximately 30 minutes drive from Liverpool.

Campbelltown Hospital is a 290 bed metropolitan hospital. Camden Hospital has 80 beds, with specialties such as palliative care, aged care, rehabilitation and day surgery. [4-6] Camden Hospital has been on ambulance bypass since 1999. Campbelltown Hospital provides acute emergency department care for patients located in the Macarthur Health Service who require urgent ambulance transport to hospital.

Fairfield Hospital is a 200 bed metropolitan hospital located approximately 30km south-west of the Sydney central business district, and serving a local population of approximately 188889 residents. The local area of Fairfield is one of the most diverse communities in Australia, with over 133 nationalities and 33 languages spoken. [4,5,6] The hospital is approximately 30 minutes drive from Liverpool.

Bowral and District Hospital is a 74 bed rural hospital located approximately 120km south-west of the Sydney central business district. It provides hospital services to the population of the Southern Highlands, a rural district of some 45000 residents on the south-western border of the Sydney metropolitan area. Bowral Hospital plays a very important role in the care of trauma patients in outer south-western Sydney. It has the only Emergency Department (ED) in the district. [4-7] The hospital is approximately 1 hour and 10 minutes drive from Liverpool.

1.5 South Western Sydney Regional Trauma Registry

When the Liverpool Hospital trauma registry, established in 1989, was modified and expanded in 1994 it became capable of capturing over 154 data items for seriously injured patients. From this the South Western Sydney Area Health Service (SWSAHS) Regional Trauma Registry was born. Data is collected from six hospitals: Liverpool, Bankstown, Campbelltown, Fairfield, Bowral, and Camden Hospitals.
The registry has many purposes, including:

- Monitoring pre-hospital triage
- Injury trend analysis
- Clinical activity analysis
- Improving clinical care
- Quality assurance
- Performance monitoring
- Trauma research
- Advising education strategies

Registry inclusion criteria

Patients are included in the registry if they are admitted to one of the six SWSAHS hospitals following acute injury. Patients are excluded when they present with minor injuries to the Emergency Department but are not admitted to hospital. In order to efficiently manage the registry data, patients are assigned to either the 'minor data category' or the 'major data category'. The inclusion criteria for each category are:

Minor data category

Patients with an isolated injury to one body region, specifically:

- Upper limb fracture / dislocation at or below level of neck of humerus
- Lower limb fracture / dislocation at or below the level of the ankle
- Isolated fracture of fibula or patella
- Isolated fracture of neck of femur (#NOF) in an elderly patient (age ≥ 65 years)
- Soft tissue injury (includes dog bites; simple lacerations not significantly involving nerves or blood loss > 500ml; partial or complete amputation of a digit; minor crush injury to the distal extremities)
- Isolated tendon injury
- Minor burns, for adults body surface area (BSA) < 20%; for children BSA < 10%
- Isolated mandibular fractures
- Minor scalp contusion or laceration with no previous loss of consciousness (LOC) or decrease in Glasgow Coma Scale (GCS), and no neurological signs

Major data category

Patients with injuries to more than one body region, or injuries not specified in the minor injury category, including:

- Injury to more than one body region
- Any skeletal or internal organ injury of the head, neck, chest, abdomen or extremities (including fractured ribs), excluding isolated fractures specified in the minor data category
- Any loss of consciousness
- Injury severity score (ISS) [(8)] of greater than or equal to 16 (ISS ≥ 16)
- Deaths following injury
- Burns: for adults BSA > 20%; for children BSA > 10%; airway burns
- Patients undergoing trauma laparoscopy, laparotomy or DPL
- Fractured tibia / fibula above ankle level

Number of data items

The minor data category contains up to 23 data items per patient. Abbreviated Injury Scale (AIS) [8] coding is not required. However all minor data category patients have an ISS between 1 and 9, and the majority have an ISS between 1 and 4.
The major data category contains up to 190 data items per patient. There are a core data set of 150 data items collected for every major data category patient, and up to 40 additional data items are available to capture information on patient transfers; retrievals; deaths and / or significant complications. Injuries, AIS codes and operation data are collected for every major data category patient.
All potentially identifying information is kept for the purposes of clinical care and review, and is protected by privacy legislation.

The major and minor data categories, whilst correlating with injury severity, are a function of economic reality. Resources are finite and approximately 69.2% of SWSAHS trauma patients meet minor data category criteria, with the ability to only collect the corresponding 23 variables per patient in this category.

Data collection

At Liverpool Hospital, the data collection process begins by identifying all injury admissions and recording them in a daily register. Injury admissions are identified via either the Emergency Department Information System (EDIS) or the Trauma Hotline Log, which is a log kept at the hospital switchboard that lists all calls received regarding patients transferred in from another hospital. These transfer patients may not be captured in EDIS as they may bypass the Emergency Department and proceed straight to the ward or operating theatre.
Once the patients are identified, the Trauma Coordinator or Trauma Case Manager collects the data on a paper form. There are different forms [Appendix 1-2] for the major and minor data categories. The data are then entered into the registry by the Trauma Data Manager. For seriously injured patients, the form is returned to the ‘current patients’ folder, which is carried to the wards on daily rounds. This allows the form to be progressively updated as required up to the date of discharge. There is a sign-off mechanism in the registry which clearly identifies which records are incomplete or require further information.
Injury admissions at SWSAHS urban and rural hospitals are identified retrospectively via EDIS. The Area Trauma Coordinator then collects the data on the paper forms and enters it into the registry. The registry automatically computes the ISS and probability of survival (Ps) using TRISS methodology. [9]

Data quality

Data quality is monitored daily by the Trauma Data Manager. There is a systematic process for identifying and monitoring data queries (items requiring further information or double-checking by the data collector). In addition data meetings are regularly held. Issues relating to data collection, quality and processes are discussed. Regular exercises of data extraction and injury severity scoring are conducted amongst the group to ensure inter-rater reliability. The meetings are attended by the Trauma Data Manager, Area Trauma Coordinator, Trauma Coordinator and Trauma Case Manager.
Further ad-hoc data quality monitoring is carried out whenever data are extracted from the registry, with any unusual findings thoroughly investigated prior to releasing the requested information.

Technical information

The registry interface is a browser based system connecting to a Sybase database at the back end. The technical aspects of the registry are managed by SWSAHS Information Services Division (ISD). Data are extracted via Microsoft Access and may be manipulated to the requestors specifications if needs be. There are also a suite of standard reports which provide quick summary information in a user-friendly format.

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Appendices

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2. SWSAHS Regional Trauma Registry data collection forms.
3. SWSAHS Regional Trauma Registry Condensed Data Dictionary.

2 Editorial Comments

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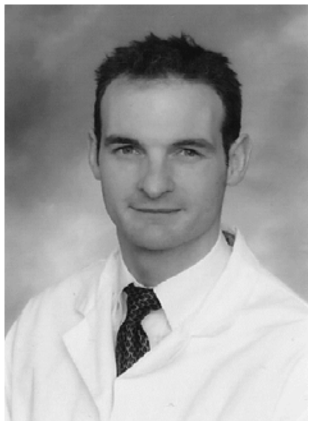

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Adam Brooks is a Consultant in Hepatobiliary Surgery, Emergency Surgery & Surgical Critical Care at Queen's Medical Centre in the UK. In addition he is Senior Lecturer in Military Surgery at the Royal Centre for Defence Medicine. He trained in hepatobiliary surgery, critical care and trauma surgery in the UK, South Africa, Australia and the USA. Academically his interests include the use of ultrasound in austere locations, tissue oxygenation and abdominal compartment syndrome, damage control techniques in trauma and emergency surgery and the organisation and provision of emergency surgery services. Very active in postgraduate education, he is faculty on courses including DSTC, ATLS, BATLS CCrISP and has taught and organised numerous ultrasound and trauma courses for civilians and military personnel worldwide. He has co-edited 6 textbooks and written more than 50 chapters and academic papers.

Chapter 11: Complications

Trauma audit is a vital component of the process to improve the quality of care delivered to injured patients. [(1)] The contemporaneous and accurate collection and analysis of complication data is a complex, difficult and often unwelcome process in the busy environment of the trauma centre. However it is a vital component of both the trauma system and trauma registry to ensure the ongoing delivery of the highest quality of care to injured patients.

In this 10-year trauma registry report, 9 complete years of complication data is presented describing the hospital episodes of more than 8000 patients with major injuries. The percentage of major data category trauma patients with complications during this time fluctuates around 20%. Over this time there has been a general downward trend in the complication rate at Liverpool Hospital. These data are clearly representative of a vigorous capturing system and a robust service that has performance improvement at its core.

Hoyt *et al* have been instrumental in the process of trauma audit and the development of a standard complication set [(2-5)] equivalent to that used at Liverpool Hospital. Initial analysis of their figures in 1992 and following 12 years of data collection showed a relatively static level of disease related complications. [(5)] The Liverpool Hospital data is comparable to this and other published data from leading trauma institutions.

The analysis of age specific complication rates and survival from the Liverpool data demonstrates that the percentage of patients and number of complications per person increases markedly with age and is associated with a clear increase in mortality. Although most apparent at the extreme of age (85+ years), the increases in complications are seen in those as young as the over 55's. With the fastest growing portion of the population the over 85 age group, the average life expectancy approaching 80 years in Western cultures and the high incidence of co-morbidity in the over 65 years age group this data is a timely reminder that these patients are a special group where attention to detail in trauma management must go hand-in-hand with optimum medical management of co-morbidity to achieve the best results.

Collection and analysis of complications is an integral part of the continuous evaluation and evolution of a trauma system. The data presented in the Liverpool Trauma Registry 10-year report demonstrates that Liverpool Hospital has developed a robust programme of capturing complications in major trauma patients from the pre-hospital response to the critical care environment, that places it on par with the leading international trauma institutions and at the forefront of the drive to continuously improve the delivery of trauma care for the most seriously injured patients.

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Andrea Delprado is a registered nurse with over 20 years experience. Andrea became involved in trauma management in 1989 has had held roles as a trauma research nurse, trauma coordinator, educator and trauma systems manager. Andrea is currently engaged as a consultant to the NSW Institute of Trauma & Injury Management and is also establishing the National Institute of Trauma Education, Research and Clinical Standards – NITERCS.

Chapter 4: Liverpool Hospital Overview

Thankyou for the invitation to review the Liverpool Hospital Overview chapter of the South Western Sydney Area Health Service Trauma Registry 10 Year Report. This report provides us with a great opportunity to view the spectrum of Trauma managed by one of the leading Major Trauma Centres in NSW.

Over the 10 year period reported on, Liverpool Hospital admitted over 21,000 injured patients, of these approximately 11% were classified as having suffered serious injury with an Injury Severity Score (ISS) of ≥ 16. This is similar to other reported rates of serious injury within major Trauma Centres in NSW, this being 8-10% of all trauma admissions.

Classically the age and sex distribution displays the male predominance earlier in life, especially in the 15-40 year age group, with elderly females dominating from 70 years upwards. The home is the place where most injury occurs (34%) followed by the street (28%). This important fact has implications for injury prevention strategies which span all age groups. Matching this data with particular mechanisms of injury and targeted ages will be very valuable for future prevention programs. For the ISS ≥ 16 subgroup the place of injury is reversed, however the concept of the home as a safe environment needs to be pursued.

As is the traditional pattern in Australia, the ratio of penetrating trauma seen in our injured population is relatively small compared to some areas of North America and South Africa. While the relative frequency is low, when these injuries do occur it is important that clinical staff have had appropriate education and experience in managing these injuries. This is one reason why it is particularly important that the trauma system ensures that these patients are transported directly to the most appropriate hospital for care.

46% of more seriously injured patients (major data set) arrive at Liverpool Hospital between 4pm and midnight with a further 17-18% arriving from midnight to 8am. This information is vitally important for service planning relating to the staffing and facility resources that need to be available to meet the demand for expert injury care around the clock. These figures support the concept that trauma tends to be an “out of hours” disease with over 60% of more serious injuries arriving outside normal business hours. The most common mechanism of injury, from the major data category, that occurs during business hours is industrial accidents.

Mechanism of Injury at Liverpool Hospital is also reflective of the patterns seen across Australia with falls and road trauma topping the list. In the falls < 5m category there is an alarming increase in annual admission rates over the last five years from some 500 admission per year to over 800 admissions per year. Comparatively road trauma has remained steady ranging from 500 to 600 plus admissions annually.

Of note also is the decreasing number of gunshots due to interpersonal violence, although overall trends for interpersonal violence remain fairly constant. Again, more serious injury as a result of interpersonal violence occurs between 4pm and 8am in approximately 75% of these cases. From an injury prevention perspective the data identifies the age groups for targeting programs on interpersonal violence issues as the 15-44 year olds who account for over 80% of these admissions (the unreported breakdown of males v females in the 15-24 age group reveals a 426 - 36 distribution).

One of the most interesting aspects of this chapter relates to the reporting of substance use by those injured. Inherent in interpreting this type of data is the understanding of its' subjective nature. Given this limitation, within the major data category, the age groups 15-19, 20-29 and 30-39 reported 20%, 30% and 30% substance use respectively. The top 3 mechanisms of injury impacted on by reported substance use were road trauma, interpersonal violence and falls. In actual patients this represents some 1322 admissions over 6 years (approx 220 per year) where the potential for either the injury to not have occurred or to not be as severe could have been influenced by substance use!

Lastly this chapter reviews the transfers into Liverpool Hospital over the 10 year reporting period. For all admissions in the major data category 77% of the transfers in are from the urban hospitals within the area health service. Of these patients not all arrive at the first hospital via the ambulance service, however for those that do (73%), the ongoing review of the original trauma bypass-triage process is appropriate to ensure the trauma system is working effectively to deliver the patient to the most appropriate level of care in the first instance.

In summary this chapter provides an insight into the spectrum of injury managed within one of New South Wales' Major Trauma Services. This data should be utilised to drive trauma system and trauma service improvements and to determine appropriate benchmarks for trauma care both locally and nationally.

Chapter 9: Injury Severity Scores

It is not often that we have an opportunity to review such a detailed breakdown of Injury Severity Scores from an Australian Trauma Registry. This information is useful to map the types of injuries that are being treated at the smaller trauma hospitals in the Area Health Service, who may then require transfer to the Major Trauma Service. The identification of patients with AIS scores of 4-6 in the head, chest and abdominal cavities provides us with triggers for case review and the investigation of the specificity of the triage tool utilised in the pre-hospital environment. This data enables us to match triage tool criteria with the identification of severe injury. It is pleasing to note that the majority of patients being treated at the urban trauma centres have injury severity scores < 16 as this indicates an appropriate use of trauma system resources.

Overall the distribution of minor to severe injury across the hospitals has remained fairly consistent over the reporting period. The trends for serious injury admissions in the ISS ≥ 16 group at Liverpool Hospital have remained consistent over the last 5 years after a gradual increase in the preceding 5 years. This would reflect the increasing local population and the application of the trauma bypass tool.
In reviewing the death rates for the ISS ≥ 16, at 11% to 13% from 2002 to 2004, Liverpool hospital figures are in line with rates published within NSW (15%, 14% and 11% for 02,03,04) [(1)] and the National Trauma Registry Consortium (15% for 2003). [(2)] These rates have significantly improved from the early years of the report (18% – 26%).

Across the urban and rural hospitals examination of the data relating to age groups and severity distribution shows that the 0-14 age group accounts for 19.6% of admissions and the 65+ age group accounts for 27.1% of admissions, however the death rates for both of these are 0.5% and 28.2% respectively. Closer examination of the injury severity in these groups shows similarity in that the majority of injuries are not coded as serious. Older trauma patients are at a higher risk of death even though suffering from relatively minor injuries. This fact has implications for the management of elderly injured patients within both the pre hospital and acute care settings.

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Chapter 3: South Western Sydney Area Health Service Overview

Injury is a major cause of death and disability in Australia, especially in those under 45 years of age. The first ever national burden of disease study undertaken in Australia (1) reported that, in 1996, injury was responsible for 8.4% of the total disease burden as measured by 'disability adjusted life years' (or DALYs, one DALY equates to one lost year of 'healthy' life). Suicide and self-inflicted injuries, and road traffic accidents account for about 53% of all injury DALYs, and with a disproportionate contribution from males.

There is a gender difference with injuries contributing to 11.4% of total DALYS in males (fourth in rank order) and 5.0% of all DALYS in females (sixth in rank order), and with a greater contribution to injury DALYS in the younger age groups in males. Not expectedly, there are also differentials in injury disease burden between the top and bottom quintiles for socio-economic status. (1)

The direct health system cost of injuries is significant. The estimated direct health system costs for Australia in 2000-2001 was $4 billion or 8% of total health expenditure, with about 75% of the expenditure in the hospital and aged care sector . (2) In 1993-1994, accidental falls (31%), adverse effects of medical treatment (15%) and road traffic accidents (14%) were the major contributors to the health system costs. (3)

In New South Wales, there are about 2,400 injury related deaths and 154,000 injury-related hospital admissions each year. (4) Hospitalisation rates for injury and poisoning have increased over the period 1989/90 to 2002/03, with the rates in 2002/03 being 2,284 per 100,000 population. Hospitalisation rate for males was around 1.5 to 2 times the female rate. The most common causes of injury-related hospitalisations for both males and females of all ages were falls (35.4%), motor vehicle crashes (10.8%) and suicides (6.2%).

This report, by the Trauma Department, is a comprehensive description of injury-related hospital admissions in south western Sydney. This chapter gives an overview of injury-related hospital admissions for the ten-year period 1995 to 2004. As for New South Wales, the most common mechanisms of injury are falls and road traffic accidents, with injuries occurring mainly in the home and on the roads. The total number of injury-related hospitalisations has fallen over the last ten years which is good news, but what is of concern is that the proportions of major injuries and severe injuries have both significantly increased over this period of time. Of concern also are the increasing numbers of injury-related hospital admissions in the elderly (75+ years of age). On a positive note, however, the proportion of deaths in the hospitalised patients has remained constant despite the increase in the proportions of injury-related hospitalisations for major trauma and severe injuries over the ten-year period. It is regrettable that we do not have any measures of long-term morbidity in this group of hospitalised patients. However, it is clear from the report that injury-related hospitalisations will continue to be a major contributor to morbidity and mortality in south western Sydney.

Given that injury contributes significantly to the burden of disease in Australia and that there is potential for health gain, it is not surprising that injury prevention and control is a National Health Priority Area. The National Injury Prevention Plans (5,6) take a population approach to injury prevention and have provided clear priority areas for investment in injury prevention.

Falls in older people and road traffic accidents, two of the major contributors to health care costs, are largely preventable. For falls in older people, evidence based interventions include individual risk assessments and targeted interventions (for example, strength and balance programs, use of hip protectors, calcium and vitamin D supplements). (6) Approaches to improving road safety fall into three broad groups: engineering measures (road design and traffic management), vehicle design and equipment (helmets and seat belts), and road user measures (speed limits and restrictions on alcohol drinking and driving). (7)
It is hoped that the implementation of effective evidence-based population-based injury prevention and control programs together with best practice clinical management will lead to better outcomes for both individuals and communities.

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2.4 Clifford W. Pollard BD MB BS (Qld) FRACS FRCS (Edin) FACS

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Chapter 6: Abdominal Injuries

This 10 year report on abdominal injuries is a major contribution to the national trauma database. Over this period, abdominal injury was recorded in 1666 admitted patients, of whom 605 (36.3 %) proceeded to laparotomy. The mean age was 32.5 years, and males comprised 71.3% of the total. While there were peaks for blunt trauma admissions in 1999 and for penetrating injury in 2000 – 2001, the decade has shown a gradual increase in admissions, with male / female ratios relatively constant. The ratio of blunt to penetrating injuries was 81.2% to 18.8 per cent.

For 642 patients (38.5% of the total number of abdominal injuries), the abdomen was the predominant site of injury. For 193 patients (11.6%), the abdominal injury was one of several body sites with significant injuries. The death rate of 7.4 % is better than most published series.

Laparotomy was performed on 605 patients (36.3%). Laparoscopy was performed on 128 patients (7.6%) with progression to laparotomy in 46 patients (36%) and to thoracotomy in two patients. Of this group proceeding to laparotomy from laparoscopy, the non-therapeutic laparotomy rate (NTL) was 17.3% – 21 patients all penetrating trauma. Overall 97 (16%) had a NTL which is a high figure. Many centres would aim for a 2% NTL rate for blunt trauma and under 10% for penetrating trauma. [1,2] Morbidity from NTL for patients with multiple injuries may be as high as 61.3%. [2]

Of the 605 patients proceeding to laparotomy, CT was performed on 197 (32.5%) with 79.7% of these CT scans being interpreted as positive. DPL was performed in 169 cases (28%) with 83.4% positive. Another 279 patients (46%) had neither CT nor DPL, the need for laparotomy determined on clinical grounds. The figure of 79.7% positive CT scans is low. Sensitivity rates between 92 to 97.6% and specificity rates up to 98.7% can be expected. [3] Thirty-two patients (32) had both CT and DPL. Eighteen patients were positive for both modalities, 14 for DPL only, two for CT. Three patients were negative on both tests (two of those laparotomies were non-therapeutic). Of the 14 patients with a positive DPL and a negative CT, 11 laparotomies were therapeutic. This shows the need to continue to use DPL where clinical suspicion exists in the presence of negative CT findings.

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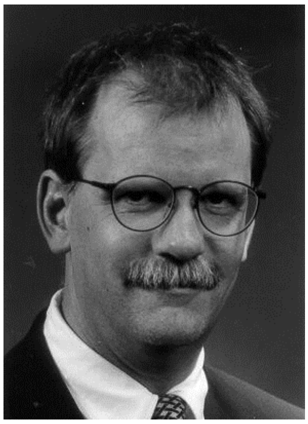
2.5 David B. Hoyt MD FACS



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In 1995 Dr. Hoyt was appointed Professor of Surgery and was awarded The Monroe E. Trout Professorship in Surgery at UCSD (1996). He currently serves as Chief of the Division of Trauma, Burns, and Critical Care. He has served as Chairman of the UCSD Medical Group Board of Governors in the past. He is currently the immediate Past President of the American Association for the Surgery of Trauma, Past President of the Society of General Surgeons of San Diego, Past President of the Shock Society, and Past Chairman of the American College of Surgeons Committee on Trauma.

Chapter 8: Performance Indicators

This is possibly the best data set of process indicators that exists for major trauma patients. The opportunity to use this data to focus quality improvement efforts or determine that program goals have been achieved is compelling. This is the essence of practicing evidence based medicine and the ability to use data to demonstrate effectiveness will be the backbone of multidisciplinary care systems in the future.

Review of the survey data reveals some opportunity to improve scene times in the pre-hospital arena. Pre-hospital intubation, though in concept of value to the head injured patient, is now very controversial and the low rates reported for GCS <9 are probably not of concern.

The resuscitation management indicators reveal consistency in airway management and use of head CT but some opportunity for improvement with overall guideline follow through, and initiation of blood transfusion. This is not unusual in our own hospital and consistent with the overall problem of implementation of any management guidelines.

During definitive care, the data demonstrates several opportunities for focused improvement of timing of care, a low incidence of missed fractures, and good initiation of thrombosis/embolism prophylaxis.

Overall the value of this kind of analysis is that it establishes a proactive positive systematic approach to the maintenance of quality rather than a reactive fault finding approach which has been the tradition in the past. This provides a methodology by which expected or usual frequencies of various complications can give an institution a defined target so that variations over time can be tracked and efforts made using the continuous quality improvement process. The authors are to be congratulated on a wonderful effort to improve quality of care through this data collection process and subsequent analysis.

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2.6 Erica Caldwell BA RN

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Erica is the Trauma Coordinator at Liverpool Hospital in Sydney, Australia. She has been a member of the trauma department since 1995 originally as the Trauma Data Manager for the Regional Trauma Registry. Erica has also authored several previous Trauma Registry reports for the South West Sydney Area Health Service and remains very active in data collection and analysis. Erica is a senior course coordinator for EMST (ATLS) courses and also coordinates the DSTC (Definitive Surgical Trauma Care Course) and has been involved in the development of the associated DPNTC (Definitive Perioperative Nursing Trauma Care Course) which is now held in several countries.
Her nursing background is diverse with experience in the Emergency Departments, Occupational Health, Mental Health Crisis intervention and Nursing Education.

A Regional Trauma Registry Ten Years On

The ways we are organised and trained in the health care system can significantly affect the outcome of people with injury. Achieving the best outcomes for injury victims requires high standards of performance in all phases of care. Excellence and continuing improvements are features of each of these components in SWSAHS. However, it is not always evident or emphasised that even if all of these components are functioning well, good outcomes require a high level of coordination, education, and quality assessment and improvement across the continuum of care. It is in this area where the focus on trauma care in SWSAHS is setting standards that are of national significance.

A formal system of pre-hospital trauma triage was introduced by the Ambulance Service of New South Wales in 1992 providing guidelines and protocols for ambulance officers. Protocol 4 guides transport decisions and allows seriously injured patients to bypass a nearer urban hospital and be delivered directly to the MTS. The registry is useful to measure the ability of the health care system to respond to the needs of the injured patient. There are many elements of care that can be measured and then compared. For example, monitoring the time for an ambulance to reach an injured patient; monitoring the time to stabilise the patient at the scene; and monitoring the time to theatre for patients requiring an urgent operation. These data allow the measurement of care given to patients, to see where improvements can be made and then to measure whether system changes actually helped the patients' recovery.

The Trauma Department at Liverpool Health Service initiated the development of the Regional Trauma Registry in August 1994. While many hospitals maintain an institutional registry, our registry aims to provide a broader view on trauma admissions throughout of all the six hospitals in SWSAHS. This information can be used to identify trends in injuries over a period of time. It is also useful to see the number and type of injuries, to monitor where the patients are admitted and keep track of where they go next, if they are transferred to another hospital in the same area or to a hospital in another health service. Other items of information can be collected about the condition and treatment of the injured patients. The registry now contains information on patients enrolled over a ten year period. Our registry has been instrumental in evaluating key aspects of trauma care in South Western Sydney contributing to alteration in trauma care such as abolition of MAST (military anti-shock trouser device) in penetrating trauma. A Regional Trauma Registry provides a unique insight to trauma care. It is an essential ingredient of a regional approach to trauma management and should be established at a state and national level.

This report bears testimony to a high level of cooperation between individuals and hospitals in SWSAHS. It reflects the value of collaborating with other Major Trauma Services in Australia and internationally. The trauma registry is a useful tool to measure the care we administer and provide benchmarks for improvement. One of the strengths of the registry is that it is adaptable and can be modified to capture data on new diagnostic and treatment modalities as well as clinically important patient cohorts. Examples include the introduction of FAST Ultrasound in 1998 and recombinant Factor VIIa as a treatment adjunct since 2003, which have been tracked in the registry. The process of clinical review often uncovers anecdotally recognised trends that can be monitored and quantified in the registry such as cohort at risk for abdominal compartment syndrome or patients receiving massive blood transfusion. Reports from the Regional Trauma Registry reflect changes in the organisation of injury care, which have occurred over the last 15-20 years and since the introduction of the Metropolitan Trauma Plan of NSW Health in March 1992. These changes include trauma team responses, pre-hospital trauma triage, education programs in trauma care and injury prevention strategies.

2.7 Fiona M. Wood FRACS AM

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Clinical Professor Fiona Wood is currently Director of the Western Australian Burns Service. She is also the Chairman of the McComb Research Foundation established in 1999 with Marie Stoner and a co-founder of Clinical Cell Culture (C3).
Fiona received the 2003 Australian Medical Association 'Contribution to Medicine' Award, and an Order of Australia Medal for work with Bali bombing victims. Fiona was named West Australian of the Year for 2004 and 2005; and Australian of the Year for 2005.

Chapter 6: Burns

Burn trauma is common, fortunately the majority of injuries are minor and appropriately dealt with in the home or general practice surgery. However, if the injury involves certain areas of the body, such as the hands or the face or involves a large surface area then specialist care is needed, as in the case of 1188 patients admitted to the SWSAHS hospital in the 10 year period.

A major burn injury has a considerable physical and psychological impact on the individual. Survival is associated with significant societal burden in relation to consumption of health care costs. An increasingly aggressive approach to the treatment of the burn wound associated with advances in intensive care support has resulted in improved survival rates as demonstrated with 0.6% death despite 7% ISS $\geq$ 16. It is vital to ensure that the quality of the scar outcome is worth the pain of survival. The focus of management needs to be on the outcome incurred in terms of physical function, psychological impact and resulting cosmetic appearance. Therefore the understanding that every intervention from the time of injury impacts on the rest of their life is pivotal. Understanding the patterns of injuries, circumstance and response is essential in progressing prevention strategies. All of the future initiatives need to be based on solid data. Understanding who, where, and when is the key. The SWSAHS hospitals data demonstrates areas of need, i.e. < 4 years old, where prevention and first aid education in preschool and parenting classes can influence the scar worn for life. With the aging demographic are the elderly more at risk? With advancing tissue engineering technologies for around healing, the implementation hinges on health, economics and once again solid data.

The SWSAHS data demonstrates a 56.1% transfer rate, again it is vital to undertake burn care in the most appropriate environment – regarding physical structure and personnel. Bringing together resources, experience with the needs of the patient focused on optimal outcome requires health care facilities of all levels working in collaboration.

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Chapter 10: Outcome Measures

This is an excellent review from a mature trauma system that treats predominantly blunt trauma patients. In almost every year since 1995 the trauma registry of the Sydney South Western Area Health Service shows that it has outperformed the MTOS by achieving survival rates that are higher than expected. An observed-to-expected mortality ration of 0.79 is certainly laudable for the Liverpool Hospital. Similar rates are reported by the other SWSAHS hospitals.

When all "urban and rural" hospitals are included in the statistical analysis, the mortality rate is worse overall but returns to excellent levels after excluding deaths of elderly patients with femur fractures. Presumably many such patients are transferred to these hospitals, contributing to an unavoidably high mortality rate. Alternatively, the care of such patients in certain hospitals could be a focus of closer attention and potential improvement.

Penetrating injuries comprise only 7.5% of the trauma population; gunshot wounds are associated with the highest mortality in the series (16.6%). This is a four-fold increase compared to the average mortality rate (4.8%) but still consistent with most published reports. Due to the low frequency of penetrating trauma, the opportunities for operative intervention among trauma staff surgeons are limited. There should be systems in place to ensure alternative sources of surgical exposure for the SWSAHS trauma surgeons. The emergency non-trauma surgical population is one such source.

The report shows a well-balanced and effective regional trauma system that through its flagship Trauma Centre at the Liverpool Hospital and with significant contributions from the other hospitals offers a major service to the local community.

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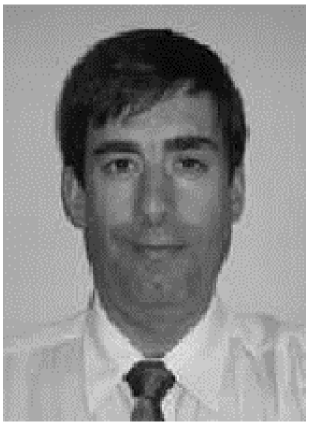

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Grant Christey is a General Surgeon and Trauma Surgeon; born, bred and trained in New Zealand. He is committed to improving all aspects of trauma care with special interest in trauma systems analysis, complex traumatic wound management, mass casualty management and abdominal compartment syndrome. He completed a trauma fellowship in Auckland City Hospital then moved to Liverpool Hospital in Sydney as a General and Trauma Surgeon. He is a DSTC instructor, a member of various Trauma organisations and is currently Director of Trauma and fulltime General Surgeon with an interest in liver surgery at Waikato Hospital in Hamilton, New Zealand.

Chapter 7: Management and Diagnostic Work-up

This extensive report reflects the widespread adoption of FAST (Focussed Assessment with Sonography in Trauma) scanning and to a lesser extent, a steady increase in the use of abdominal CT scanning.

The significant increase in the use of FAST scanning for detection of free intra-abdominal fluid has been mirrored by a decrease in the use of DPL (Diagnostic Peritoneal Lavage). This is not surprising given that FAST is a rapid, accurate and non-invasive test [(1)] that has become accessible to a wide range of trauma clinicians.
The test is most useful in the unstable trauma patient as it gives key information on whether to proceed to immediate operation or not, however the increase in use of the technique by clinicians honing their skills on stable patients may result in a rise in the use of the test without significant influence on subsequent diagnosis or treatment.

The use of DPL in the emergency room is decreasing but it maintains its value if FAST is equivocal or not available, or if exclusion of potentially fatal hollow viscus injuries is required in the Operating Room or Intensive Care Unit.

The efficacy of abdominal CT is well established and likely to improve with advances in scanner technology and accessibility [(2)]. The steady rate of negative CT scans at about 80% does not represent a failure of injury prediction and clinical skill, but rather a consistent approach to exclusion of potentially major occult injuries.

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2.10 Ian Harris MB BS MM(Clin Epid) FRACS (Orth)

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Ian Harris is a locally trained orthopaedic surgeon who specialises in orthopaedic trauma. He has been working at Liverpool Hospital since 1995 and is the Head of the Orthopaedic Department. He is also a Conjoint Senior Lecturer at the University of New South Wales.
Dr Harris is active in clinical research relating to surgical outcomes, both in orthopaedics and trauma.

Chapter 6: Orthopaedic Injuries

The important role of orthopaedics in any trauma service can be seen by the overall statistics which show that over half of all trauma admissions, major and minor, involve orthopaedic injuries, usually fractures. It indicates that strong ties should be maintained between the orthopaedic department and other departments involved in the care of trauma patients, such as the trauma department, neurosurgery and plastic surgery.

There has been a significant increase in the number and proportion of patients admitted to Liverpool who were transferred in from another hospital over the reporting period. For major trauma, the increase was from 35 (9.6%) in 1995 to 146 (26.3%) in 2004, and for minor trauma the figures were 11 (1.6%) and 191 (24.6%) for the same decade. An obvious cause for this trend was the continuing development of Liverpool Hospital as a tertiary referral centre for trauma, including orthopaedic trauma. Along with an increase in expertise, equipment and operating time at Liverpool Hospital, the formal processes for referral to Liverpool were also streamlined. The most significant example of this was the development of guidelines to control the transfer of orthopaedic trauma from Fairfield Hospital to Liverpool Hospital, which was formalised in August 2001, and formed part of a "network" between the two hospitals in which the elective load was transferred from Liverpool Hospital to Fairfield Hospital. This would have accounted for the jump in minor trauma cases transferred in to Liverpool Hospital after 2001.

Similar processes to streamline admission of major trauma patients were undertaken by the trauma department, which would have increased the number of patients with orthopaedic injuries transferred to Liverpool Hospital.

The concentration of trauma at Liverpool Hospital over the ten years covered by this report indicates that apart from the fall in orthopaedic trauma admissions to Fairfield Hospital over the last few years (due to patients being networked to Liverpool Hospital), numbers in the other hospitals remained steady except for Liverpool Hospital, where the number of admissions steadily increased.
The proportion of patients with orthopaedic trauma transferred out of hospital, and their discharge destination simply reflects the role of each hospital, its resources, its geography, and the strength of its associations with the tertiary referral centre (Liverpool Hospital).

In short, this section shows us the increasing role of Liverpool Hospital as a tertiary referral centre for trauma, and orthopaedic trauma in particular. Centralisation of orthopaedic trauma has advantages, but most of the obvious advantages are to the staff and hospitals, as referring hospitals are absolved of the need to supply equipment, staff and theatres to treat these patients, and the receiving hospital can concentrate its services on orthopaedic trauma, without competing with elective orthopaedics in the case of Liverpool Hospital. Cost savings to the area may also be possible by avoiding duplication of services. The benefits to the patients are less clear. Indeed, there are some obvious disadvantages to transferring patients to a tertiary trauma centre for treatment. They will have to travel (or be transported) to the centre, and their transfer may be delayed by having to wait for acceptance of the transfer and availability of a bed. The extra distance that may need to be covered to visit the patient may also inconvenience their family. The theoretical benefit to the patients is that they will be treated in a centre that has staff with greater experience in managing orthopaedic trauma, and one that has the resources to do so. Whether or not this system will provide tangible benefits to orthopaedic trauma patients remains to be seen, and future research into outcomes in these patients is necessary to answer this question.

Chapter 8: Long bone fracture fixed or reduced ≤ 24 hours

For this performance indicator, a clear trend can be seen over the ten-year period, with the benchmark being met in 92.0% of cases in 1995, decreasing to 66.8% in 2004. The possible reasons for this fall will be discussed, along with the evidence regarding whether the fall should be considered favourable or unfavourable.

The period covered in this summary coincides with two important changes: local changes in theatre availability and scheduling for orthopaedic trauma, and general changes in orthopaedic practice regarding the timing of long bone fixation. In 1995, there were no dedicated orthopaedic trauma theatres at Liverpool Hospital, which meant that orthopaedic trauma cases competed with other, higher priority, emergency cases on a single emergency operating list. This resulted in orthopaedic cases being booked as soon as they arrived, often undergoing surgery after-hours as a result of difficulties accessing theatre in normal hours. With the gradual introduction of orthopaedic trauma lists over the last decade, after-hours operating for orthopaedic trauma declined, as cases began being scheduled for routine trauma lists during normal hours. While this often meant a delay to surgery, it carried advantages, as the change to in-hours operating for orthopaedic trauma is associated with increased availability of experienced support staff (including medical, nursing, sterilising and radiology staff) and reflected changes in orthopaedic trauma practice elsewhere. [(1)]

The other change which may have influenced the delay seen in the timing of fixation of long bone fractures may be the gradual introduction of “damage control orthopaedics”, in contrast to the previous doctrine of “early total care”. Damage control orthopaedics involves minimising the effect of a surgical “second-hit” to the patient when they are acutely unstable. Consequently, definitive fixation of long bones may be delayed for over 24 hours until the patient’s condition has stabilised. In the literature, studies from the 1980’s recommended early fixation of long bone fractures, but more recent literature is less clear on this matter, indicating that we should be tailoring our treatment to the patient, not the fracture. [(2)]

It may be that the decline in early fixation for long bone fractures reflects changes in orthopaedic practice, but whether any such change has resulted in a benefit to the patients requires evidence that matches this change with validated, patient-based outcomes.

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Chapter 8: Open long bone fracture fixation ≤ 6 hours

Although there was little change in the figures for this benchmark over time, the most notable finding was that only 62.4% of open long bone fractures received definitive treatment within 6 hours. The indicator measures “fracture fixation” rather than “surgical debridement”, but it can

probably be assumed that the two coincided for the vast majority of cases. We must explore the factors that may explain this figure, and whether this indicator reflects patient outcomes, as is its intention.
Firstly, many of the open fractures in this group may have been minor, or Grade I according to Gustilo and Anderson. [1] Grade I open fractures do not require urgent treatment, as the outcome for these fractures is similar to that for closed fractures. Indeed, it is really only the Grade III open fractures that are associated with a high complication rate.

However, does the complication rate for high grade open fractures reflect the timing to theatre? Or is it influenced by other factors such as the extent of soft tissue injury? Whereas the evidence up to 1995 indicated a higher infection rate in fractures treated after 6 hours [2,3], studies performed within the last 10 years have shown that the complication rate (in particular the infection rate) after open fractures is not related to timing to theatre. [4,5]

At this institution, we have analysed the complication rate after open tibia fractures [6] and found that the major complications occurred almost universally in high grade injuries (comminuted fractures, high energy injuries and high grade open fractures), and that there was a dose-response relationship for these variables. There was no correlation between complications and delay to theatre in these cases, as all infections except one occurred in patients undergoing surgery within 6 hours.

These findings regarding this indicator go with the findings from the previous indicator regarding time to theatre for long bone fractures. As there is a shift towards operating on orthopaedic trauma in-hours, this shift is carrying with it open fractures. It may be that it is better to operate on an open tibia fracture that arrives at midnight by delaying surgery to 8am, when the surgical environment (pertaining to surgical experience, assistance, nursing experience, and availability of equipment and imaging) is optimised. Only further research in this area will answer this question for us.

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2.11 John A Crozier AM CSM FRACS DDU(Vasc)

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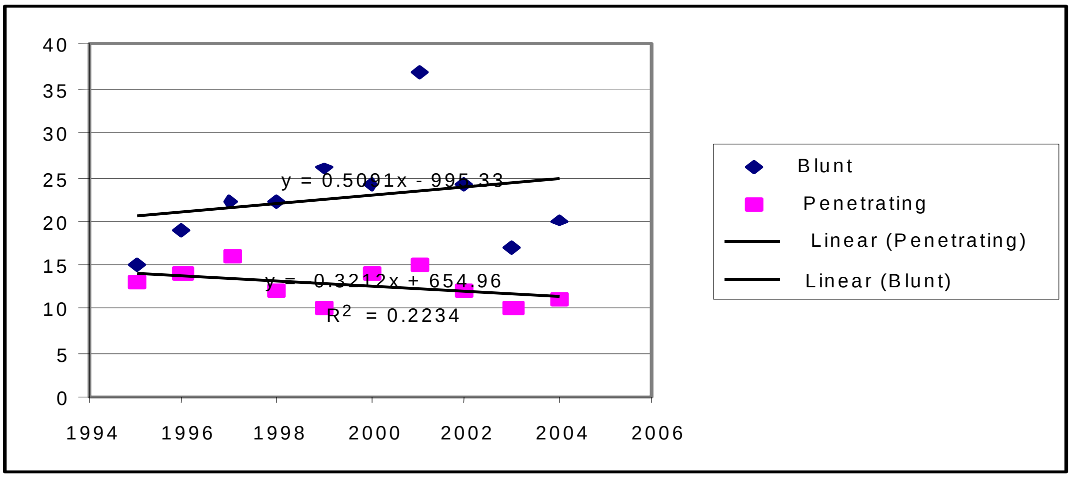
John Crozier is a Vascular Surgeon who has been on staff in Liverpool Hospital from 1996. He is an Executive on the National Trauma Committee of the Royal Australasian College of Surgeons. He directs Early Management of Severe Trauma Courses and regularly participates as a faculty member on Definitive Management of Severe Trauma Courses.
He is a Councillor for the Australasian Society of Ultrasound in Medicine.
He is a Colonel in the Royal Australian Army Medical Corps and has deployed operationally to Rwanda, Bougainville, East Timor, Papua New Guinea and Banda Aceh, Indonesia. He has helped in the development of a Military Module of the Definitive Management of Severe Trauma Course.

The incidence of trauma related vascular injuries has remained stable during the ten year period of the report with an average of 35.3 vascular injuries coded per year. Vessel injuries were disproportionately more likely to be present in injured males (86%) than injured females (14%). Blunt injury (62%) predominated over penetrating trauma (38%) as a mechanism for vessel injury. There appears to have been a slight down trend in the ratio of vascular injuries due to penetrating versus blunt injury over the decade.



Stabbings were 3.6 times more frequently the cause of vessel injury than gunshot wounds. However, GSW associated with vessel injuries were more likely to be fatal (8/23 35%) than stabbings associated with vessel injury (8/83 10%).

Vessel injury involved the extremities in 44%, the torso in 43% and the head and neck in 13% of the cohort recorded in the ten year period.

There have been changed trends in the treatment of vascular injuries due to trauma over the decade of the report. Stented endograft treatment of blunt traumatic aortic injury has been performed in the last nine patients with this injury in the series from 2002. A trend toward endovascular techniques to treat a variety of the other vessel injuries is also noted.

2.12 John Fildes MD FACS FCCM

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Chair, National Trauma Data Bank
Chair, American College of Surgeons Committee on Trauma

Dr. John Fildes is Professor of Surgery and Chief of the Division of Trauma and Critical Care at the University of Nevada School of Medicine. He is also busy acting as chair of University Medical Centre's Department of Trauma, one of the nation's busiest trauma centres and the only free-standing trauma centre in the western United States.

Dr. Fildes has been involved with the American College of Surgeons' National Trauma Data Bank (NTDB®) for over a decade. Dr. Fildes was appointed Chair of the American College of Surgeons Committee on Trauma in 2006.

General Comment

This report of the south western Sydney Regional Trauma Registry provides a review of data spanning ten years from 1995 to 2004. More than 45,000 injury cases are included in this analysis. Patients were included in the registry if they were admitted to one of the six hospitals in the region following acute injury. Patients with injuries that presented to the emergency department but were not admitted were excluded. The patients in the registry were then categorised as having sustained major or minor injuries based on their mechanism and injury severity scores. This report provides a detailed analysis of injury epidemiology, pre-hospital care, hospital based management, performance indicators and outcomes measures. In addition it brings the strength of trend analysis to the report.

It has often been said that data is of little value until it is turned into useful information. The authors are to be commended for their extensive and detailed report. It will provide a framework for informed decision making by the medical community, the public and policy makers. Ultimately, the information in the south western Sydney Regional Trauma Registry 10 Year Report will lead to further reduction in the mortality and morbidity of injured patients. This comprehensive process of data collection and analysis is the result of the cooperation, coordination and hard work of all health care providers in the region.

Congratulations to the editors and contributors for their vision, leadership and commitment to the care of injured patients.

2.13 Peter Cameron MBBS MD FACEM

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Head Victorian State Trauma Registry

Professor Peter Cameron is head of the Prehospital, Emergency and Trauma group within the Department. He is also Academic Director of the Emergency and Trauma Centre, The Alfred Hospital, Head of the Victorian State Trauma Registry and Associate Director of the National Trauma Research Institute. His main research interests include trauma epidemiology, injury prevention and management, prehospital care and health services and systems research. He is a past president of the Australasian College of Emergency Medicine (ACEM), co-editor of the Adult Textbook of Emergency Medicine and a senior examiner for ACEM.

Injury Prevention

Injury continues to be the single largest cause of lost years of life in Australia. Importantly it causes severe morbidity in young people that may continue for the rest of their life. This report by the SWSAHS is significant in demonstrating the enormous burden that injury places on the region served by the hospitals reporting to the registry. Over a ten year period, more than 45,000 patients were admitted and 30% of these were major trauma. The mortality was relatively low for those admitted to hospital, however the majority of trauma deaths now occur before patients reach hospital. Even the best trauma management in hospital won't prevent these deaths. Injury prevention strategies will help and potentially improvements in the organisation and coordination of pre-hospital care may help. Improvements in trauma management have led to a decrease in hospital mortality. There are still improvements in trauma management to be made however these improvements are most likely to result in improvements in long term morbidity and not significant improvements in hospital mortality. Unfortunately our present data collection processes do not allow us to measure and report this accurately. The Victorian State Trauma registry has now started reporting morbidity of survivors on a routine basis. This approach is feasible and will allow comparisons between regions. The success rate of major trauma victims in returning to work and normal life with expert hospital care and intensive rehabilitation is the most important measure of the trauma system for more than 90% of trauma victims.

Despite the high profile media reports of inner urban conflict in the area served by the SWSAHS, the pattern of injury in this region reflects that of Australia as a whole. There was only a small percentage of patients suffering from assault and penetrating injuries. It is important to note that this is decreasing. This suggests that prevention strategies, including gun control and better policing methods are working. The media enjoys commentary on interpersonal violence but the two largest killers in Australia are motor vehicle collisions and falls in the elderly. We have been particularly successful in Australia in reducing injury secondary to motor vehicles, despite the high usage of motor vehicle transport.

In stark contrast to countries with less well-developed injury prevention programs, such as Argentina, our injury and mortality rates have reduced to a third of their peak in the early seventies. The success in road injury has been mirrored in work place injury, schools and other organised activities. There is still a large burden of injury in the home, where regulation is less effective. A different approach is required in this environment to encourage a "culture of safety" in high risk activities such as home improvements. The overall decrease in injuries across Australia would suggest that present injury prevention strategies have been effective however trauma registries are essential in monitoring effectiveness over time.

Elderly patients frequently present following falls and there is a high mortality associated with these admissions. There is increasing evidence that much of the morbidity and mortality associated with falls is preventable through falls prevention programs. There is also evidence that targeted management of the elderly patients following admission to hospital results in better outcomes. Improved liaison with medical units and enhanced allied health support are essential. This represents a challenge for trauma services to coordinate.

Alcohol and drug usage was reported in 16% of patients in this report. This may be under reported as 52% of patients had undetermined results. From the Victorian experience, it is likely that usage is possibly higher than this. The effects of alcohol and other drugs have been widely reported, not only decreasing coordination and risk of injury but increasing disinhibition and likelihood of performing high risk activities.

Random drug testing is now being trialled in Victoria and the preliminary results would suggest that this will be a further advance in injury prevention.
It is essential that every region monitors injury rates, management and outcomes, to assess whether injury prevention and injury management interventions are improving mortality and morbidity rates. The SWSAHS is to be commended on maintaining a comprehensive registry over the last decade.

2.14 Rao R. Ivatury MD FACS

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Dr. Ivatury is a surgeon and intensivist for more than two decades with an active interest in student and resident teaching and research. He is a member and leader in all the major surgical organizations of North America and has received honorary membership in many other South American Countries.
Most importantly, he loves to take care of patients in the operating room and the Intensive Care Unit.

Chapter 8: Penetrating Injuries

Michael Sugrue, Erica Caldwell and colleagues continue to define trauma care in Australia in their tradition of accomplishing several "firsts" : the first centre to undergo successful verification by the Royal Australasian College of Surgeons, the first to establish a comprehensive regional Trauma Registry, the first to promulgate trauma education through the SWAN trauma conference and so on. [(1)] This ten year registry report of more than 45000 patients is their latest labor of love and is a phenomenal accomplishment.

Looking at penetrating trauma in the region, it contributed only 7.9% of patients with major injuries. As might be expected, it affected mostly young males. Wounds caused from interpersonal violence and stabbings constituted the majority. Contrary to an earlier report from the same registry [(2)], the incidence of these injuries remained constant throughout the study period. The registry documented evidence of modern management of these wounds (for example, selective operations, use of laparoscopy to reduce non-therapeutic laparotomy, emergency department thoracotomy for resuscitation of moribund victims) and as a result, a remarkable survival of 94% of these patients.

As is the case in North America, the registry noted only a small number of operative procedures in these patients: 199 patients having laparotomy and 55 patients having a thoracotomy. Considering that a bulk of operative experience comes from penetrating trauma now, these 25 cases per year are a meager operative load for a trauma service to maintain operative skills. The Definitive Surgical Trauma Course (DSTC) provided by the Liverpool Hospital team is a great resource, therefore, for operative techniques.
Unlike in North America where there were 4.08 deaths from gun-related violence for 100,000 population (2002 figures), the Australian statistics show this number to be approximately 0.25. In 2003 the Australian Bureau of Statistics revealed that the total number of gun-related deaths in Australia for year 2003 was 290, markedly reduced from the approximate number of 700 in the 1970's and 1980's. [(3)]
The Liverpool registry documented a prevalence of 21% (156) among a total of 722 penetrating trauma victims. These figures are consistent with national statistics. This is welcome progress in prevention and whatever the cause may be (gun control or self control) will, hopefully, continue the downward trend.

Trauma care in Australia has made advances by leaps and bounds due to the strong commitment of the Royal Australasian College of Surgeons and its Trauma Committee. Trauma center verification and regionalization of care are being developed and will, undoubtedly, lead to further improvements. Registries such as this one will be an integral component for monitoring trauma as a devastating problem. They are crucial for minimizing the tragic sequelae of trauma by providing timely and superior care, spurred by constant and honest self-appraisal of performance. Efforts such as that of the Liverpool team should serve as an inspiration to us all.

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2.15 Rod McClure MBBS BA PhD FAFPHM

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Dr McClure has medical qualifications, extensive clinical experience in emergency medicine, a PhD in injury epidemiology and specialist training in public health medicine. Over the past 10 years, Rod McClure has established (as Foundation Director) the Queensland Trauma Registry and (as Foundation Acting Director and subsequently Deputy Director) the Centre of National Research on Disability and Rehabilitation Medicine. In 2002 he left both these positions to become CEO and Research Director of Injury Prevention and Control (Australia) Ltd and from January 2005, Professor of Community Care and Epidemiology with Griffith University.

Outcome Measures

A description of the epidemiology of the injury outcomes within a defined population is an essential measure of the burden of injury experienced within that community. Reporting of outcomes data is also a critical aspect of the evaluation of trauma systems established to ensure optimal care of those people within the population who sustain serious injuries. Evaluation of the effectiveness of a trauma system ultimately focuses on the question – “Are patients being managed within this particular trauma system achieving the best possible health outcomes?” As it is probably not possible to compare patient outcomes against the hypothetical best possible, it is usual practice to benchmark outcomes against what has been achieved by trauma services in similar communities. Trauma registries provide the data to enable such evaluations. Trauma registries are thus critical components of quality assurance and performance improvement programs for trauma systems throughout Australia.

Trauma systems have traditionally focused on minimising the number of preventable deaths occurring within the injured population served by the system. Tools have been developed to support benchmarking of trauma systems against others in terms of this indicator. While it has been observed that death is a non-sensitive outcome to use as a measure of trauma system activity, and is relevant only in a small percent of cases managed within a trauma system, there have to date been no valid and reliable models for evaluating trauma systems in terms of non-fatal outcomes. [(1-3)]

The South Western Sydney Area Health Service (SWSAHS) is to be commended in its ongoing documentation of data in the registry relating to injury outcomes. The information reported in this chapter is the most comprehensive outcome data series for a system-based registry in Australia, covering as it does, all the hospitals within a defined population, for a full 10 year period. The outcome data obtained was obtained and analysed using standard audit tools which have been previously validated and extensively used throughout the world. While the described outcomes are restricted to deaths, and are therefore somewhat limited in scope, the restriction to deaths outcomes has been the accepted norm for evaluations of this kind. An examination of the results presented in this chapter provides an unparalleled opportunity to illustrate the process of benchmarking trauma care. The results also make a major contribution to our understanding of injury outcomes in contemporary Australia.

Consistent with evidence in the literature there was a bimodal distribution of deaths by time in days following admission, with a peak at day one and another between days 7-14. Risk of death increased with increasing ISS. The distribution of deaths by age was consistent with previously published population data, with an over representation of people between the ages of 16 to 24 and greater than 75 years. Mean length of stay increased with increasing ISS.

Analysis of outcomes using the TRISS methodology indicates that the SWSAHS trauma system performed significantly better than the systems used to develop the TRISS benchmarks. The data suggests improvement in the trauma system performance was achieved over the ten year reporting period. While numbers within several categories were insufficient to support sound comparisons, it would appear that results against benchmarks achieved for older people and patients with penetrating injuries were less satisfactory than for younger people and those with blunt injuries.

There are a number of conclusions which can be drawn from the findings presented in this chapter. First and foremost the chapter provides an excellent illustration of the potential of trauma registries to support trauma system performance and quality assurance. While the selected analyses presented in the chapter are only a few of what could be undertaken, they are appropriate, informative, and provide clear indication of the nature and extent of the information that can be obtained from the trauma registry data. A particular strength of this report is its whole-of-system rather than hospital based capacity.

The chapter also draws conscious attention to the methodological tools used in the performance evaluation process and demonstrates the need to refine these tools within the Australian context. This chapter also highlights the importance of further developing outcome indicators which capture essential goals of the care of non-fatal injury. [2] There is an acknowledged need for valid and reliable measures, suitable for use at the population level, which categorise injury on the basis of threat-to-disability rather than threat-to-life. While these tools are not yet available, their development and inclusions in data sets such as this, would enrich the capacity of trauma systems to self-monitor their performance and increase the quality of care provided to injury patients. [3]

Finally, the authors of this report should be congratulated for producing such a comprehensive and transparent document and making this available for public scrutiny. Clearly the results achieved by the SWSAHS are excellent, however it takes considerable leadership and some courage to place this kind of information in the public domain for informed discussion. This report represents a tremendous step forward for trauma care in Australia and I would hope the example is followed by trauma systems throughout the country in efforts to achieve the common goal of improved systems across Australia.

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2.16 Russell Stitz RFD MB BS FRACS FRCS ASDA

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Russell Stitz is a Senior Surgeon in the Colorectal Unit at the Royal Brisbane Hospital. He is an Honorary Member of the American Society of Colon and Rectal Surgeons and the Association of Coloproctology of Great Britain and Ireland. He has been a pioneer in the development of laparoscopic colorectal surgery. He has been on the Council of the Royal Australasian College of Surgeons since 1998, and in May 2005 assumed the role of President of the College.

General Comment

This comprehensive study over a ten year period (1995–2004) of a large health district in NSW is a major contribution to the study of trauma in Australia and the authors should be commended for this large body of work. During this time 45,278 patients were admitted as a direct result of injury and 30.1% were classified in the major data category. The aim has been to use the data to map out the future for trauma care in Australia and re-emphasises the need for on-going funding, particularly by Government, for an Australian Trauma Registry. In his editorial for this report, Associate Professor Bin Jalaludin refers to the national impact of trauma in Australia with particular reference to the cost to the health system. There is also a significant human cost which underpins the data in this study. Detailed data collection is matched with performance indicators to measure outcomes which will facilitate the development of trauma care strategies in SWSAHS and elsewhere in the country.

The extensive demographic data in the SWSAHS Overview chapter outlines trends over the decade with road trauma and falls dominating the major data category. The survival outcome in patients with an Injury Severity Score equal to or greater than 16 has progressively improved over the decade sitting at 87-88% over the last three years of the study.

Performance indicators are summarised and the indicators defined. The study provides detailed data regarding outcomes related to the performance indicators in the pre-hospital phase, the resuscitating management phase and the definitive care phase. The performance indicators judged to be suitable at the beginning of the study have been consistently used throughout the period.

Although limited to the major data category, they provide useful information to inform trauma care in SWSAHS and elsewhere in Australia. This aspect of the study identifies areas where performance can be improved, eg. clinical pathways were instituted in 2000 for severe head injury, fractured ribs, blunt abdominal trauma, fractured shaft of the femur and fractured pelvis and over the ensuing four year period, observance of the appropriate clinical pathway dropped from 81.8% to 78.6%. Analysis of the results of these performance indicators will improve trauma services and will provide a focus for educational initiatives.

The 'Complications' chapter not only provides a detailed account of the complication rates but focuses particularly on age specific rates and the relationship between complication type and survival outcome.
It is difficult to explain why the complication rate has varied over the period particularly as there has been considerable fluctuation. However, the general trend appears to be downwards. What is clear is that complication rates increase with increasing age as does the number of complications per patient. These figures are related to survival outcome in the major data category where the mortality rate in the 0 – 14 year age group is 13.3% rising to 46.9% in patients aged 85 years or older.

In summary, this comprehensive collection of trauma data over a ten year period supports the view that detailed audit in the form of a trauma registry can lead to strategies which can improve the care of injuries in Australia. On behalf of the Royal Australasian College of Surgeons, I congratulate Michael Sugrue and his team for this significant contribution to the trauma literature.

2.17 Scott K. D'Amours MDCM FRCS(C) FRACS

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Scott D'Amours is a trauma and general surgeon trained in both Canada and Australia. He is an enthusiastic trauma educator and has been active in developing the Definitive Trauma Surgical Care (DSTC) course. He is an active member of the RACS Trauma Committee and many of its subcommittees including Trauma Verification.
Dr. D'Amours also has interests in pre-hospital trauma care, critical care, trauma education and trauma systems development.

Chapter 7: Management and Diagnostic Work-up

I am very pleased to see publication of the most comprehensive regional registry report ever seen in Australasia. This attests to the tremendous vision and dedication of the staff of the Department of Trauma Services at Liverpool Hospital more than 10 years ago, and especially its Director A/Professor Michael Sugrue.

This chapter of the registry report on "Management and Diagnostic Work-up" is fascinating and revealing as to the patterns of injury but also the evolution in management strategies for the seriously injured patient over the time frame of the report. In 1995, the roles and capabilities of both diagnostic and therapeutic imaging were quite different than they are currently and that is reflected not only in the care patients received and the data presented in this chapter but also in the changes the registry has undergone to remain contemporary. The following comments highlight some of the important or interesting findings of the 10-year report.

It is interesting to note from the data that there is a small but significant 'miss rate' of between 7.0 and 7.5% for patients that met trauma team activation (TTA) criteria but did not have a trauma team response. It would be interesting to know on which criteria trauma team activation would have otherwise occurred. Is there a consistent or identifiable group of patients that is being missed and do the criteria for TTA need to be re-assessed or clarified to avoid potential delays in care?

It is well recognised that increasing patient age is correlated with increasing morbidity and mortality when similar injuries are compared across injured populations. For that reason it is even more important to recognise the older injured patient as a group that is particularly 'at-risk' for poor outcomes. The report reveals slightly concerning information that this high-risk patient group is missing a TTA (11% missed TTA age > 65 years compared with only 6.4% missed TTA age < 65 years) when presenting with criteria that would normally mandate TTA. This could have a significant and negative effect on outcomes and complications in a group of patients that is least able to tolerate it. This is something that deserves closer examination as to potential causes and trends over the timeframe of this reporting period.

This chapter of the report is very relevant for those responsible for any regional system of trauma care. It very ably demonstrates that while the designated Level 1 major trauma service does the vast majority of interventions in the resuscitation room, there are still a number of these same procedures being performed in the smaller, less-resourced hospitals. This has implications for a great many issues including education and training, maintenance of skills, equipment requirements and level of comfort in managing complex decision-making in trauma - especially for those working in centres where these sorts of patients are not seen frequently.

It is unclear from the data on patients receiving CPR in the resuscitation room as to how many of these patients were actually dead on arrival versus those who had a non-agonal rhythm. It is interesting is that 10/80 patients with a blunt mechanism of injury received CPR and survived versus only 1/32 patients with a penetrating mechanism of injury. This raises far more questions than it answers, as one would expect, in general, worse outcomes for blunt cardiac arrests than for penetrating ones.

It appears from the data that more than 1/3 of injured patients in the emergency department did not receive supplemental oxygen in the ED, a number that seems to be somewhat higher than would be expected. While the majority of patients would not and did not require advanced airway skills, most injured patients would arguably gain some benefit from supplemental oxygen.

While there is an increasing number of CT scans of the head being done year by year, this is likely reflective of both easy availability as well as changing indications. However, on average more than 20% of patients with a GCS<8 are not having a CT scan of the head and this is potentially concerning. It may be that the CT scan does not occur during the resuscitative phase of care and is still being done, but earlier imaging allows earlier recognition of serious injury and also avoids unnecessary delays that may otherwise result.

Again the effect of improving technology and changing indications and patterns of investigation and management is seen with the number of aortograms done over the timeframe of the report remarkably stable, but a clear change in the utilisation of CT scanning of the thorax. The data does not seem to differentiate between CT angiography of the thorax and non-contrast CT but clearly there is a dramatic increase in the utilisation of the available technology. It will be interesting to continue to observe these trends over the coming years to see if there is ultimately a decrease in the overall number of invasive aortograms being done as the quality of CT aortography continues to improve.

The data indicates a clear trend toward increasing the percentage of patients with major injury that have a FAST exam as part of their initial assessment, this number is still less than 1/3 of patients presenting with major injury. Clearly many of these patients may be at very low risk for abdominal injury and FAST does have limitations in terms of sensitivity. It also brings forth questions that are clearly beyond the scope of a registry, such as: Are there enough clinicians skilled at undertaking and reporting on FAST examinations? Are there clear clinical guidelines as to which patients should have a FAST?

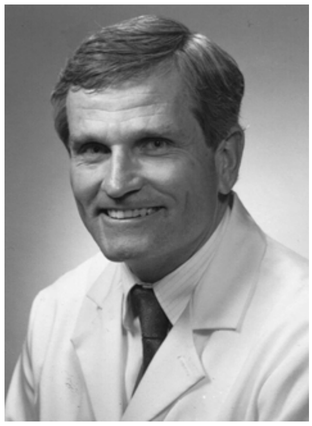
Equally interesting is the clear increase in the utilisation of CT scanning in the evaluation of the abdomen and while that, in itself, is not all that surprising or interesting, it also shows that only about 20% of the scans done show some kind of abnormality. Unquestionably CT scanning has revolutionised investigation and assisted in management decision-making with major trauma patients. Additionally, CT of the abdomen is also being used more liberally as a screening tool for abdominal injury now than it was a decade ago. It is important for planners to note that as the numbers of patients managed continues to increase with regionalised systems of care, easy and reliable access to CT scanning from the resuscitation room must be available. In many situations, dedicated scanners incorporated into or immediately adjacent to the resuscitation room are the most practical and, for the patient, also the safest.

Non-therapeutic laparotomy is a specific interest of mine and although it is also covered in the “Types of Injury” chapter, the investigation of this particular group of patients is described in this chapter. There are a couple of very interesting points to make on the data presented. In patients who had a therapeutic laparotomy (total 508), there were still 29/173 patients that had a negative CT scan. While the performance and technical aspects of CT scanning continue to improve, that data translates to a sensitivity of only 83%. In the data highlighting investigations in the group of 97 patients who underwent a non-therapeutic laparotomy, I find it most interesting that 60/97 did not have a DPL or a CT scan prior to their laparotomy.

Not surprisingly it is impossible for a registry to capture the subtleties of clinical management and the complexities of decision-making in a critically unwell and multiply injured patient. However, the patient having a non-therapeutic laparotomy does not benefit from the procedure and although the information gained can be a ‘pertinent negative’, it makes sense to avoid one if at all possible. Perhaps the increased utilisation of CT scanning (when possible) or DPL in this patient group could have lowered the non-therapeutic laparotomy rate. While the overall non-therapeutic laparotomy rate in this report is quite comparable to that seen in the literature at 16%, this could perhaps still be improved upon.

Clearly a great deal of effort has gone into both producing this 10-year report and into the years of painstaking data collection. The trauma registry Data Manager and Data Collectors are to be congratulated on the resulting report. Like all good registry reports, the data is invaluable for both assessing past delivery of care and for planning the future delivery of care. At the same time, the data produced results in as many questions as it answers. Quite simply it is this type of information that provides the inspiration that drives us to ask the question "why?" When we see information, data or trends (whether good or bad) we want to know why and we also want to improve or fix the identified problems. It is this data and these questions which form the fundamental basis of the scientific process that we hope will assist us in ultimately improving delivery of trauma patient care.

2.18 Steven R. Shackford MD FACS



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Dr. Steven Shackford is Professor and Chairman of the Department of Surgery in the College of Medicine at the University of Vermont. He has authored or co-authored over 280 scientific papers, 28 book chapters and 3 monographs, mostly relating to secondary brain injury and the effect of hemorrhagic shock on the injured brain. He is on the editorial board of several journals. In addition to his interest in trauma he is an active vascular surgeon. Working with a number of other surgeons, Dr. Shackford helped to develop the ultrasound educational program for the American College of Surgeons. He was Chair of the National Ultrasound Faculty of the American College of Surgeons. He was President of the American Association for the Surgery of Trauma 2004 – 2005.

Any editorial comment on the South Western Sydney Regional Trauma Registry 10 Year Report would be incomplete without noting the prodigious amount of work that was required to compile, edit and analyse the accumulated data. The Editorial Committee and its Director (Dr. Michael Sugrue) and its Data Manager (Ms. Katherine Brown) are to be commended.

General Comment

The concept of quality cannot be explicitly defined because quality, like taste and beauty, is a tertiary attribute that is completely dependent upon perspective. Defining the concept of quality as it relates to health care is even more complex. From the perspective of a trauma surgeon quality trauma care may mean survival of the trauma patient or discharge from the acute trauma hospital without any provider related complications (Hoyt *et al.,* 1992). [(1)] On the other hand, from the perspective of the Chief Financial Officer of the hospital, quality trauma care may mean a trauma patient hospitalisation in which the payment for the hospitalisation exceeded the cost. Finally, from the patient's perspective quality trauma care means discharge from rehabilitation with no decrement in health status or functionality.

Recognizing the complexity of defining the quality of health care, policy analysts view quality of health care as being effective (good outcome) and efficient (good process with a "reasonable" use of resources). From this the analysts derive the "value equation", in which value is equal to the quality of the outcome plus the quality of the process divided by the cost of care. In assessing the quality of care, placing resource utilisation into the value equation is important because health care resources are limited and restraint is necessary so that we continually evaluate not only the care we provide but also the methodology we utilise to evaluate it.

Performance indicators are known as process measures because, as the Editorial Committee points out, they can be used to evaluate the process of care. Process measures have their greatest importance, however, as surrogates for outcome measures, provided that there is an evidence base that links the process to the desired outcome. (Birkmeyer *et al.,* 2006). [(2)] For example, use of venous thromboembolism prophylaxis (process) is associated with a significant reduction in thromboembolic events (outcome) (Geerts *et al.,*1996). [(3)] Performance indicators are useful as surrogates for outcome measures when there are no confounding variables that might affect the relationship between the performance indicator and the outcome. For example, scene time of less than 20 minutes is often cited as a process measure of efficient pre-hospital care, but it is affected by numerous confounders such as whether or not extrication is needed, location of the victims relative to the transporting vehicle, weather and terrain, number of victims, etc. Finally, performance indicators are useful as surrogates for outcome when the outcome variable is too costly to measure or is affected by known and unknown confounders that prohibit risk adjustment.
Using the example of venous thromboembolism prophylaxis, it would be more costly to repeatedly assess patients for the presence of deep venous thrombosis following trauma than to assess whether or not they received anticoagulation or compression hose. Outcome in the US

Medicare population is affected by numerous confounders, such as co-morbidities, functional status, and medications, making risk adjustment difficult and comparison between providers impossible. For this reason, process measures are used (Zhan and Miller, 2003). [(4)] For the most part, these confounders do not exist in the trauma patient population, which tends to be young, physiologically homogenous, and without co-morbidities. Thus, they are more suitable for risk adjustment and for evaluation of performance.

Chapter 8: Performance Indicators

As stated at the outset, the Editorial Committee has arrayed in this chapter of performance indicators a sizeable amount of data. Their aim is to improve the quality of their processes and the quality of their outcomes. However, gathering of data can be costly (Shackford *et al.,* 1987). [(5)] If possible, all process indicators should be validated by examining their effect on outcome and by knowing the cost of obtaining the data. If gathering of data regarding a specific indicator is costly, but appears by validation to be strongly linked to outcome, the process indicator should be retained and data collected at regular intervals. If, on the other hand, the link between process and outcome is less clear, perhaps the indicator should be eliminated or the data captured less frequently.

Regarding the pre-hospital process indicators (bypass, intubation for traumatic coma, scene time, and initiation and infusion of fluid), compliance rates are variable. The “undertriage” rate appears to be very good with only 5% of patients presumed to have major trauma being transported to the closest facility. These data are certainly useful, but it would be informative to know the “overtriage” rate; that is, what percent of patients triaged to the trauma centre had insignificant injuries and could have been adequately managed at the closer hospital? Knowing **both** undertriage and overtriage rates allows modulation of the triage criteria. I recommend that scene time and initiation and infusion of fluid be eliminated as performance indicators. Scene time, as mentioned previously has too many confounders to provide useful information about performance. Pre-hospital airway control for traumatic coma would seem intuitively to be associated with a better outcome, but recent data has brought this into question (Davis *et al.*, 2005). [(6)] I would recommend a focused audit of this parameter in the South West Area trauma system, which may demonstrate different results. Pre-hospital fluid initiation and infusion is ineffective in raising blood pressure or in improving outcome, particularly with short transport times (Kaweski *et al.*, 1990). [(7)] Therefore, I recommend eliminating the monitoring of this performance indicator.

Regarding the resuscitative and management indicators, I would eliminate routine monitoring of the MRT turn-around time and duration of time spent at a referring hospital. Because, as mentioned previously, there are many confounders that will affect this interval of time, these indicators have little valid association with outcome. They may, however, be useful to compare performance year-to-year or among transport teams. As such, they could be monitored periodically. Pathway compliance monitoring is important, particularly when a trauma service may be covered by general surgeons without fellowship training in trauma and critical care. Blood products administered **promptly** when greater than 2 litres of resuscitation fluids have been given may have relevance in the patient who is haemodynamically unstable, but this indicator is confusing—what does “promptly” mean? The recent retrospective data suggesting that blood transfusions may increase mortality in trauma patients and the recommendation to decrease the transfusion trigger to a haemoglobin of 7 (Hebert *et al.,* 1999) [(8)] should provide strong consideration to amend this indicator and, perhaps, to monitor it less frequently. Exploring penetrating trauma within 1 hour of arrival appears to have poor compliance—there could be a number of reasons for this lack of compliance and I would recommend determining why only 57% are able to do it. I recommend continuing to monitor patient time in CT. There should be 100% compliance with obtaining a head CT in patients with moderate head injury—6% non-compliance, in my opinion, could be improved. Intubation for traumatic coma in the emergency department is very important and compliance with the guideline appears to be very good. I would like to know the percentage of patients in the “no” category who were never intubated and why. Answers to these queries may yield an opportunity for improvements.

Regarding definitive care phase indicators, I recommend eliminating re-presenting within 72 hours as a performance indicator. A 2.0% rate is about as low as you will ever get. Also, patients may represent at doctors’ offices or other hospitals resulting in an incorrect numerator.

I suggest periodically selecting a few of the representing patients for chart review, rather than continuing this as a routine monitor. There appears to be very good compliance with the venous thromboembolism prophylaxis guideline and I recommend continuing to monitor this indicator regularly. Your missed fracture rate parallels the rate at most good systems and is probably as low as it gets—I recommend periodic review rather than routine. I recommend alteration of the hypothermia indicator to reflect the effect of therapy on the patient’s temperature. As written now, patients who are hypothermic at the time of admission are included in the “no” category. Aren’t you more interested in the effect of treatment while in hospital, particularly since this indicator is in the definitive care phase? Both of the indicators for fracture fixation appear to have only moderate compliance. This may reflect a systems problem (i.e., operating theatre availability) or an issue of surgical judgment (i.e., there are data suggesting that long bone fracture fixation can be delayed for up to 72 hours (Rogers *et al.,* 1994). [(9)] This should be discussed with your orthopaedic surgeons.
The non-therapeutic laparotomy rate is consistent with the current literature and you may want to monitor this periodically or annually for individual surgeons. There appears to be very poor compliance with your craniotomy indicators suggesting that this indicator may need

refinement after meeting with the neurosurgeons. It appears that transfer to another MTS has shown improvement over the years with the addition of ICU beds. This indicator should be monitored annually to provide data for expansion of services—when they are needed. There appears to be relatively low compliance with major joint relocation—there may be a number of major confounders here as well; i.e., higher priority injury, missed diagnosis, etc. Understanding the low compliance rate would be helpful. Laparotomy to arrest haemorrhage is an important indicator and should be retained and monitored closely. It is difficult to understand why performance with this indicator vacillates so widely.

The time from injury to revascularisation is suspect as an indicator because the exact time of injury is rarely accurate and the time that reflow is established is always an estimate. The important outcome indicator here is amputation rate for a dysvascular limb.

I think a more appropriate process indicator would be that the patient with an ischemic limb is in the operating room within 1 hour of arrival. Unplanned returns to the OR and ICU appear to be consistent and I would recommend monitoring these periodically, but not annually. Lack of documentation of patient temperature in the operating room is occurring at an alarming rate and this poor rate of compliance is consistent. This should be a priority in the quality improvement program. For the reasons mentioned, I suggest that the transfusion trigger (8.5 g/L) be reconsidered. The indicator for all injuries diagnosed is probably as good as it gets and I would recommend periodic, but not annual monitoring of this indicator.

Conclusions

This is a remarkable report that can provide immense guidance to improve the care of the trauma patient. My review suggests that there are opportunities for improvement by reducing the number of performance indicators. This would result in utilization of fewer resources, potentially lowering the cost, and improving the “value equation”.

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Colonel Hodgetts has served in peace in military hospitals in Hanover, Woolwich and Aldershot; he has served on operations in hospitals in Northern Ireland, Kosovo, Oman, Afghanistan, Kuwait and Iraq (3 tours). Within the Defence Medical Services he has been responsible for nurturing the specialty of emergency medicine from infancy to maturity.

Colonel Hodgetts is the author of over 60 original papers and 20 books. Colonel Hodgetts' passion is medical education and following personal experience has established the international standard for disaster medical preparedness in 17 countries.

Colonel Hodgetts was named a Queen's Honorary Physician in 2004. In 1999 he was made Officer of the Order of St John of Jerusalem for services to medical education and humanity. He has been awarded 12 academic medals, including the Mitchener Medal of the Royal College of Surgeons of England, and has been made a Fellow of the Royal College of Surgeons of Edinburgh without examination.

Chapter 5: Pre-Hospital Care

The academic foundation of pre-hospital care is often criticised, with limited evidence available to support best practice. This chapter presents the pre-hospital data from over 10,000 casualties in the 10 year period 1995-2004.

But what do these data mean, and more importantly how can it make a difference to improved care in the future? There are fundamental questions in pre-hospital care that require to be answered. What interventions really make a difference to outcome? In what timeframe must these interventions be undertaken? Does it make a difference who undertakes the [(1)]interventions? Finally, how do we use this knowledge to move towards a more standardized doctrine for pre-hospital care, with common training and equipment standards?

Interventions that are highlighted in this report are ambulance versus private transport, cardiopulmonary resuscitation (CPR), basic versus advanced airway, intravenous fluids, and MAST.

A private vehicle accounted for transport to the initial hospital in up to 40% of patients with a major data category injury. It is not clear whether the outcome was different in these groups. Superficially this would seem obvious, but Demetriades demonstrated an improved outcome in patients utilising private transport.

Where an ambulance is used there appears to be an upward trend in use of Category 4, *Serious Bypass* (statistical significance not tested). This could equally be explained by an increased seriousness of the casualties attended or reduced threshold for bypass—either because of improved intuition through training and experience, or conversely from reduced confidence. Within the triage criteria, which are generally pragmatic and applicable across the spectrum of injury mechanisms (including 'military' trauma, potentially seen in terrorist incidents), Category 6 stands out as somewhat incongruous. In a disaster would you *really* close the MTS hospital? Or would you just make the necessary space in the wards and corridors? In the Asian tsunami (26 Dec 04), Takua Pa Hospital in Phuket admitted 628 patients in the first 24 hours with a declared capacity of only 177 beds. [(2)]

The lack of survivors from CPR for penetrating trauma is unsurprising, but can this be used to influence pre-hospital resuscitation practice? Is there a continuing justification to transfer an irretrievable cardiac arrest at high speed to hospital, placing both the crew and other road users at risk? The justification needs to be made for the one-quarter of patients in last three years who were receiving CPR and bypassed the nearest hospital for diversion to MTS (although the number of survivors in this group is not stated). All initial survivors of cardiac arrest who were transferred out (all children, n = 4) died: this policy requires to be questioned and the process reviewed to identify adverse trends.

It is not possible from the way the data is presented to link the pre-hospital airway intervention during CPR (basic vs advanced airway) with eventual survival. In UK, outcome from *ischaemic* cardiac arrest has been shown to be no better with a paramedic vs technician (Basic Life Support) crew, although the paramedic crew spends significantly longer at scene. [(3)] If an advanced airway makes no difference (or makes the outcome worse) it is simply an example of *skill thrill*—skills for skills sake.

A total of 3903 patients received IV fluids, but the proportion who received <500ml fluid has risen noticeably to 80% for last 2 years. If so little fluid is given, why undertake the skill and how is this adding (potentially unnecessarily) to the on-scene time? However, it is not clear in what proportion the IV cannula was used primarily for drugs (specifically for morphine or ketamine analgesia; or for rapid sequence induction of anaesthesia), particularly because the recorded use of analgesia is stated to be an underestimate.

61.5% of hypotensive penetrating trauma patients did receive >500mls fluid, but it can be argued that this is the very group that does badly with aggressive pre-hospital fluid resuscitation. [(4)] This trend was dramatically reversed in 2002, although not sustained, for unknown reasons (but speculated to be an influential educational initiative).

Chest drains were infrequently undertaken pre-hospital and often by paramedics. Clinical governance would challenge how the skill base of paramedics across the ambulance service is maintained to do a chest drain, when it is such an infrequently performed procedure. Additional information is required to ascertain whether all insertions undertaken by paramedics were considered appropriate when reviewed in the emergency department together with the incidence and nature of complications (which are variable in published pre-hospital series).

The use of MAST has almost completely disappeared in SWSAHS. The justification for continued access to MAST seems minimal. It is expensive to replace and, more importantly, the collective experience of its problems/protocol for removal will rapidly fade from the corporate memory (even at major trauma service hospitals): this opens up opportunities for practice errors. It would appear now to be a clinical practice anachronism.

Almost half of the inter-hospital transfers for ISS ≥ 16 were conducted by general duties ambulance rather than paramedic ambulance or medical retrieval team (MRT). I am unclear if this fails to represent that a medical escort was present in a general duties (GD) ambulance. If not, it would be a worrying trend that requires investigating and remedial action.

In summary, the model developed at Liverpool Hospital for improving clinical effectiveness through major trauma audit is highly sophisticated. It is the model that has been adapted for use in the UK Defence Medical Services. Performance indicators can be used to improve individual areas of pre-hospital practice. Whether this contributes to improved outcome may be difficult to disentangle without supporting randomised controlled trials. The success of this initiative must be partly measured by how this information can be used to improve injury prevention or ameliorate the effects of injury - in other words, the linkages established and exploited with policy makers who can influence injury prevention. This is our aim in the military sister model, with success in linking injury patterns to combat body armour design.

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2.20 Trish McDougall RN Cert Health Economics

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Trish McDougall is the inaugural executive manager of the NSW Institute for Trauma and Injury Management (ITIM) which was established in 2002 to coordinate the state-wide trauma system in New South Wales, in partnership with the New South Wales Department of Health. Prior to her current appointment she was the Trauma Program Manager at Westmead Hospital. In 2005 she was elected President of the Australasian Trauma Society.

General Comment

The evaluation of trauma care is a challenge to clinicians working within the health system. It is pivotal to administrators who must plan services and allocate funding appropriately. The South Western Sydney Regional Trauma Registry Ten Year Report 1995-2004 is a valuable contribution to the clinical auditing and planning processes which Sydney South West (South West Sector) will need to review to deliver optimal trauma care to patients in this extensive Area Health Service. The information contained in the report will also add to the knowledge bank which supports trauma care both at state, national and international levels.

The key performance indicators are of particular interest. This section of the report identifies the important phases of care which are required for the trauma patient to progress safely through a complex area of clinical management. The data presents a large number of patients which gives an evidence base to initiate protocol and clinical practice guideline change where necessary. This information also can influence areas of data collection which have not been as useful in the final analysis as was initially expected when the performance indicators were first instigated. The ability to analyse the data with the extended population base contained in the report is the true strength of this project.

Performance indicators collected prospectively and reviewed regularly by peer review are an essential requirement of a functioning trauma program. The data in the ten year report illustrates a commitment to quality improvement, an ongoing contribution to developing standards of clinical management and most importantly a document open to constructive critical assessment.

Thank you for the opportunity to comment on this comprehensive trauma registry ten year report.

2.21 Valerie Malka FRACS MIPH

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Dr Valerie Malka has been the Director of Trauma at Westmead Hospital since 2000, a position which was expanded to involve the greater area of Western Sydney in 2003. She is a trauma and general surgeon with particular interests in Education and Quality Assurance, as well as being an EMST/ATLS Director and DSTC Instructor. Her greatest passion is in Humanitarian Work, having most recently joined the International Committee of the Red Cross and the International Rescue Committee.

Implications of the Report for the Community

I thank Professor Michael Sugrue for the opportunity to comment on this excellent 10 Year Regional Trauma Registry Report 1995-2004 and commend him and his team on a thorough and extremely comprehensive body of work. I will limit my comments by focusing on the implications of this report to the Community, noting from the outset that extensive research has clearly shown that the most effective prevention strategies are those which take an all-inclusive public health approach. This includes involving the general community at large as well as the media, the government, the police and other law enforcement agencies and commercial enterprises.

First and foremost, this report serves to clearly illustrate the magnitude and gravity of this neglected epidemic known as trauma. It is critical that the community recognise that it is the number one cause of death in the under 50 age group and the third cause of death overall and globally. It is particularly important to point out that serious and life-threatening injuries occur more commonly in the 15-24 years age group, which are our youth and our future. Additionally of concern, the number of elderly patients injured is increasing annually. With this in mind, the community needs to understand that they have a key role and responsibility in preventing these tragic losses of life and dreadful injuries which can rob people of any quality of life, which are witnessed by health care professionals on a daily basis. They can be vital in advocating for various injury prevention strategies as well as supporting their Major Trauma Centres and local hospitals in ensuring the highest standards of care are available and given to all injured patients.

This report, as is well known, demonstrates that falls were the most common mechanism of injury requiring admission with road trauma the most common mechanism of injury in the major category. It also notes, not surprisingly, that the most common place of injury is the home for all injury admissions and the street for major injuries. Again this emphasizes the fundamental role the community has in preventing these injuries at home and in lobbying their local governments for changes, improvements and advancements in road and vehicle usage. They must appreciate that they are ultimately responsible for their own well-being and those of their family and friends and take heed and actively promote campaigns regarding driver distraction and risk-taking behaviour, speeding, fatigue, drug and alcohol usage and seat-belt and helmet wearing in their community. Although the incidence of penetrating trauma and interpersonal violence is relatively low it is far from insignificant and again an educated, united and strong community can work to address and reduce this disturbing part of our society.

This Report serves another very important purpose for the community, that of enabling the public to understand the differences between hospitals which serve them. Liverpool Hospital is a well-recognised centre of trauma management excellence and leadership. It is a Level 1 Centre with all available expertise and resources to care for the multiply injured and severely injured patient. It is the major source of advice and referral for the large Area of South Western Sydney, working in partnership with the other hospitals to ensure the right patient gets to the right hospital. It is a well-structured and organised system of trauma care, such as is evident in SWSAHS, which accounts for the noted reduced mortality in the seriously injured population of patients. It is imperative that the public has an understanding of this system of care and works with health care professionals to ensure these institutions are well funded and expertly staffed and resourced by the Government.

In conclusion, I would only once again emphasise the great importance of this Report in increasing community awareness and education of both the risks of injuries and the role they must play in their own health and safety as well as the role their various hospitals play in increasing their chances of survival and returning to as normal a life as possible. Congratulations on an exceptional Report.

2.22 Zsolt Balogh MD PhD

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Associate Professor Zsolt Balogh is the Director of Trauma at the John Hunter Hospital, Newcastle. He is a full time Trauma Specialist trained for both torso and orthopaedic trauma from his Hungarian background. Zsolt's main scientific interests are traumatic shock & resuscitation, polytrauma management, surgical critical care, physiological response to trauma, pelvic fractures, abdominal compartment syndrome and post-injury multiple organ failure (PhD Thesis). He is involved in various trauma related research and teaching activities and is a regular speaker at international trauma meetings and the author of several book chapters and peer-reviewed journal articles.

Chapter 4: Liverpool Hospital Overview

The Liverpool Hospital is one of the busiest trauma centres in New South Wales but more importantly a clinical, educational and scientific leader of the Australian Traumatology. The 10-year Liverpool Trauma Registry report is a landmark document in trauma epidemiology review and potentially a valuable tool to utilise during the reorganisation of the New South Wales Trauma Services. Personally for me from outside Australia only Liverpool was visible in 2002 when I was influenced by the 5-year Liverpool registry data to come over to Australia and work as a trauma fellow after finishing my United States Trauma fellowship.

The total trauma admissions to Liverpool Hospital gradually increased about 30% during the last decade. The increase in severe injured (ISS>15) is even more pronounced (more than 40%). South Western Sydney's population is generally young and exponentially growing, this is reflected in the peak age of the injured patients between 20-24 years. This has great socio-economic impact on society. The usual late peak of injuries above 80 years is less pronounced in the registry data but might be due to the lack of resources of the Liverpool Trauma Department to collect all injuries including every single low energy traumatic injury. The latter elderly population with predominantly low energy trauma is going to be a new challenge to our health care.

Sixty-three percent of the trauma admissions happened after hours based on the time of the day, which is significantly higher if we consider the weekend admissions (Friday-Sunday peak). Most of the potentially life-threatening penetrating traumas (74%) came after hours. This is an interesting paradox; currently the overwhelming majority of critically injured trauma patients arrive to Australian trauma hospitals when the most junior medical staff is available to manage this major clinical challenge. The two dedicated trauma surgeons at Liverpool Hospital have a unique approach to stay in hospital during the night, which is well established in busy European and American Trauma Centres. The Liverpool Trauma Department has the preliminary data to show how efficient the in-house consultant trauma surgeon system is to prevent adverse outcomes.

3 South Western Sydney Area Health Service Overview

Executive comment

This ten year report identifies a large number of trauma admissions to the hospitals in the region; in excess of 45000. Trauma occurs in all age groups but has a dominant peak in the young. Serious injury is more prevalent in the young to middle age groups while there is an increasing incidence of elderly trauma admissions. Fortunately assault and penetrating trauma injuries decreased over the report period. It is pleasing to see overall survival rate improve, with only 1.3% of trauma patients now dying; this however still translates to significant mortality with 609 deaths in the 45278 trauma patients. Of particular note is the improved survival in those seriously injured patients with an injury severity score of ≥ 16. This is even more commendable given the reduction in penetrating trauma which may have a slightly higher survival rate than matched blunt trauma.

Inter-hospital trauma transfers from SWSAHS urban and rural hospitals to Liverpool Hospital, the major trauma service (MTS), occurred in 2692 patients, accounting for 12.7% of the entire trauma load at Liverpool Hospital. The arrival time of admissions varied between the urban, rural and major trauma services with the major trauma service, Liverpool Hospital, having more admissions after normal working hours than in normal working hours.

Recommendations

1. A focused, integrated federal, state and area trauma system is required to deal with the significant challenges of trauma care. The system must be comprehensive and inclusive of the different disciplines and hospitals dealing with trauma care from injury right through to rehabilitation.

2. Regional and institutional registries need to be linked to the National Trauma Registry Consortium with linkages to other injury databases. Reports from the registry data need to be provided not just for trauma care providers, but also administrators. In addition policy leaders in health and industry, at federal and state level, need to be involved in the analysis and interpretation of data. The learned societies and professional colleges need to take an active role in reducing the burden of trauma on our society through prevention and injury management strategies.

3. National trauma benchmarks for the care of the trauma patient need to be identified, implemented and prospectively evaluated. This would include both process, data, costing and outcome in terms of safety and mortality.

4. A comprehensive assessment of the role of substance use in trauma, including alcohol, is required.

5. Planning of staff allocation, with particular reference to experience and trauma expertise; needs to be based upon patient loads both at individual hospitals and across Area Health Services.

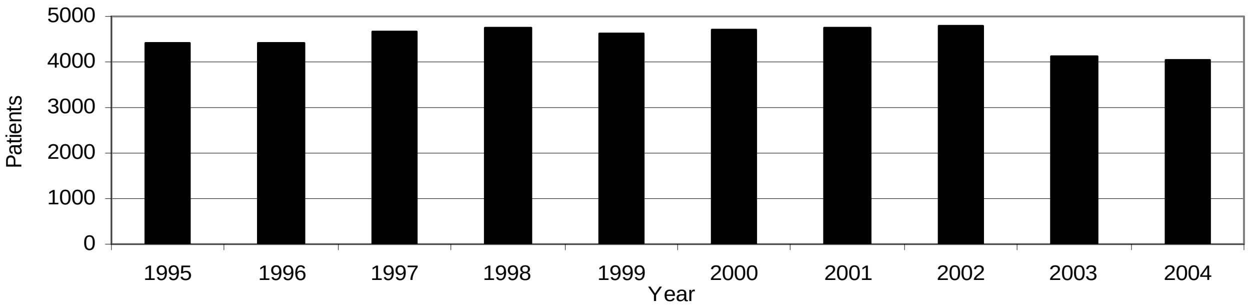
3.1 Total injured patients

During the 10-year period 1995 to 2004, 45278 patients were admitted to SWSAHS hospitals as a direct result of injury or trauma. 13629 (30.1%) were classified as major data category and 31649 (69.9%) were classified as minor data category. (Refer to the Introduction for a full explanation of each data category).

Table 3.1: Patients admitted due to injury, SWSAHS hospitals, 1995-2004

Year	Major data category		Minor data category		Total
	n	%	n	%	
1995	995	22.6	3409	77.4	4404
1996	1035	23.4	3391	76.6	4426
1997	1339	28.8	3308	71.2	4647
1998	1453	30.6	3289	69.4	4742
1999	1441	31.1	3198	68.9	4639
2000	1516	32.2	3194	67.8	4710
2001	1653	34.9	3087	65.1	4740
2002	1591	33.3	3182	66.7	4773
2003	1319	31.8	2826	68.2	4145
2004	1287	31.8	2765	68.2	4052
Total	13629	30.1	31649	69.9	45278

Figure 3.1: Patients admitted due to injury, SWSAHS hospitals, 1995-2004 (n=45278)



3.2 Serious injury

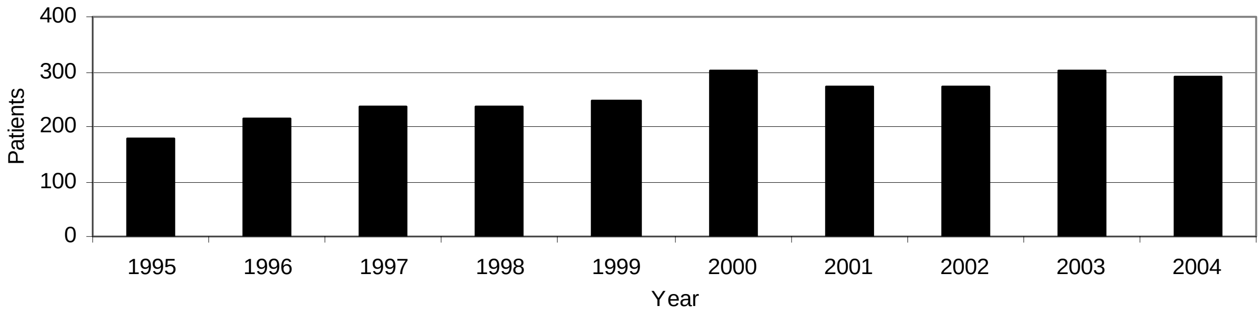
The Injury Severity Score (ISS) provides a measure of the overall seriousness of a patients injuries, and is calculated for all patients in the major data category. Patients in the minor data category do not have their ISS calculated due to their large volume, however, by definition they have an ISS < 16. This occurs due to careful planning of the minor data category inclusion criteria.

The ISS is the sum of the highest AIS (Abbreviated Injury Scale) code in each of the three most severely injured ISS body regions. [1] AIS and ISS are discussed in more detail in Chapters 6, 9 and 10. An ISS ≥ 16 indicates serious injury. 2547 (5.6%) of all patients admitted to SWSAHS hospitals between 1995-2004 following injury had an ISS ≥ 16. The table below presents the percentage of patients with an ISS ≥ 16 admitted to SWSAHS hospitals during the 10-year period 1995-2004.

Table 3.2: Patients admitted by ISS (ISS < 16 or ISS ≥ 16), SWSAHS hospitals, 1995-2004

Year	ISS < 16		ISS ≥ 16		Total
	n	%	n	%	
1995	4227	96.0	177	4.0	4404
1996	4211	95.1	215	4.9	4426
1997	4411	94.9	236	5.1	4647
1998	4507	95.0	235	5.0	4742
1999	4392	94.7	247	5.3	4639
2000	4409	93.6	301	6.4	4710
2001	4469	94.3	271	5.7	4740
2002	4500	94.3	273	5.7	4773
2003	3844	92.7	301	7.3	4145
2004	3761	92.8	291	7.2	4052
Total	42731	94.4	2547	5.6	45278

Figure 3.2: Patients with ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=2547)



3.3 Sex and age distribution

The highest proportion of injury admissions occurs in the 0-24 year age group. The number of elderly patients, especially those aged 75 years and over, is increasing annually.

Whilst patients aged 0-24 years have the highest number of injury admissions, serious injuries occur more commonly in the 15-24 years age group. Minor injuries are most commonly sustained by paediatric patients aged 0-14 years.

Table 3.3: Age distribution, SWSAHS hospitals, 1995-2004

Age group (years)		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
0-14	n	1178	1169	1188	1131	1156	1162	1087	1053	975	917	11016
	%	26.7	26.4	25.6	23.9	24.9	24.7	22.9	22.1	23.5	22.6	24.3
15-24	n	833	781	770	807	695	745	731	725	598	595	7280
	%	18.9	17.6	16.6	17.0	15.0	15.8	15.4	15.2	14.4	14.7	16.1
25-34	n	586	582	630	616	586	606	653	607	483	483	5832
	%	13.3	13.1	13.6	13.0	12.6	12.9	13.8	12.7	11.7	11.9	12.9
35-44	n	403	486	466	510	460	534	563	532	403	365	4722
	%	9.2	11.0	10.0	10.8	9.9	11.3	11.9	11.1	9.7	9.0	10.4
45-54	n	324	336	380	385	416	404	381	416	370	352	3764
	%	7.4	7.6	8.2	8.1	9.0	8.6	8.0	8.7	8.9	8.7	8.3
55-64	n	243	274	306	305	306	313	298	338	264	294	2941
	%	5.5	6.2	6.6	6.4	6.6	6.6	6.3	7.1	6.4	7.3	6.5
65-74	n	302	299	322	345	348	290	324	327	308	292	3157
	%	6.9	6.8	6.9	7.3	7.5	6.2	6.8	6.9	7.4	7.2	7.0
75-84	n	348	312	386	426	429	422	457	492	445	469	4186
	%	7.9	7.0	8.3	9.0	9.2	9.0	9.6	10.3	10.7	11.6	9.2
85+	n	187	187	199	217	243	234	246	283	299	285	2380
	%	4.2	4.2	4.3	4.6	5.2	5.0	5.2	5.9	7.2	7.0	5.3
Total		4404	4426	4647	4742	4639	4710	4740	4773	4145	4052	45278

Figure 3.3: Age distribution, all injuries, SWSAHS hospitals, 1995-2004 (n=45278)

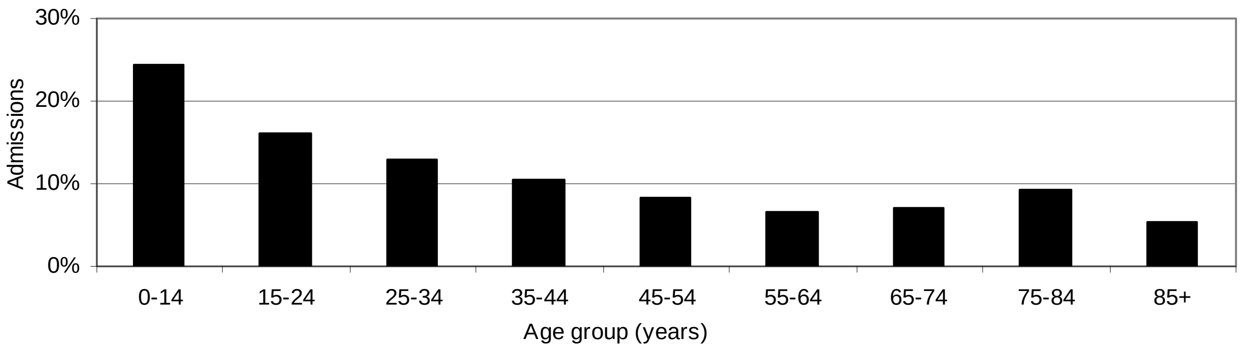


Figure 3.4: Age and sex distribution, all injuries, SWSAHS hospitals, 1995-2004 (n=45278)

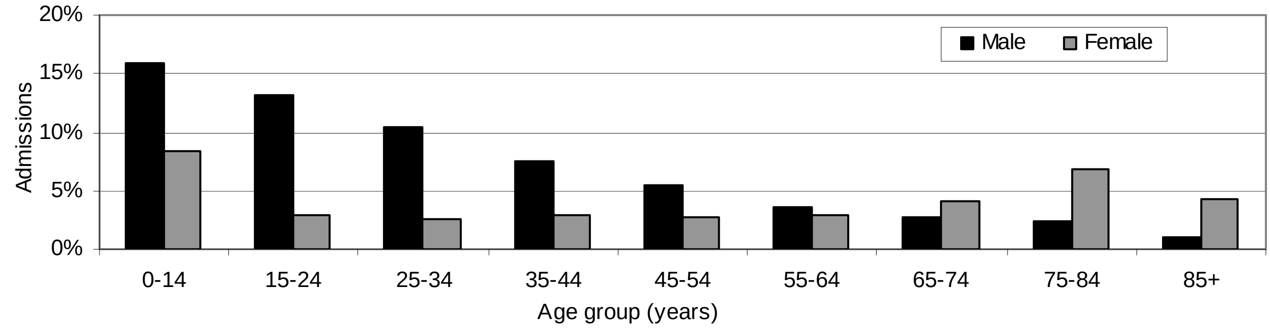


Figure 3.5: Age distribution, ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=2547)

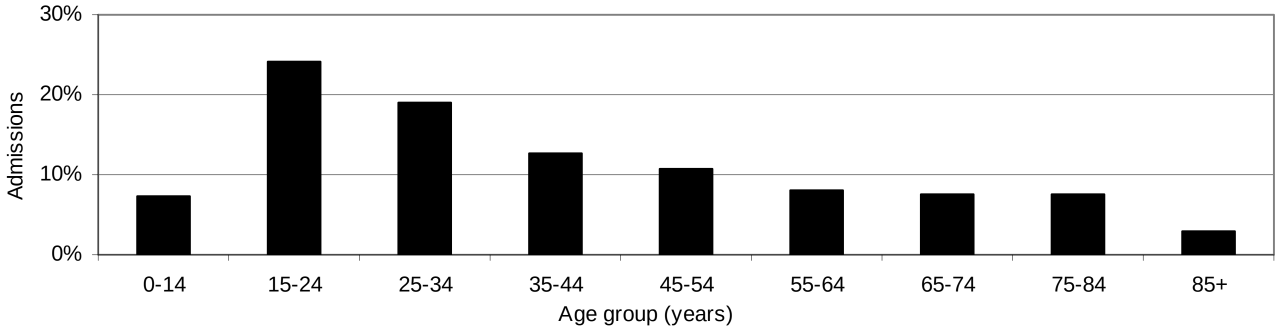


Figure 3.6: Age and sex distribution, ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=2547)

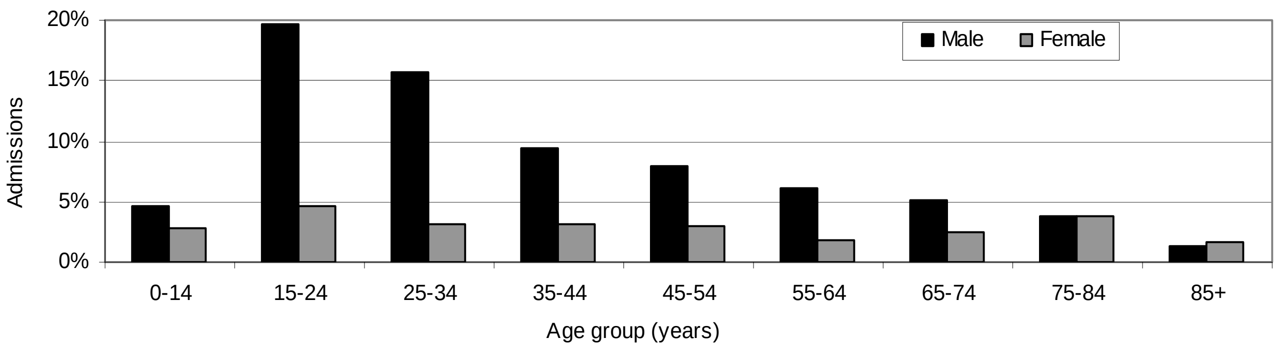


Figure 3.7: Age distribution, major data category, SWSAHS hospitals, 1995-2004 (n=13629)

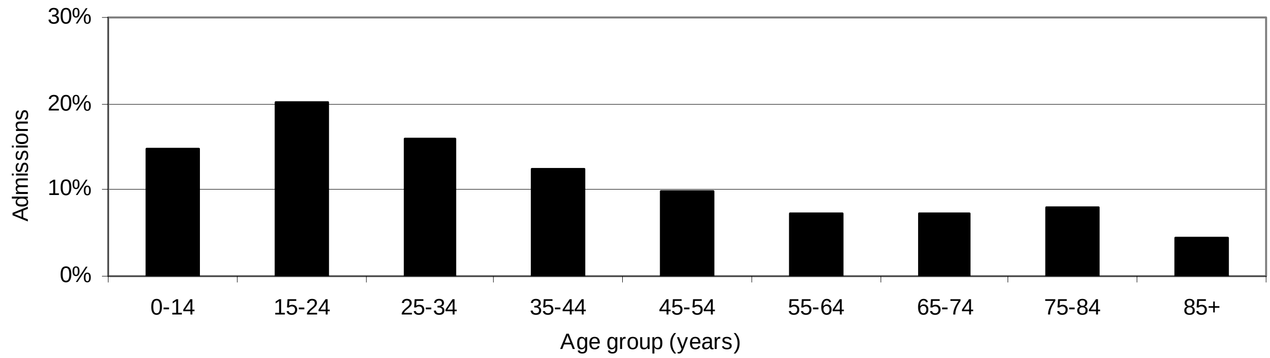


Figure 3.8: Age and sex distribution, major data category, SWSAHS hospitals, 1995-2004 (n=13629)

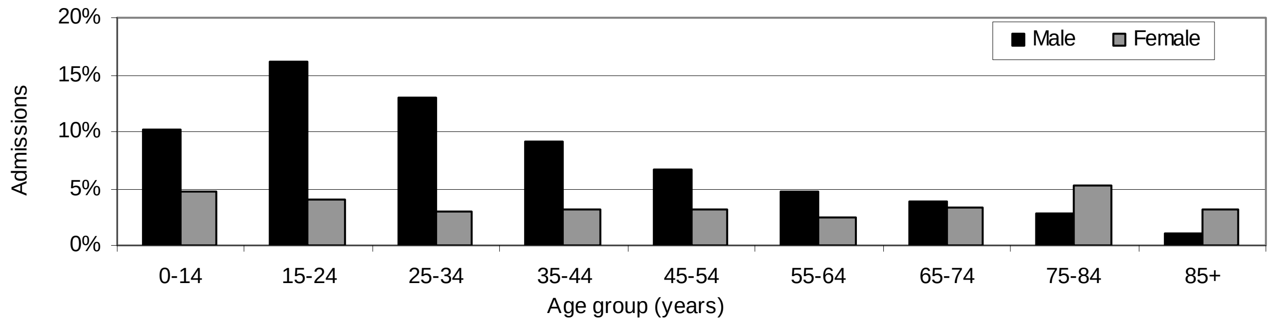


Figure 3.9: Age distribution, minor data category, SWSAHS hospitals, 1995-2004 (n=31649)

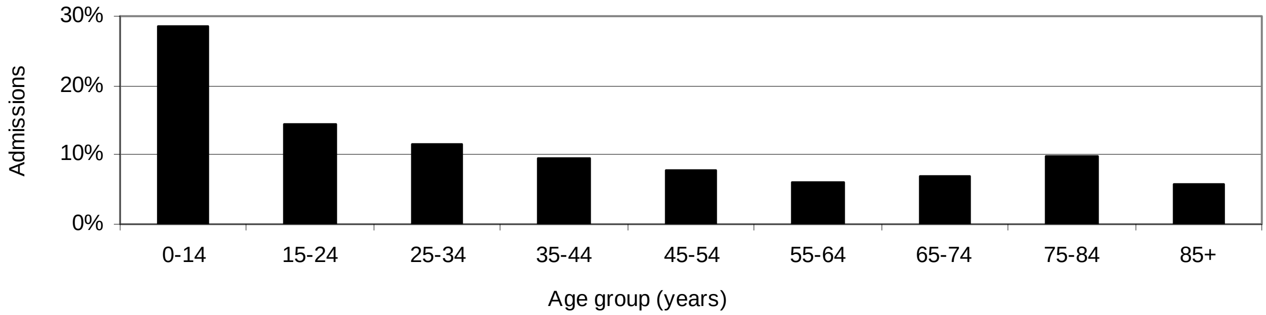
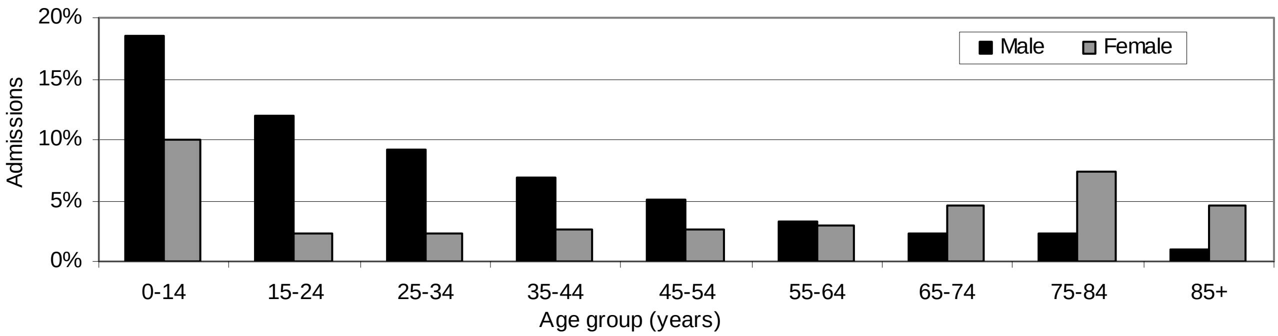


Figure 3.10: Age and sex distribution, minor data category, SWSAHS hospitals, 1995-2004 (n=31649)



3.4 Mechanism of injury

Falls were the most common mechanism of injury requiring admission to SWSAHS hospitals during 1995-2004. Road trauma is the most common mechanism of injury in major data category patients.

The following table presents the mechanism of injury for all injury admissions to SWSAHS hospitals between 1995-2004.

Table 3.4: Mechanism of injury, all injuries, SWSAHS hospitals, 1995-2004 (n=45278)

Group	Mechanism	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total	
												n	%
Falls	Fall < 5m	1821	1692	1798	1825	1747	1708	1731	1870	1705	1625	17522	38.7
	Fall ≥ 5m	31	33	39	35	40	32	41	47	37	32	367	0.8
	Total	1852	1725	1837	1860	1787	1740	1772	1917	1742	1657	17889	39.5
Road trauma	MVC driver	252	251	315	277	285	322	284	281	242	265	2774	6.1
	MBC rider	132	116	145	149	167	199	227	173	169	204	1681	3.7
	Pedestrian	156	128	125	131	131	107	110	110	109	107	1214	2.7
	MVC front passenger	97	107	88	124	92	101	98	85	99	102	993	2.2
	MVC back passenger	67	53	37	46	59	38	37	55	37	43	472	1.0
	Cyclist (vs. vehicle)	28	29	34	27	23	24	17	29	24	32	267	0.6
	MBC pillion	5	9	11	6	1	10	10	7	8	4	71	0.2
	Total	737	693	755	760	758	801	783	740	688	757	7472	16.5
Other	Other	508	776	494	332	345	351	336	331	329	271	4070	9.0
	Cyclist (not vs. vehicle)	29	89	116	123	125	133	103	121	98	109	1046	2.3
	Not documented	87	26	42	42	48	28	44	53	95	90	555	1.2
	Limb through glass*	-	-	49	51	56	54	65	70	33	31	412	0.9
	Dog bite	32	43	36	36	36	51	36	31	21	32	354	0.8
	Fall from horse	13	7	23	35	54	37	52	39	45	44	349	0.8
	Hanging	1	5	5	9	4	5	6	5	3	7	50	0.1
	Total	670	946	765	628	668	659	642	650	624	585	6837	15.1
Recreation		306	195	378	517	560	619	599	561	463	442	4640	10.2
Industrial		470	431	454	501	443	453	428	425	242	247	4094	9.0
Interpersonal violence	Blunt assault	209	243	235	228	214	195	254	234	195	179	2186	4.8
	Stabbing	51	62	87	98	78	110	103	88	70	60	807	1.8
	Gunshot	15	18	20	19	21	30	39	41	20	12	235	0.5
	Total	275	323	342	345	313	335	396	363	285	251	3228	7.1
Burns		94	113	116	131	110	103	120	117	101	114	1119	2.5
Total		4404	4426	4647	4742	4639	4710	4740	4773	4145	4052	45278	100.0

* The limb through glass mechanism of injury was introduced in 1997. Prior to this the 'Other' category was used.

Figure 3.11: Mechanism of injury, all injuries, SWSAHS hospitals, 1995-2004 (n=45278)

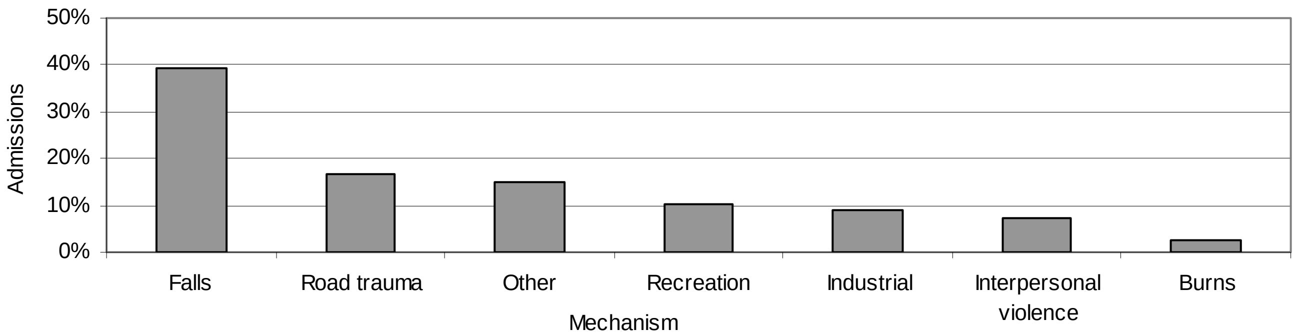


Figure 3.12: Mechanism of injury, ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=2547)

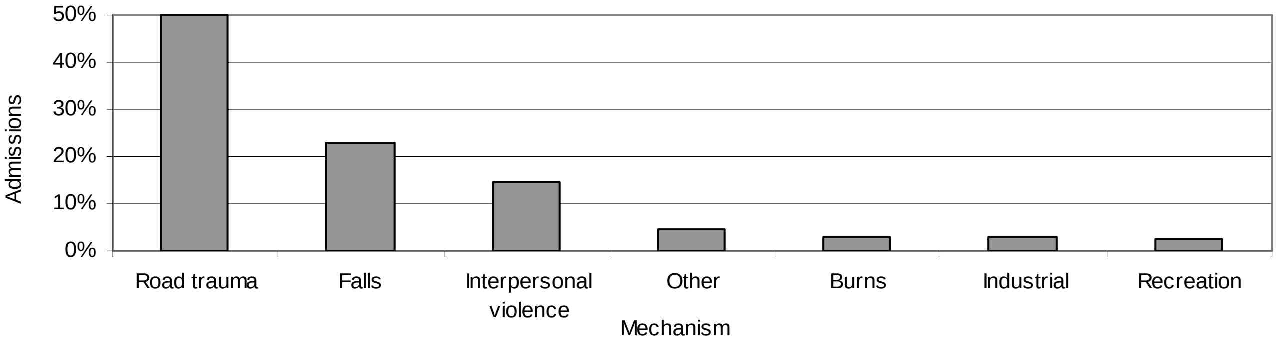


Figure 3.13: Mechanism of injury, major data category, SWSAHS hospitals, 1995-2004 (n=13629)

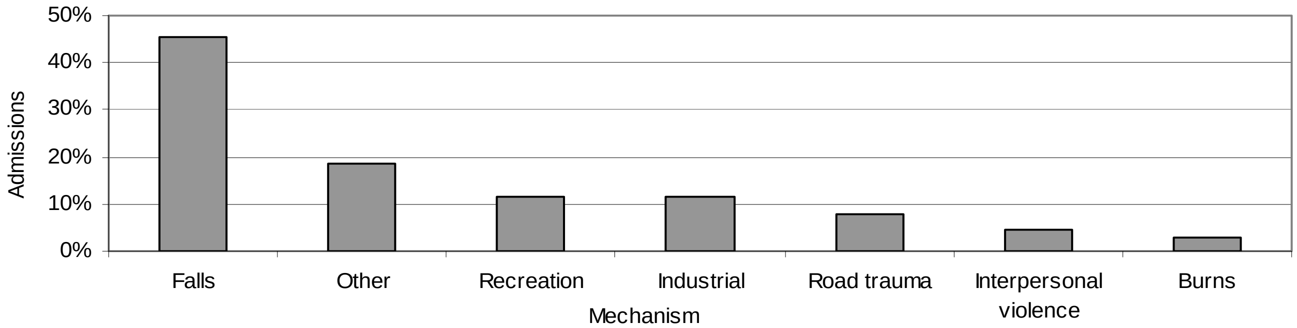
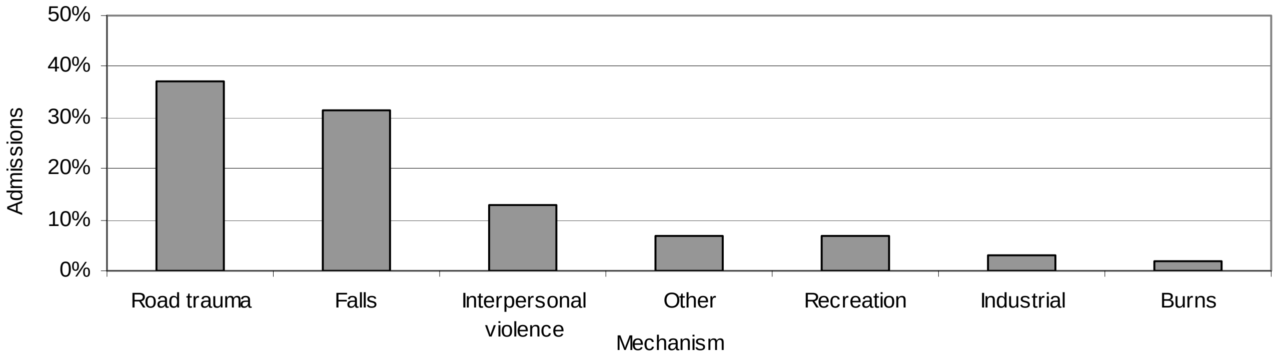


Figure 3.14: Mechanism of injury, minor data category, SWSAHS hospitals, 1995-2004 (n=31649)



3.5 Place of injury

Overall, home was the most common place of injury. For major data category patients, the street was the most common place of injury, and road trauma was the most common mechanism of injury.

Figure 3.15: Place of injury, all injuries, SWSAHS hospitals, 1995-2004 (n=45278)

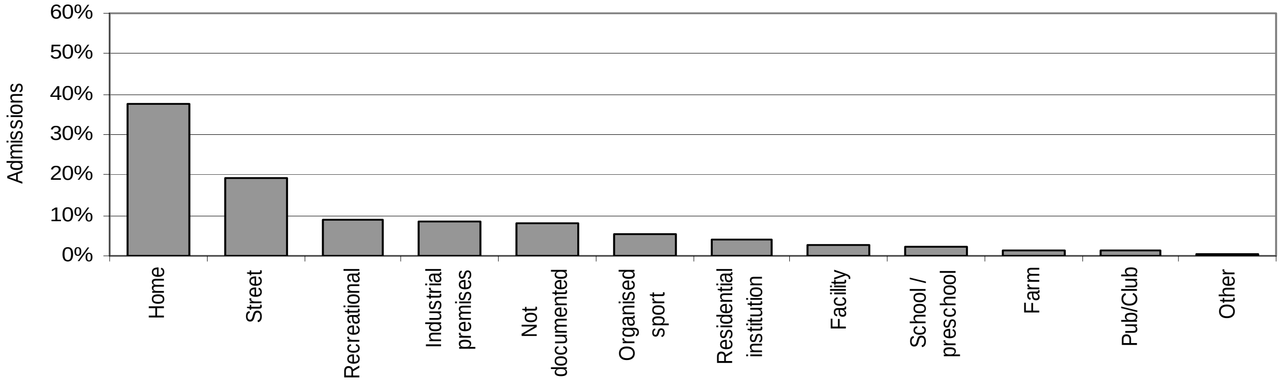


Figure 3.16: Place of injury, ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=2547)

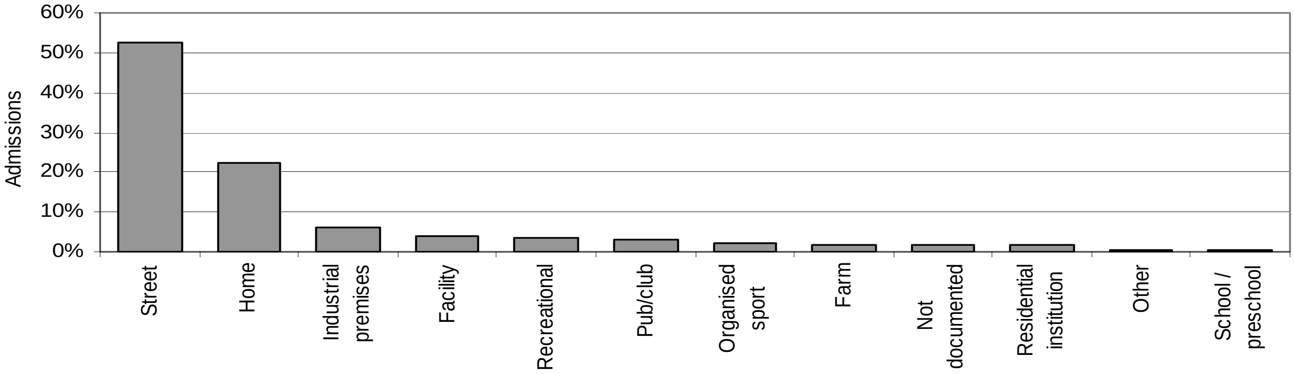


Figure 3.17: Place of injury, major data category, SWSAHS hospitals, 1995-2004 (n=13629)

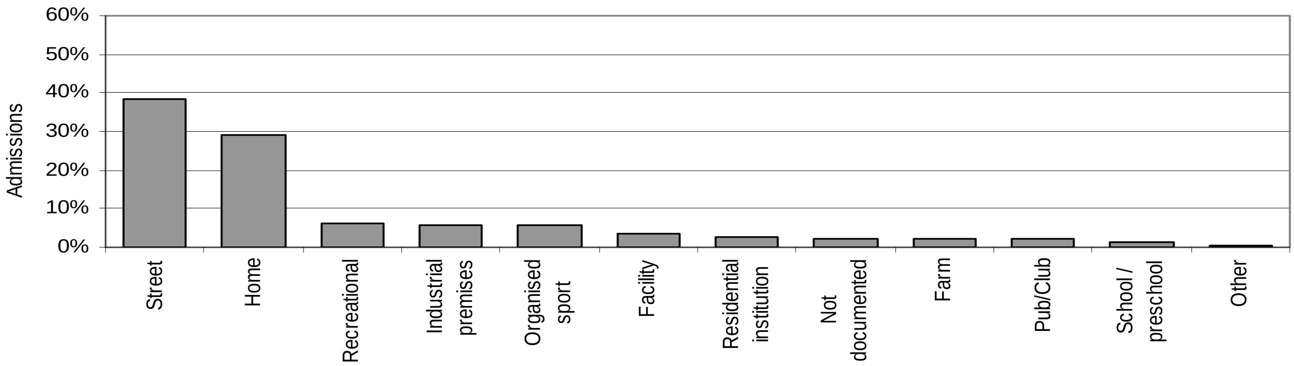
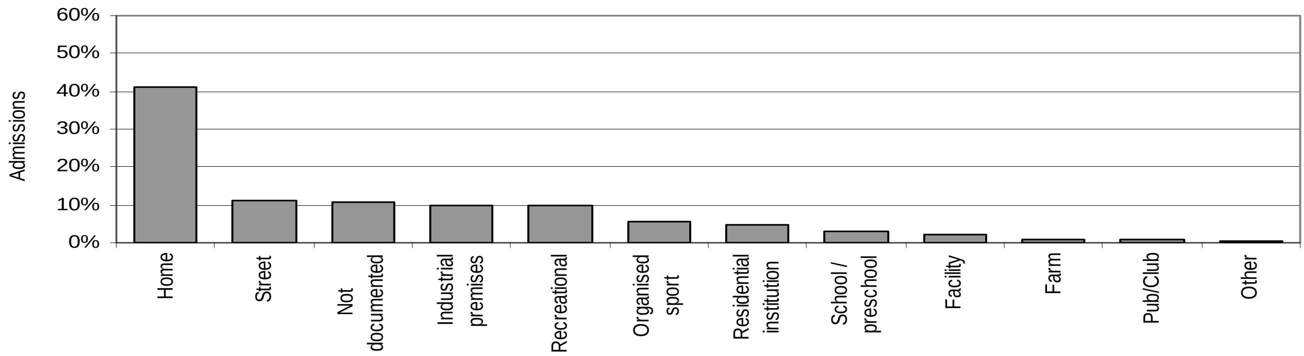


Figure 3.18: Place of injury, minor data category, SWSAHS hospitals, 1995-2004 (n=31649)



3.6 Injury intent

Injury intent can provide useful information for injury prevention purposes. It is challenging to accurately collect intent data, as it is largely subjective. Patients may report their injuries as accidental to clinicians when in fact the mechanism is assault or self harm. 'Self harm' includes all injuries where there was a clear intent to cause injury to oneself.

Table 3.5: Injury intent, major data category, SWSAHS hospitals, 1995-2004

Intent		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Accidental	n	4135	4062	4245	4324	4253	4311	4303	4349	3812	3759	41553
	%	93.9	91.8	91.3	91.2	91.7	91.5	90.8	91.1	92.0	92.8	91.8
Assault	n	269	312	320	321	293	308	363	342	265	238	3031
	%	6.1	7.0	6.9	6.8	6.3	6.5	7.7	7.2	6.4	5.9	6.7
Self harm*	n	-	52	82	97	93	91	74	82	68	55	694
	%	-	1.2	1.8	2.0	2.0	1.9	1.6	1.7	1.6	1.4	1.5
Total		4404	4426	4647	4742	4639	4710	4740	4773	4145	4052	45278

*Self harm data was first collected in 1996.

Figure 3.19: Injury intent, all injuries, SWSAHS hospitals, 1995-2004 (n=45278)

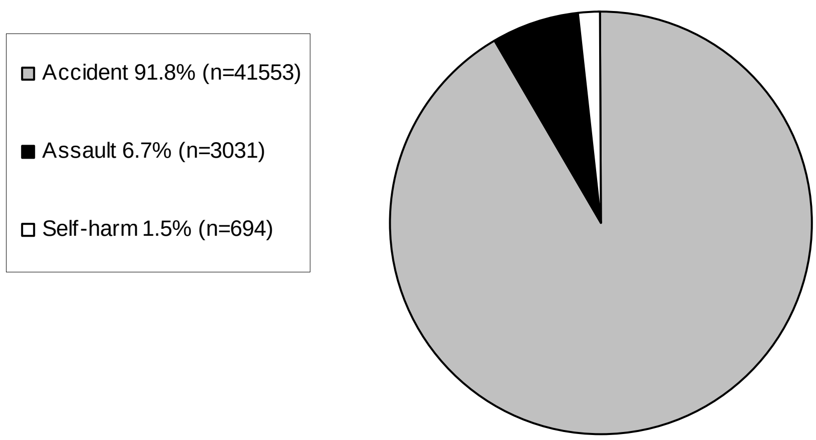
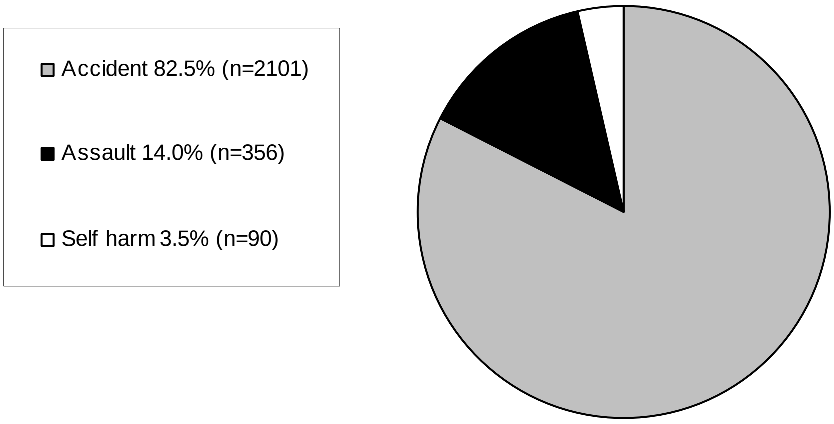


Figure 3.20: Injury intent, ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=2547)



3.7 Survival outcome

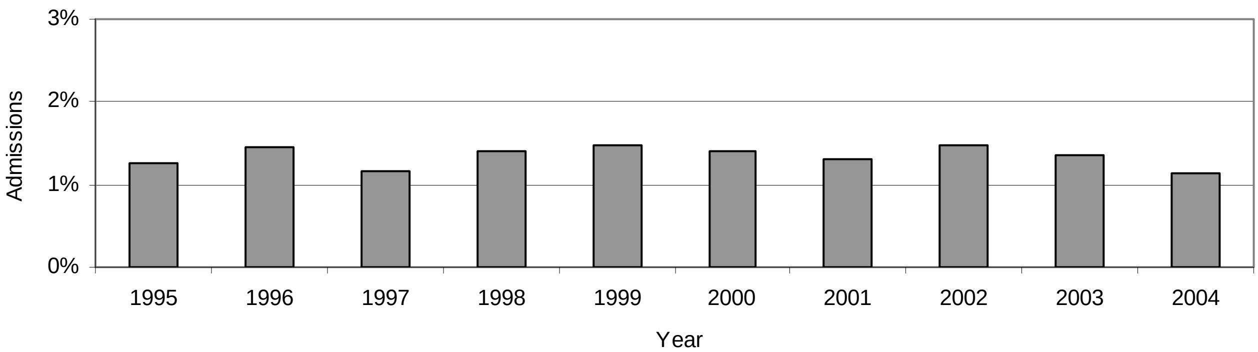
Table 3.6: Survival outcome, all injuries, SWSAHS hospitals, 1995-2004

Outcome		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Survived	n	4349	4362	4593	4676	4570	4644	4678	4702	4089	4006	44669
	%	98.8	98.6	98.8	98.6	98.5	98.6	98.7	98.5	98.6	98.9	98.7
Died	n	55	64	54	66	69	66	62	71	56	46	609
	%	1.2	1.4	1.2	1.4	1.5	1.4	1.3	1.5	1.4	1.1	1.3
Total		4404	4426	4647	4742	4639	4710	4740	4773	4145	4052	45278

Table 3.7: Survival outcome, ISS ≥ 16, SWSAHS hospitals, 1995-2004

Outcome		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Survived	n	147	161	194	194	212	261	228	241	266	252	2156
	%	83.1	74.9	82.2	82.6	85.8	86.7	84.1	88.3	88.4	86.6	84.6
Died	n	30	54	42	41	35	40	43	32	35	39	391
	%	16.9	25.1	17.8	17.4	14.2	13.3	15.9	11.7	11.6	13.4	15.4
Total		177	215	236	235	247	301	271	273	301	291	2547

Figure 3.21: Deaths following injury, ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=391)



3.8 Blunt versus penetrating injuries

All major data category injuries are classified as either blunt or penetrating. The classification is based on the actual injury sustained, rather than the mechanism of injury. Patients who sustain both blunt and penetrating trauma are categorised according to whether the blunt or penetrating trauma caused the more serious injury. The majority of penetrating injuries are due to stabbings and gunshot wounds. Further data regarding penetrating injury can be found in Chapter 4 (Liverpool Hospital Overview) and Chapter 6 (Types of Injury).

Table 3.8: Blunt versus penetrating injuries, major data category, SWSAHS hospitals, 1995-2004

Type		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Blunt	n	924	948	1230	1356	1370	1421	1544	1482	1244	1224	12743
	%	92.9	91.6	91.9	93.3	95.1	93.7	93.4	93.1	94.3	95.1	93.5
Penetrating	n	71	87	109	97	71	95	109	109	75	63	886
	%	7.1	8.4	8.1	6.7	4.9	6.3	6.6	6.9	5.7	4.9	6.5
Total		995	1035	1339	1453	1441	1516	1653	1591	1319	1287	13629

Figure 3.22: Blunt versus penetrating injuries, major data category, SWSAHS hospitals, 1995-2004 (n=13629)

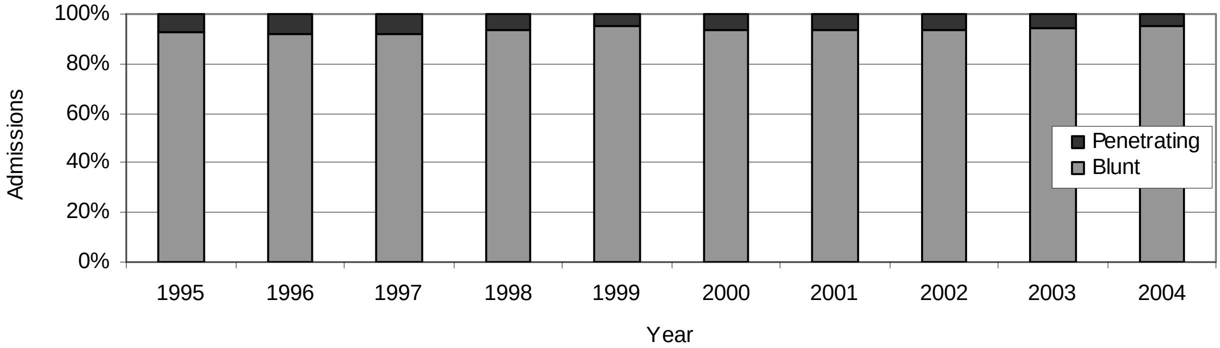


Figure 3.23: Sex distribution for blunt trauma, major data category, SWSAHS hospitals, 1995-2004 (n=12743)

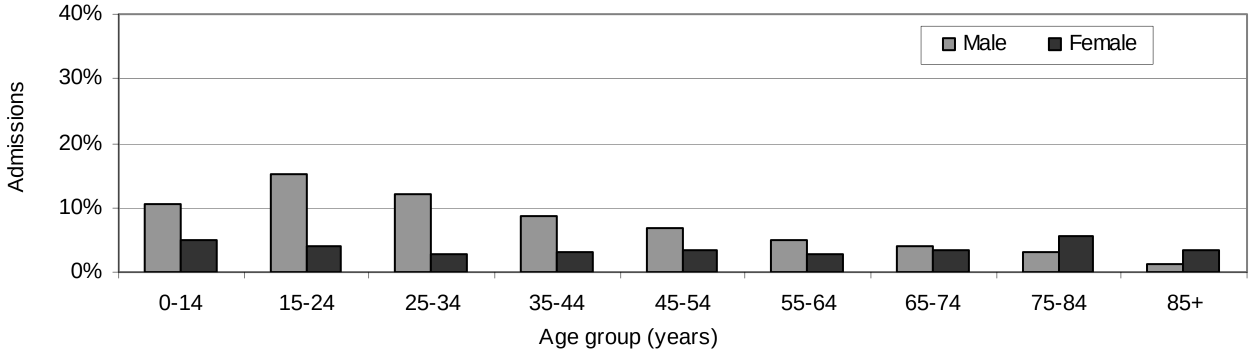


Figure 3.24: Sex distribution for penetrating trauma, major data category, SWSAHS hospitals, 1995-2004 (n=886)

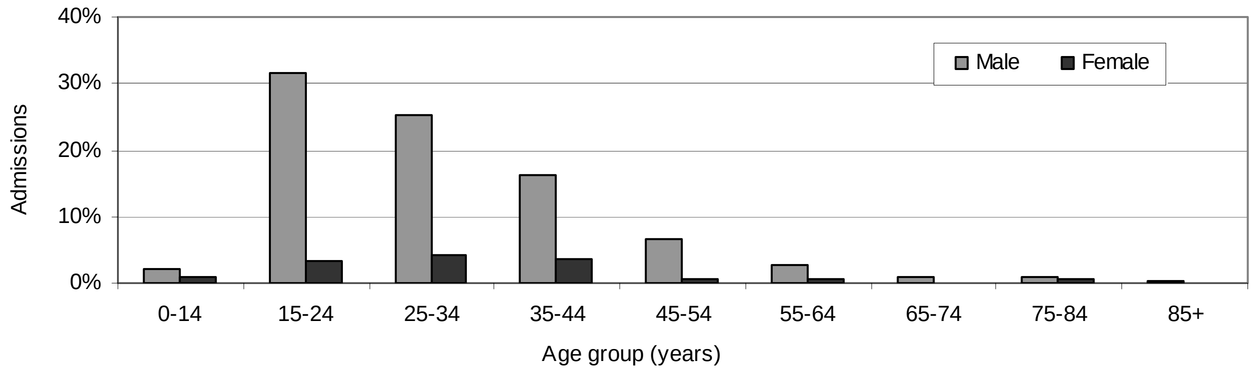


Figure 3.25: Mechanism of injury for blunt trauma, major data category, SWSAHS hospitals, 1995-2004 (n=12743)

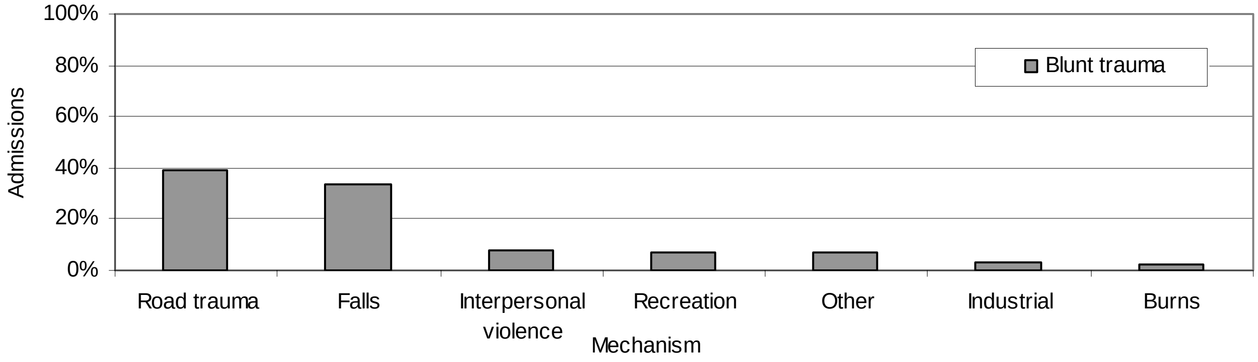
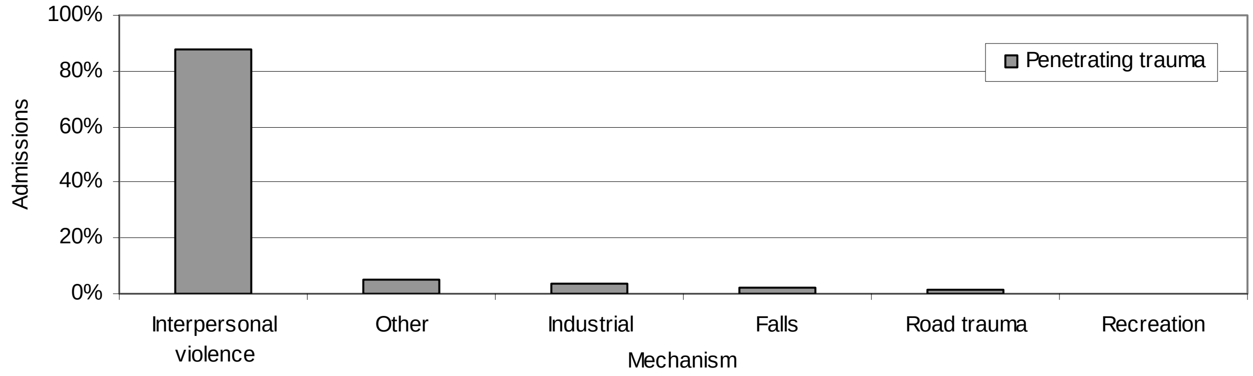


Figure 3.26: Mechanism of injury for penetrating trauma, major data category, SWSAHS hospitals, 1995-2004 (n=886)

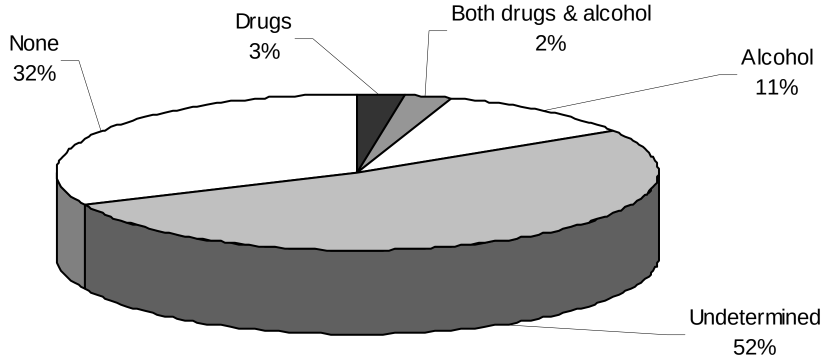


3.9 Substance use

Substance use data has been collected on all major data category patients since 1998. 'Substance use' is recorded if the patient was under the influence of illicit drugs and / or alcohol at the time of injury. This is determined by one or more of the following: toxicology; information provided by the patient; or subjective assessment by clinical staff. If there is any uncertainty as to whether drugs or alcohol were used, the value 'undetermined' is assigned.

Substance use at time of injury was undetermined in 52% of major data category patients. This data relies on either substance-specific blood test results or self-declaration by the patient. Patients may be unwilling or unable to provide substance use information. Therefore it is possible the data under-estimates the exact number of patients with substance use at time of injury.

Figure 3.27: Substance use at time of injury, major data category, SWSAHS hospitals, 1998-2004 (n=10261)



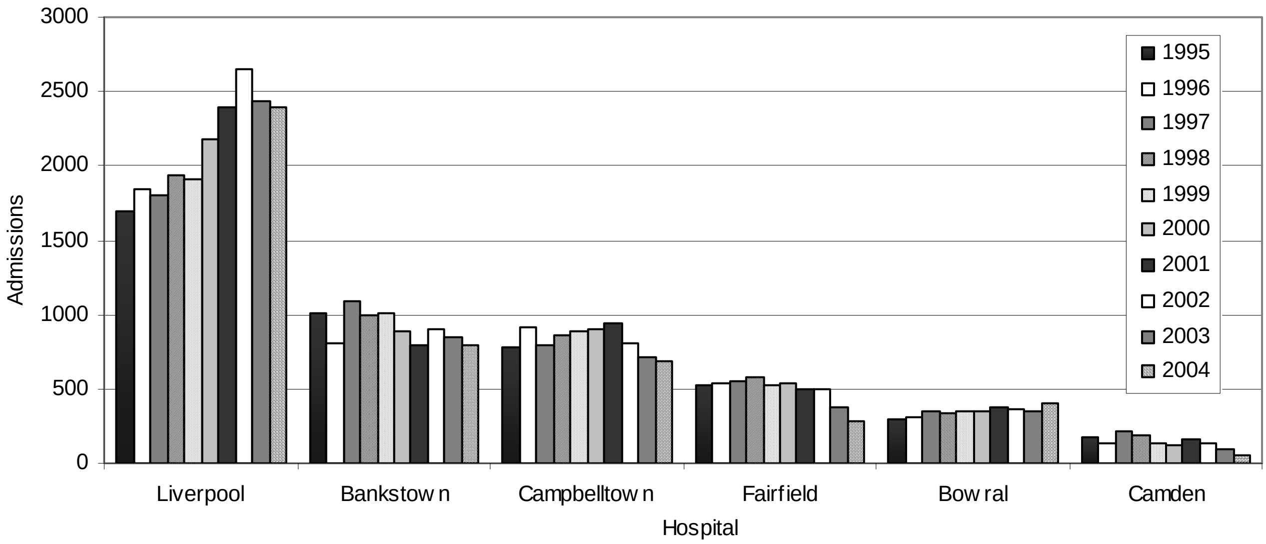
3.10 Annual admissions

So far the data has described the total number of trauma patients (n=45278). This section describes the total number of trauma admissions (n=48509). The difference in these two figures is due to inter-hospital trauma transfers (n=3231). These generally occur when a patient presents to a metropolitan or rural hospital, but requires treatment at a major trauma service, and is subsequently transferred to the major trauma service. Of the 3231 inter-hospital trauma transfers, 2692 patients initially presented at a SWSAHS hospital, and 539 initially presented at a hospital in another Area Health Service (AHS).

Table 3.9: Annual injury admissions to SWSAHS hospitals, 1995-2004

Year	Liverpool	Bankstown	Campbelltown	Fairfield	Bowral	Camden	Total
1995	1700	1011	778	526	299	169	4483
1996	1848	813	915	533	305	139	4553
1997	1802	1084	791	555	353	217	4802
1998	1939	999	856	583	342	191	4910
1999	1911	1007	890	530	352	129	4819
2000	2184	892	905	532	347	125	4985
2001	2393	790	946	504	372	166	5171
2002	2648	899	809	502	364	139	5361
2003	2429	844	713	381	356	88	4811
2004	2389	800	689	283	399	54	4614
Total	21243	9139	8292	4929	3489	1417	48509

Figure 3.28: Annual injury admissions to each SWSAHS hospital, 1995-2004 (n=48509)



3.11 Admissions by data category

Please refer to the Introduction for a full explanation of major and minor data categories.

Table 3.10: Admissions by data category, SWSAHS hospitals, 1995-2004

Hospital	Major data category	Minor data category	Total	
			n	%
Liverpool	9123	12120	21243	43.8
Bankstown	1773	7366	9139	18.8
Campbelltown	1849	6443	8292	17.1
Fairfield	977	3952	4929	10.2
Bowral	896	2593	3489	7.2
Camden	300	1117	1417	2.9
Total	14918	33591	48509	100.0

Figure 3.29: Admissions by data category, SWSAHS hospitals, 1995-2004 (n=48509)

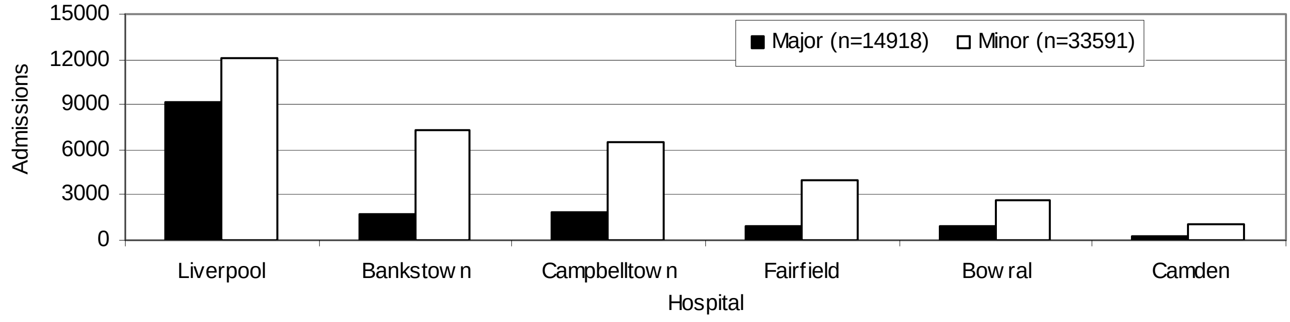
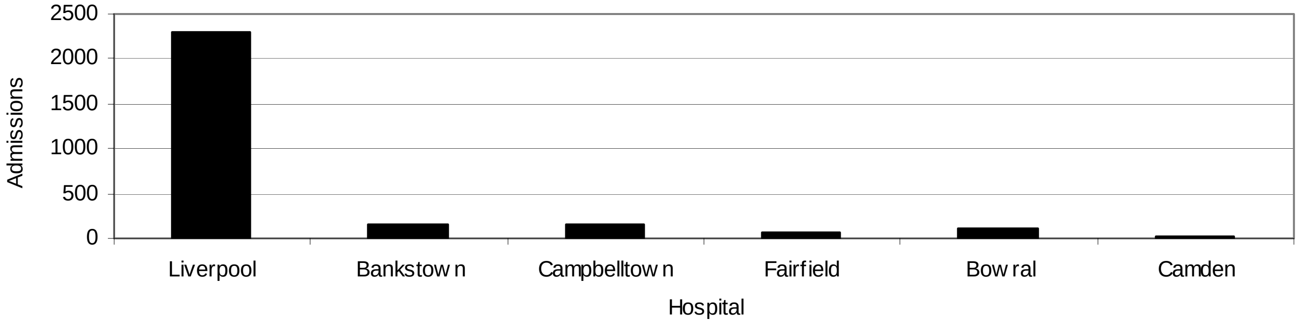


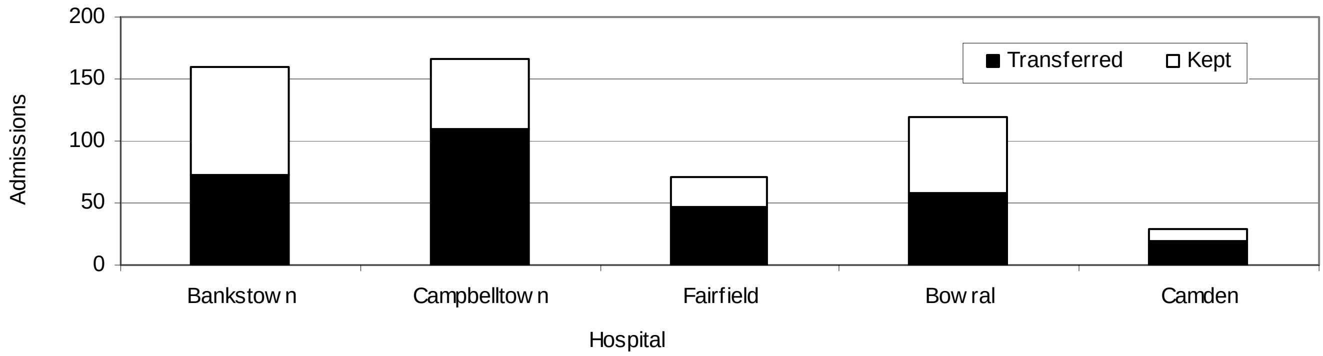
Figure 3.30: Admissions with ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=2858)



The majority of patients with ISS ≥ 16 were admitted to Liverpool Hospital, which is appropriate as Liverpool Hospital is the major trauma service. 306 (56.0%) of patients with ISS ≥ 16 who presented at SWSAHS urban / rural hospitals were subsequently transferred to Liverpool Hospital. The proportion of patients transferred is much lower for Bankstown Hospital compared to the other hospitals.

This information only reports transfers to Liverpool Hospital. It does not report transfers to other specialist trauma services, such as burns, spinal injury, paediatrics or a major trauma service outside SWSAHS.

Figure 3.31: Admissions with ISS ≥ 16, SWSAHS urban and rural hospitals, 1995-2004 (n=546)



3.12 Emergency department disposition

The trends for emergency department disposition are different for major and minor data categories, as demonstrated in the following figures.

Figure 3.32: ED disposition, all injuries, SWSAHS hospitals, 1995-2004 (n=48509)

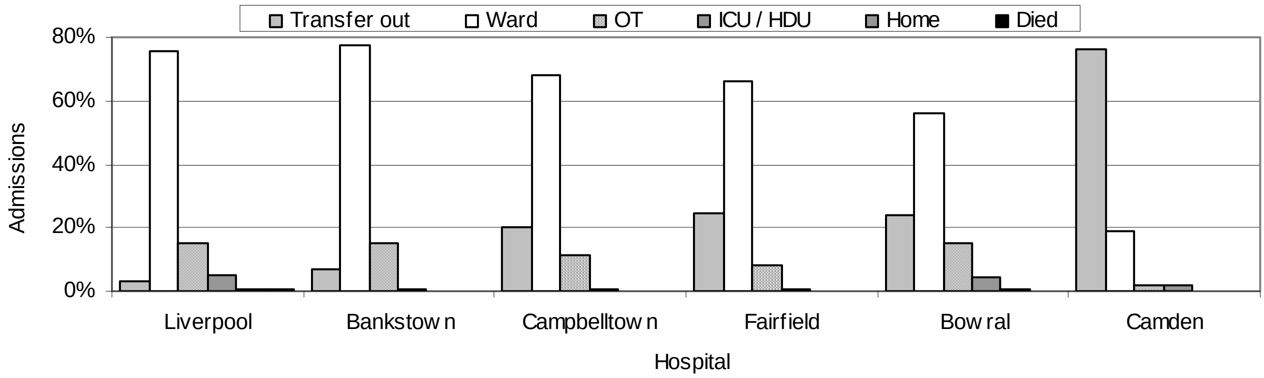


Figure 3.33: ED disposition, major data category, SWSAHS hospitals, 1995-2004 (n=14918)

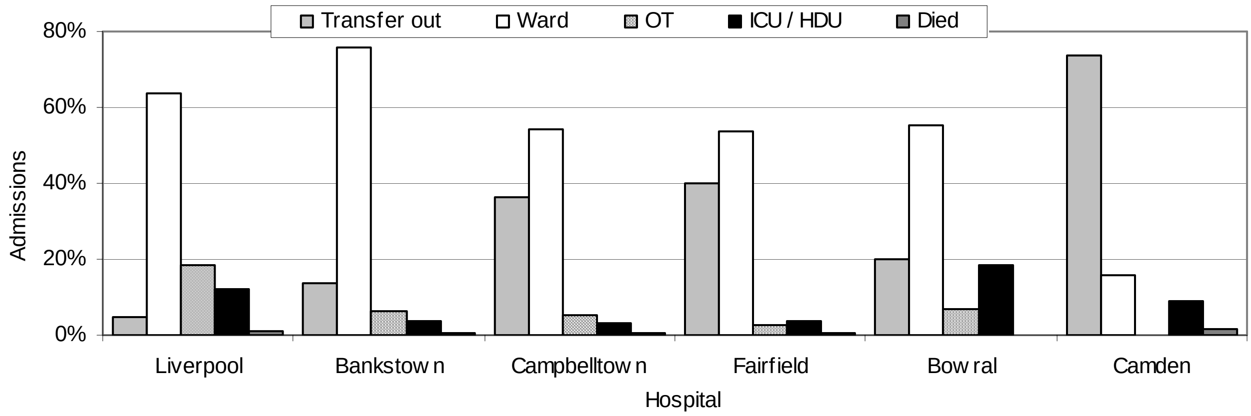
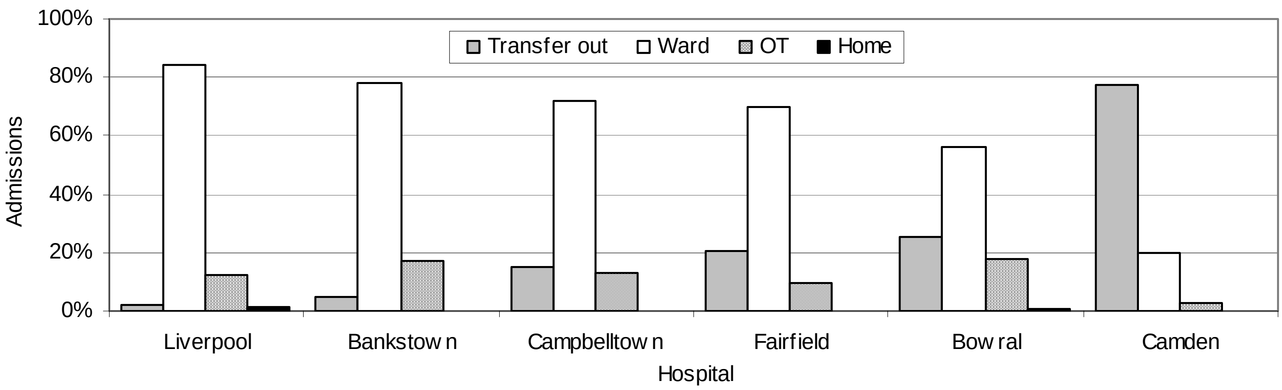


Figure 3.34: ED disposition, minor data category, SWSAHS hospitals, 1995-2004 (n=33591)



3.13 Day of presentation

Figure 3.35: Day of presentation, all injuries, Liverpool Hospital,1995-2004 (n=21243)

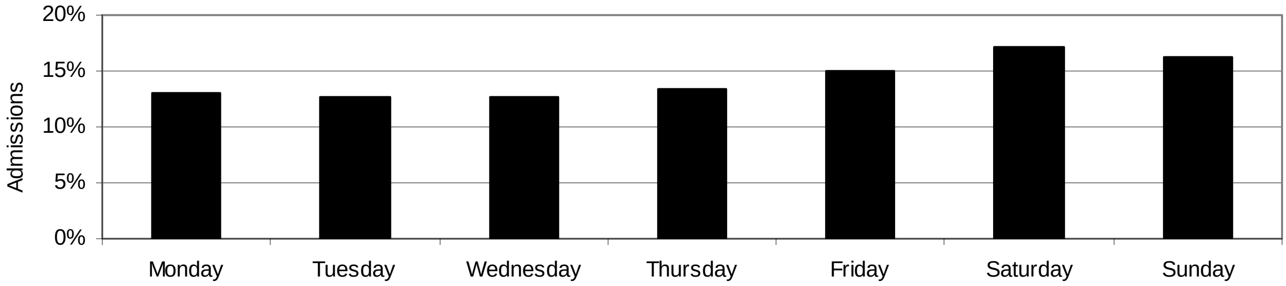


Figure 3.36: Day of presentation, all injuries, Bankstown Hospital,1995-2004 (n=9139)

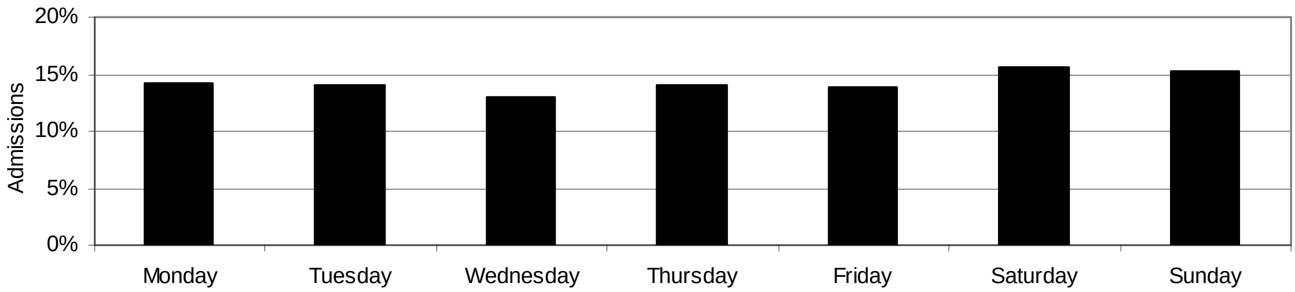


Figure 3.37: Day of presentation, all injuries, Campbelltown Hospital,1995-2004 (n=8292)

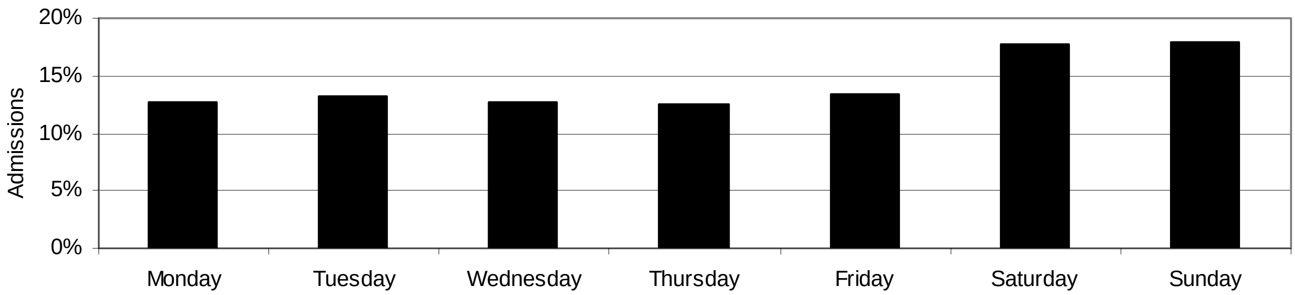


Figure 3.38: Day of presentation, all injuries, Fairfield Hospital,1995-2004 (n=4929)

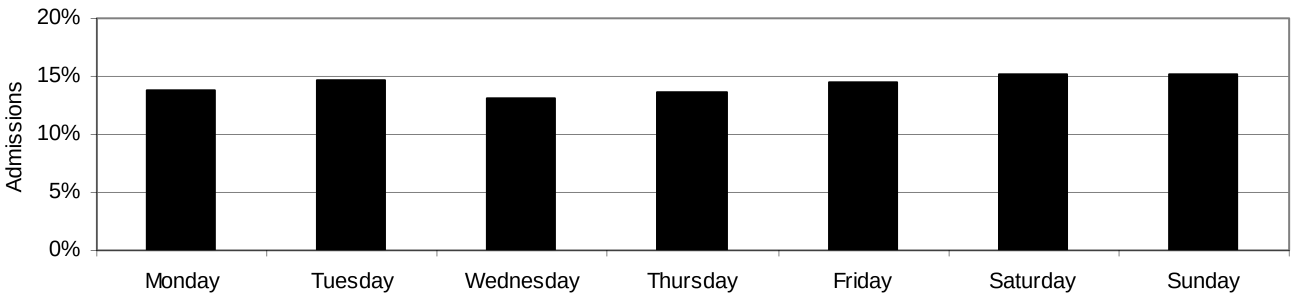


Figure 3.39: Day of presentation, all injuries, Camden Hospital,1995-2004 (n=1417)

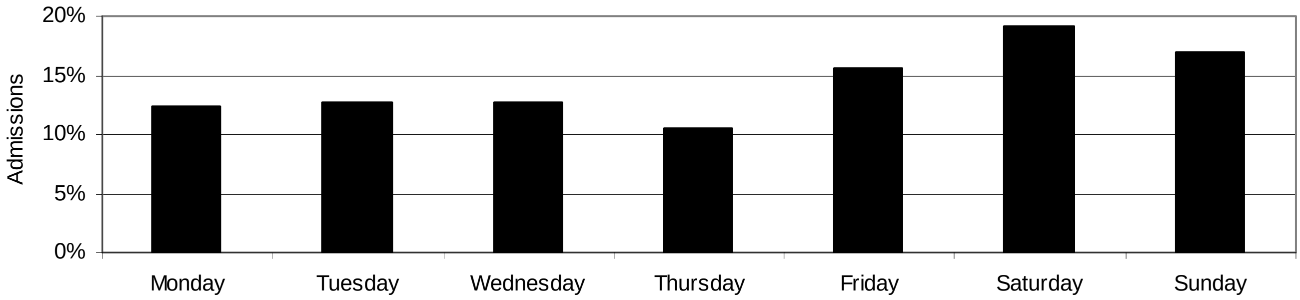
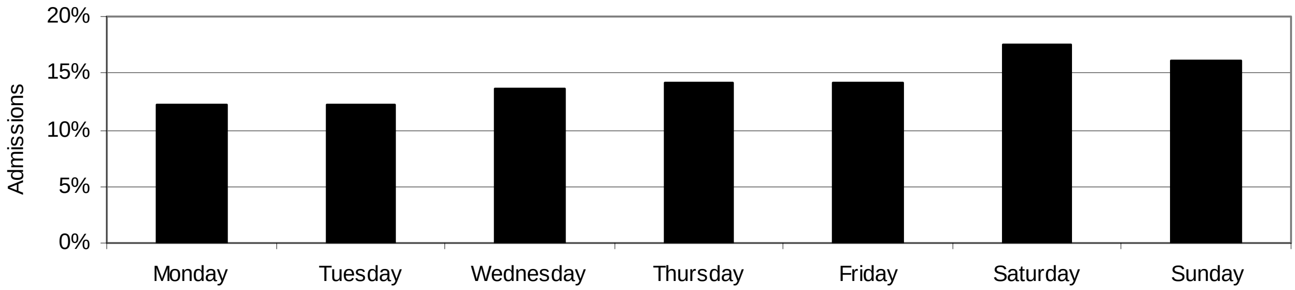


Figure 3.40: Day of presentation, all injuries, Bowral Hospital,1995-2004 (n=3489)



3.14 Time of arrival

Time of arrival in ED is captured for major data category patients. 6854 (45.9%) of patients present between 4pm and midnight. For the period midnight to 8am, Liverpool Hospital sees the highest proportion of presentations of all SWSAHS hospitals.

Table 3.11: Time of arrival, major data category, SWSAHS hospitals, 1995-2004

Hospital	Midnight-8am		8am-4pm		4pm-midnight		Total
	n	%	n	%	n	%	
Liverpool	1618	17.7	3280	36.0	4225	46.3	9123
Bankstown	206	11.6	829	46.8	738	41.6	1773
Campbelltown	178	9.6	743	40.2	928	50.2	1849
Fairfield	73	7.5	447	45.8	457	46.8	977
Bowral	88	9.8	437	48.8	371	41.4	896
Camden	21	7.0	144	48.0	135	45.0	300
Total	2184	14.6	5880	39.4	6854	45.9	14918

Figure 3.41: Time of arrival, major data category, SWSAHS hospitals, 1995-2004 (n=14918)

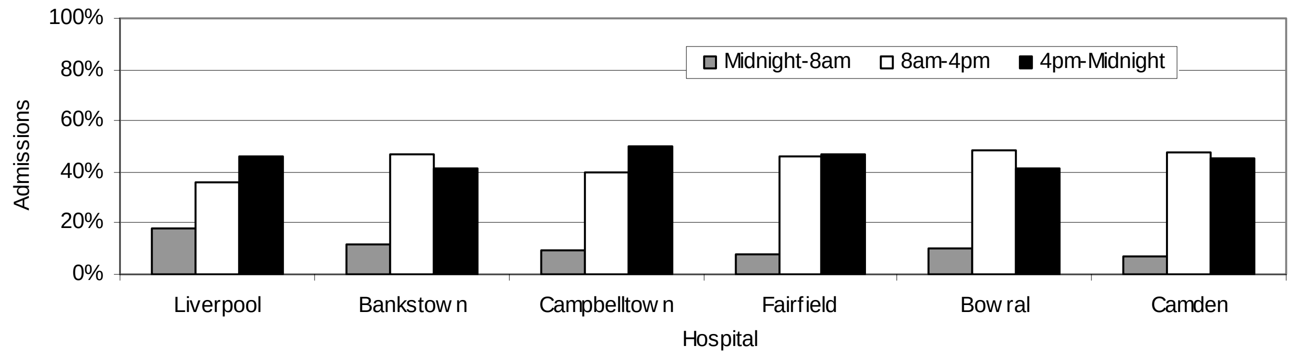
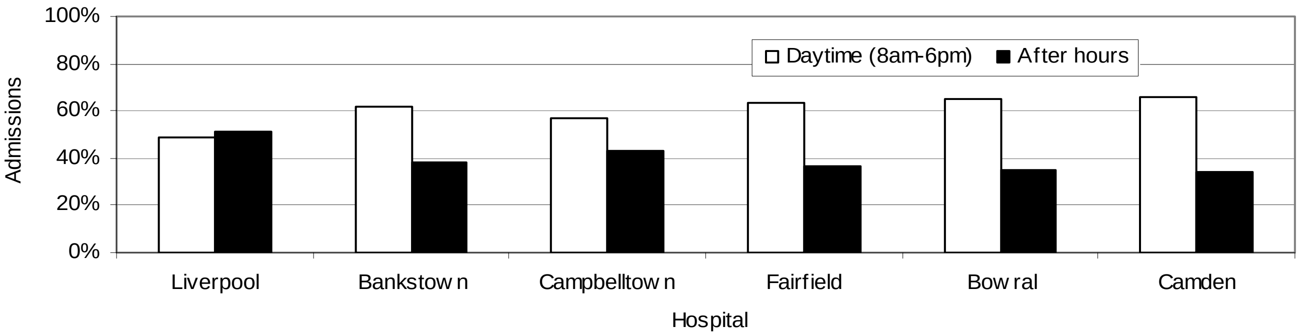


Figure 3.42: Time of arrival: Work hours versus after hours, major data category, SWSAHS hospitals, 1995-2004 (n=14918)



3.15 Length of stay

Table 3.12: Average length of stay (ALOS) in days, major data category, SWSAHS hospitals, 1995-2004

Hospital		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Liverpool	Patients	663	739	736	817	833	1002	1153	1146	1013	1021	9123
	ALOS	12.8	10.2	10.7	9.9	10.0	9.7	9.2	9.4	9.9	10.1	10.0
Bankstown	Patients	117	94	228	237	244	202	191	200	141	119	1773
	ALOS	8.7	8.2	8.5	8.6	7.4	6.2	8.7	10.1	10.2	10.8	8.6
Campbelltown	Patients	112	138	191	215	227	226	257	204	140	139	1849
	ALOS	7.7	6.4	5.3	6.7	4.1	4.3	4.0	5.8	5.2	4.2	5.2
Fairfield	Patients	73	69	113	114	104	124	110	103	63	104	977
	ALOS	7.2	6.3	4.6	7.3	4.5	6.2	4.3	4.6	4.1	3.2	5.2
Bowral	Patients	72	35	93	112	122	94	103	97	66	102	896
	ALOS	5.2	9.3	4.1	4.0	3.2	2.8	3.5	2.9	4.3	3.0	3.8
Camden	Patients	16	20	56	40	24	30	43	32	18	21	300
	ALOS	2.8	2.8	2.9	2.0	1.6	2.6	2.4	1.5	3.6	1.0	2.3
Total	Patients	1053	1095	1417	1535	1554	1678	1857	1782	1441	1506	14918
	ALOS	10.7	9.1	8.4	8.4	7.7	7.8	7.6	8.3	8.9	8.5	8.4

Table 3.13: ALOS for patients admitted to ICU or HDU, major data category, SWSAHS hospitals, 1995-2004

Hospital		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Liverpool	Patients	206	234	209	234	220	215	225	199	188	168	2098
	ALOS	5.1	4.8	4.2	4.7	5.3	6.3	4.6	5.7	7.8	6.8	5.5
	ISS mean	17.6	18.8	21.6	18.8	20.3	22.9	19.6	20.5	22.0	22.0	20.3
	ISS sd	13.6	12.6	12.8	12.1	11.6	12.8	11.7	11.1	12.7	11.7	12.4
	ISS range	1-75	1-75	2-75	1-75	1-66	1-75	1-66	4-75	1-75	1-59	1-75
Bankstown	Patients	14	11	9	12	16	12	16	13	7	2	112
	ALOS	5.1	3.7	5.6	2.6	5.3	4.9	3.7	5.6	2.9	3.0	4.4
Campbelltown*	Patients	18	7	11	19	13	7	4	8	5	3	95
	ALOS	2.8	2.1	1.7	2.3	2.5	2.0	2.8	3.0	3.8	5.7	2.6
Fairfield†	Patients	13	9	8	7	6	11	2	10	2	2	70
	ALOS	4.7	2.7	2.5	3.6	3.8	3.5	1.5	2.5	4.0	3.0	3.3
Bowral†	Patients	7	11	15	27	33	21	11	17	12	4	158
	ALOS	3.0	3.1	2.3	2.7	3.3	2.3	3.0	1.9	2.6	2.8	2.7
Camden†	Patients	2	3	11	10	0	0	1	3	0	0	30
	ALOS	4.5	3.0	2.3	2.2	-	-	2.0	2.3	-	-	2.5
Total	Patients	260	275	263	309	288	266	259	250	214	179	2563
	ALOS	4.9	4.5	3.9	4.2	4.9	5.7	4.4	5.2	7.2	6.6	5.0

* Between 1995-2004, 5937 patients were admitted to Campbelltown ICU / HDU. Of these, 95 (1.6%) were admitted following trauma. (2)

† Fairfield, Bowral and Camden Hospitals only have an High Dependency Unit.

References

1. Association for the Advancement of Automotive Medicine. The Abbreviated Injury Scale 1990 Revision. Update 98. Barrington (IL) USA: Association for the Advancement of Automotive Medicine; 2001.
2. Campbelltown Hospital ICU Department. Campbelltown Hospital ICU Admission Book. Figures provided courtesy of Campbelltown ICU Department; 03-02-2006.

4 Liverpool Hospital Overview

Executive comment

Liverpool Hospital is a 500-plus bed hospital and one of the principal university hospitals of the University of New South Wales, Sydney. Trauma patients are admitted after a thorough assessment by a multidisciplinary trauma team or via direct admission to the Emergency Department for less serious injuries. Day to day trauma care is provided by the general surgical team. The Trauma Department employs a Trauma Director and since 2001 a second trauma surgeon. There is not a formal trauma surgical admitting service so that the patients remain under the individual surgeon's care. Data has been continuously collected since 1995 by the Trauma Nurse Co-ordinator and Trauma Case Managers, and is entered into the registry on an ongoing basis.

Of all injury admissions in Sydney South West Area Health Service 47% are directed to the major trauma centre. Elderly patients, particularly elderly female patients, are at the greatest risk of sustaining an injury. The data indicates that admissions resulting from assault are steadily declining. Of particular note is that not only is blunt assault decreasing; so too are penetrating stab and gunshot injuries. Substance use is reported in a significant number of admissions, with an increasing association with assault, unlawful activities, self harm or assault by a partner compared to other forms of trauma.

Recommendations

1. Liverpool Hospital, as major trauma centre for south western Sydney needs to develop a trauma surgical service with patients admitted under trauma surgeons, facilitating consistent day to day trauma care.

2. Currently Liverpool Hospital, in international terms, would be considered a moderate volume trauma centre. To facilitate a trauma surgical unit, trauma needs to be combined with acute general surgery care.

3. The re-organisation of New South Wales Trauma Services will facilitate the concentration of skills and resources ensuring consistent care for large volumes of patients.

4. Given the pattern of admissions, particularly after hours, in-house specialist care will become essential across the disciplines of emergency; trauma surgery; acute general surgery; anaesthesia and intensive care.

4.1 Total admissions

During the 10 years 1995-2004 there were 21243 patients were admitted to Liverpool Hospital as a result of injury. Of these, 9123 (42.9%) were classified to the major data category and 12120 (57.1%) were classified to the minor data category (refer to the Introduction for a full explanation of each data category). 2309 (10.9%) of all patients sustained serious injury with an Injury Severity Score (ISS) ≥ 16.

Table 4.1: Total annual injury admissions, Liverpool Hospital, 1995-2004

Admissions:	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Total injuries	1700	1848	1802	1939	1911	2184	2393	2648	2429	2389	21243
Major data category	663	739	736	817	833	1002	1153	1146	1013	1021	9123
Minor data category	1037	1109	1066	1122	1078	1182	1240	1502	1416	1368	12120
Patients with ISS ≥ 16	151	196	206	203	221	281	246	256	281	268	2309

Figure 4.1: Total annual injury admissions, Liverpool Hospital, 1995-2004 (n=21243)

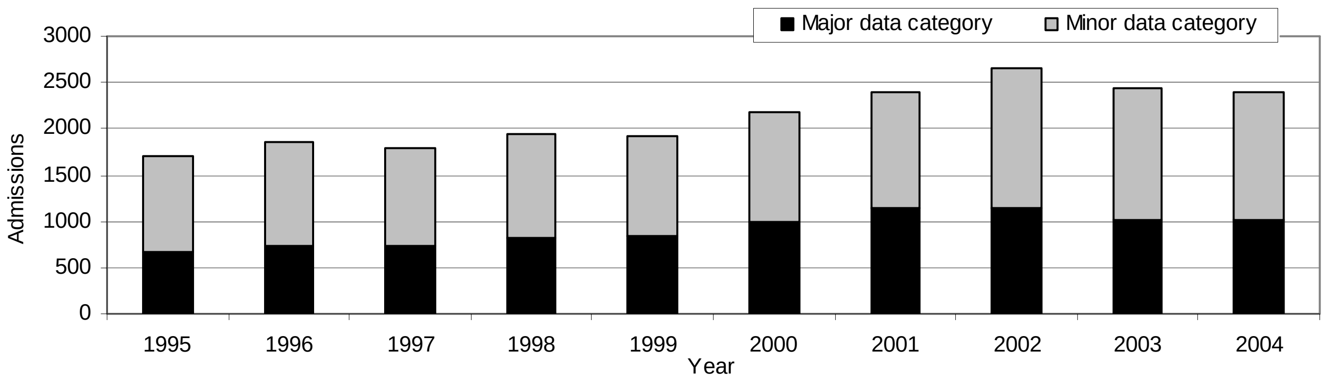
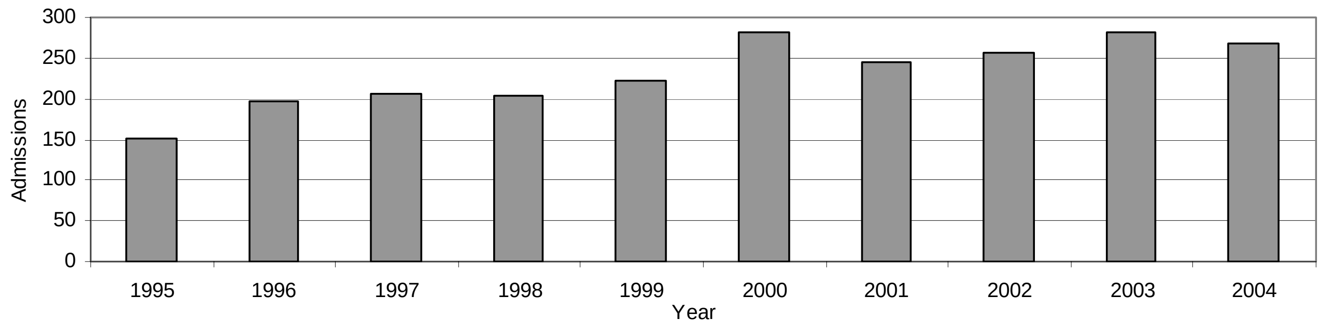
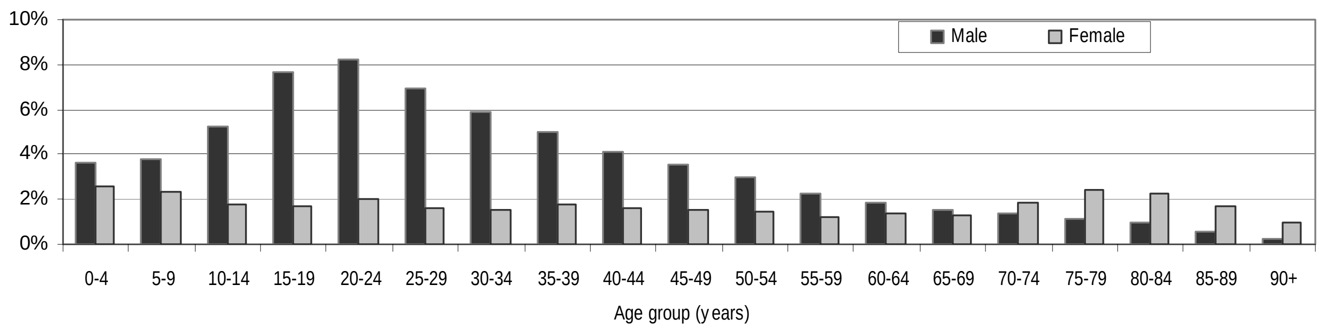


Figure 4.2: Annual admissions for serious injury (ISS≥16), Liverpool Hospital, 1995-2004 (n=2309)



4.2 Age and sex distribution

Figure 4.3: Age and sex distribution, Liverpool Hospital, all injuries, 1995-2004 (n=21243)



4.3 Place of injury

Place of injury data further describes the nature of the injury and is widely used for injury prevention and planning. ‘Street’ includes all roads, suburban streets, highways and motorways. ‘Industrial’ is used for all injuries occurring at work. ‘Recreation’ refers to general leisure activities aside from ‘organised sport’. ‘Residential institution’ refers to facilities providing live-in care, eg. nursing homes. ‘Facility’ includes public places such as shopping centres and railway stations, excluding pubs and clubs. The ‘school’ category includes pre-school, primary school and high school.

Overall, most injuries occur at home. Most minor data category admissions also occur at home. Major data category and ISS ≥ 16 admissions most commonly occur on the street (including highways and motorways), reflecting the large number of road trauma in these two groups.

Table 4.2: Place of injury, Liverpool Hospital, all injury admissions, 1995-2004

Place of injury		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Street	n	536	545	596	578	583	630	669	648	600	673	6058
	%	31.5	29.5	33.1	29.8	30.5	28.8	28.0	24.5	24.7	28.2	28.5
Home	n	533	636	591	666	695	788	786	879	843	814	7231
	%	31.4	34.4	32.8	34.3	36.4	36.1	32.8	33.2	34.7	34.1	34.0
Industrial	n	155	183	188	195	155	177	211	233	194	172	1863
	%	9.1	9.9	10.4	10.1	8.1	8.1	8.8	8.8	8.0	7.2	8.8
Recreation	n	114	117	102	118	129	219	173	192	182	169	1515
	%	6.7	6.3	5.7	6.1	6.8	10.0	7.2	7.3	7.5	7.1	7.1
Organised sport	n	82	70	61	57	57	78	116	127	129	118	895
	%	4.8	3.8	3.4	2.9	3.0	3.6	4.8	4.8	5.3	4.9	4.2
Residential institution	n	68	46	46	51	61	44	64	85	83	94	642
	%	4.0	2.5	2.6	2.6	3.2	2.0	2.7	3.2	3.4	3.9	3.0
Facility	n	46	46	50	66	47	57	73	78	57	58	578
	%	2.7	2.5	2.8	3.4	2.5	2.6	3.1	2.9	2.3	2.4	2.7
Pub / club	n	38	38	43	31	29	38	38	41	50	34	380
	%	2.2	2.1	2.4	1.6	1.5	1.7	1.6	1.5	2.1	1.4	1.8
School	n	24	35	26	24	22	27	38	47	35	26	304
	%	1.4	1.9	1.4	1.2	1.2	1.2	1.6	1.8	1.4	1.1	1.4
Farm	n	23	26	22	20	26	24	33	27	29	40	270
	%	1.4	1.4	1.2	1.0	1.4	1.1	1.4	1.0	1.2	1.7	1.3
Other	n	5	9	7	4	1	4	9	1	13	9	62
	%	0.3	0.5	0.4	0.2	0.1	0.2	0.4	0.0	0.5	0.4	0.3
Not documented	n	76	97	70	129	106	98	183	290	214	182	1445
	%	4.5	5.2	3.9	6.7	5.5	4.5	7.6	11.0	8.8	7.6	6.8
Total		1700	1848	1802	1939	1911	2184	2393	2648	2429	2389	21243

Figure 4.4: Top two places of Injury, Liverpool Hospital, all injury admissions, 1995-2004 (n=21243)

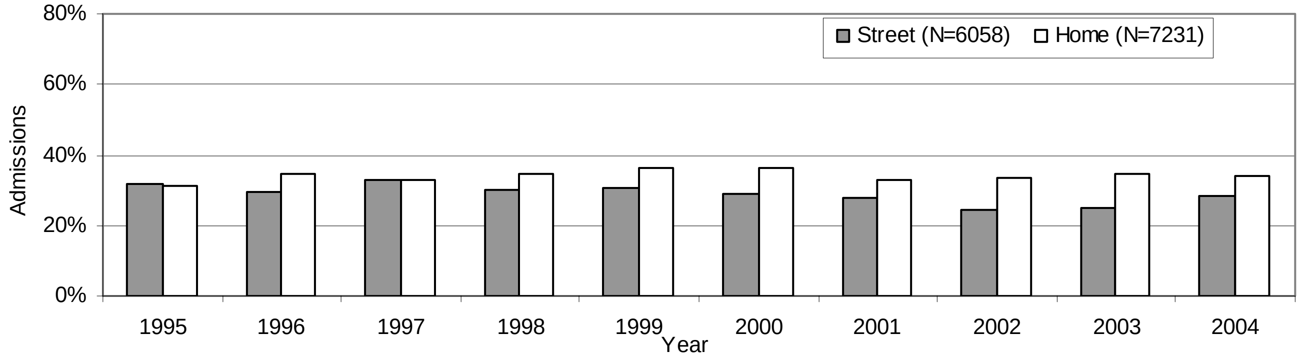
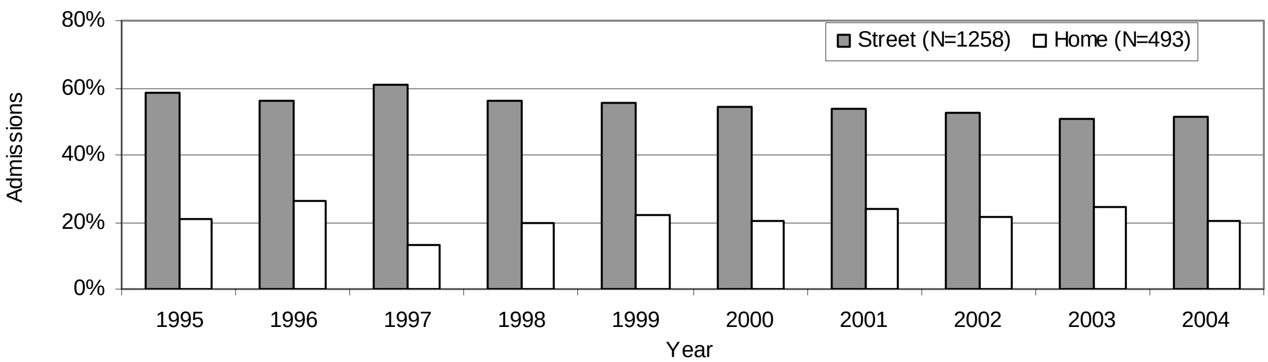


Table 4.3: Place of injury for ISS ≥ 16, Liverpool Hospital, 1995-2004

Place of injury		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Street	n	88	110	125	114	123	153	132	134	142	137	1258
	%	58.3	56.1	60.7	56.2	55.7	54.4	53.7	52.3	50.5	51.1	54.5
Home	n	32	51	27	40	49	57	59	55	68	55	493
	%	21.2	26.0	13.1	19.7	22.2	20.3	24.0	21.5	24.2	20.5	21.4
Industrial	n	12	13	15	14	15	18	9	19	11	21	147
	%	7.9	6.6	7.3	6.9	6.8	6.4	3.7	7.4	3.9	7.8	6.4
Recreation	n	2	3	5	3	7	14	8	8	12	11	73
	%	1.3	1.5	2.4	1.5	3.2	5.0	3.3	3.1	4.3	4.1	3.2
Organised sport	n	3	0	7	4	3	5	10	7	6	7	52
	%	2.0		3.4	2.0	1.4	1.8	4.1	2.7	2.1	2.6	2.3
Residential institution	n	1	3	2	4	3	2	7	2	6	5	35
	%	0.7	1.5	1.0	2.0	1.4	0.7	2.8	0.8	2.1	1.9	1.5
Facility	n	3	4	13	3	5	10	11	7	13	8	77
	%	2.0	2.0	6.3	1.5	2.3	3.6	4.5	2.7	4.6	3.0	3.3
Pub / club	n	0	0	0	1	0	1	1	2	0	1	6
	%				0.5		0.4	0.4	0.8		0.4	0.3
School	n	1	2	2	4	5	3	1	4	7	6	35
	%	0.7	1.0	1.0	2.0	2.3	1.1	0.4	1.6	2.5	2.2	1.5
Farm	n	1	0	1	1	0	2	1	0	0	0	6
	%	0.7		0.5	0.5		0.7	0.4				0.3
Other	n	3	4	0	3	3	6	1	5	5	6	36
	%	2.0	2.0		1.5	1.4	2.1	0.4	2.0	1.8	2.2	1.6
Total		151	196	206	203	221	281	246	256	281	268	2309

Figure 4.5: Top two places of injury, ISS ≥ 16, Liverpool Hospital, 1995-2004 (n=2309)



4.4 Blunt versus penetrating trauma

Major data category injuries are classified as either blunt or penetrating. The classification is based on the actual injury sustained, rather than the mechanism of injury. When both blunt and penetrating injuries are present, the force that resulted in the most serious injury is coded. Most penetrating injuries are due to stabbings and gunshot wounds. Further data regarding penetrating injury is presented in Chapter 6 (Types of Injury).

Figure 4.6: Blunt versus penetrating injury, Liverpool Hospital, major data category, 1995-2004 (n=9123)

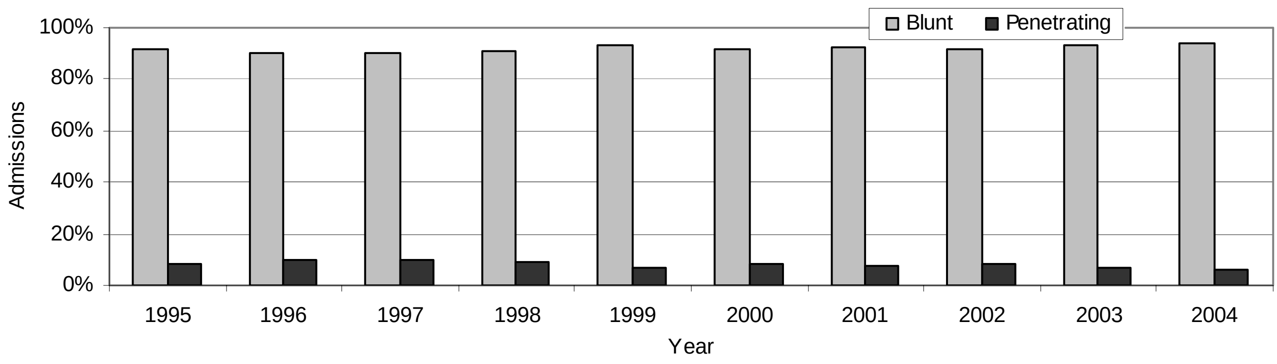


Figure 4.7: Blunt versus penetrating injury, Liverpool Hospital, ISS ≥ 16, 1995-2004 (n=2309)

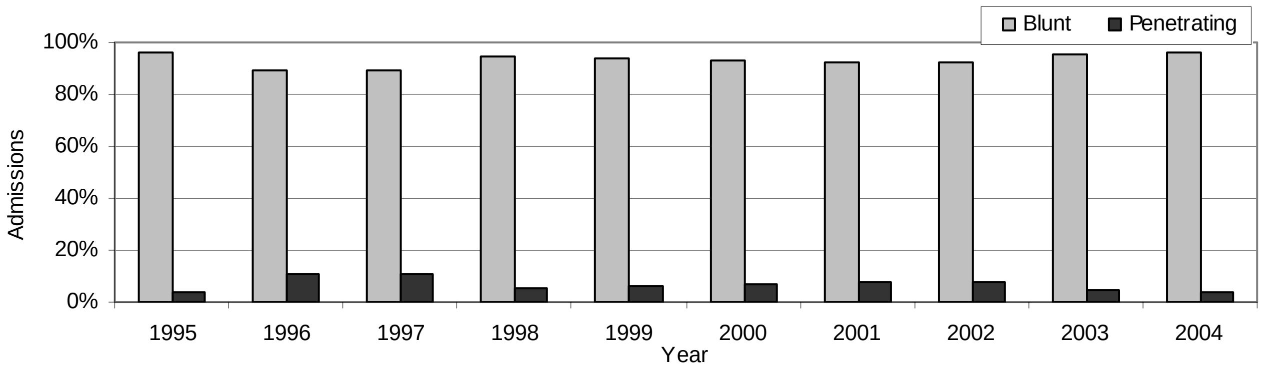


Figure 4.8: Penetrating trauma by sex, Liverpool Hospital, major data category, 1995-2004 (n=724)

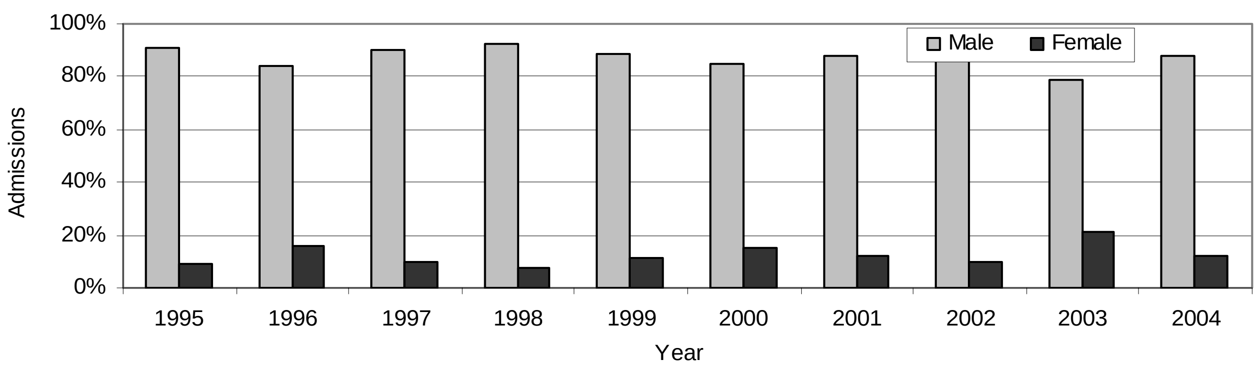


Figure 4.9: Penetrating trauma age distribution (years), Liverpool Hospital, major data category, 1995-2004 (n=724)

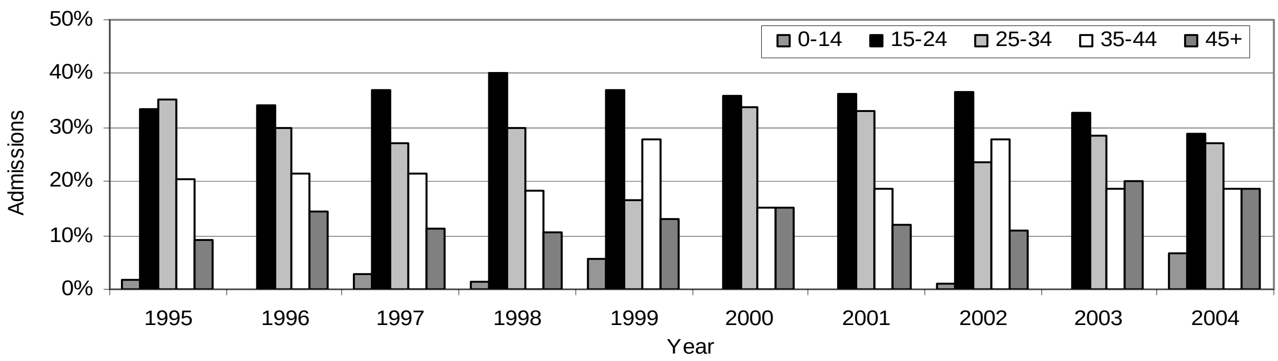
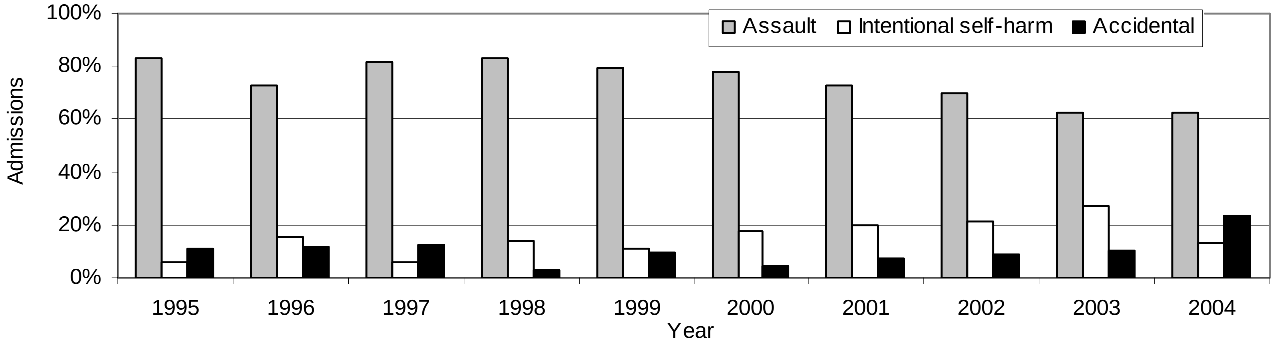


Figure 4.10: Penetrating trauma by injury intent, Liverpool Hospital, major data category, 1995-2004 (n=724)



4.5 Injury intent

The most common injury intent is accidental (87.9%), followed by assault (10.1%) and self-harm (2.0%). The rate of non-accidental injury increases in patients with ISS ≥ 16.

Table 4.4: Injury intent, all injuries, Liverpool Hospital, 1995-2004

Year	Accidental		Assault		Self-harm		Total
	n	%	n	%	n	%	
1995	1535	90.3	160	9.4	5	0.3	1700
1996	1613	87.3	204	11.0	31	1.7	1848
1997	1553	86.2	210	11.7	39	2.2	1802
1998	1694	87.4	196	10.1	49	2.5	1939
1999	1672	87.5	196	10.3	43	2.3	1911
2000	1898	86.9	228	10.4	58	2.7	2184
2001	2057	86.0	283	11.8	53	2.2	2393
2002	2319	87.6	272	10.3	57	2.2	2648
2003	2162	89.0	212	8.7	55	2.3	2429
2004	2172	90.9	178	7.5	39	1.6	2389
Total	18675	87.9	2139	10.1	429	2.0	21243

Figure 4.11: Injury intent, all injuries, Liverpool Hospital, 1995-2004 (n=21243)

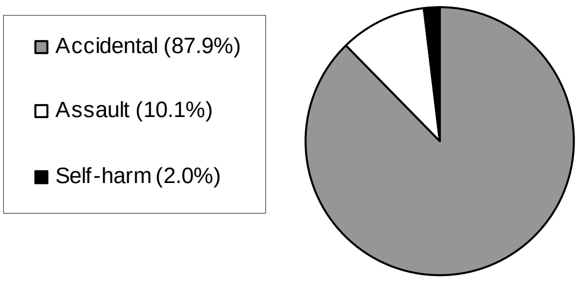
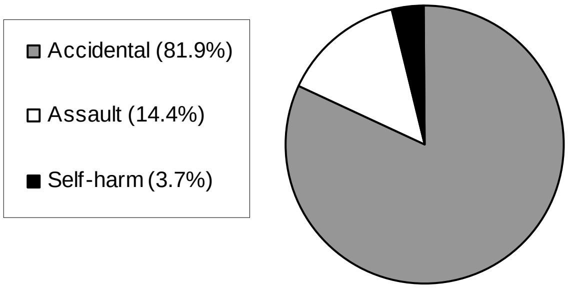


Table 4.5: Injury intent, ISS ≥ 16, Liverpool Hospital, 1995-2004

Year	Accidental		Assault		Self-harm		Total
	n	%	n	%	n	%	
1995	137	90.7	13	8.6	1	0.7	151
1996	151	77.0	34	17.3	11	5.6	196
1997	163	79.1	40	19.4	3	1.5	206
1998	170	83.7	25	12.3	8	3.9	203
1999	180	81.4	32	14.5	9	4.1	221
2000	231	82.2	41	14.6	9	3.2	281
2001	194	78.9	39	15.9	13	5.3	246
2002	206	80.5	38	14.8	12	4.7	256
2003	227	80.8	42	14.9	12	4.3	281
2004	231	86.2	29	10.8	8	3.0	268
Total	1890	81.9	333	14.4	86	3.7	2309

Figure 4.12: Injury intent, ISS ≥ 16, Liverpool Hospital, 1995-2004 (n=2309)



4.6 Time of arrival

Almost half of all major data category admissions occur between 4pm and midnight, followed by 8am to 4pm. The least common time of arrival is between 12 midnight and 8am, however 17.7% of admissions still occur during this time. The proportion of admissions occurring during midnight and 8am; 8am to 4pm; and 4pm to midnight remains constant over the 10-year period.

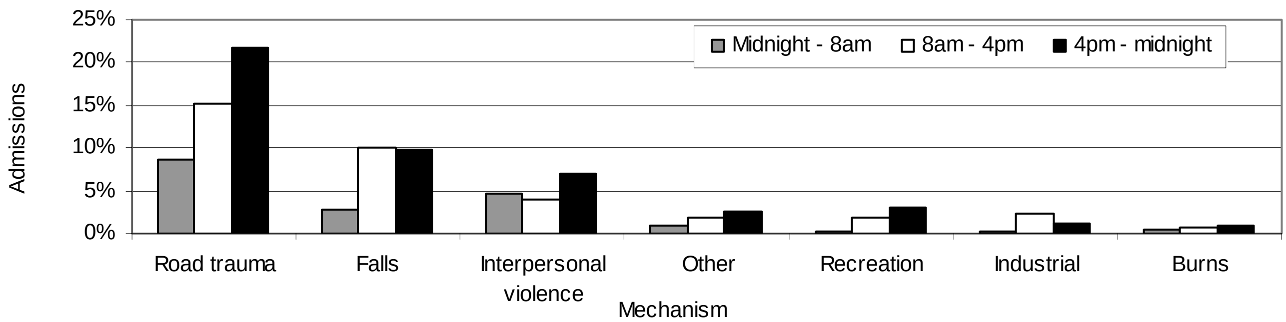
Table 4.6: Time of arrival by year, in 8-hour intervals, major data category, Liverpool Hospital, 1995-2004

Year	Midnight - 8am		8am - 4pm		4pm - Midnight		Total
	n	%	n	%	n	%	
1995	114	17.2	257	38.8	292	44.0	663
1996	129	17.5	282	38.2	328	44.4	739
1997	136	18.5	283	38.5	317	43.1	736
1998	149	18.2	285	34.9	383	46.9	817
1999	156	18.7	312	37.5	365	43.8	833
2000	178	17.8	366	36.5	458	45.7	1002
2001	222	19.3	386	33.5	545	47.3	1153
2002	210	18.3	399	34.8	537	46.9	1146
2003	168	16.6	351	34.6	494	48.8	1013
2004	156	15.3	359	35.2	506	49.6	1021
Total	1618	17.7	3280	36.0	4225	46.3	9123

Table 4.7: Time of arrival by mechanism of injury, in 8-hour intervals, major data category, Liverpool Hospital, 1995-2004

Mechanism	Midnight - 8am		8am - 4pm		4pm - Midnight		Total
	n	%	n	%	n	%	
Road trauma	783	18.9	1383	33.3	1986	47.8	4152
Falls	246	11.9	921	44.5	903	43.6	2070
Interpersonal violence	428	29.8	358	24.9	650	45.3	1436
Other	75	15.5	181	37.3	229	47.2	485
Recreation	27	5.6	177	37.0	275	57.4	479
Industrial	21	6.5	203	62.5	101	31.1	325
Burns	38	21.6	57	32.4	81	46.0	176
Total	1618	17.7	3280	36.0	4225	46.3	9123

Figure 4.13: Time of arrival by mechanism of injury, in 8-hour intervals, major data category, Liverpool Hospital, 1995-2004 (n=9123)



There are many ways of presenting 'time of arrival' information. Using different time intervals may be particularly useful to identify trends with certain mechanisms of injury. The following figure presents mechanism of injury by time of arrival, using different time intervals to those above, for road trauma, falls and interpersonal violence.

Figure 4.14: Time of arrival for top three mechanisms of injury, major data category, Liverpool Hospital, 1995-2004 (n=7658)

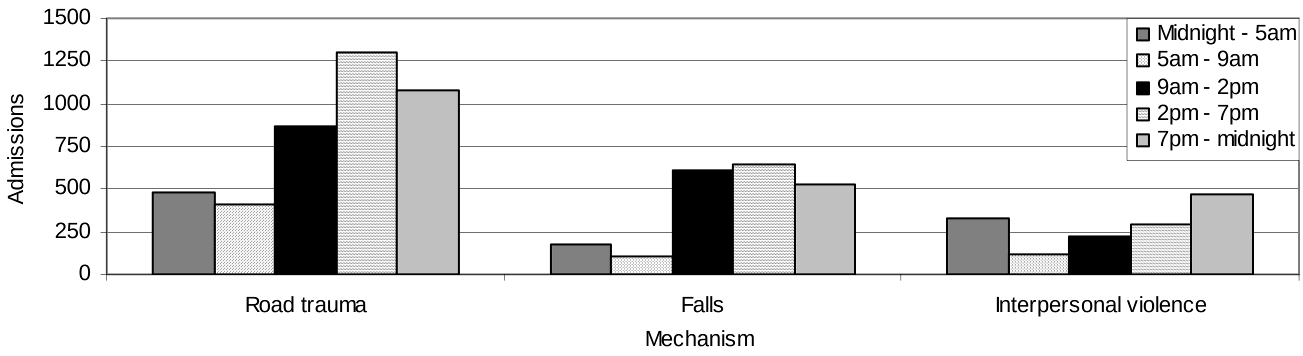


Figure 4.15: Time of arrival for road trauma, major data category, Liverpool Hospital, 1995-2004 (n=4152)

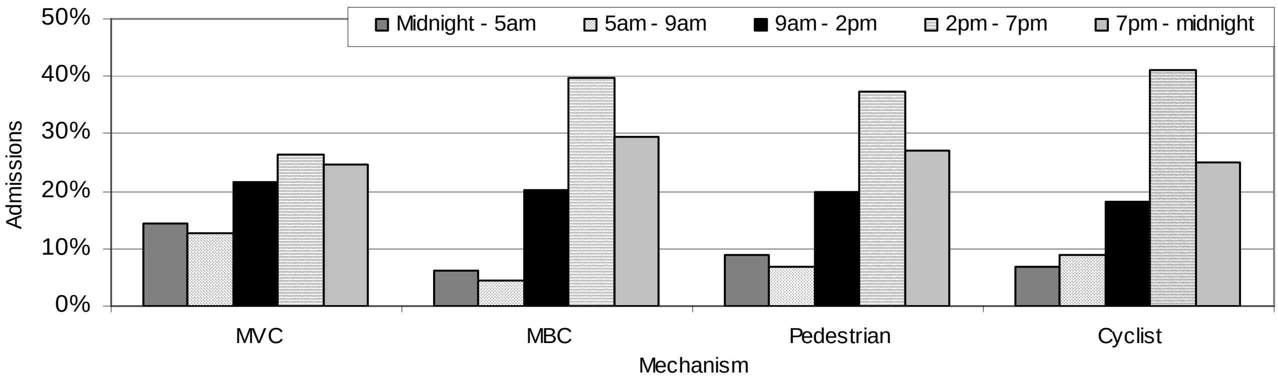


Table 4.8: Time of arrival by ISS, major data category, Liverpool Hospital, 1995-2004

ISS	Midnight - 8am		8am - 4pm		4pm - Midnight		Total	
	n	%	n	%	n	%	n	%
ISS < 16	1148	16.8	2486	36.5	3180	46.7	6814	100.0
ISS ≥ 16	470	20.4	794	34.4	1045	45.3	2309	100.0
Total	1618	17.7	3280	36.0	4225	46.3	9123	100.0

Table 4.9: Time of arrival by ISS, road trauma, Liverpool Hospital, 1995-2004

ISS	Midnight - 8am		8am - 4pm		4pm - Midnight		Total	
	n	%	n	%	n	%	n	%
ISS < 16	526	17.8	995	33.6	1441	48.6	2962	100.0
ISS ≥ 16	257	21.6	388	32.6	545	45.8	1190	100.0
Total	783	18.9	1383	33.3	1986	47.8	4152	100.0

Table 4.10: Time of arrival for blunt versus penetrating trauma, major data category, Liverpool Hospital, 1995-2004

Trauma type	Midnight - 8am		8am - 4pm		4pm - Midnight		Total	
	n	%	n	%	n	%	n	%
Blunt	1425	17.0	3091	36.8	3883	46.2	8399	100.0
Penetrating	193	26.7	189	26.1	342	47.2	724	100.0
Total	1618	17.7	3280	36.0	4225	46.3	9123	100.0

4.7 Mechanism of injury

Table 4.11: Mechanism of injury, all injuries, Liverpool Hospital, 1995-2004

Mechanism		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total n	Total %
Falls	Fall < 5m	505	525	473	523	543	565	636	798	826	832	6226	29.3
	Fall ≥ 5m	28	32	34	31	28	29	32	42	38	30	324	1.5
	Total	533	557	507	554	571	594	668	840	864	862	6550	30.8
Road trauma	MVC driver	158	164	215	199	232	261	242	241	206	233	2151	10.1
	MBCA rider	78	72	63	102	70	77	85	77	83	84	791	3.7
	Pedestrian	42	35	28	32	48	28	35	43	32	37	360	1.7
	MVC front passenger	78	66	72	74	80	121	138	105	121	158	1013	4.8
	MVC back passenger	3	5	4	6	0	7	8	6	5	4	48	0.2
	Cyclist (vs. vehicle)	102	92	75	94	90	78	90	97	89	92	899	4.2
	MBC pillion	23	24	18	21	14	21	14	25	24	25	209	1.0
	Total	484	458	475	528	534	593	612	594	560	633	5471	25.8
Other	Other	91	164	129	125	149	147	149	205	196	161	1516	7.1
	Cyclist (not vs. vehicle)	19	27	35	28	37	47	35	60	47	51	386	1.8
	Not documented	29	19	28	33	16	14	28	36	51	51	305	1.4
	Limb through glass*	-	-	15	22	23	33	41	46	29	16	225	1.1
	Dog bite	12	24	16	18	14	25	16	20	16	14	175	0.8
	Fall from horse	13	6	5	8	16	19	26	21	21	23	158	0.7
	Hanging	1	5	0	8	3	5	6	5	3	7	43	0.2
	Total	165	245	228	242	258	290	301	393	363	323	2808	13.2
Interpersonal violence	Blunt assault	108	143	151	125	138	136	192	181	147	123	1444	6.8
	Stabbing	43	57	63	71	52	83	88	78	60	56	651	3.1
	Gunshot	13	16	13	16	16	26	32	35	17	11	195	0.9
	Total	164	216	227	212	206	245	312	294	224	190	2290	10.8
Industrial		149	188	186	204	170	220	220	228	167	150	1882	8.9
Recreation		149	131	140	144	121	190	211	226	189	174	1675	7.9
Burns		56	53	39	55	51	52	69	73	62	57	567	2.7
Total		1700	1848	1802	1939	1911	2184	2393	2648	2429	2389	21243	100.0

*Limb through glass mechanism commenced in 1997. Prior to this the 'Other' category was used for this injury.

Figure 4.16: Mechanism of injury, all injury admissions, Liverpool Hospital, 1995-2004 (n=21243)

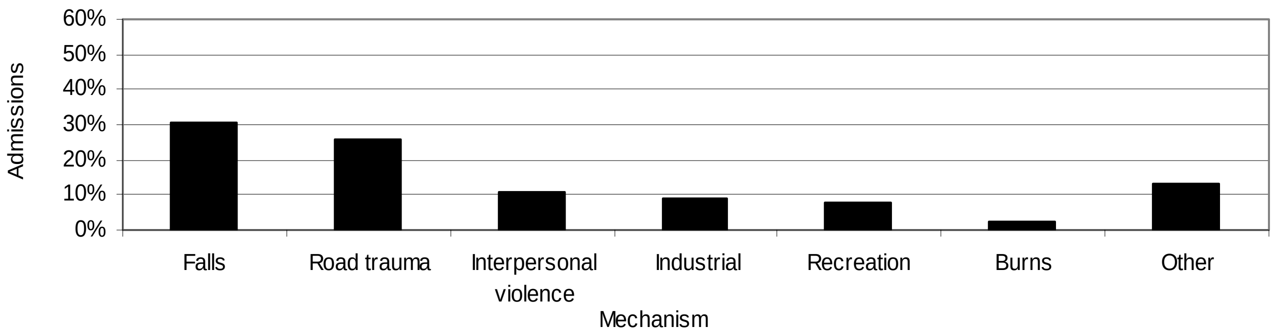


Figure 4.17: Mechanism of injury, ISS ≥ 16, Liverpool Hospital, 1995-2004 (n=2309)

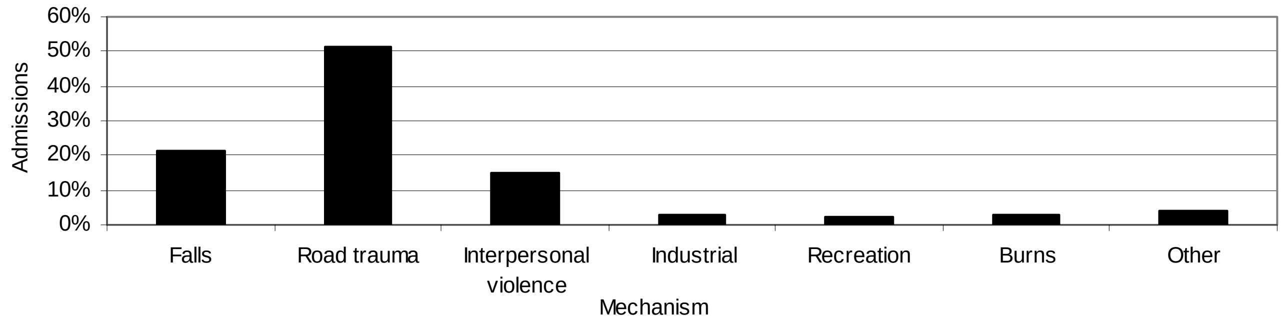


Figure 4.18: Mechanism of injury, major data category, Liverpool Hospital, 1995-2004 (n=9123)

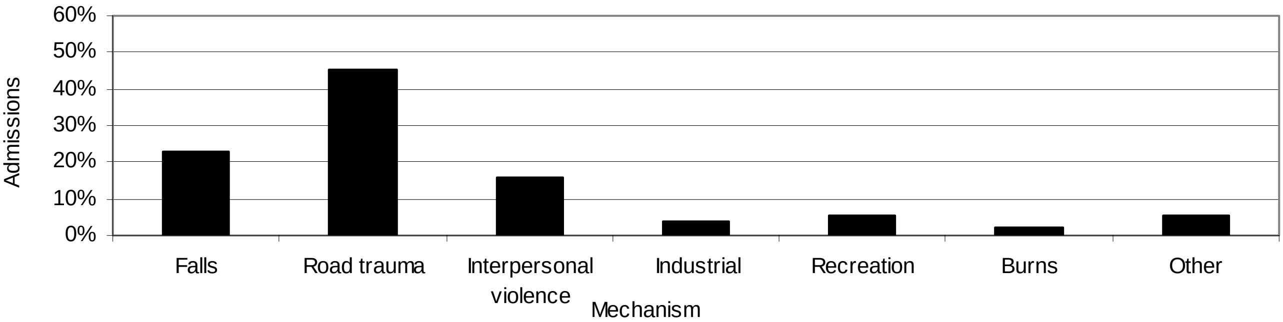


Figure 4.19: Mechanism of injury, minor data category, Liverpool Hospital, 1995-2004 (n=12120)

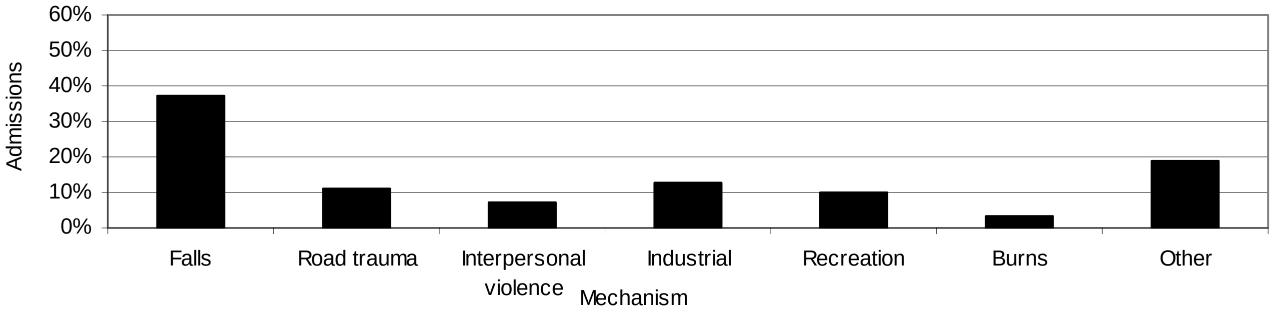


Figure 4.20: Annual trends for falls, road trauma and interpersonal violence, Liverpool Hospital, 1995-2004 (n=14311)

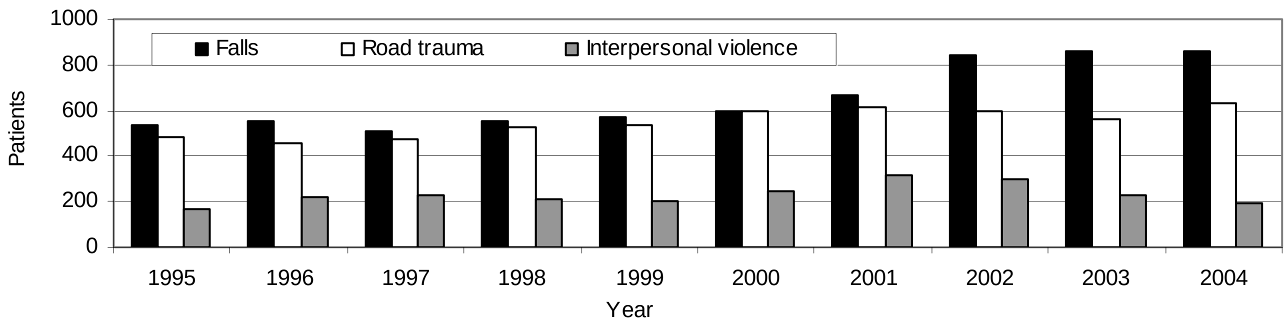
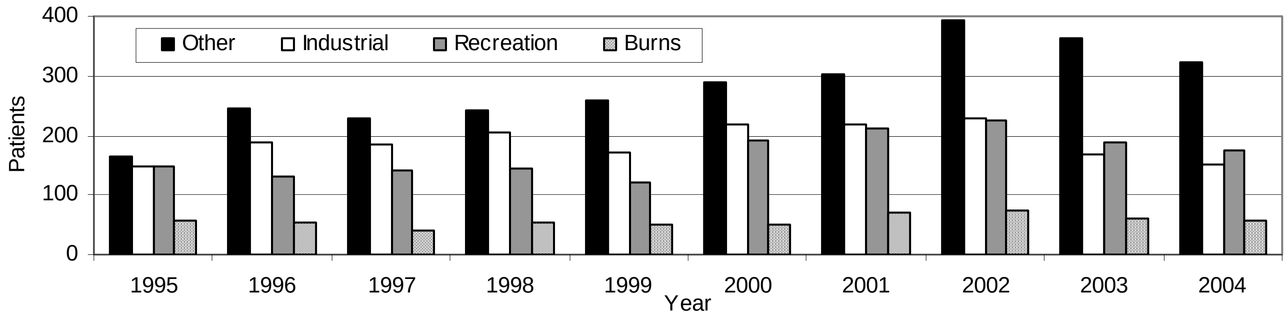


Figure 4.21: Annual trends for other, industrial, recreational injuries and burns, Liverpool Hospital, 1995-2004 (n=6932)



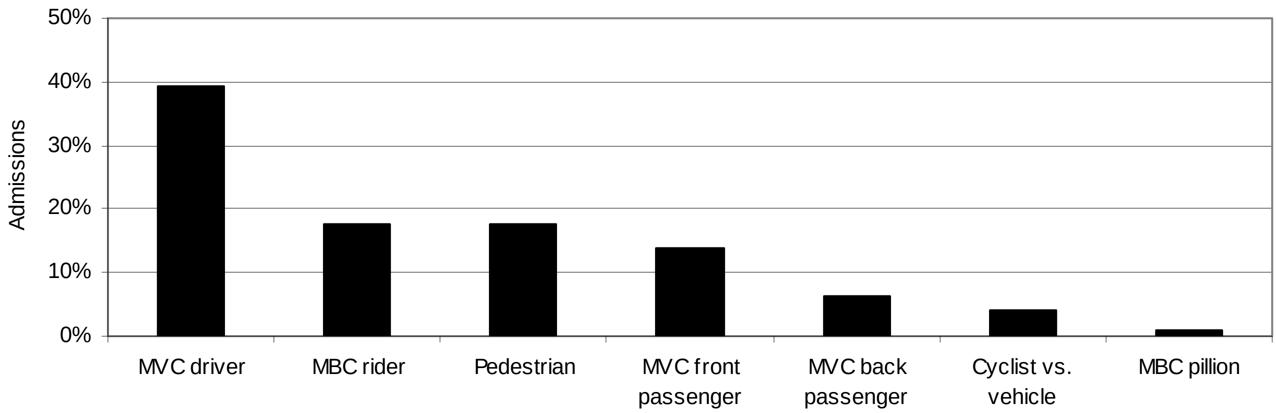
4.8 Road trauma

Drivers in motor vehicle crashes are the most commonly admitted type of road trauma, followed by motorbike crashes, pedestrians, and front passengers in motor vehicle crashes.

Table 4.12: Road trauma annual trends, major data category, Liverpool Hospital, 1995-2004

Year	MVC driver		MBC rider		Pedestrian		MVC front passenger		MVC back passenger		Cyclist vs. vehicle		MBC pillion		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
1995	111	32.6	53	15.6	79	23.2	52	15.3	29	8.5	15	4.4	1	0.3	340
1996	123	35.7	45	13.0	77	22.3	53	15.4	25	7.2	18	5.2	4	1.2	345
1997	169	45.7	46	12.4	60	16.2	54	14.6	22	5.9	15	4.1	4	1.1	370
1998	155	38.3	58	14.3	80	19.8	69	17.0	23	5.7	16	4.0	4	1.0	405
1999	171	43.1	58	14.6	73	18.4	52	13.1	32	8.1	11	2.8		0.0	397
2000	192	43.4	82	18.6	65	14.7	55	12.4	22	5.0	20	4.5	6	1.4	442
2001	183	37.9	116	24.0	71	14.7	64	13.3	32	6.6	12	2.5	5	1.0	483
2002	191	40.8	81	17.3	73	15.6	63	13.5	34	7.3	21	4.5	5	1.1	468
2003	164	37.8	90	20.7	75	17.3	56	12.9	23	5.3	21	4.8	5	1.2	434
2004	177	37.8	108	23.1	74	15.8	62	13.2	23	4.9	22	4.7	2	0.4	468
Total	1636	39.4	737	17.8	727	17.5	580	14.0	265	6.4	171	4.1	36	0.9	4152

Figure 4.22: Road trauma mechanisms of injury, major data category, Liverpool Hospital, 1995-2004 (n=4152)



Monday, Tuesday and Sunday are the three most common days for road trauma presentations, however the variation between days is relatively small.

Table 4.13: Road trauma by day of arrival, major data category, Liverpool Hospital, 1995-2004

Year		MVC driver	MVC front passenger	MVC back passenger	MBC rider	MBC pillion	Pedestrian	Cyclist vs. vehicle	Total
Monday	n	276	108	38	123	3	127	25	700
	%	16.9	18.6	14.3	16.7	8.3	17.5	14.6	16.9
Tuesday	n	258	89	48	97	14	114	31	651
	%	15.8	15.3	18.1	13.2	38.9	15.7	18.1	15.7
Wednesday	n	202	79	34	90	2	81	24	512
	%	12.3	13.6	12.8	12.2	5.6	11.1	14.0	12.3
Thursday	n	225	72	47	105	6	83	18	556
	%	13.8	12.4	17.7	14.2	16.7	11.4	10.5	13.4
Friday	n	213	83	35	102	6	110	22	571
	%	13.0	14.3	13.2	13.8	16.7	15.1	12.9	13.8
Saturday	n	193	70	30	107	1	97	13	511
	%	11.8	12.1	11.3	14.5	2.8	13.3	7.6	12.3
Sunday	n	269	79	33	113	4	115	38	651
	%	16.4	13.6	12.5	15.3	11.1	15.8	22.2	15.7
Total	n	1636	580	265	737	36	727	171	4152
	%	39.4	14.0	6.4	17.8	0.9	17.5	4.1	100.0

Figure 4.23: Road trauma by day of arrival, major data category, Liverpool Hospital, 1995-2004 (n=4152)

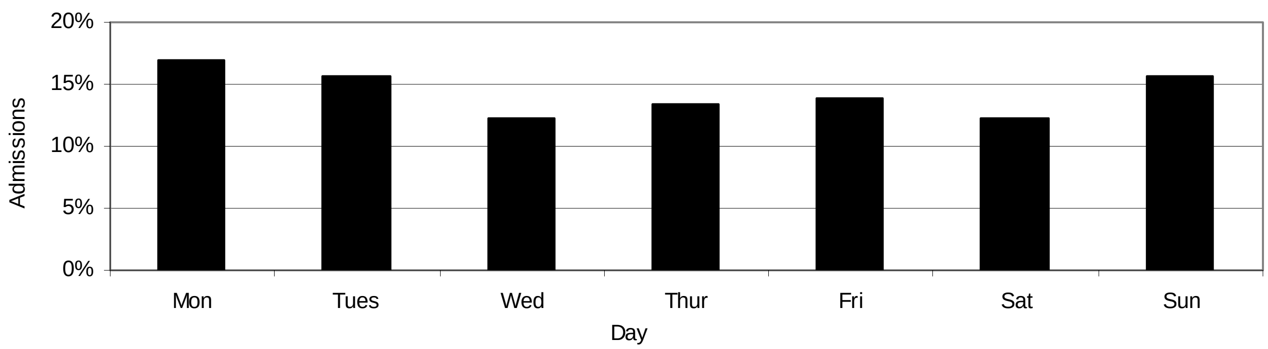


Figure 4.24: Road trauma by time of arrival, major data category, Liverpool Hospital, 1995-2004 (n=4152)

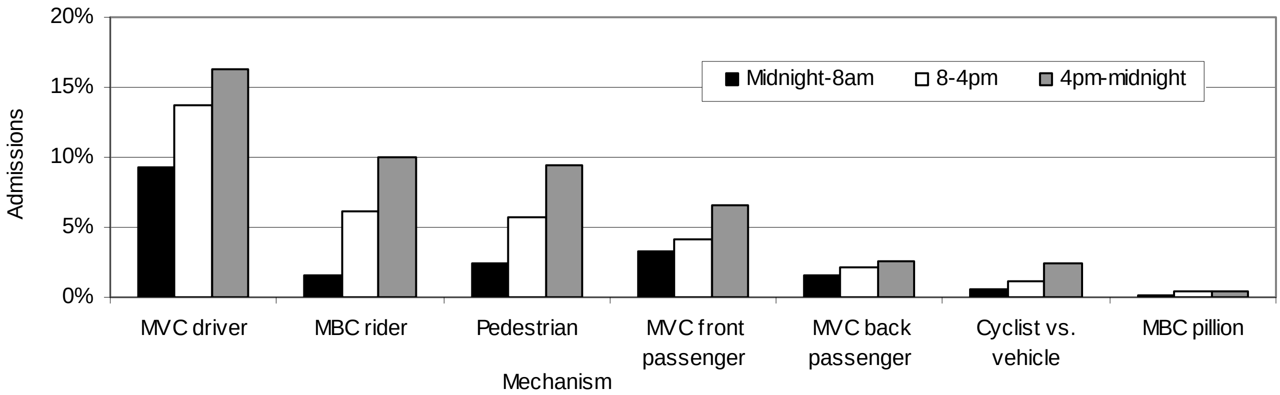
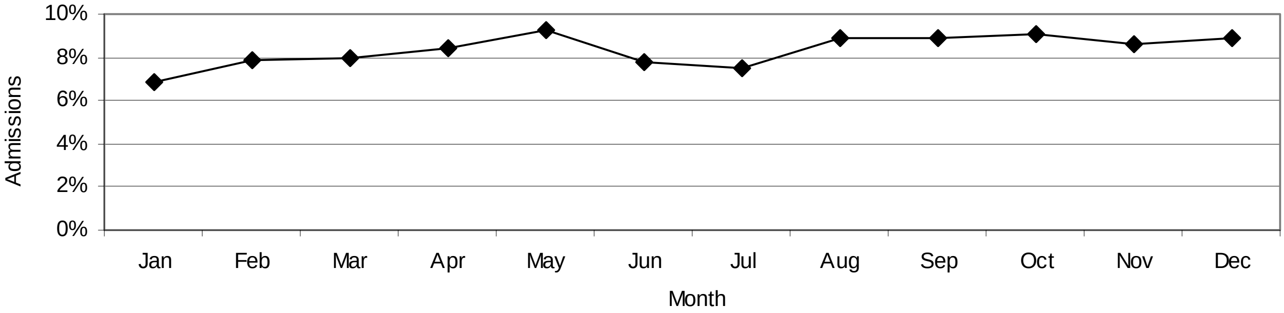


Figure 4.25: Monthly road trauma admissions, major data category, Liverpool Hospital, 1995-2004 (n=4152)



4.9 Falls

Table 4.14: Annual falls admissions, major data category, Liverpool Hospital, 1995-2004

Year	Fall < 5m		Fall > 5m		Total
	n	%	n	%	
1995	107	82.9	22	17.1	129
1996	136	85.5	23	14.5	159
1997	116	81.7	26	18.3	142
1998	152	86.4	24	13.6	176
1999	159	88.3	21	11.7	180
2000	209	90.9	21	9.1	230
2001	232	90.3	25	9.7	257
2002	247	88.8	31	11.2	278
2003	226	88.3	30	11.7	256
2004	240	91.3	23	8.7	263
Total	1824	88.1	246	11.9	2070

Figure 4.26: Annual trends for falls, major data category, Liverpool Hospital, 1995-2004 (n=2070)

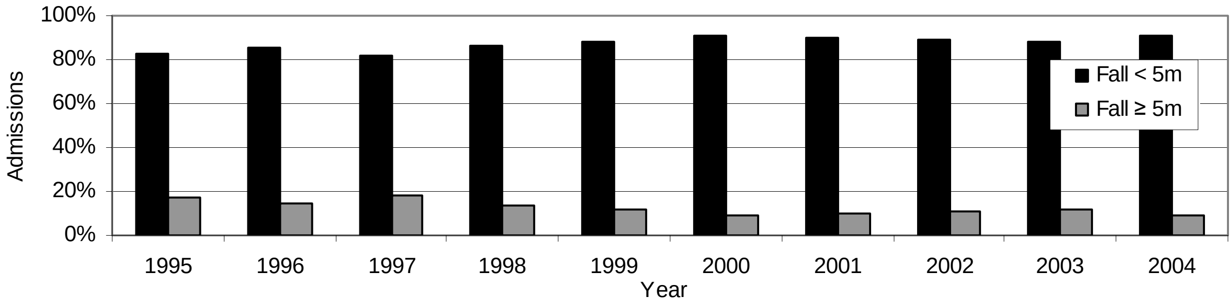


Table 4.15: Falls by age group, major data category, Liverpool Hospital, 1995-2004

Age group (years)	Fall < 5m		Fall ≥ 5m		Total	
	n	%	n	%	n	%
0-14	213	10.3	29	1.4	242	11.7
15-24	78	3.8	58	2.8	136	6.6
25-34	126	6.1	57	2.8	183	8.8
35-44	162	7.8	36	1.7	198	9.6
45-54	229	11.1	34	1.6	263	12.7
55-64	236	11.4	12	0.6	248	12.0
65-74	262	12.7	17	0.8	279	13.5
75-84	324	15.7	2	0.1	326	15.7
85+	194	9.4	1	0.0	195	9.4
Total	1824	88.1	246	11.9	2070	100.0

Figure 4.27: Falls by age group, major data category, Liverpool Hospital, 1995-2004 (n=2070)

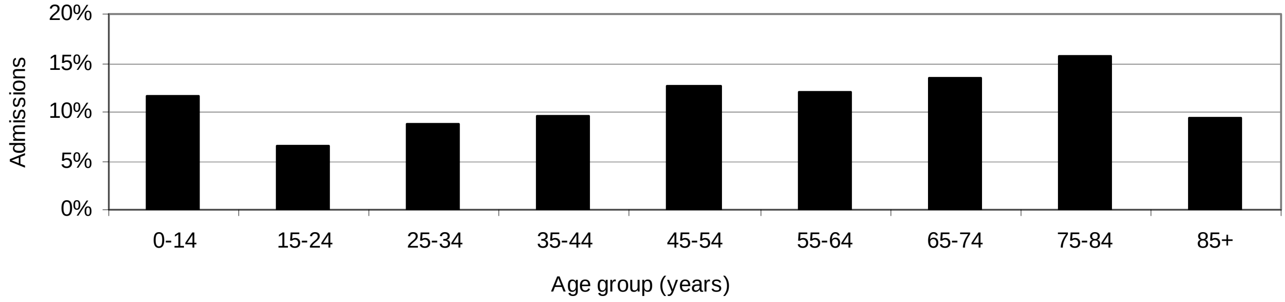
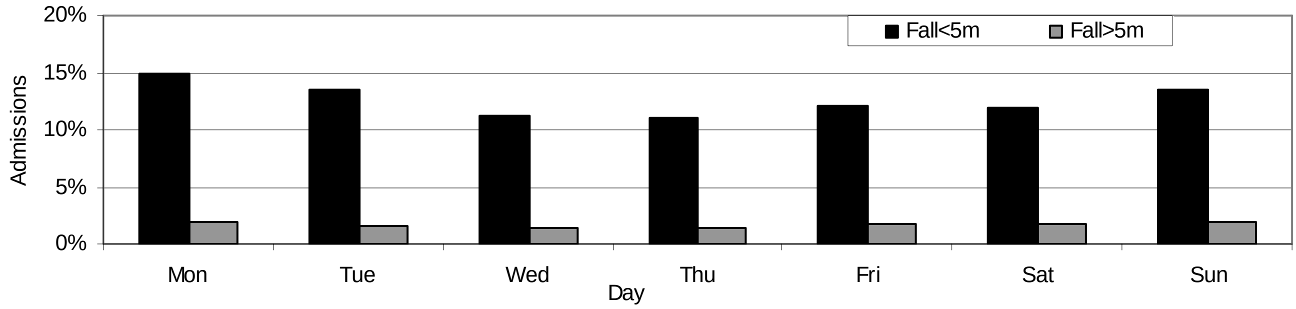


Table 4.16: Falls by day of arrival, major data category, Liverpool Hospital, 1995-2004

Day	Fall < 5m		Fall ≥ 5m		Total	
	n	%	n	%	n	%
Monday	307	14.8	39	1.9	346	16.7
Tuesday	279	13.5	31	1.5	310	15.0
Wednesday	232	11.2	30	1.4	262	12.7
Thursday	228	11.0	30	1.4	258	12.5
Friday	251	12.1	37	1.8	288	13.9
Saturday	246	11.9	38	1.8	284	13.7
Sunday	281	13.6	41	2.0	322	15.6
Total	1824	88.1	246	11.9	2070	100.0

Figure 4.28: Falls by day of arrival, major data category, Liverpool Hospital, 1995-2004 (n=2070)



4.10 Interpersonal violence

Table 4.17: Annual interpersonal violence injury admissions, major data category, Liverpool Hospital, 1995-2004

Year	Blunt assault		Stabbing		Gunshot		Total
	n	%	n	%	n	%	
1995	46	50.0	37	40.2	9	9.8	92
1996	68	55.3	42	34.1	13	10.6	123
1997	69	54.3	49	38.6	9	7.1	127
1998	55	42.3	59	45.4	16	12.3	130
1999	85	63.9	35	26.3	13	9.8	133
2000	76	47.5	60	37.5	24	15.0	160
2001	121	57.9	67	32.1	21	10.0	209
2002	104	54.2	58	30.2	30	15.6	192
2003	91	58.7	50	32.3	14	9.0	155
2004	69	60.0	38	33.0	8	7.0	115
Total	784	54.6	495	34.5	157	10.9	1436

Figure 4.29: Annual trends for interpersonal violence, major data category, Liverpool Hospital, 1995-2004 (n=1436)

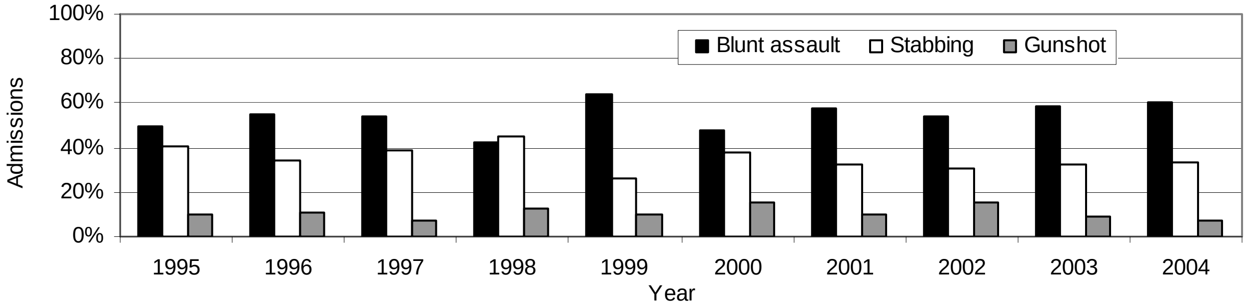


Table 4.18: Interpersonal violence injury admissions by day of arrival, major data category, Liverpool Hospital, 1995-2004

Day	Blunt assault		Stabbing		Gunshot		Total	
	n	%	n	%	n	%	n	%
Monday	128	8.9	83	5.8	24	1.7	235	16.4
Tuesday	113	7.9	75	5.2	24	1.7	212	14.8
Wednesday	109	7.6	68	4.7	18	1.3	195	13.6
Thursday	100	7.0	64	4.5	21	1.5	185	12.9
Friday	93	6.5	79	5.5	20	1.4	192	13.4
Saturday	96	6.7	56	3.9	27	1.9	179	12.5
Sunday	145	10.1	70	4.9	23	1.6	238	16.6
Total	784	54.6	495	34.5	157	10.9	1436	100.0

Figure 4.30: Interpersonal violence injury admissions by day of arrival, major data category, Liverpool Hospital, 1995-2004 (n=1436)

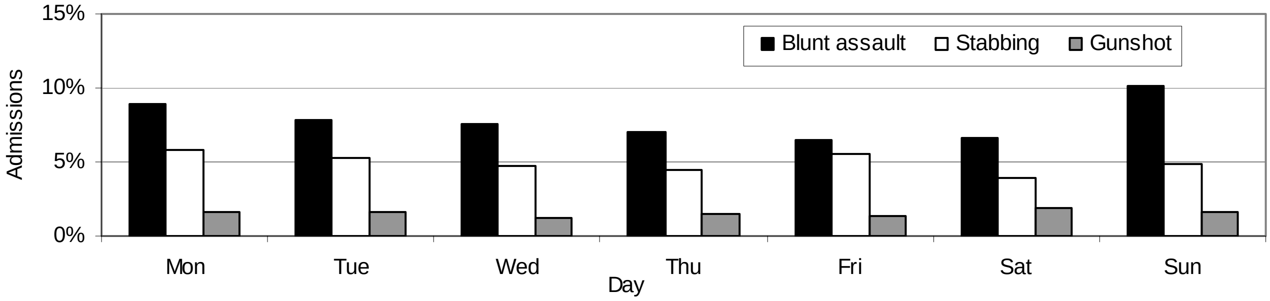


Table 4.19: Interpersonal violence injury admissions by time of arrival, major data category, Liverpool Hospital, 1995-2004

Time	Blunt assault		Stabbing		Gunshot		Total	
	n	%	n	%	n	%	n	%
Midnight-8am	246	17.1	129	9.0	53	3.7	428	29.8
8am-4pm	207	14.4	129	9.0	22	1.5	358	24.9
4pm-midnight	331	23.1	237	16.5	82	5.7	650	45.3
Total	784	54.6	495	34.5	157	10.9	1436	100.0

Figure 4.31: Interpersonal violence by time of arrival, major data category, Liverpool Hospital, 1995-2004 (n=1436)

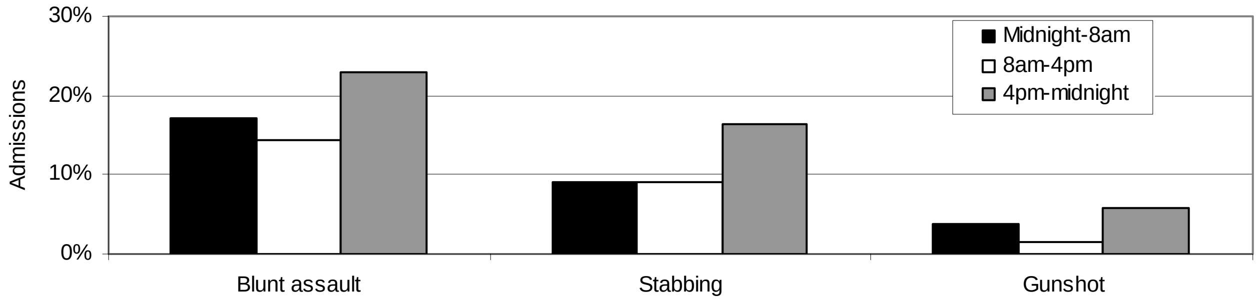
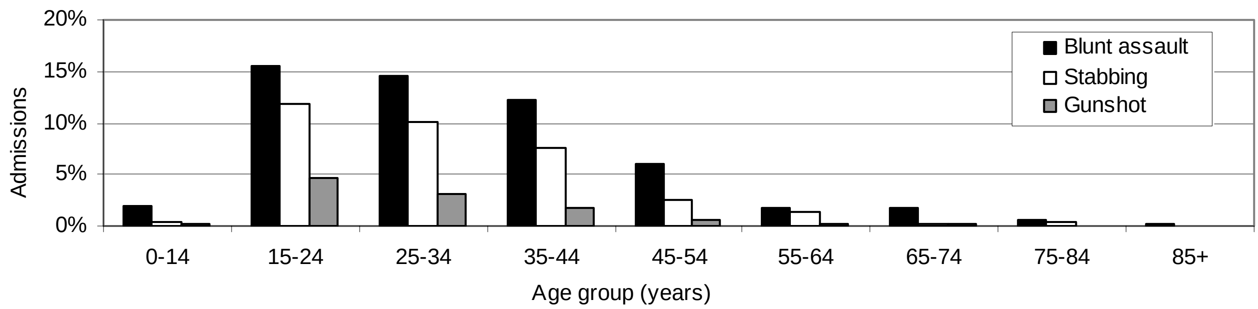


Table 4.20: Interpersonal violence injury admissions by age group (years), major data category, Liverpool Hospital 1995-2004

Age group (years)	Blunt assault		Stabbing		Gunshot		Total	
	n	%	n	%	n	%	n	%
0-14	27	1.9	5	0.3	3	0.2	35	2.4
15-24	223	15.5	171	11.9	68	4.7	462	32.2
25-34	209	14.6	145	10.1	44	3.1	398	27.7
35-44	176	12.3	109	7.6	26	1.8	311	21.7
45-54	86	6.0	35	2.4	9	0.6	130	9.1
55-64	26	1.8	20	1.4	3	0.2	49	3.4
65-74	26	1.8	3	0.2	3	0.2	32	2.2
75-84	8	0.6	6	0.4	1	0.1	15	1.0
85+	3	0.2	1	0.1	-	-	4	0.3
Total	784	54.	495	34.5	157	10.9	1436	100.0

Figure 4.32: Interpersonal violence by age group, major data category, Liverpool Hospital, 1995-2004 (n=1436)



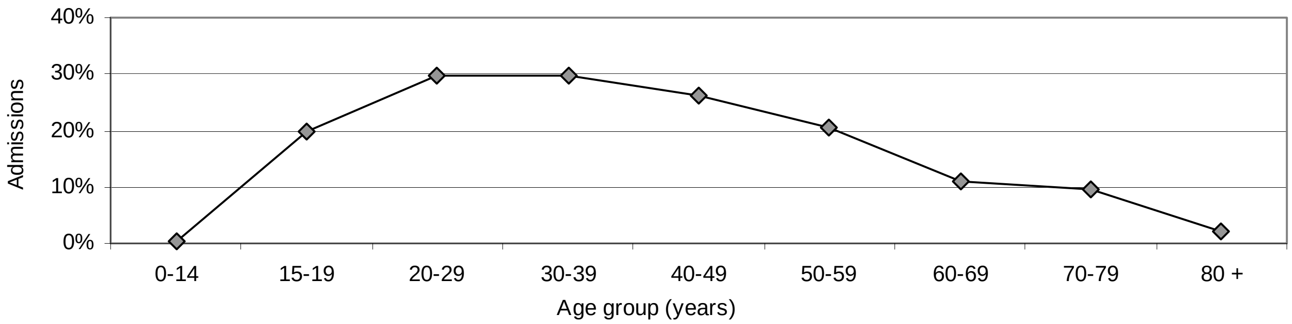
4.11 Substance use

The following tables and figures present patients under the influence of either drugs and/or alcohol at the time of injury. This data is not available for a large percentage of patients, due to the fact it relies on self-declaration by the patient or family and friends accompanying the patient. Patients aged 20-29 years, followed by those aged 30-39 years, are most likely to report substance use. Substance use is collected for major data category patients, and was first collected in 1998.

Table 4.21: Substance use at time of injury by age group (years), major data category, Liverpool Hospital, 1998-2004

Age group (years)	Substance used		No substance use / undetermined		Total	
	n	%	n	%	n	%
0-14	2	0.3	716	99.7	718	100.0
15-19	154	19.9	618	80.1	772	100.0
20-29	456	29.8	1075	70.2	1531	100.0
30-39	347	29.8	819	70.2	1166	100.0
40-49	227	26.1	642	73.9	869	100.0
50-59	127	20.4	495	79.6	622	100.0
60-69	52	11.0	421	89.0	473	100.0
70-79	46	9.5	439	90.5	485	100.0
80 +	7	2.1	327	97.9	334	100.0
Total	1418	20.3	5552	79.7	6970	100.0

Figure 4.33: Substance use at time of injury by age group, major data category, Liverpool Hospital, 1998-2004 (n=6970)

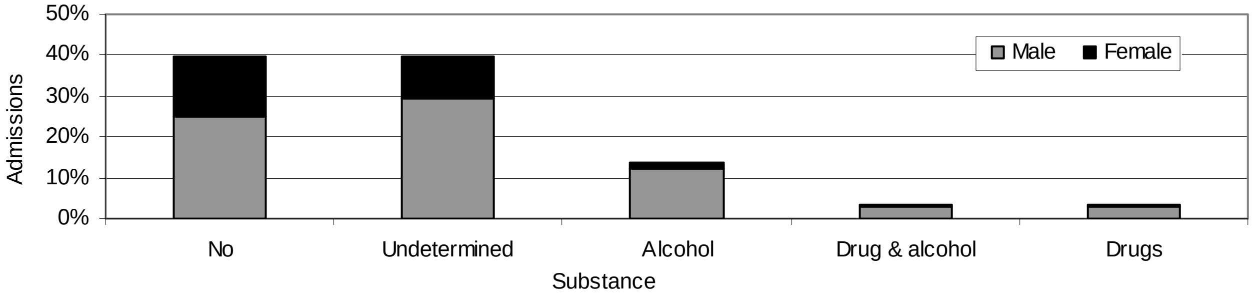


Substance use at time of injury is much more common in males compared to females, regardless of the type of substance used.

Table 4.22: Substance use at time of injury by sex, major data category, Liverpool Hospital, 1998-2004

Substance use	Male		Female		Total	
	n	%	n	%	n	%
Nil	1745	25.0	1024	14.7	2769	39.7
Undetermined	2047	29.4	736	10.6	2783	39.9
Alcohol	842	12.1	105	1.5	947	13.6
Drug and alcohol	193	2.8	35	0.5	228	3.3
Drugs	191	2.7	52	0.7	243	3.5
Total	5018	72.0	1952	28.0	6970	100.0

Figure 4.34: Frequency of substance use and gender, major data category, Liverpool Hospital, 1998-2004 (n=6970)

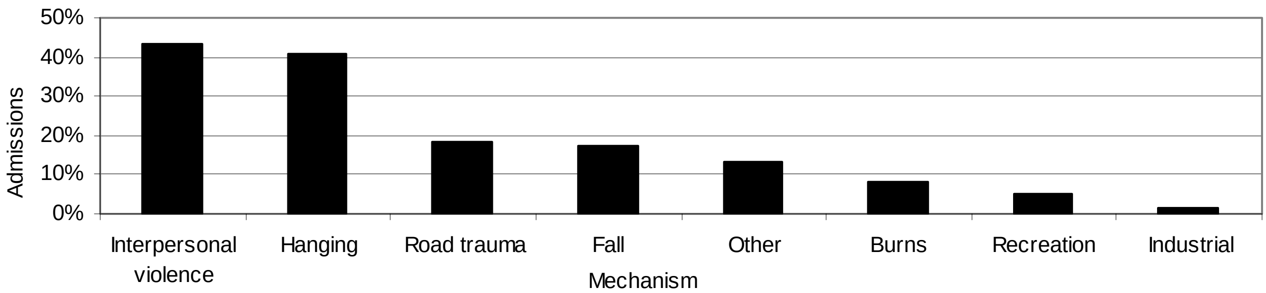


The highest percentage of patients with substance use (43.6%) sustained interpersonal violence (blunt assault, stabbing or gunshot). Substance use was also very high with hanging injuries (40.6%), as shown in the following table.

Table 4.23: Substance use and mechanism of injury, major data category, Liverpool Hospital, 1998-2004

Mechanism	Substance used		No substance use / undetermined		Total	
	n	%	n	%	n	%
Interpersonal violence	476	43.6	616	56.4	1092	100.0
Hanging	13	40.6	19	59.4	32	100.0
Road trauma	564	18.2	2533	81.8	3097	100.0
Fall	282	17.3	1345	82.7	1627	100.0
Other	48	13.3	314	86.7	362	100.0
Burns	11	8.3	121	91.7	132	100.0
Recreation	20	5.0	377	95.0	397	100.0
Industrial	4	1.7	227	98.3	231	100.0
Total	1418	20.3	5552	79.7	6970	100.0

Figure 4.35: Substance use by mechanism of injury, major data category, Liverpool Hospital, 1998-2004 (n=6970)

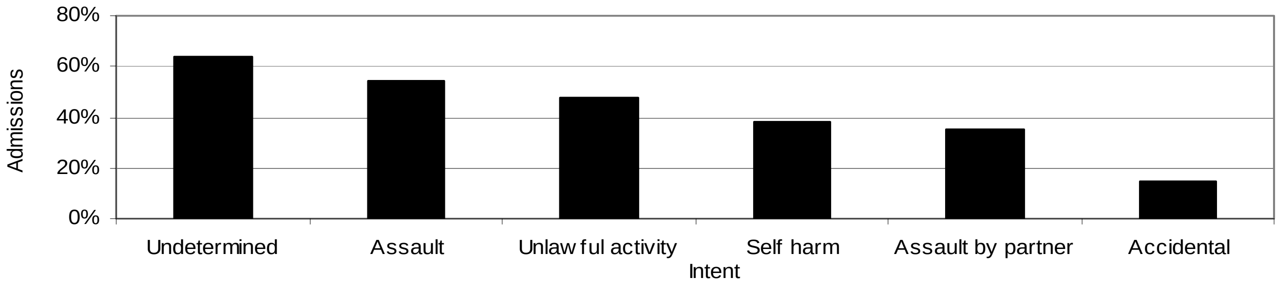


There is a strong association between substance use at time of injury and injury intent. Substance use occurs least commonly with accidental injuries (14.8%), and most commonly with injuries of 'undetermined' intent (63.9%). Substance use at time of injury is also frequently reported with injuries sustained during assaults (54.6%) and unlawful activity (47.5%).

Table 4.24: Substance use and injury intent, major data category, Liverpool Hospital, 1998-2004

Mechanism	Substance used		No substance used / undetermined		Total	
	n	%	n	%	n	%
Undetermined	23	63.9	13	36.1	36	100.0
Assault	425	54.6	513	45.4	938	100.0
Unlawful activity	28	47.5	31	52.5	59	100.0
Self harm	82	38.0	134	62.0	216	100.0
Assault by partner	22	35.5	40	64.5	62	100.0
Accidental	838	14.8	4821	85.2	5659	100.0
Total	1418	20.3	5552	79.7	6970	100.0

Figure 4.36: Substance use and injury intent, major data category, Liverpool Hospital, 1998-2004 (n=6970)



4.12 Origin of patients

There were 9123 major data category patients admitted to Liverpool Hospital between 1995-2004. Of these, 7526 (82.5%) were admitted directly to Liverpool Hospital, and 1597 (17.5%) were transferred in from another hospital. Of the transfers in, 1352 (14.8%) were transferred from another SWSAHS hospital, and 245 (2.7%) were transferred from a hospital outside of SWSAHS.

Table 4.25: Origin of patients, major data category, Liverpool Hospital, 1995-2004

Year	Direct admission		Transfer in from another hospital		Total	
	n	%	n	%	n	%
1995	588	88.7	75	11.3	663	100.0
1996	652	88.2	87	11.8	739	100.0
1997	657	89.3	79	10.7	736	100.0
1998	713	87.3	104	12.7	817	100.0
1999	689	82.7	144	17.3	833	100.0
2000	806	80.4	196	19.6	1002	100.0
2001	903	78.3	250	21.7	1153	100.0
2002	916	79.9	230	20.1	1146	100.0
2003	826	81.5	187	18.5	1013	100.0
2004	776	76.0	245	24.0	1021	100.0
Total	7526	82.5	1597	17.5	9123	100.0

Table 4.26: Patients transferred in to Liverpool Hospital: Origin of arrival for all transfers in, major data category, 1995-2004

Year	SWSAHS urban hospital		SWSAHS rural hospital (Bowral)		Other area health service		Total	
	n	%	n	%	n	%	n	%
1995	51	68.0	13	17.3	11	14.7	75	100.0
1996	67	77.0	5	5.7	15	17.2	87	100.0
1997	58	73.4	8	10.1	13	16.5	79	100.0
1998	72	69.2	11	10.6	21	20.2	104	100.0
1999	114	79.2	9	6.3	21	14.6	144	100.0
2000	157	80.1	14	7.1	25	12.8	196	100.0
2001	208	83.2	10	4.0	32	12.8	250	100.0
2002	179	77.8	12	5.2	39	17.0	230	100.0
2003	146	78.1	10	5.3	31	16.6	187	100.0
2004	179	73.1	29	11.8	37	15.1	245	100.0
Total	1231	77.1	121	7.6	245	15.3	1597	100.0

Table 4.27: Patients transferred in to Liverpool Hospital: Origin of arrival for patients self-presenting at referring hospital, major data category, 1995-2004

Year	SWSAHS urban hospital		SWSAHS rural hospital (Bowral)		Other area health service		Total	
	n	%	n	%	n	%	n	%
1995	25	71.4	4	11.4	6	17.1	35	100.0
1996	28	82.4	1	2.9	5	14.7	34	100.0
1997	22	81.5	1	3.7	4	14.8	27	100.0
1998	29	82.9	3	8.6	3	8.6	35	100.0
1999	50	86.2	1	1.7	7	12.1	58	100.0
2000	65	83.3	2	2.6	11	14.1	78	100.0
2001	90	87.4	1	1.0	12	11.7	103	100.0
2002	69	81.2	3	3.5	13	15.3	85	100.0
2003	74	82.2	1	1.1	15	16.7	90	100.0
2004	66	82.5	6	7.5	8	10.0	80	100.0
Total	518	82.9	23	3.7	84	13.4	625	100.0

Table 4.28: Patients transferred in to Liverpool Hospital: Origin of arrival for patients transported by ambulance to the referring hospital, major data category, 1995-2004

Year	SWSAHS urban hospital		SWSAHS rural hospital (Bowral)		Other area health service		Total	
	n	%	n	%	n	%	n	%
1995	26	65.0	9	22.5	5	12.5	40	100.0
1996	39	73.6	4	7.5	10	18.9	53	100.0
1997	36	69.2	7	13.5	9	17.3	52	100.0
1998	43	62.3	8	11.6	18	26.1	69	100.0
1999	64	74.4	8	9.3	14	16.3	86	100.0
2000	92	78.0	12	10.2	14	11.9	118	100.0
2001	118	80.3	9	6.1	20	13.6	147	100.0
2002	110	75.9	9	6.2	26	17.9	145	100.0
2003	72	74.2	9	9.3	16	16.5	97	100.0
2004	113	68.5	23	13.9	29	17.6	165	100.0
Total	713	73.4	98	10.1	161	16.6	972	100.0

5 Pre-Hospital Care

Executive comment

Patients are predominantly transported to hospital by basic life support ambulance officers, advanced life support level 4 officers and level 5 paramedics. Over the last ten years there has been increasing use of medical retrieval teams. In NSW, the Medical Retrieval Unit coordinates air and road retrieval services. The helicopter services in NSW are staffed with Doctor / Paramedic and Paramedic / Paramedic combinations. During the 10-year period, the percentage of patients transported to hospital by private transport fell from 20% to 17%.

Paramedics cannot administer induction and muscle relaxant drugs to facilitate endotracheal intubation. Therefore it is not surprising that the intubation rate is low, with only 188 (1.9%) of all patients being intubated pre-hospital. 52 (27.7%) of these patients were intubated by the medical retrieval team. Significant shifts in pre-hospital treatment have occurred during the report period with a very considerable reduction in pre-hospital fluid administration. Despite the reduction in pre-hospital fluid volume and the almost complete withdrawal of the military anti-shock trouser (MAST device) scene time has not changed significantly.

During the decade of this report there were no major disasters in our region.

Recommendations

1. Clinical standards and clinical practice guidelines relating to pre-hospital communication, retrieval, scene time, interventions and inter-hospital trauma transfer need to be reviewed and updated in line with current evidence as a priority. These guidelines should be national and subsequently adopted within each state trauma system.

2. A national co-ordinated approach to pre-hospital care is required. Engagement of national representatives of pre-hospital care providers should occur. This will facilitate the transfer of new treatment modalities, supported by evidence, into the pre-hospital clinical environment.

3. Prospective review of pre-hospital interventions and scene / transport times should occur to ensure a robust triage and to ensure the treatment environment is maintained and supported by current evidence.

4. Formalised links and communication processes between pre-hospital care providers and in-hospital care providers need to be embedded within the trauma system. These links should be well defined, with a transparent reporting process.

5. Implementation of information technology and corresponding clinical communication guidelines should be prioritised to enable communications between pre-hospital and in hospital teams.

Helipad on roof of Liverpool Hospital with view of original hospital in background

Photo of NRMA Careflight rescue service attending multiple trauma patients

Photo reproduced with permission of NRMA Careflight medical retrieval service.

5.1 Overview

Of the 13629 major data category patients admitted to SWSAHS hospitals, 10130 (74.3%) received pre-hospital care, from either ambulance officers (basic life support, advanced life support or paramedics) or medical retrieval services (Westpac Life Saver and NRMA Careflight), either by road or helicopter. Of the 2556 SWSAHS admissions with ISS ≥ 16, 2216 (83.3%) received pre-hospital care.

Of the 9123 major data category patients admitted to Liverpool Hospital between 1995-2004, 7367 (80.8%) had pre-hospital care. 1597 (17.5%) of the patients were transferred in from another hospital: 1352 (14.8%) from another SWSAHS hospital, and 245 (2.7%) from a hospital outside of SWSAHS.

5.2 Terms used in this chapter

Ambulance officer level of training

There are various levels of training for ambulance officers in NSW. These are:

Level 1 to 3	Probationer through to qualified ambulance officer
Level 4	Ambulance officer, advanced life support (ALS)
Level 5	Paramedic

The level of training of the most senior attending officer is captured in the registry. Probationary (Level 1) ambulance officers do not appear in the data as they are always accompanied by a more senior officer.

Protocol 4: Pre-hospital triage of trauma

Protocol 4 is a triage tool with a decision matrix that determines which level of trauma centre the patient should be transported to. A copy of Protocol 4 is presented in the Appendix.

The Ambulance Service of NSW also issued an instructional circular, effective 12 July 2003, that directed ambulance officers in SWSAHS to [2]:

- Transport patients with airway obstructions to the nearest hospital
- Transport patients suffering severe trauma located in a radius >10 minutes north-west of Bowral to Liverpool Hospital.

This joint initiative was introduced to reduce the number of dying patients being brought to urban and rural hospitals where resources are relatively limited.

Ambulance transport decision categories

Ambulance officers use transport decision categories, defined by the NSW Department of Health, to decide which hospital a patient needs to be transported to. The transport decision categories are:

1 Minor	Injury is minor and nearest hospital is a local hospital / UTS*
2 Minor	Injury is minor and nearest hospital is a MTS†
3 Minor	Injury is minor bypass MTS† to a local hospital / UTS*
4 Serious	Injury is serious, bypass UTS* and take patient to MTS†
5 Serious	Injury is serious, MTS† is nearest
6 Serious	Injury is serious and MTS† has restricted services (eg. disaster), take patient to another hospital (should be rare)
7 Dying	To nearest hospital 1995-1999
	NB. From 2004 onwards, this definition was changed to “if occluded or threatened airway”
8 Rural DP4	Rural DP4‡ (designated Protocol 4)

* UTS = Urban Trauma Service. In SWSAHS these are Bankstown, Campbelltown, Fairfield and Camden Hospitals.

† MTS = Major trauma service. In SWSAHS this is Liverpool Hospital.

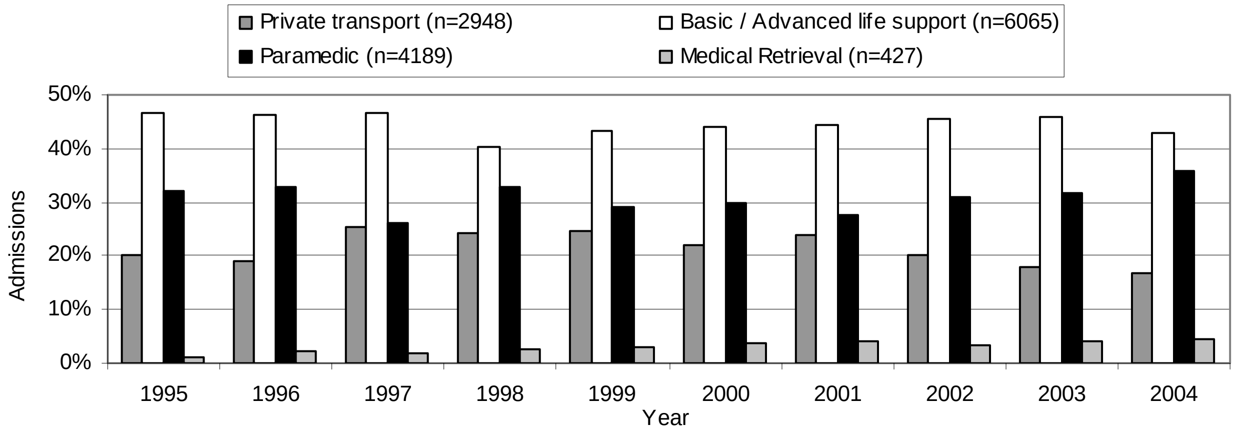
‡ Bowral Hospital is a DP4 (designated rural Protocol 4) hospital, therefore above bypass criteria do not apply.

Note: The term "serious" in the pre-hospital setting identifies potential serious injury in a patient based on anatomical injuries, mechanism of injury and abnormal vital signs. It is not related to an injury severity score ≥ 16, which is also defined as a serious injury. Similarly the term "minor" in pre-hospital setting is not related to the trauma registry minor data category.

5.3 Type of pre-hospital care

The type of pre-hospital care received by major data category patients admitted to SWSAHS hospitals between 1995-2004 is presented below. 'Private transport' indicates the patient did not receive pre-hospital care and transport from either ambulance or medical retrieval team personnel.

Figure 5.1: Type of pre-hospital care, major data category, SWSAHS hospitals, 1995-2004 (n=13629)



The following table presents the type of pre-hospital care for patients ultimately admitted to Liverpool Hospital. This includes patients admitted directly to Liverpool Hospital, and patients transferred in from another SWSAHS hospital. There were only two patients transported by medical retrieval units to a SWSAHS urban hospital. In most circumstances medical retrieval teams transport patients directly to Liverpool Hospital.

Table 5.1: Type of pre-hospital care for patients admitted directly or transferred in to Liverpool Hospital, major data category, 1995-2004

Mode of Arrival	Admitted directly to Liverpool Hospital		Transfer in from SWSAHS hospital		Transfer in from non-SWSAHS hospital		Total	
	n	%	n	%	n	%	n	%
Private	1131	15.0	541	40.0	84	34.3	1756	19.2
General duties ambulance	2977	39.6	590	43.6	105	42.9	3672	40.2
Paramedic	3241	43.1	219	16.2	49	20.0	3509	38.5
Medical Retrieval	177	2.4	2	0.1	7	2.9	186	2.0
Total	7526	100.0	1352	100.0	245	100.0	9123	100.0

5.4 Time at scene

Of the 10130 SWSAHS major data category patients who received pre-hospital care, scene time was available for 9595 (94.7%) of patients. 6265 (65.3%) of these patients had a scene time of ≤ 20 minutes. From 1997, entrapment at scene data was also collected. Between 1997-2004, 656 (6.8%) of all SWSAHS major data category patients who received pre-hospital care were trapped at the scene.

Figure 5.2: Pre-hospital scene time, including entrapped patients, major data category, SWSAHS hospitals, 1995-2004 (n=9595)

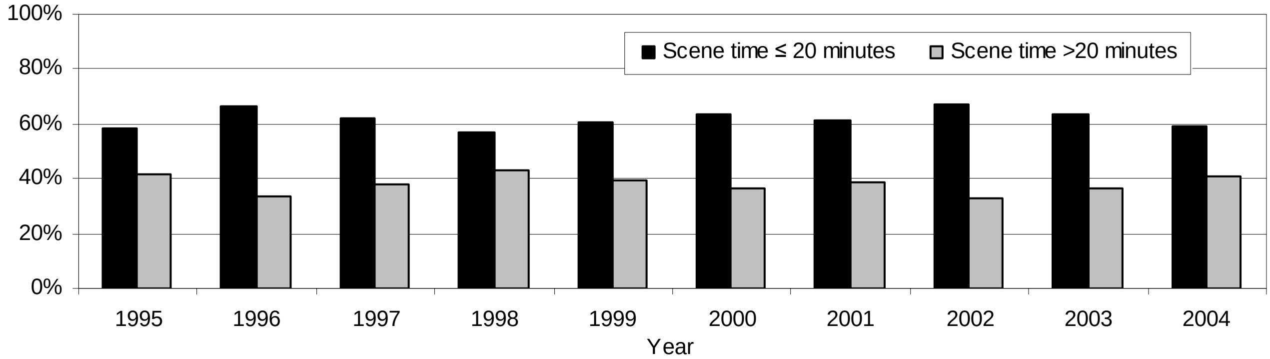
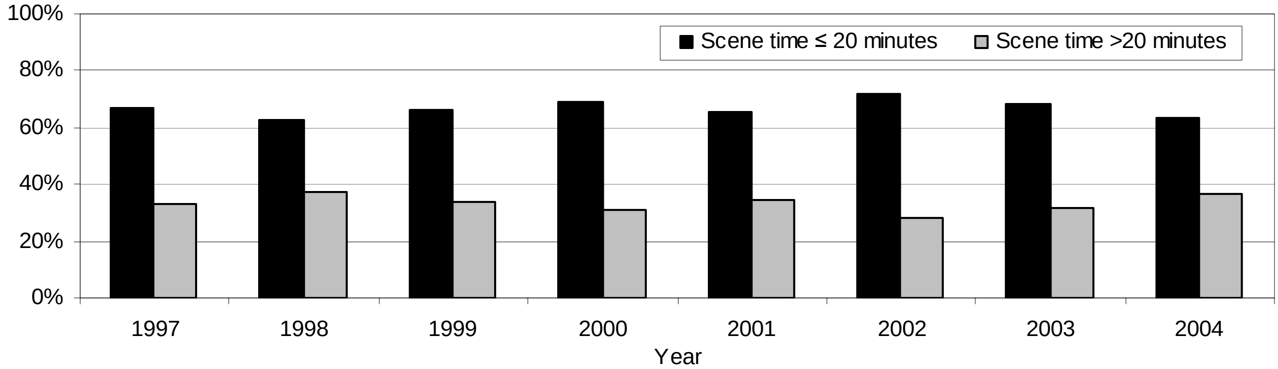


Figure 5.3: Pre-hospital scene time, excluding entrapped patients, major data category, SWSAHS hospitals, 1997-2004 (n=8939)



5.5 Transport decision category

Ambulance transport decision category was available for 8900 (87.9%) of the 10130 SWSAHS major data category patients who received pre-hospital care. The category is recorded on the ambulance case sheet.

Table 5.2: Ambulance transport decision category for patients brought to SWSAHS hospitals, major data category, 1995-2004

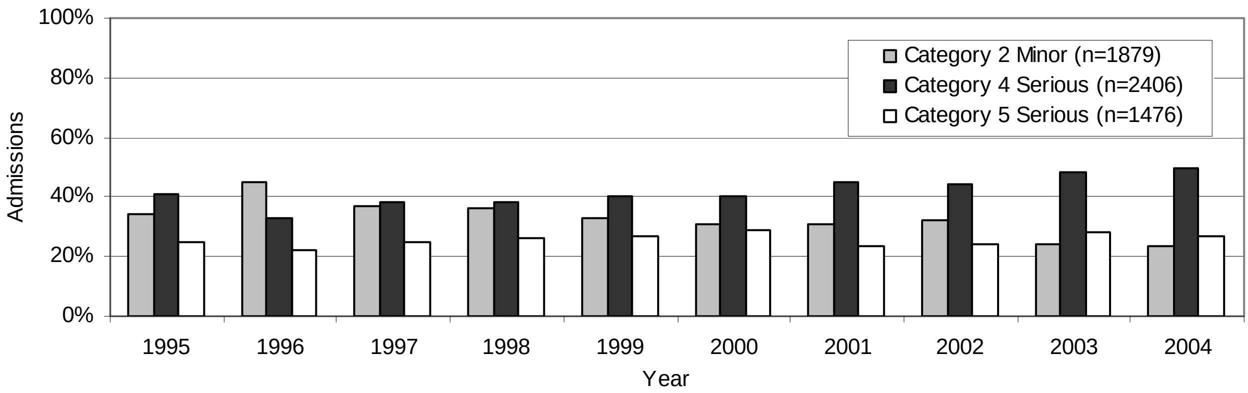
Year	Category 1: Minor		Category 2: Minor		Category 3: Minor		Category 4: Serious		Category 5: Serious		Category 6: Serious		Category 7: Dying; occluded / threatened airway		Category 8: Rural DP4		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
1995	211	30.4	160	23.1	0	-	196	28.3	118	17.0	0	-	8	1.2	0	-	693
1996	185	24.0	255	33.1	0	-	192	24.9	128	16.6	0	-	11	1.4	0	-	771
1997	349	38.1	208	22.7	0	-	212	23.1	141	15.4	0	-	7	0.8	0	-	917
1998	410	39.8	220	21.3	0	-	236	22.9	161	15.6	0	-	4	0.4	0	-	1031
1999	367	39.1	183	19.5	1	0.1	224	23.9	150	16.0	0	-	13	1.4	0	-	938
2000	366	36.1	193	19.0	2	0.2	257	25.3	182	17.9	0	-	10	1.0	5	0.5	1015
2001	384	38.9	180	18.3	1	0.1	266	27.0	140	14.2	0	-	8	0.8	7	0.7	986
2002	365	33.9	221	20.5	6	0.6	307	28.5	168	15.6	0	-	5	0.5	5	0.5	1077
2003	216	27.7	132	16.9	8	1.0	264	33.8	154	19.7	1	0.1	3	0.4	3	0.4	781
2004	116	16.8	128	18.5	4	0.6	279	40.4	150	21.7	1	0.1	10	1.4	3	0.4	691
Total	2969	33.4	1880	21.1	22	0.2	2433	27.3	1492	16.8	2	0.0	79	0.9	23	0.3	8900

Of the 7526 patients admitted directly to Liverpool Hospital, 6395 (85.0%) received pre-hospital care, and the transport decision category was available for 5761 (90.0%) patients.

Table 5.3: Ambulance transport decision category for patients brought directly to Liverpool Hospital, major data category, 1995-2004

Year	Category 2: Minor, MTS is nearest		Category 4: Serious, bypass to MTS		Category 5: Serious, MTS is nearest		Total
	n	%	n	%	n	%	n
1995	160	33.9	194	41.1	118	25.0	472
1996	255	44.7	188	33.0	127	22.3	570
1997	208	37.2	212	37.9	139	24.9	559
1998	220	36.1	231	37.9	158	25.9	609
1999	183	33.1	222	40.1	148	26.8	553
2000	192	30.7	254	40.6	180	28.8	626
2001	180	31.0	263	45.3	138	23.8	581
2002	221	31.9	305	44.0	167	24.1	693
2003	132	24.0	264	48.1	153	27.9	549
2004	128	23.3	273	49.7	148	27.0	549
Total	1879	32.6	2406	41.8	1476	25.6	5761

Figure 5.4: Ambulance transport decision category, patients transported directly to Liverpool Hospital, major data category, 1995-2004 (n=5761)



5.6 Pre-hospital cardiopulmonary resuscitation

During the 10 years 1995-2004, 112 patients received pre-hospital cardiopulmonary resuscitation (CPR). 10 patients (8.9%) initially survived, however only 6 patients survived long-term. The 4 patients that did not survive long term were all paediatric patients, who were promptly transferred to a paediatric major trauma service, but subsequently died. All patients who initially survived had sustained blunt trauma.

Table 5.4: Age group and survival outcome, trauma patients receiving pre-hospital CPR, SWSAHS hospitals, 1995-2004

Age group (years)	Outcome		
	Survived	Died	Total
0-9	3	9	12
10-19	2	19	21
20-29	4	29	33
30-39		13	13
40-49		12	12
50-59		6	6
60-69		6	6
70-79	1	5	6
80-89		3	3
Total	10	102	112

Table 5.5: Mechanism of injury and survival outcome, trauma patients receiving pre-hospital CPR, SWSAHS hospitals, 1995-2004

Mechanism	Outcome		
	Survived	Died	Total
Pedestrian	1	17	18
MVC driver	2	15	17
Gunshot		15	15
Hanging	1	10	11
Stabbing		9	9
MVC back passenger		7	7
Blunt assault		7	7
Industrial		7	7
MBC rider		5	5
Fall>5m	2	2	4
MVC front passenger		3	3
Burns	3		3
Recreation		2	2
Other	1	1	2
Fall<1m		1	1
Fall from horse		1	1
Total	10	102	112

Table 5.6: Airway intervention, trauma patients receiving pre-hospital CPR, SWSAHS hospitals, 1995-2004

Year	Oxygen	Guedel / nasopharyngeal	Bag / mask	Intubated	Not documented	Total
1995	0	0	1	5	0	6
1996	0	2	5	8	0	15
1997	0	1	3	9	0	13
1998	0	0	2	5	0	7
1999	0	0	1	7	1	9
2000	0	0	3	8	0	11
2001	1	0	0	9	1	11
2002	1	1	0	9	1	12
2003	0	0	1	12	0	13
2004	0	1	3	9	2	15
Total	2	5	19	81	5	112

Table 5.7: Predominant injury body region, trauma patients receiving pre-hospital CPR, SWSAHS hospitals, 1995-2004

Predominant body region	Highest AIS score in predominant injury body region:				
	3 Serious	4 Severe	5 Critical	6 Maximum	Total
Head	2	2	34	16	54
Torso		6	26	12	44
External / Burns			2	4	6
Both head and other		2	3		5
Lower extremity	1	2			3
Total	3	12	65	32	112

Table 5.8: Emergency Department disposition, trauma patients receiving pre-hospital CPR who initially survived, SWSAHS, 1995-2004

Transport category	ED disposition	Eventual outcome	Predominant injury region	Age	ISS	Comment
4	ICU	Survived	Head	20	9	Hanging
4	OT / ICU	Survived	Head	23	30	MVC driver. GCS 3, cerebral contusions, #L2 transverse process
5	Transfer out	Died	Head	1	25	Hanging
5	Transfer out	Died	Head	3	75	Pedestrian, transferred to paediatric major trauma service
5	Transfer out	Died	External	8	25	Airway burns transferred to paediatric major trauma service
5	Transfer out	Died	External	11	25	Airway burns transferred to paediatric major trauma service
5	ICU	Survived	Head	18	45	MVC driver. Multiple head and chest injuries, pelvic fracture
5	ICU	Survived	External	20	75	Electrocution with cardiac arrest
5	ICU	Survived	Both head and other	23	41	Fall 20-30m. Multiple severe head injuries, #T & L spine, liver and kidney haematoma
5	HDU	Survived	Abdomen	76	17	Fall 10m. LOC, CPR at scene, retroperitoneal bleed, open book #pelvis

Table 5.9: Pre-hospital ambulance transport decision category, trauma patients receiving pre-hospital CPR, SWSAHS hospitals, 1995-2004

Year	Category 4: Serious Bypass to MTS	Category 5: Serious MTS is nearest	Category 7: Dying; occluded / threatened airway	Total
1995	1	3	2	6
1996	4	7	4	15
1997	5	7	1	13
1998	2	3	2	7
1999	2	1	6	9
2000	1	7	3	11
2001	0	7	4	11
2002	5	6	1	12
2003	4	7	2	13
2004	1	10	4	15
Total	25	58	29	112

Table 5.10: Ambulance category 7 (dying; occluded / threatened airway) patients receiving pre-hospital CPR, SWSAHS hospitals, 1995-2004

Year	n	Survived	Died	Mean ISS
1995	2	0	2	47.5
1996	4	0	4	43.8
1997	1	0	1	75.0
1998	2	0	2	50.0
1999	6	0	6	29.7
2000	3	1*	2	42.0
2001	4	0	4	58.5
2002	1	0	1	75.0
2003	2	0	2	21.5
2004	4	0	4	52.0
Total	29	1*	28	45.1

*This patient was transferred out to paediatric facility, but died en route

Table 5.11: Predominant injury body region, ambulance category 7 (dying; occluded / threatened airway) patients receiving pre-hospital CPR, SWSAHS hospitals, 1995-2004

Predominant injury body region	Patients
Head / neck	13
Face	1
Chest	2
Abdomen	3
Spinal	2
Extremities	2
Head / chest	2
Head / extremities	1
Chest / abdomen	3
Total	29

5.7 Pre-hospital airway interventions

Table 5.12: Pre-hospital airway interventions, major data category, SWSAHS hospitals, 1995-2004

Year	None		Oxygen		Guedel / nasopharyngeal		Bag / mask		Intubated		Not documented		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
1995	80	10.5	602	79.1	8	1.1	25	3.3	15	2.0	31	4.1	761
1996	132	16.2	591	72.7	9	1.1	39	4.8	10	1.2	32	3.9	813
1997	233	23.8	664	67.7	12	1.2	24	2.4	19	1.9	29	3.0	981
1998	252	23.5	660	61.5	14	1.3	32	3.0	11	1.0	104	9.7	1073
1999	164	15.9	653	63.3	7	0.7	29	2.8	13	1.3	165	16.0	1031
2000	169	15.2	698	62.8	14	1.3	21	1.9	20	1.8	189	17.0	1111
2001	183	15.7	638	54.7	11	0.9	16	1.4	25	2.1	293	25.1	1166
2002	142	12.0	704	59.3	21	1.8	6	0.5	21	1.8	293	24.7	1187
2003	94	9.4	737	73.4	13	1.3	13	1.3	33	3.3	114	11.4	1004
2004	238	23.7	657	65.5	13	1.3	24	2.4	20	2.0	51	5.1	1003
Total	1687	16.7	6604	65.2	122	1.2	229	2.3	187	1.8	1301	12.8	10130

Table 5.13: Age group and pre-hospital airway interventions, major data category, SWSAHS hospitals, 1995-2004

Age group (years)	None		Oxygen		Guedel / nasopharyngeal		Bag / mask		Intubated		Not documented		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
<10	105	20.9	311	61.8	5	1.0	17	3.4	11	2.2	54	10.7	503
10-19	257	17.6	957	65.5	22	1.5	38	2.6	30	2.1	156	10.7	1460
20-29	260	12.9	1386	69.0	38	1.9	74	3.7	57	2.8	194	9.7	2009
30-39	219	14.4	1081	70.9	15	1.0	35	2.3	27	1.8	148	9.7	1525
40-49	161	13.9	794	68.7	13	1.1	24	2.1	25	2.2	139	12.0	1156
50-59	155	17.1	618	68.1	11	1.2	18	2.0	14	1.5	92	10.1	908
60-69	133	18.1	478	65.2	6	0.8	10	1.4	11	1.5	95	13.0	733
70-79	177	19.0	544	58.4	11	1.2	11	1.2	8	0.9	180	19.3	931
80+	220	24.3	435	48.1	1	0.1	2	0.2	4	0.4	243	26.9	905
Total	1687	16.7	6604	65.2	122	1.2	229	2.3	187	1.8	1301	12.8	10130

Table 5.14: Level of training for airway interventions, major data category, SWSAHS hospitals, 1995-2004

Level of Training	Guedel / naso-pharyngeal		Bag / mask		Intubated		Total
	n	%	n	%	n	%	
Level 1-3	20	41.7	28	58.3	0	-	48
Level 4 (ALS)	16	41.0	23	59.0	0	-	39
Paramedic	86	21.6	177	44.5	135	33.9	398
Medical officer	0	-	1	1.9	52	98.1	53
Total	122	22.7	229	42.6	187	34.8	538

Table 5.15: Pre-hospital personnel performing intubation, major data category, SWSAHS hospitals, 1995-2004

Year	Paramedics		Medical retrieval team		Total
	n	%	n	%	
1995	14	93.3	1	6.7	15
1996	10	100.0	0	-	10
1997	16	84.2	3	15.8	19
1998	6	54.5	5	45.5	11
1999	10	76.9	3	23.1	13
2000	14	70.0	6	30.0	20
2001	15	60.0	10	40.0	25
2002	12	57.1	9	42.9	21
2003	22	66.7	11	33.3	33
2004	16	80.0	4	20.0	20
Total	135	72.2	52	27.8	187

5.8 Pre-hospital fluid

The table below presents the total number of trauma patients who received IV fluid in the pre-hospital setting prior to being transported to a SWSAHS hospital. Further data on pre-hospital fluid administration is available in Chapter 8 (Performance Indicators).

Table 5.16: Patients who received pre-hospital IV fluid, major data category, SWSAHS hospitals, 1995-2004

Year	Patients	< 500ml		≥ 500ml	
		n	%	N	%
1995	315	132	41.9	183	58.1
1996	309	145	46.9	164	53.1
1997	322	159	49.4	163	50.6
1998	421	217	51.5	204	48.5
1999	387	213	55.0	174	45.0
2000	379	177	46.7	202	53.3
2001	403	222	55.1	181	44.9
2002	408	290	71.1	118	28.9
2003	515	416	80.8	99	19.2
2004	444	352	79.3	92	20.7
Total	3903	2323	59.5	1580	40.5

Figure 5.5: Patients who received pre-hospital IV fluid, major data category, SWSAHS hospitals, 1995-2004 (n=3903)

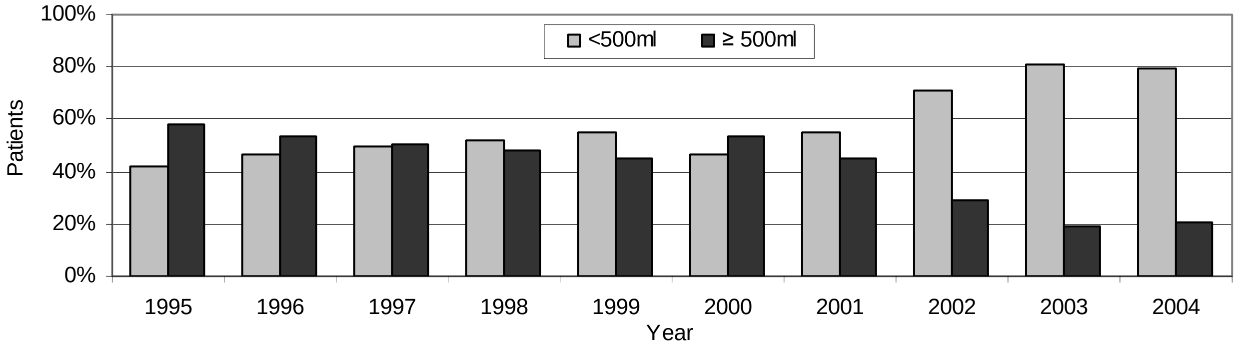


Table 5.17: Level of training of attending officer administering IV fluid, major data category, SWSAHS hospitals, 1995-2004

Year	Level 1-3		Level 4 (ALS)		Paramedic		Medical officer		Not documented		Total
	n	%	n	%	n	%	n	%	n	%	
1995	17	5.4	82	26.0	214	67.9	2	0.6	0	-	315
1996	6	1.9	94	30.4	209	67.6	0	-	0	-	309
1997	4	1.2	98	30.4	208	64.6	5	1.6	7	2.2	322
1998	5	1.2	86	20.4	309	73.4	19	4.5	2	0.5	421
1999	10	2.6	67	17.3	279	72.1	12	3.1	19	4.9	387
2000	7	1.8	61	16.1	281	74.1	20	5.3	10	2.6	379
2001	16	4.0	75	18.6	258	64.0	32	7.9	22	5.5	403
2002	15	3.7	61	15.0	303	74.3	25	6.1	4	1.0	408
2003	92	17.9	54	10.5	329	63.9	27	5.2	13	2.5	515
2004	50	11.3	37	8.3	319	71.8	20	4.5	18	4.1	444
Total	222	5.7	715	18.3	2709	69.4	162	4.2	95	2.4	3903

5.9 Pre-hospital blood pressure

Pre-hospital systolic blood pressure was available for 9066 (89.5%) of the SWSAHS major data category patients who received pre-hospital care. The following section presents trauma type (blunt or penetrating), blood pressure (normotensive or hypotensive), IV cannula use, and IV fluid volume for these patients. Pre-hospital hypotension was defined, in the trauma registry, as a pre-hospital systolic blood pressure ≤ 90mmHg.

1289 (14.2%) patients were hypotensive. Of these, 1084 (84.1%) sustained blunt trauma and 205 (15.9%) sustained penetrating trauma.

Pre-hospital hypotension

Table 5.18: Pre-hospital IV fluid, hypotensive patient and blunt trauma, major data category, SWSAHS hospitals, 1995-2004

Year	Total	No cannula		<500ml		≥ 500ml	
		n	%	n	%	n	%
1995	122	34	27.9	20	16.4	68	55.7
1996	98	26	26.5	22	22.4	50	51.0
1997	108	33	30.6	23	21.3	52	48.1
1998	121	30	24.8	27	22.3	64	52.9
1999	102	40	39.2	20	19.6	42	41.2
2000	124	50	40.3	21	16.9	53	42.7
2001	112	44	39.3	22	19.6	46	41.1
2002	106	38	35.8	28	26.4	40	37.7
2003	103	28	27.2	47	45.6	28	27.2
2004	88	33	37.5	30	34.1	25	28.4
Total	1084	356	32.8	260	24.0	468	43.2

Figure 5.6: Pre-hospital IV fluid, hypotensive patient and blunt trauma, major data category, SWSAHS hospitals, 1995-2004 (n=1084)

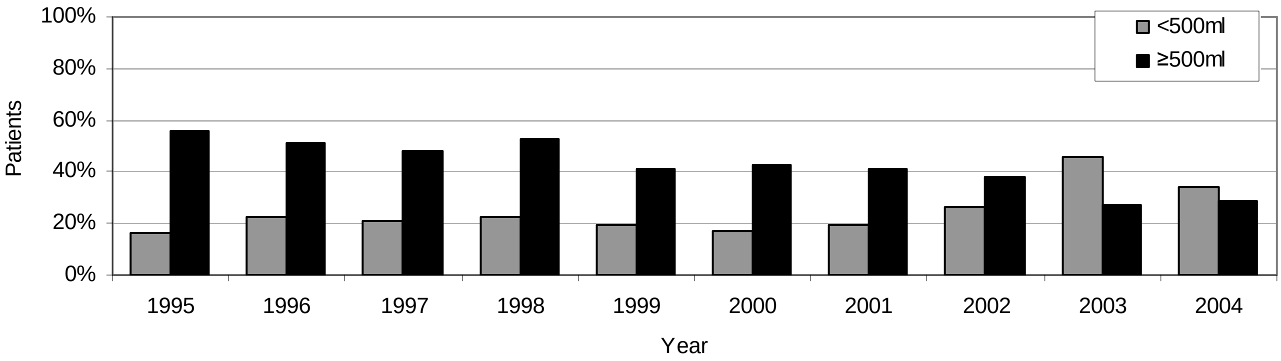
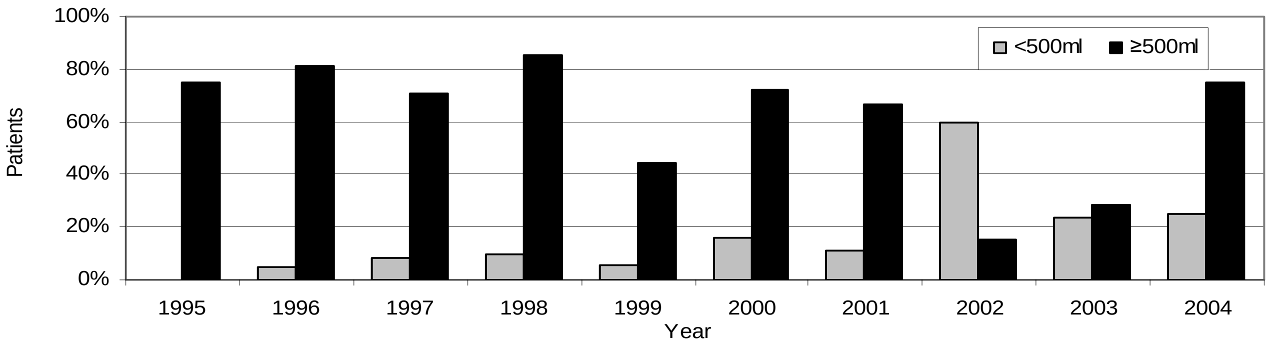


Table 5.19: Pre-hospital IV fluid, hypotensive patient and penetrating trauma, major data category, SWSAHS hospitals, 1995-2004

Year	Total	No cannula		<500ml		≥ 500ml	
		n	%	n	%	n	%
1995	20	5	25.0	0	-	15	75.0
1996	21	3	14.3	1	4.8	17	81.0
1997	24	5	20.8	2	8.3	17	70.8
1998	21	1	4.8	2	9.5	18	85.7
1999	18	9	50.0	1	5.6	8	44.4
2000	25	3	12.0	4	16.0	18	72.0
2001	27	6	22.2	3	11.1	18	66.7
2002	20	5	25.0	12	60.0	3	15.0
2003	21	10	47.6	5	23.8	6	28.6
2004	8	0	-	2	25.0	6	75.0
Total	205	47	22.9	32	15.6	126	61.5

Figure 5.7: Pre-hospital IV fluid, hypotensive patient and penetrating trauma, major data category, SWSAHS hospitals, 1995-2004 (n=158)



Pre-hospital normotension

Table 5.20: Pre-hospital IV fluid, normotensive patient and blunt trauma, major data category, SWSAHS hospitals, 1995-2004

Year	Total	No cannula		<500ml		≥ 500ml	
		n	%	n	%	n	%
1995	541	356	65.8	100	18.5	85	15.7
1996	596	411	69.0	113	19.0	72	12.1
1997	731	534	73.1	122	16.7	75	10.3
1998	821	551	67.1	172	21.0	98	11.9
1999	779	496	63.7	178	22.8	105	13.5
2000	793	555	70.0	138	17.4	100	12.6
2001	827	565	68.3	171	20.7	91	11.0
2002	857	577	67.3	217	25.3	63	7.4
2003	699	319	45.6	323	46.2	57	8.2
2004	741	402	54.3	286	38.6	53	7.2
Total	7385	4766	64.5	1820	24.6	799	10.8

Figure 5.8: Pre-hospital IV fluid, normotensive patient and blunt trauma, major data category, SWSAHS hospitals, 1995-2004 (n=7385)

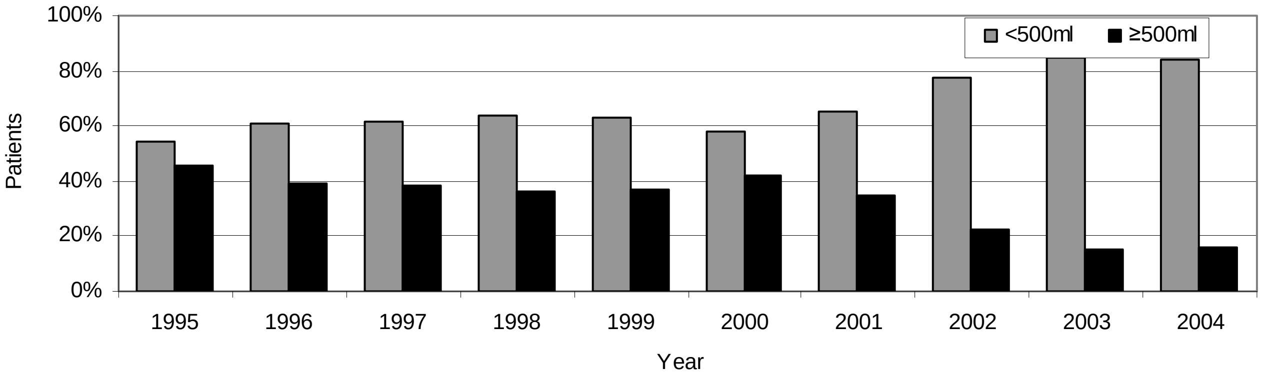
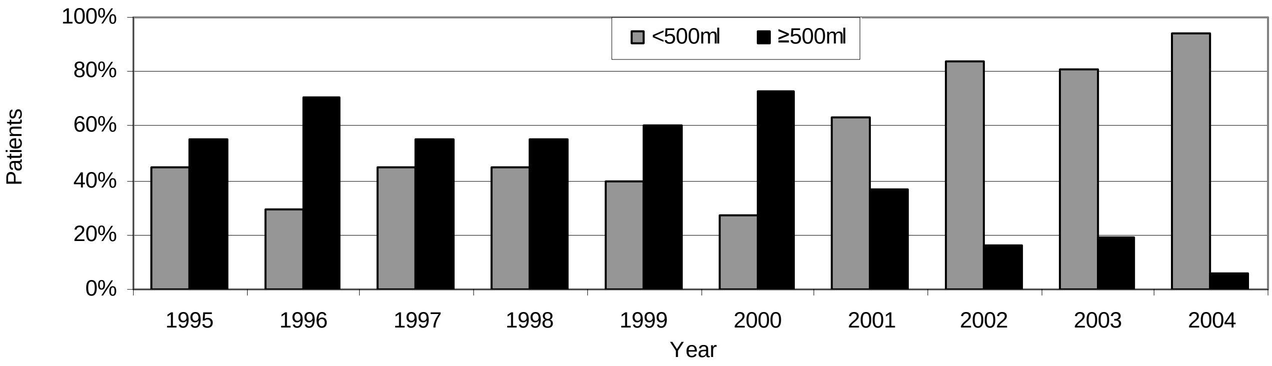


Table 5.21: Pre-hospital IV fluid, normotensive patient and penetrating trauma, major data category, SWSAHS hospitals, 1995-2004

Year	Total	No cannula		<500ml		≥ 500ml	
		n	%	n	%	n	%
1995	30	10	33.3	9	30.0	11	36.7
1996	47	20	42.6	8	17.0	19	40.4
1997	43	23	53.5	9	20.9	11	25.6
1998	44	15	34.1	13	29.5	16	36.4
1999	20	10	50.0	4	20.0	6	30.0
2000	48	15	31.3	9	18.8	24	50.0
2001	39	12	30.8	17	43.6	10	25.6
2002	59	34	57.6	21	35.6	4	6.8
2003	32	11	34.4	17	53.1	4	12.5
2004	30	12	40.0	17	56.7	1	3.3
Total	392	162	41.3	124	31.6	106	27.0

Figure 5.9: Pre-hospital IV fluid, normotensive patient and penetrating trauma, major data category, SWSAHS hospitals, 1995-2004 (n=230)



5.10 Pre-hospital medication

Pre-hospital medication data was available for 8695 (92.8%) of the 9370 SWSAHS major data category patients admitted who received pre-hospital care and were admitted between 1996-2004. Medication data from 1995 was excluded as data collection commenced during 1995. Patients administered multiple medications have the most clinically and/or pharmacologically significant drug recorded.

Over the ten years, drug protocols have changed. Medical retrieval doctors can now administer drugs such as thiopentone, suxamethonium, and fentanyl. In addition, other drugs such as midazolam, ketamine and sodium bicarbonate are now being used by both medical retrieval and ambulance services.

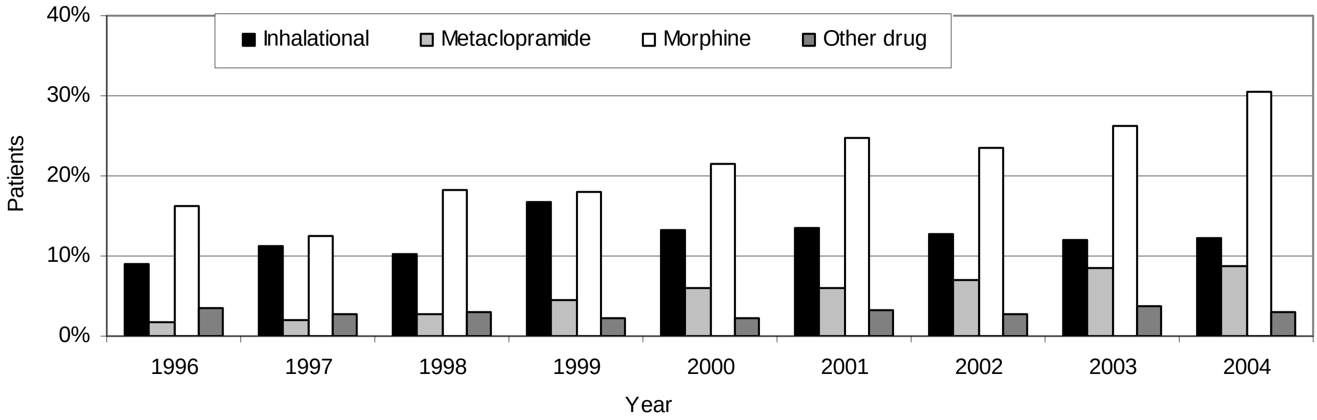
Table 5.22: Pre-hospital medication, major data category, SWSAHS hospitals, 1995-2004

Year	None		Inhalational*		Metaclopramide		Midazolam		Morphine		Other drug†		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
1996	449	69.3	58	9.0	12	1.9	0	-	106	16.4	23	3.5	648
1997	680	71.4	108	11.3	19	2.0	0	-	119	12.5	27	2.8	953
1998	695	65.8	109	10.3	29	2.7	0	-	192	18.2	31	2.9	1056
1999	578	58.3	166	16.8	45	4.5	0	-	179	18.1	23	2.3	991
2000	608	57.1	140	13.2	65	6.1	0	-	228	21.4	23	2.2	1064
2001	561	52.7	143	13.4	63	5.9	0	-	263	24.7	35	3.3	1065
2002	594	54.0	141	12.8	76	6.9	0	-	259	23.5	30	2.7	1100
2003	424	47.1	107	11.9	77	8.5	24	2.7	236	26.2	33	3.7	901
2004	402	43.8	113	12.3	80	8.7	14	1.5	280	30.5	28	3.1	917
Total	4991	57.4	1085	12.5	466	5.4	38	0.4	1862	21.4	253	2.9	8695

* Inhalational includes both entenox and methoxyflurane

† Other drug includes drugs such as ketamine, fentanyl, suxamethonium

Figure 5.10: Pre-hospital medication, major data category, SWSAHS hospitals, 1995-2004 (n=3704)*



* Midazolam excluded from this figure due to the small number of patients (n=38)

5.11 Pre-hospital intercostal catheter or thoracocentesis

From 1995-2004, 43 (0.42%) of all patients receiving pre-hospital care had an intercostal catheter or intercostal thoracocentesis pre-hospital. Currently, ambulance officers (Levels 4 and 5) are authorised to insert thoracocentesis needles, but not intercostal catheters.

For patients receiving an intercostal catheter or intercostal thoracocentesis pre-hospital, 35 (81.4%) were carried out by paramedics and 8 (18.6%) were carried out by a medical retrieval team medical officer. Of these patients, 27 (62.8%) survived.

Table 5.23: Pre-hospital personnel inserting intercostal catheter / thoracocentesis, SWSAHS hospitals, 1995-2004

Year	Paramedic		Medical retrieval team		Total
	n	%	n	%	
1995	1	100.0	0	-	1
1996	1	100.0	0	-	1
1997	2	66.7	1	33.3	3
1998	4	100.0	0	-	4
1999	2	66.7	1	33.3	3
2000	5	71.4	2	28.6	7
2001	5	100.0	0	-	5
2002	6	85.7	1	14.3	7
2003	6	75.0	2	25.0	8
2004	3	75.0	1	25.0	4
Total	35	81.4	8	18.6	43

Table 5.24: Survival outcome, patients undergoing pre-hospital intercostal catheter / thoracocentesis, SWSAHS hospitals, 1995-2004

ISS	Survived		Died		Total
	n	%	n	%	
0-15	4	100.0	0	-	4
16-30	13	92.9	1	7.1	14
31-45	6	54.5	5	45.5	11
46-74	4	44.4	5	55.6	9
75	0	-	5	100.0	5
Total	27	62.8	16	37.2	43

5.12 Military anti-shock trouser device

The military anti-shock trouser device (MAST) is an inflatable device used for splinting lower limb fractures or for increasing blood pressure. Use of this device is very limited and is decreasing. In October 1996 the Medical Advisory Committee, of the Ambulance Service of NSW, advised changes to the ambulance protocol concerning use of MAST. Since March 1997 use is contraindicated in penetrating torso injuries and ruptured diaphragm.

Table 5.25: Pre-hospital MAST device used, major data category, Liverpool Hospital, 1995-2004

Year	Not used	Applied, not inflated	Applied, inflated	Total
1995	713	24	24	761
1996	775	18	20	813
1997	956	15	10	981
1998	1057	13	3	1073
1999	1020	10	1	1031
2000	1104	5	2	1111
2001	1160	1	5	1166
2002	1184	1	2	1187
2003	1003	1	0	1004
2004	1003	1	0	1004
Total	9975	89	67	10131

Table 5.26: Pre-hospital MAST use and ISS, major data category, Liverpool Hospital, 1995-2004

ISS	Applied, not inflated	Applied, inflated	Total
ISS <16	49	29	78
ISS ≥16	40	38	78
Total	89	67	156

Figure 5.11: Pre-hospital MAST device used, major data category, Liverpool Hospital, 1995-2004

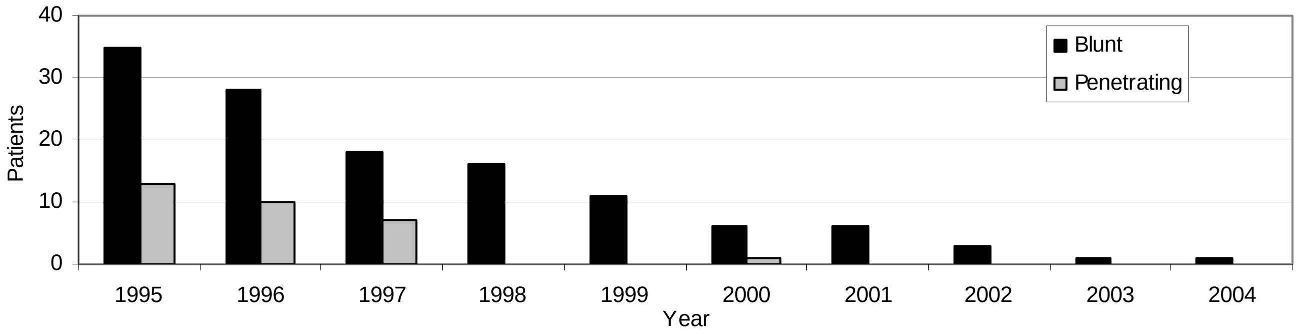


Table 5.27: Pre-hospital MAST device use in blunt and penetrating trauma, major data category, SWSAHS hospitals, 1995-2004

Year	Blunt	Penetrating	Total
1995	35	13	48
1996	28	10	38
1997	18	7	25
1998	16	0	16
1999	11	0	11
2000	6	1	7
2001	6	0	6
2002	3	0	3
2003	1	0	1
2004	1	0	1
Total	125	31	156

Photo of NRMA Careflight rescue

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5.13 Liverpool Hospital admissions for serious injury

There were 2309 patients with an ISS ≥ 16 admitted to Liverpool Hospital between1995-2004. Of these, 1853 (80.3%) were admitted directly to Liverpool Hospital and 456 (19.7%) patients were transferred in from other hospitals. The following table presents the mode of arrival for patients admitted directly to Liverpool Hospital.

Table 5.28: Type of pre-hospital care for patients with ISS ≥ 16 admitted directly to Liverpool Hospital, 1995-2004

Year	Ambulance				Medical retrieval team				Private transport		Total
	Paramedic		General duties		Helicopter		Road retrieval				
	n	%	n	%	n	%	n	%	n	%	
1995	81	65.9	34	27.6	1	0.8	0	-	7	5.7	123
1996	88	52.4	70	41.7	0	-	0	-	10	6.0	168
1997	107	59.1	60	33.1	4	2.2	0	-	10	5.5	181
1998	109	66.1	38	23.0	6	3.6	0	-	12	7.3	165
1999	93	53.8	58	33.5	6	3.5	0	-	16	9.2	173
2000	127	58.0	60	27.4	14	6.4	1	0.5	17	7.8	219
2001	93	49.7	68	36.4	12	6.4	3	1.6	11	5.9	187
2002	135	65.9	49	23.9	15	7.3	0	-	6	2.9	205
2003	134	59.3	50	22.1	23	10.2	1	0.4	18	8.0	226
2004	124	60.2	49	23.8	15	7.3	0	-	18	8.7	206
Total	1091	58.9	536	28.9	96	5.2	5	0.3	125	6.7	1853

Figure 5.12: Type of pre-hospital care for patients with ISS ≥ 16 admitted directly to Liverpool Hospital, 1995-2004 (n=1853)

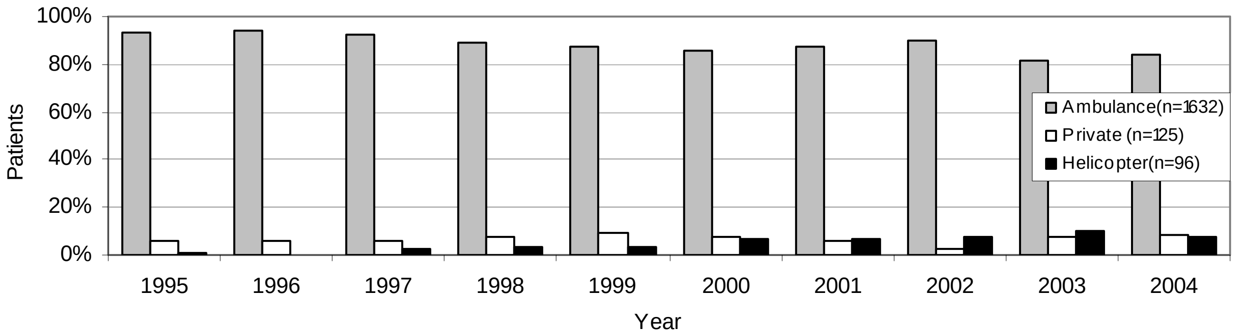


Table 5.29: Hospital of origin for ISS ≥ 16 transfers in to Liverpool Hospital, 1995-2004

Year	SWSAHS		Outside Sydney		Sydney metropolitan		Total
	n	%	n	%	n	%	
1995	22	78.6	5	17.9	1	3.6	28
1996	18	64.3	9	32.1	1	3.6	28
1997	19	76.0	5	20.0	1	4.0	25
1998	29	76.3	8	21.1	1	2.6	38
1999	38	79.2	7	14.6	3	6.3	48
2000	50	80.6	9	14.5	3	4.8	62
2001	46	78.0	12	20.3	1	1.7	59
2002	27	52.9	21	41.2	3	5.9	51
2003	40	72.7	15	27.3	0	-	55
2004	50	80.6	10	16.1	2	3.2	62
Total	339	74.3	101	22.2	16	3.5	456

Figure 5.13: Hospital of origin for ISS ≥ 16 transfers in to Liverpool Hospital, 1995-2004 (n=456)

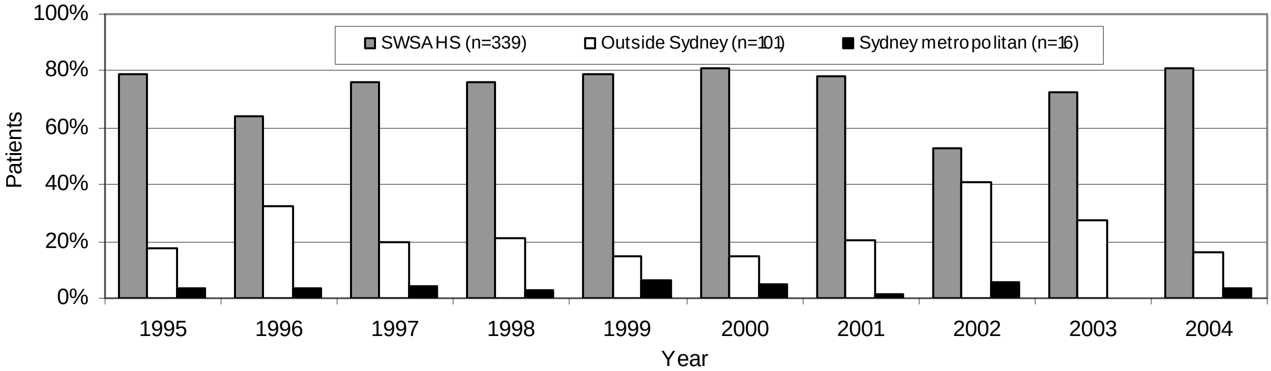


Table 5.30: Pre-hospital ambulance transport decision category for ISS ≥ 16 direct admissions to Liverpool Hospital, 1995-2004

Year	Serious - Bypass to MTS		Serious - MTS is nearest		Minor - MTS is nearest		Unknown		Total
	n	%	n	%	n	%	n	%	
1995	55	47.4	46	39.7	0	-	15	12.9	116
1996	63	39.9	59	37.3	0	-	36	22.8	158
1997	81	47.4	61	35.7	5	2.9	24	14.0	171
1998	66	43.1	62	40.5	2	1.3	23	15.0	153
1999	78	49.7	51	32.5	9	5.7	19	12.1	157
2000	86	42.6	82	40.6	12	5.9	22	10.9	202
2001	77	43.8	49	27.8	23	13.1	27	15.3	176
2002	110	55.3	61	30.7	8	4.0	20	10.1	199
2003	94	45.2	71	34.1	24	11.5	19	9.1	208
2004	60	31.9	41	21.8	69	36.7	18	9.6	188
Total	770	44.6	583	33.7	152	8.8	223	12.9	1728

5.14 SWSAHS inter-hospital trauma transfers to Liverpool Hospital

Of the 9123 major data category patients admitted to Liverpool Hospital between1995-2004, 1281 (14.0%) were adult (age ≥14 years) inter-hospital trauma transfers from another SWSAHS hospital.

Inter-hospital trauma transfers are carried out by medical retrieval teams or ambulance officers. The mode of transport is determined by the referring hospital physicians' judgement. (A small number of patients were transferred via private vehicle, as no specialised transport was deemed necessary).

After arrival in Liverpool ED, 11.9% of the patients went to the operating theatre, 7.7% went to ICU and 73.5% went to the ward.

Table 5.31: Liverpool Hospital Emergency Department disposition, SWSAHS inter-hospital trauma transfers, major data category, 1995-2004

Liverpool ED disposition:	n	%
Ward	941	73.5
OT	152	11.9
ICU	98	7.7
HDU	76	5.9
Transfer out to specialist major trauma service	8	0.6
Died in ED	4	0.3
Died in OT	2	0.2
Total	1281	100.0

Table 5.32: Interventions at referring hospital, SWSAHS inter-hospital trauma transfers to Liverpool Hospital, major data category, 1995-2004

Intervention:	n	%
IV fluid > 1500ml	134	10.5
Intubation	116	9.1
Chest tube insertion	42	3.3

Table 5.33: Mode of arrival to first hospital for inter-hospital trauma transfers from SWSAHS hospitals to Liverpool Hospital, major data category, 1995-2004

Variable		General duties Ambulance		Paramedic		Medical retrieval team		Private		Total	
		n	%	n	%	n	%	n	%	n	%
Total Patients		873	68.1	216	16.9	154	12.0	38	3.0	1281	100.0
Sex:	Male	627	67.3	160	17.2	116	12.4	29	3.1	932	72.8
	Female	246	70.5	56	16.0	38	10.9	9	2.6	349	27.2
Outcome:	Survived	854	69.7	206	16.8	127	10.4	38	3.1	1225	95.6
	Died	19	33.9	10	17.9	27	48.2	0	-	56	4.4
Age:	Mean	42.7	-	39.7	-	38.8	-	39.5	-	41.6	-
	Standard deviation	21.1	-	21.0	-	19.3	-	19.3	-	20.9	-
Mechanism:	Falls	301	74.1	52	12.8	40	9.9	13	3.2	406	31.7
	Road trauma	244	64.9	77	20.5	48	12.8	7	1.9	376	29.4
	Interpersonal violence	150	62.0	56	23.1	32	13.2	4	1.7	242	18.9
	Other	178	69.3	31	12.1	34	13.2	14	5.4	257	20.0
ISS:	ISS < 16	720	75.9	146	15.4	54	5.7	29	3.1	949	74.1
	ISS ≥ 16	153	46.1	70	21.1	100	30.1	9	2.7	332	25.9
Altered physiological status at referring hospital:	Respiratory rate < 10 or > 29	22	35.5	16	25.8	23	37.1	1	1.6	62	4.8
	Systolic BP < 90mmHg	9	42.9	6	28.6	6	28.6	0	-	21	1.6
	GCS < 9	43	64.2	12	17.9	9	13.4	3	4.5	67	5.2

References

1. Ambulance Service of New South Wales. Pre-Hospital Triage Trauma Protocol 4 (NSW). NSW, Australia: Ambulance Service of New South Wales; 2004 Sep.
2. Ambulance Service of New South Wales. Instructional circular number ICO3/22: Trauma Patients, South Western Sydney Area Health Service. NSW, Australia: Ambulance Service of New South Wales; 2003 Jul.

6 Types of Injury

Executive comment

Trauma tends to be a multi-system phenomenon. Even an injury to a single body region may have multiple injuries within that region. For example, the 3334 patients admitted with head injuries sustained 15688 injuries overall, with associated injuries particularly in the face and thorax. Similarly, the 2896 patients with thoracic injuries sustained over 13000 injuries overall, and these predominately affected the head and extremities. Road trauma accounted for the dominant source of abdominal injury. Many of these are related to seatbelt usage.
Of particular note, small bowel injury is now the commonest injury to be found at laparotomy. While splenic injury is almost as common in the blunt trauma patient with abdominal injury, small bowel injury needs to be at the forefront of the surgeon's mind. The diagnosis and management of small bowel injury is much more challenging.
Laparoscopy has altered the management of abdominal trauma, particularly penetrating trauma. The number of laparoscopies performed for trauma has increased significantly since 1995.
Whilst vascular injuries are less frequent, they are associated with a high mortality and predominantly affect the extremities followed by the abdomen, pelvis and thorax.

The importance of orthopaedic injuries cannot be over-emphasised, with 31215 (64.3%) patients admitted with orthopaedic injuries. The increase over the years in the number of admissions reflects in part the number of increased transfers in to Liverpool Hospital. In 2004, 20% of the orthopaedic workload was transferred in from other hospitals. It is clear, however, that urban hospitals are still treating large numbers of orthopaedic patients, accounting for between 57-78% of their admissions for trauma.

Restraints in motor vehicles are increasingly used, particularly airbags, with 35% of trauma admissions from motor vehicle crashes now associated with the deployment of airbags. Motorbike riders, however, continue to be relatively noncompliant with helmet wearing with 21.6% not wearing a helmet at the time of injury.

The issue of child safety around vehicles is raised, with 29.8% child pedestrian injuries occurring in places other than on the street, and most commonly in driveways. The number of adult patients sustaining significant burns has declined over the past ten years. The number of penetrating trauma patients sustaining assault has decreased over the last two years. It is interesting to note that the pattern of penetrating injury, predominantly affecting the abdomen is associated with small bowel injury. It would appear that the diagnosis and management of small bowel injury has become extremely important, for both blunt and penetrating trauma.

Recommendations

1. Injury epidemiology must be taught at undergraduate and postgraduate levels, across disciplines. In order to facilitate an understanding of the mechanisms and treatment of trauma, core curricula must be defined and adopted.

2. Clinical practice guidelines need to be developed for the assessment of the trauma patient. This will ensure that minimal standards of care are maintained, regardless of the level or location of the treating hospital.

3. Seatbelt design needs to be reviewed in order to reduce the incidence of abdominal injuries.

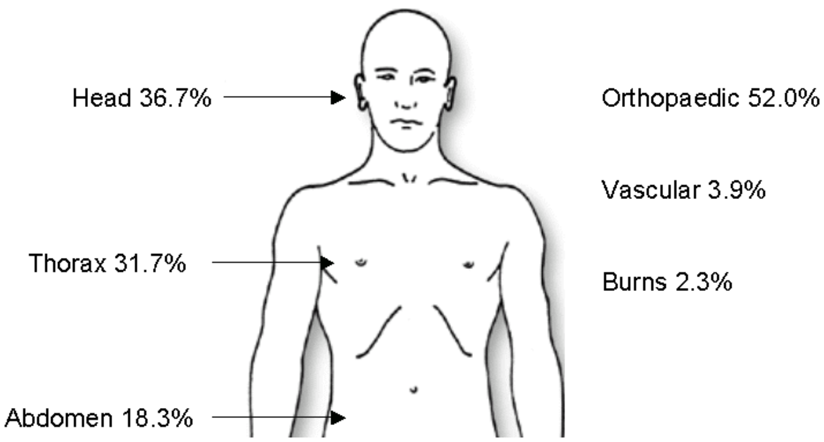
4. A national forum on ladder injuries needs to be convened. This should include manufacturers, retailers, clinicians and injury prevention specialists.

6.1 Overview

Of the 9123 major data category patients admitted to Liverpool Hospital between 1995-2004, 36.7% of patients sustained a head injury, 31.7% sustained a thoracic injury, 18.3% sustained an abdominal injury, 52.8% sustained an orthopaedic injury, 3.9% sustained a vascular injury and 2.3% sustained burns. Many patients sustained multiple injuries, in which case each single injury was counted. In order to be included in the major data category, patients met one or more of the following criteria:

- Injury to more than one body region
- Any skeletal or internal organ injury of the head, neck, chest, abdomen or extremities (including fractured ribs), excluding isolated fractures specified in the minor data category
- Any loss of consciousness
- Injury severity score (ISS) [8] of greater than or equal to 16 (ISS ≥ 16)
- Deaths following injury
- Burns: for adults BSA > 20%; for children BSA > 10%; airway burns
- Patients undergoing trauma laparoscopy, laparotomy or DPL
- Fractured tibia / fibula above ankle level

Figure 6.1: Frequency of specific types of injury in trauma patients admitted to Liverpool Hospital, major data category, 1995-2004 [1]



The various injuries were identified using Abbreviated Injury Scale (AIS) codes. [2] The AIS is a consensus derived, anatomically based system that classifies individual injuries by body region on a 6-point ordinal severity scale:

Minor 1
Moderate 2
Serious 3
Severe 4
Critical 5
Maximum 6

AIS data can be used to calculate the injury severity score (ISS), which is an overall measure of the combined severity of all injuries sustained by a patient. The ISS is calculated by summing of the squares of the highest AIS score in each of the three most seriously injured body regions. There are six body regions: head or neck; face; chest; abdominal or pelvic contents; extremities or pelvic girdle, and external.

ISS scores range from 1 (minor) to 75 (unsurvivable injury). An ISS of 75 results in one of two ways, either with three AIS 5 injuries, or with at least one AIS 6 injury. [2,3]

6.2 Head injuries

- Of all the trauma patients admitted to SWSAHS hospitals from 1995-2004, 3344 (15.7%) sustained a head injury with an AIS score > 1
- 2511 (75.1%) of patients were male, and 833 (24.9%) were female; the mean age was 34.5 (± 21.4) years (range 0-95)
- 3075 (92.0%) of patients survived and 269 (8.0%) of patients died
- The average length of stay (ALOS) in hospital was 9.5 (± 14.9) days (range 1-277)
- 2810 (84.0%) received pre-hospital intervention, whilst 308 (9.2%) arrived via private transport
- For 2204 (65.9%) patients the head or neck was the predominant body region of injury; for 443 (13.2%) of patients the head or neck had equal severity with another body region; and for 697 (20.8%) injuries to other body regions were more serious than the head injury
- 229 (6.8%) of head injured patients underwent craniotomy for an acute subdural or extradural haemorrhage (SDH or EDH)

Table 6.1: Head injury sex and age distribution, Liverpool Hospital, major data category, 1995-2004

Year	Total	Sex distribution				Age distribution		
		Male		Female		Mean		sd*
		n	%	n	%			
1995	212	154	72.6	58	27.4	30.5	±	20.9
1996	270	209	77.4	61	22.6	33.0	±	21.8
1997	250	193	77.2	57	22.8	31.1	±	19.2
1998	292	224	76.7	68	23.3	32.5	±	21.2
1999	346	264	76.3	82	23.7	36.1	±	21.7
2000	390	297	76.2	93	23.8	35.0	±	20.5
2001	441	321	72.8	120	27.2	35.7	±	21.2
2002	413	315	76.3	98	23.7	33.6	±	21.2
2003	388	283	72.9	105	27.1	35.8	±	21.9
2004	342	251	73.4	91	26.6	38.5	±	22.6
Total	3344	2511	75.1	833	24.9	34.5	±	21.4

* Standard deviation

Figure 6.2: Head injury age and sex distribution, Liverpool major data category 1995-2004 (N=3344)

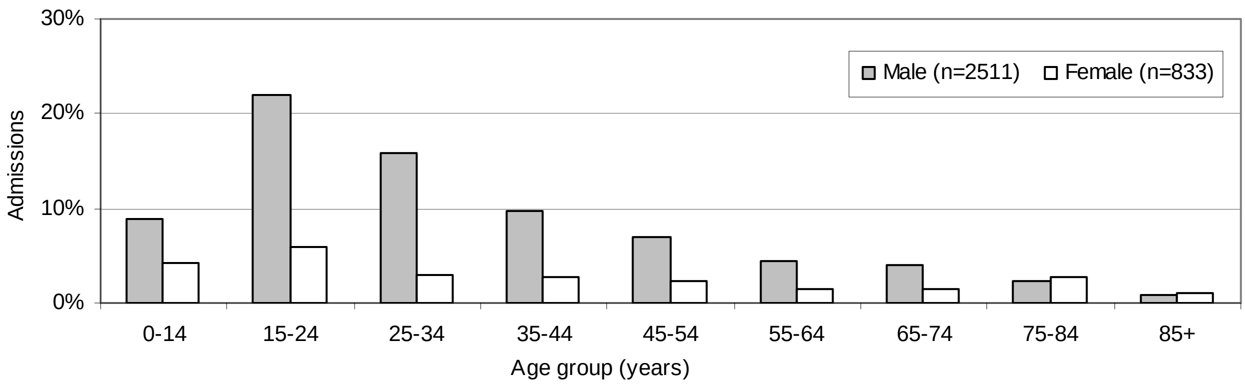


Table 6.2: Head injury and ISS, Liverpool Hospital, major data category, 1995-2004

Year	Total	ISS < 16		ISS ≥ 16		Mean		sd	Range
		n	%	n	%				
1995	212	117	55.2	95	44.8	17.0	±	13.7	4-75
1996	270	142	52.6	128	47.4	17.8	±	14.1	4-75
1997	250	117	46.8	133	53.2	18.9	±	13.7	4-75
1998	292	145	49.7	147	50.3	17.4	±	11.8	4-75
1999	346	187	54.0	159	46.0	17.4	±	12.5	4-75
2000	390	194	49.7	196	50.3	17.6	±	12.3	4-75
2001	441	263	59.6	178	40.4	14.9	±	10.5	4-75
2002	413	239	57.9	174	42.1	14.7	±	10.7	4-75
2003	388	187	48.2	201	51.8	16.6	±	10.3	4-75
2004	342	163	47.7	179	52.3	17.9	±	11.6	4-75
Total	3344	1754	52.5	1590	47.5	16.8	±	12.0	4-75

Table 6.3: Head injury by ISS range, Liverpool Hospital, major data category, 1995-2004

Year	ISS 4-8		ISS 9-15		ISS 16-24		ISS 25-49		ISS 50-74		ISS 75		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
1995	55	25.9	62	29.2	48	22.6	38	17.9	5	2.4	4	1.9	212
1996	57	21.1	85	31.5	60	22.2	56	20.7	7	2.6	5	1.9	270
1997	51	20.4	66	26.4	61	24.4	61	24.4	9	3.6	2	0.8	250
1998	58	19.9	87	29.8	69	23.6	71	24.3	5	1.7	2	0.7	292
1999	67	19.4	120	34.7	71	20.5	78	22.5	8	2.3	2	0.6	346
2000	78	20.0	116	29.7	96	24.6	84	21.5	14	3.6	2	0.5	390
2001	122	27.7	141	32.0	98	22.2	73	16.6	6	1.4	1	0.2	441
2002	125	30.3	114	27.6	107	25.9	61	14.8	2	0.5	4	1.0	413
2003	68	17.5	119	30.7	124	32.0	72	18.6	5	1.3	0	-	388
2004	52	15.2	111	32.5	95	27.8	75	21.9	7	2.0	2	0.6	342
Total	733	21.9	1021	30.5	829	24.8	669	20.0	68	2.0	24	0.7	3344

Table 6.4: Head injury, blunt versus penetrating trauma, Liverpool Hospital, major data category, 1995-2004

Year	Blunt		Penetrating		Total
	n	%	n	%	
1995	210	99.1	2	0.9	212
1996	263	97.4	7	2.6	270
1997	244	97.6	6	2.4	250
1998	287	98.3	5	1.7	292
1999	341	98.6	5	1.4	346
2000	387	99.2	3	0.8	390
2001	431	97.7	10	2.3	441
2002	405	98.1	8	1.9	413
2003	384	99.0	4	1.0	388
2004	339	99.1	3	0.9	342
Total	3291	98.4	53	1.6	3344

Table 6.5: Head injury mechanism of injury, Liverpool Hospital, major data category, 1995-2004

Mechanism		Outcome					
		Survived		Died		Total	
		n	%	n	%	n	%
Road trauma	MVC driver	590	92.3	49	7.7	639	19.1
	Pedestrian	319	87.9	44	12.1	363	10.9
	MBC rider	226	93.8	15	6.2	241	7.2
	MVC front passenger	181	92.8	14	7.2	195	5.8
	MVC back passenger	89	87.3	13	12.7	102	3.1
	Cyclist vs. vehicle	96	95.0	5	5.0	101	3.0
	MBC pillion	14	100.0	0	*	14	0.4
	Road trauma total	1515	91.5	140	8.5	1655	49.5
Falls	Fall<1m	439	88.3	58	11.7	497	14.9
	Fall 1-5m	157	97.5	4	2.5	161	4.8
	Fall>5m	85	84.2	16	15.8	101	3.0
	Falls total	681	89.7	78	10.3	759	22.7
Interpersonal violence	Blunt assault	487	96.4	18	3.6	505	15.1
	Stabbing	20	87.0	3	13.0	23	0.7
	Gunshot	9	47.4	10	52.6	19	0.6
	I/P violence total	516	94.3	31	5.7	547	16.4
Other	Industrial	55	93.2	4	6.8	59	1.8
	Cyclist not v. vehicle	58	100.0	0	-	58	1.7
	Fall from horse	48	98.0	1	2.0	49	1.5
	Other mechanism	41	93.2	3	6.8	44	1.3
	Hanging	26	72.2	10	27.8	36	1.1
	Not documented	7	100.0	0	-	7	0.2
	Burns	6	100.0	0	-	6	0.2
	Other total	241	93.1	18	6.9	259	7.7
Recreation total		122	98.4	2	1.6	124	3.7
Total		3075	92.0	269	8.0	3344	100.0

Table 6.6: Head injury origin of arrival and pre-hospital intervention, Liverpool Hospital, major data category, 1995-2004

Year	Direct - pre-hospital care		Direct - private transport		Transfer from other hospital		Total
	n	%	n	%	n	%	
1995	154	72.6	17	8.1	41	19.3	212
1996	202	74.8	22	8.1	46	17.0	270
1997	205	82.0	14	5.6	31	12.4	250
1998	206	70.5	30	10.3	56	19.2	292
1999	239	69.1	29	8.4	78	22.5	346
2000	270	69.2	34	8.7	86	22.1	390
2001	290	65.8	57	12.9	94	21.3	441
2002	294	71.2	44	10.6	75	18.2	413
2003	287	74.0	29	7.4	72	18.6	388
2004	246	71.9	32	9.4	64	18.7	342
Total	2393	71.6	308	9.2	643	19.2	3344

Table 6.7: Head injury survival outcome, Liverpool Hospital, major data category, 1995-2004

Year	Survived		Died		Total
	n	%	n	%	
1995	189	89.2	23	10.8	212
1996	231	85.6	39	14.4	270
1997	228	91.2	22	8.8	250
1998	261	89.4	31	10.6	292
1999	319	92.2	27	7.8	346
2000	366	93.8	24	6.2	390
2001	414	93.9	27	6.1	441
2002	395	95.6	18	4.4	413
2003	361	93.0	27	7.0	388
2004	311	90.9	31	9.1	342
Total	3075	92.0	269	8.0	3344

Table 6.8: Head injury status on discharge, Liverpool Hospital, major data category, 1995-2004

Status on discharge	Survived	
	n	%
Full recovery	2074	62.0
Transfer to other facility	347	10.4
Brain injury unit rehabilitation	343	10.3
Died	269	8.0
Home help and/or outpatient rehabilitation	220	6.6
Discharge against medical advice	91	2.7
Total	3344	100.0

Table 6.9: Head injury and Glasgow Coma Scale (GCS) on arrival in ED, Liverpool Hospital, 1995-2004

Year	Patients	GCS on arrival in ED*									
		GCS 3†		GCS 4-8		GCS 9-12		GCS 13-14		GCS 15	
		n	%	n	%	n	%	n	%	n	%
1995	212	28	13.2	21	9.9	24	11.3	49	23.1	90	42.5
1996	270	34	12.6	32	11.9	40	14.8	46	17.0	118	43.7
1997	250	35	14.0	27	10.8	26	10.4	56	22.4	106	42.4
1998	289	46	15.9	22	7.6	30	10.4	62	21.5	129	44.6
1999	345	38	11.0	27	7.8	31	9.0	79	22.9	170	49.3
2000	390	37	9.5	17	4.4	32	8.2	88	22.6	216	55.4
2001	439	32	7.3	32	7.3	32	7.3	107	24.4	236	53.8
2002	411	41	10.0	27	6.6	36	8.8	109	26.5	198	48.2
2003	387	34	8.8	31	8.0	31	8.0	107	27.6	184	47.5
2004	341	43	12.6	23	6.7	25	7.3	86	25.2	164	48.1
Total	3334	368	11.0	259	7.8	307	9.2	789	23.7	1611	48.3

* Glasgow Coma Scale (GCS) on arrival in ED was available for 3334 (99.7%) of head injury patients

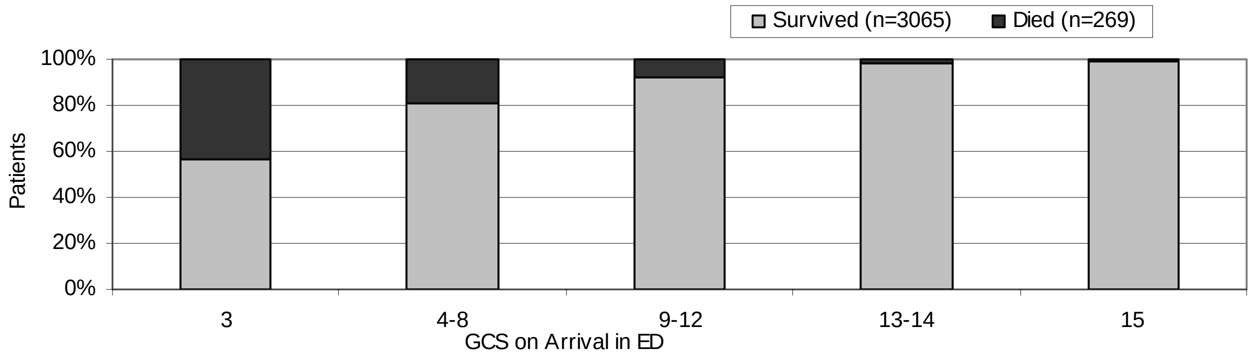
† Includes patients with GCS >8 pre-hospital who are sedated and intubated (resulting in GCS 3)

The lower the GCS on arrival in ED, the higher the mortality rate. Patients with a head injury who have GCS 3 on arrival have a very high mortality rate of 43.8%.

Table 6.10: Head injury survival outcome by GCS on arrival in ED, Liverpool Hospital, major data category, 1995-2004

GCS	Survived		Died		Total
	n	%	n	%	
3	207	56.3	161	43.8	368
4-8	210	81.1	49	18.9	259
9-12	282	91.9	25	8.1	307
13-14	776	98.4	13	1.6	789
15	1590	98.7	21	1.3	1611
Total	3065	91.9	269	8.1	3334

Figure 6.3: Head injury survival outcome by GCS on arrival in ED, Liverpool Hospital, major data category, 1995-2004 (n=3334)



164 (40.8%) of all head injury patients with a GCS motor score 1 on arrival in the emergency department subsequently died.

Table 6.11: Head injury GCS 3-8 on arrival: GCS motor score and outcome, Liverpool Hospital, major data category, 1995-2004

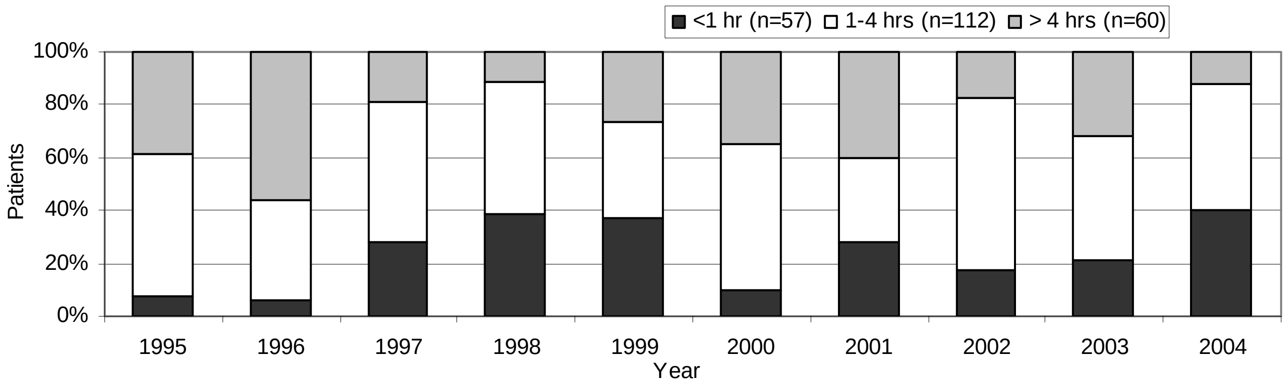
GCS motor score on arrival in ED	Survived		Died		Total
	n	%	n	%	
1	238	59.2	164	40.8	402
2	29	78.4	8	21.6	37
3	36	76.6	11	23.4	47
4	50	73.5	18	26.5	68
5	64	87.7	9	12.3	73
Total	417	66.5	210	33.5	627

Time from arrival in ED to craniotomy for acute subdural or extradural haemorrhage (SDH / EDH)

Table 6.12: Time from arrival in ED to craniotomy for patients with acute SDH / EDH, Liverpool Hospital, major data category, 1995-2004

Year	< 1 hour		1-4 hours		> 4 hours		Total
	n	%	n	%	n	%	
1995	1	7.7	7	53.8	5	38.5	13
1996	1	6.3	6	37.5	9	56.3	16
1997	9	28.1	17	53.1	6	18.8	32
1998	10	38.5	13	50.0	3	11.5	26
1999	7	36.8	7	36.8	5	26.3	19
2000	2	10.0	11	55.0	7	35.0	20
2001	7	28.0	8	32.0	10	40.0	25
2002	6	17.6	22	64.7	6	17.6	34
2003	4	21.1	9	47.4	6	31.6	19
2004	10	40.0	12	48.0	3	12.0	25
Total	57	24.9	112	48.9	60	26.2	229

Figure 6.4: Time from arrival to craniotomy for patients with acute SDH / EDH, Liverpool Hospital, major data category, 1995-2004 (n=229)



Head CT results

In summary:

- During the resuscitative phase of care, 2157 head injured patients underwent CT scan of the head
- 1039 patients (48.2%) had normal cerebral findings and 1118 patients (51.8%) had abnormal cerebral findings
- When multiple injuries are present, the most serious or significant injury was recorded
- The figures only include head CT undertaken during the resuscitative phase of care

Table 6.13: Head injury CT results, Liverpool Hospital, major data category, 1995-2004

Head CT result:	n	%
Normal	1039	48.2
Subdural	284	13.2
Cerebral contusion	260	12.1
Other*	204	9.5
Extradural	119	5.5
Subarachnoid blood	97	4.5
Intracerebral bleed	82	3.8
Cerebral oedema	72	3.3
Total	2157	100.0

*Includes fractured skull with no intracranial injury

Head injury patients: injury descriptions and scores

The following table presents the 6572 specific head injuries that were sustained by the 3344 patients with diagnosed head injury. These patients all had one or more AIS codes in the head region with an AIS score > 1. If an additional minor head injury with AIS = 1 was also present, this is listed in the table, but was not used as part of the initial ‘head injury’ selection criteria.

Table 6.14: Head injury patients: Injury description and score for head injuries, major data category, Liverpool Hospital, 1995-2004

Anatomic structure / injury	AIS score						Total	
	1	2	3	4	5	6	n	%
Whole area								28.4
Scalp	692	108	15				815	
Penetrating injury			8		10		18	
Skeletal - base of skull fracture			360	11			371	
Skeletal - vault fracture		385	156	40			581	
Massive destruction cranium / brain						5	5	
Cranial nerves		54					54	
Vessels - intracranial			5	6	9		20	
Whole area total	692	547	544	57	19	5	1864	
Internal organs								37.0
Brainstem					79	9	88	
Cerebellum			41	23	31		95	
Cerebrum - contusion			439	56	46		541	
Cerebrum - DAI (white matter shearing)					60		60	
Cerebrum - epidural or extradural				144	80		224	
Cerebrum – oedema			51	30	38		119	
Cerebrum – intracerebral				193	53		246	
Cerebrum – NFS			3				3	
Cerebrum – subdural				309	236		545	
Cerebrum – brain swelling / oedema			30	25	28		83	
Cerebrum – infarction or ischaemia			19				19	
Cerebrum - intraventricular haemorrhage				24			24	
Cerebrum – laceration				4			4	
Cerebrum - penetrating injury					4		4	
Cerebrum - pneumocephalus			49				49	
Cerebrum - subarachnoid haemorrhage			326				326	
Cerebrum - subpial haemorrhage			1				1	
Internal organs total			959	808	655	9	2431	
Level of consciousness								34.6
GCS<=8 +/- neurological deficit		44	12	26	13		95	
GCS 9-14 +/- prior LOC +/- neurological deficit		399	160	2			561	
GCS 15 +/- prior LOC +/- neurological deficit	22	791	83				896	
Unconsciousness +/- neurological deficit		447	109	40	41		637	
Cerebral concussion		88					88	
Level of consciousness total	22	1769	364	68	54		2277	
Total	714	2316	1867	933	728	14	6572	100

The table below presents the total number and type of injury to every body region for the 3344 patients with head injury. A total of 15688 injuries were sustained.

Table 6.15: Head injury patients: Injury description and score for all injuries sustained, major data category, Liverpool Hospital, 1995-2004

AIS description		AIS Score						Total
Region	Subregion	1	2	3	4	5	6	
Head	Internal organs			959	808	655	9	2431
	Level of consciousness	22	1769	364	68	54		2277
	Nerves - cranial		54					54
	Skeletal		385	516	51			952
	Vessels - intracranial			5	6	9		20
	Whole area	692	108	23		10	5	838
Head total		714	2316	1867	933	728	14	6572
Face	Internal organs	165	20					185
	Nerves	1	5					6
	Skeletal	429	659	121	9			1218
	Vessels	2		1				3
	Whole area	1064	104	2				1170
Face total		1661	788	124	9			2582
Neck	Internal organs	1	10	2	1	1		15
	Skeletal		3					3
	Vessels	1		3	3			7
	Whole area	86	3	1				90
Neck total		88	16	6	4	1		115
Spine	Cervical spine	97	139	73	2	3	5	319
	Lumbar spine	19	208	21				248
	Thoracic spine	17	131	31	1	7		187
Spine total		133	478	125	3	10	5	754
Thorax	Internal organs	21	5	229	67	32		354
	Skeletal	133	267	157	90	27		674
	Vessels			1	11	11		23
	Whole area	185		4				189
Thorax total		339	272	391	168	70		1240
Abdomen and pelvic	Internal organs	21	228	100	61	33		443
	Vessels			10	5	1		16
	Whole area	195	2					197
Abdomen and pelvic total		216	230	110	66	34		656
Lower extremity	Muscle / tendons / ligaments		45	7				52
	Nerves		1					1
	Skeletal - bones	19	594	390	15	23		1041
	Skeletal - joints	76	66					142
	Vessels	4	2	5	4			15
	Whole area	407	60	20	1			488
Lower extremity total		506	768	422	20	23		1739
Upper extremity	Muscle / tendons / ligaments	12	8					20
	Nerves	3	5					8
	Skeletal - bones	49	518	168				735
	Skeletal - joints	114	54	1				169
	Vessels	3		4				7
	Whole area	344	35	7				386
Upper extremity total		525	620	180				1325
External / burns / other	Burns	9	5	1	1			16
	Skin and subcutaneous tissue	682	1					683
	Other trauma		4	2				6
External / burns / other total		691	10	3	1			705
Total		4873	5498	3228	1204	866	19	15688

6.3 Thoracic injuries

- 2896 patients with thoracic injuries were admitted to Liverpool Hospital during the 10-year period 1995-2004
- Thoracic injury patients are defined as all patients who had an AIS-98 coded injury in the chest region
- 2031 (70.1%) were male and 865 (29.9%) were female; the mean age was 42.4 (± 20.0) years (range 1-99)
- 2691 (92.9%) survived and 205 (7.1%) died
- The average length of stay (ALOS) in hospital was 10.5 (± 19.8) days (range 1-626)
- 2691 (92.9%) of patients received pre-hospital intervention, whilst 205 (7.1%) arrived via private transport
- For 1360 (47.0%) of patients the thorax was the predominant body region of injury
- 127 (4.4%) underwent thoracotomy, and 18 (14.2%) of all thoracotomies were emergency thoracotomies performed in the ED

Table 6.16: Thoracic injury sex and age distribution, Liverpool Hospital, major data category, 1995-2004

Year	Total	Sex distribution				Age distribution		
		Male		Female		Mean		sd
		n	%	n	%			
1995	196	139	70.9	57	29.1	39.3	±	21.1
1996	263	187	71.1	76	28.9	41.1	±	20.8
1997	266	193	72.6	73	27.4	39.7	±	18.1
1998	253	189	74.7	64	25.3	39.9	±	18.8
1999	293	202	68.9	91	31.1	42.6	±	20.6
2000	343	252	73.5	91	26.5	43.1	±	19.6
2001	317	223	70.3	94	29.7	43.2	±	19.8
2002	315	212	67.3	103	32.7	43.1	±	20.6
2003	314	201	64.0	113	36.0	44.0	±	19.6
2004	336	233	69.3	103	30.7	45.3	±	20.8
Total	2896	2031	70.1	865	29.9	42.4	±	20.0

Figure 6.5: Thoracic injury age and sex distribution, Liverpool major data category 1995-2004 (n=2896)

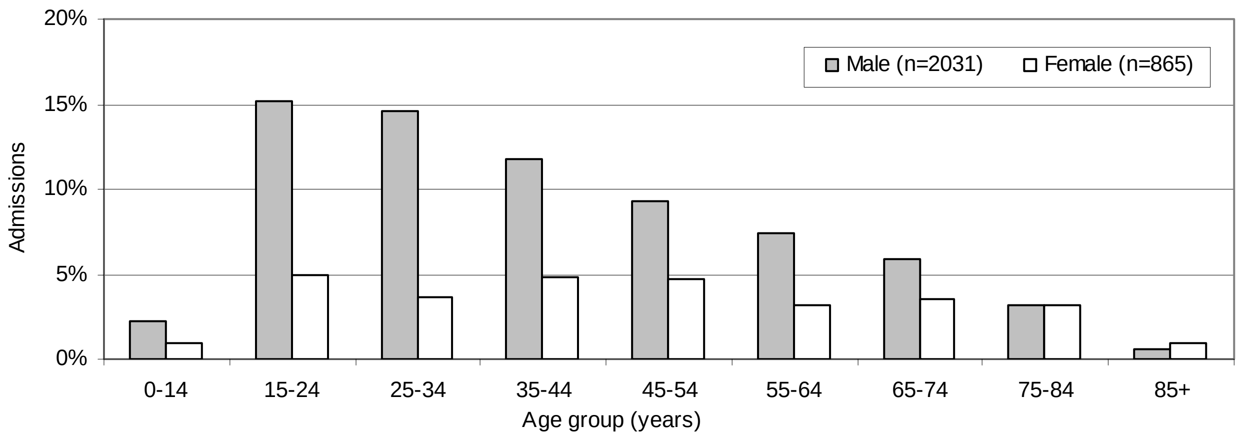


Table 6.17: Thoracic injury by ISS, Liverpool Hospital, major data category, 1995-2004

Year	Total	ISS < 16		ISS ≥ 16		Mean		sd	Range
		n	%	n	%				
1995	196	124	63.3	72	36.7	15.9	±	15.0	1-75
1996	263	165	62.7	98	37.3	15.7	±	14.7	1-75
1997	266	164	61.7	102	38.3	16.8	±	15.1	1-75
1998	253	165	65.2	88	34.8	15.8	±	14.2	1-75
1999	293	192	65.5	101	34.5	15.6	±	14.5	1-75
2000	343	207	60.3	136	39.7	16.5	±	14.9	1-75
2001	317	213	67.2	104	32.8	15.1	±	13.5	1-75
2002	315	208	66.0	107	34.0	14.3	±	12.3	1-75
2003	314	200	63.7	114	36.3	14.8	±	13.2	1-75
2004	336	211	62.8	125	37.2	15.6	±	13.4	1-75
Total	2896	1849	63.8	1047	36.2	15.6	±	14.0	1-75

Table 6.18: Thoracic injury by ISS range, Liverpool Hospital, major data category, 1995-2004

Year	ISS 4-8		ISS 9-15		ISS 16-24		ISS 25-49		ISS 50-74		ISS 75		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
1995	68	34.7	56	28.6	34	17.3	29	14.8	5	2.6	4	2.0	196
1996	100	38.0	65	24.7	39	14.8	48	18.3	8	3.0	3	1.1	263
1997	88	33.1	76	28.6	42	15.8	47	17.7	10	3.8	3	1.1	266
1998	80	31.6	85	33.6	35	13.8	42	16.6	7	2.8	4	1.6	253
1999	104	35.5	88	30.0	42	14.3	47	16.0	8	2.7	4	1.4	293
2000	111	32.4	96	28.0	69	20.1	46	13.4	16	4.7	5	1.5	343
2001	111	35.0	102	32.2	51	16.1	42	13.2	7	2.2	4	1.3	317
2002	118	37.5	90	28.6	56	17.8	44	14.0	4	1.3	3	1.0	315
2003	117	37.3	83	26.4	57	18.2	48	15.3	8	2.5	1	0.3	314
2004	110	32.7	101	30.1	60	17.9	54	16.1	8	2.4	3	0.9	336
Total	1007	34.8	842	29.1	485	16.7	447	15.4	81	2.8	34	1.2	2896

Table 6.19: Thoracic injury, blunt versus penetrating trauma, Liverpool Hospital, major data category, 1995-2004

Year	Blunt		Penetrating		Total
	n	%	n	%	
1995	178	90.8	18	9.2	196
1996	233	88.6	30	11.4	263
1997	231	86.8	35	13.2	266
1998	222	87.7	31	12.3	253
1999	267	91.1	26	8.9	293
2000	312	91.0	31	9.0	343
2001	276	87.1	41	12.9	317
2002	289	91.7	26	8.3	315
2003	285	90.8	29	9.2	314
2004	317	94.3	19	5.7	336
Total	2610	90.1	286	9.9	2896

Table 6.20: Thoracic injury mechanism of injury, Liverpool Hospital, major data category, 1995-2004

Mechanism		Outcome					
		Survived		Died		Total	
		n	%	n	%		
Road trauma	MVC driver	821	93.4	58	6.6	879	30.4
	MVC front passenger	288	94.4	17	5.6	305	10.5
	Pedestrian	194	82.2	42	17.8	236	8.1
	MBC rider	206	92.8	16	7.2	222	7.7
	MVC back passenger	84	88.4	11	11.6	95	3.3
	Cyclist vs. vehicle	31	88.6	4	11.4	35	1.2
	MBC pillion	10	100.0	0	*	10	0.3
	Road trauma total	1634	91.7	148	8.3	1782	61.5
Falls	Fall < 1m	271	95.1	14	4.9	285	9.8
	Fall 1-5m	106	99.1	1	0.9	107	3.7
	Fall > 5m	62	87.3	9	12.7	71	2.5
	Falls total	439	94.8	24	5.2	463	16.0
Interpersonal violence	Stabbing	216	95.6	10	4.4	226	7.8
	Blunt assault	174	97.2	5	2.8	179	6.2
	Gunshot	31	70.5	13	29.5	44	1.5
	I/P violence total	421	93.8	28	6.2	449	15.5
Other	Industrial	69	94.5	4	5.5	73	2.5
	Other mechanism	37	100.0	0	*	37	1.3
	Fall from horse	28	96.6	1	3.4	29	1.0
	Cyclist not vs. vehicle	20	100.0	0	*	20	0.7
	Burns	2	100.0	0	*	2	0.1
	Other total	156	96.9	5	3.1	161	5.6
Recreation total		41	100.0	0	*	41	1.4
Total		2691	92.9	205	7.1	2896	100.0

Table 6.21: Thoracic injury origin of arrival and pre-hospital intervention, Liverpool Hospital, major data category, 1995-2004

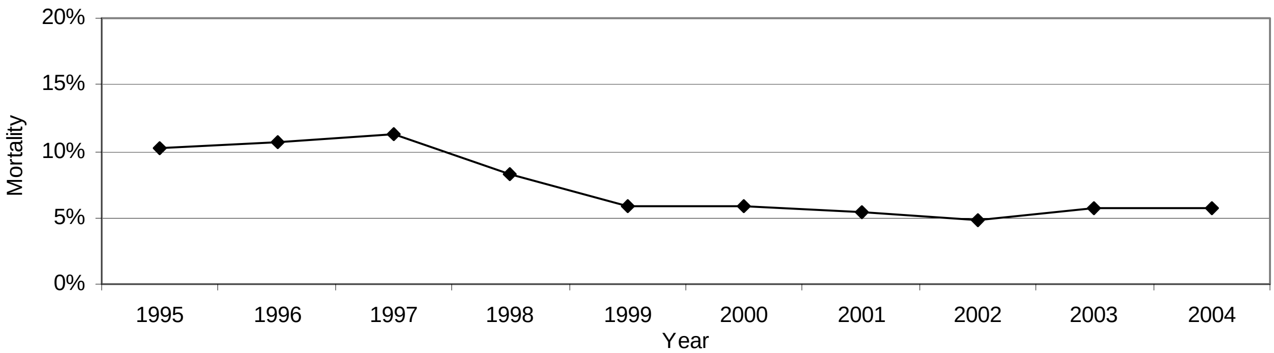
Year	Direct - pre-hospital care		Direct - private transport		Transfer from other hospital		Total
	n	%	n	%	n	%	
1995	167	85.2	15	7.7	14	7.1	196
1996	216	82.1	30	11.4	17	6.5	263
1997	220	82.7	21	7.9	25	9.4	266
1998	214	84.6	19	7.5	20	7.9	253
1999	230	78.5	31	10.6	32	10.9	293
2000	272	79.3	29	8.5	42	12.2	343
2001	221	69.7	35	11.0	61	19.2	317
2002	244	77.5	28	8.9	43	13.7	315
2003	258	82.2	22	7.0	34	10.8	314
2004	231	68.8	32	9.5	73	21.7	336
Total	2273	78.5	262	9.0	361	12.5	2896

Table 6.22: Thoracic injury survival outcome, Liverpool Hospital, major data category, 1995-2004

Year	Survived		Died		Total
	n	%	n	%	
1995	176	89.8	20	10.2	196
1996	235	89.4	28	10.6	263
1997	236	88.7	30	11.3	266
1998	232	91.7	21	8.3	253
1999	276	94.2	17	5.8	293
2000	323	94.2	20	5.8	343
2001	300	94.6	17	5.4	317
2002	300	95.2	15	4.8	315
2003	296	94.3	18	5.7	314
2004	317	94.4	19	5.6	336
Total	2691	92.9	205	7.1	2896

Of the 2896 major data category patients with thoracic injuries, 205 (7.1%) died.

Figure 6.6: Thoracic injury mortality rate, Liverpool Hospital, major data category, 1995-2004 (deaths=205)



Thoracic injury patients: injury descriptions and scores

Injuries to the thoracic region totalled 3899 for the group of 2896 patients with thoracic injury. The following table presents the number and type of thoracic injuries for this patient group. Patients were included if they were in the major data category and had one or more AIS injury codes with a score of 1-6 in the thoracic body region.

Table 6.23: Thoracic injury patients: injury description and score for thoracic injuries, major data category, Liverpool Hospital, 1995-2004

Anatomic structure / injury	AIS score						Total	
	1	2	3	4	5	6	n	%
Whole area								19.3
(Crush) bilateral of the chest cavity including internal organs						1	1	
Open (sucking) chest wound				8			8	
Penetrating injury	89	7	9				105	
Penetrating injury with haemo / pneumothorax			105				105	
Skin abrasion / contusion	472						472	
Skin laceration	51	10	1				62	
Whole area total	612	17	115	8		1	753	
Internal organs								20.7
Trachea and main stem bronchus			3	2	3	0	8	
Bronchus distal to main stem	1			2			3	
Chordae tendinae laceration (rupture)					1		1	
Diaphragm		1	67	5			73	
Heart (myocardium)	49	0	2	7	11	10	79	
Intraventricular or intra-atrial septum laceration (rupture)					5		5	
Lung contusion			272	75			347	
Lung laceration			45	25	36	0	106	
Lung NFS			1				1	
Oesophagus		4		2	1		7	
Pericardium		14	7				21	
Pleura		1	5				6	
Thoracic cavity injury with blood loss > 20% by volume				3			3	
Haemo / pneumothorax			104				104	
Haemomediastinum				6			6	
Pneumomediastinum			13				13	
Tension pneumothorax					25		25	
Thoracic duct laceration		1					1	
Internal organs total	50	21	519	127	82	10	809	
Skeletal								57.9
Rib cage contusion	102						102	
Rib cage fracture	247	807	159	21			1234	
Rib cage fracture with haemo / pneumothorax			241	136	37		414	
Rib cage fracture flail			36	57	22		115	
Sternum contusion	78						78	
Sternum fracture		313					313	
Skeletal total	427	1120	436	214	59		2256	
Vessels								2.1
Aorta, thoracic				8	17	3	28	
Brachiocephalic artery / vein			3	6			9	
Coronary artery laceration					1		1	
Pulmonary artery / vein			3	9			12	
Subclavian artery / vein			4	3			7	
Vena cava			1	2	4		7	
Other named arteries		4	6				10	
Other named veins		3	4				7	
Vessels total		7	21	28	22	3	81	
Total	1089	1165	1091	377	163	14	3899	100

Table 6.24: Thoracic injury patients: injury description and score for all injuries, major data category, Liverpool Hospital, 1995-2004

AIS description		AIS score						Total
Region	Subregion	1	2	3	4	5	6	
Head	Internal organs			276	237	239	5	757
	Level of consciousness	41	477	88	14	12		632
	Nerves - cranial		16					16
	Skeletal		65	134	23			222
	Vessels - intracranial			1	2	2		5
	Whole area	345	47	9			2	403
Head total		386	605	508	276	253	7	2035
Face	Internal organs	80	6					86
	Nerves							0
	Skeletal	184	274	42	5			505
	Vessels	4						4
	Whole area	659	60	1				720
Face total		927	340	43	5			1315
Neck	Internal organs	2	11	5	3			21
	Skeletal		2					2
	Vessels	3	1	2	4			10
	Whole area	97	8	4				109
Neck total		102	22	11	7			142
Spine	Cervical spine	83	107	66	3	1	4	264
	Lumbar spine	20	256	34	1			311
	Thoracic spine	24	177	34	1	10		246
Spine total		127	540	134	5	11	4	821
Thorax	Internal organs	50	21	519	127	82	10	809
	Skeletal	427	1120	436	214	59		2256
	Vessels		7	21	28	22	3	81
	Whole area	612	17	115	8		1	753
Thorax total		1089	1165	1091	377	163	14	3899
Abdomen and pelvic	Internal organs	24	424	175	106	64	2	795
	Vessels			15	16			31
	Whole area	366	8	8				382
Abdomen and pelvic total		390	432	198	122	64	2	1208
Lower extremity	Muscle / tendons / ligaments		38	4				42
	Nerves		4	2				6
	Skeletal - bones	23	609	367	22	32		1053
	Skeletal - joints	102	69					171
	Vessels	3	1	6	1			11
	Whole area	421	66	12	4			503
Lower extremity total		549	787	391	27	32		1786
Upper extremity	Muscle / tendons / ligaments	20	14					34
	Nerves	8	13					21
	Skeletal - bones	46	640	165				851
	Skeletal - joints	96	49	1				146
	Vessels	1	3	11				15
	Whole area	347	36	10				393
Upper extremity total		518	755	187				1460
External / burns / other	Burns	7	2			1		10
	Skin and subcutaneous tissue	516	1					517
External / burns / other total		523	3			1		527
Total		4611	4649	2563	819	524	27	13193

6.4 Abdominal injuries

- 1666 patients with abdominal injuries were admitted to Liverpool Hospital during the 10-year period 1995-2004
- Abdomen injury patients are defined as all patients who had an AIS coded injury in abdomen and pelvic contents chapter
- 1188 (71.3%) were male and 478 (28.7%) were female; the mean age was 32.5 (± 17.4) years (range 1-99)
- 1353 (81.2%) of abdominal injuries were due to blunt trauma, and 313 (18.8%) were due to penetrating trauma
- 1543 (92.6%) survived and 123 (7.4%) died; the average length of stay in hospital (ALOS) was 11.4 (± 26.4) days (range 1-626)
- 1446 (86.8%) of patients received pre-hospital intervention, whilst 220 (13.2%) arrived via private transport
- For 642 (38.5%) of patients the abdomen was the predominant body region of injury, and for 193 (11.6%) of patients the abdomen and one or more other body regions were the predominant body regions of injury

Table 6.25: Abdominal injury sex and age distribution, Liverpool Hospital, major data category, 1995-2004

Year	Total	Sex distribution				Age distribution		
		Male		Female		Mean		sd
		n	%	n	%			
1995	128	91	71.1	37	28.9	29.4	±	17.9
1996	161	116	72.0	45	28.0	33.6	±	20.0
1997	157	110	70.1	47	29.9	31.8	±	15.9
1998	154	106	68.8	48	31.2	32.6	±	15.8
1999	181	124	68.5	57	31.5	33.7	±	18.7
2000	195	150	76.9	45	23.1	33.1	±	17.2
2001	172	131	76.2	41	23.8	30.3	±	14.7
2002	168	126	75.0	42	25.0	30.6	±	16.4
2003	165	115	69.7	50	30.3	32.2	±	15.6
2004	185	119	64.3	66	35.7	36.7	±	19.6
Total	1666	1188	71.3	478	28.7	32.5	±	17.4

Figure 6.7: Abdominal injury age and sex distribution, Liverpool major data category 1995-2004 (n=1666)

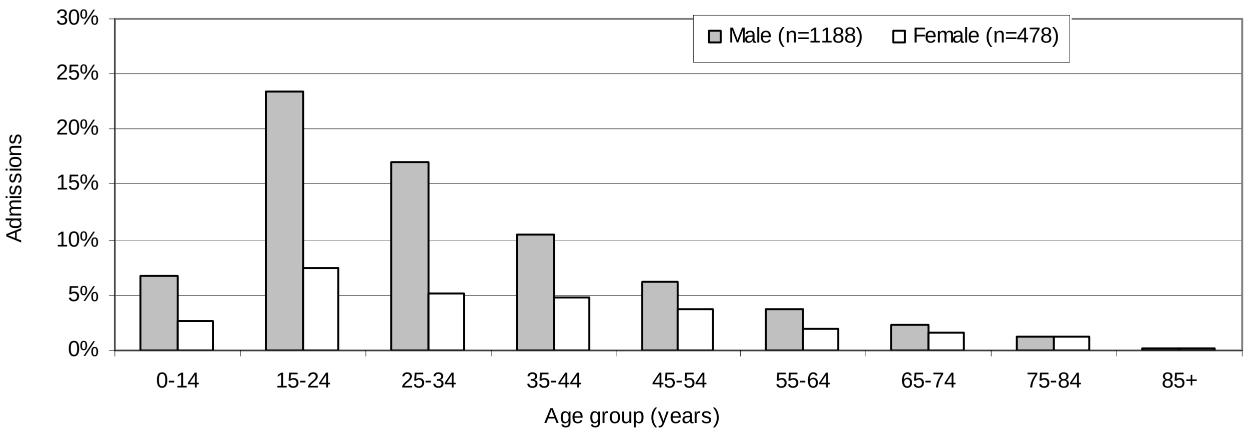


Table 6.26: Abdominal injury by ISS, Liverpool Hospital, major data category, 1995-2004

Year	Total	ISS < 16		ISS ≥ 16		Mean		sd	Range
		n	%	n	%				
1995	128	79	61.7	49	38.3	17.4	±	17.0	1-75
1996	161	99	61.5	62	38.5	16.6	±	16.4	1-75
1997	157	91	58.0	66	42.0	18.0	±	16.4	1-75
1998	154	109	70.8	45	29.2	13.8	±	13.9	1-75
1999	181	112	61.9	69	38.1	16.8	±	16.0	1-75
2000	195	111	56.9	84	43.1	17.3	±	16.0	1-75
2001	172	109	63.4	63	36.6	16.3	±	15.9	1-75
2002	168	102	60.7	66	39.3	14.4	±	11.7	1-66
2003	165	96	58.2	69	41.8	16.9	±	15.7	1-75
2004	185	119	64.3	66	35.7	15.3	±	14.2	1-75
Total	1666	1027	61.6	639	38.4	16.3	±	15.4	1-75

Table 6.27: Abdominal injury by ISS range, Liverpool Hospital, major data category, 1995-2004

Year	ISS 4-8		ISS 9-15		ISS 16-24		ISS 25-49		ISS 50-74		ISS 75		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
1995	43	33.6	36	28.1	14	10.9	27	21.1	3	2.3	5	3.9	128
1996	62	38.5	37	23.0	24	14.9	28	17.4	6	3.7	4	2.5	161
1997	50	31.8	41	26.1	22	14.0	33	21.0	10	6.4	1	0.6	157
1998	69	44.8	40	26.0	18	11.7	20	13.0	5	3.2	2	1.3	154
1999	63	34.8	49	27.1	29	16.0	29	16.0	8	4.4	3	1.7	181
2000	65	33.3	46	23.6	36	18.5	34	17.4	12	6.2	2	1.0	195
2001	59	34.3	50	29.1	27	15.7	26	15.1	7	4.1	3	1.7	172
2002	54	32.1	48	28.6	37	22.0	25	14.9	4	2.4		0.0	168
2003	60	36.4	36	21.8	30	18.2	32	19.4	5	3.0	2	1.2	165
2004	71	38.4	48	25.9	33	17.8	26	14.1	5	2.7	2	1.1	185
Total	596	35.8	431	25.9	270	16.2	280	16.8	65	3.9	24	1.4	1666

Table 6.28: Abdominal injury, blunt versus penetrating trauma, Liverpool Hospital, major data category, 1995-2004

Year	Blunt		Penetrating		Total
	n	%	n	%	
1995	107	83.6	21	16.4	128
1996	130	80.7	31	19.3	161
1997	131	83.4	26	16.6	157
1998	126	81.8	28	18.2	154
1999	165	91.2	16	8.8	181
2000	144	73.8	51	26.2	195
2001	125	72.7	47	27.3	172
2002	127	75.6	41	24.4	168
2003	138	83.6	27	16.4	165
2004	160	86.5	25	13.5	185
Total	1353	81.2	313	18.8	1666

Table 6.29: Abdominal injury, blunt versus penetrating by ISS, Liverpool Hospital, major data category, 1995-2004

ISS range	Blunt		Penetrating		Total
	n	%	n	%	
1-8	453	76.0	143	24.0	596
9-14	336	78.0	95	22.0	431
16-24	232	85.9	38	14.1	270
25-49	249	88.9	31	11.1	280
50-74	64	98.5	1	1.5	65
75	19	79.2	5	20.8	24
Total	1353	81.2	313	18.8	1666

Table 6.30: Abdominal injury origin of arrival and pre-hospital intervention, Liverpool Hospital, major data category, 1995-2004

Year	Direct - pre-hospital care		Direct - private transport		Transfer from other hospital		Total
	n	%	n	%	n	%	
1995	112	87.5	12	9.4	4	3.1	128
1996	141	87.6	11	6.8	9	5.6	161
1997	132	84.1	12	7.6	13	8.3	157
1998	131	85.1	11	7.1	12	7.8	154
1999	146	80.7	11	6.1	24	13.3	181
2000	155	79.5	16	8.2	24	12.3	195
2001	119	69.2	20	11.6	33	19.2	172
2002	122	72.6	14	8.3	32	19.0	168
2003	134	81.2	14	8.5	17	10.3	165
2004	131	70.8	18	9.7	36	19.5	185
Total	1323	79.4	139	8.3	204	12.2	1666

Table 6.31: Abdominal injury mechanism of injury, Liverpool Hospital, major data category, 1995-2004

Mechanism		Outcome					
		Survived		Died		Total	
		n	%	n	%	n	%
Road trauma	MVC driver	400	92.2	34	7.8	434	26.1
	MVC front passenger	187	94.0	12	6.0	199	11.9
	MBC rider	125	91.9	11	8.1	136	8.2
	Pedestrian	110	80.9	26	19.1	136	8.2
	MVC back passenger	89	89.9	10	10.1	99	5.9
	Cyclist vs. vehicle	17	89.5	2	10.5	19	1.1
	MBC pillion	3	100.0	0	*	3	0.2
	Road trauma total	931	90.7	95	9.3	1026	61.6
Interpersonal violence	Stabbing	245	98.4	4	1.6	249	14.9
	Blunt assault	72	98.6	1	1.4	73	4.4
	Gunshot	37	80.4	9	19.6	46	2.8
	Interpersonal violence total	354	96.2	109	29.6	368	22.1
Falls	Fall < 1m	47	95.9	2	4.1	49	2.9
	Fall 1-5m	29	87.9	4	12.1	33	2.0
	Fall > 5m	25	92.6	2	7.4	27	1.6
	Falls total	101	92.7	8	7.3	109	6.5
Industrial total		55	93.2	4	6.8	6.8%	3.5
Other	Other mechanism	27	100.0	0	*	27	1.6
	Cyclist not vs. vehicle	23	100.0	0	*	23	1.4
	Fall from horse	16	94.1	1	5.9	17	1.0
	Burns	1	100.0	0		1	0.1
	Other total	67	98.5	1	1.5	68	4.1
Recreation total		35	97.2	1	2.8	2.8%	2.2
Total		1543	92.6	123	7.4	7.4%	100.0

Table 6.32: Abdominal injury survival outcome, Liverpool Hospital, major data category, 1995-2004

Year	Survived		Died		Total
	n	%	n	%	
1995	118	92.2	10	7.8	128
1996	140	87.0	21	13.0	161
1997	142	90.4	15	9.6	157
1998	145	94.2	9	5.8	154
1999	167	92.3	14	7.7	181
2000	181	92.8	14	7.2	195
2001	159	92.4	13	7.6	172
2002	163	97.0	5	3.0	168
2003	154	93.3	11	6.7	165
2004	174	94.1	11	5.9	185
Total	1543	92.6	123	7.4	1666

Investigations performed prior to laparotomy

A total of 605 trauma laparotomies were carried out at Liverpool Hospital between 1995-2004. 508 (84.0%) of were therapeutic laparotomies, and 97 (16.0%) were non-therapeutic laparotomies. The laparotomy was considered to be therapeutic if surgical intervention was required to treat an acute injury. Chapter 8 (Performance Indicators) contains further information on therapeutic versus non-therapeutic laparotomy. Chapter 7 (Management and Diagnostic Work-up) contains further information on the investigation and management of abdominal injuries.

Table 6.33: Results of investigations (abdominal CT and DPL) for patients who subsequently underwent therapeutic laparotomy Liverpool Hospital, 1995-2004 (n=508)

Abdominal CT result		DPL result				
		DPL positive	DPL negative	No DPL	Total	%
CT positive		16	4	124	144	28.3
CT negative		11	1	17	29	5.7
No CT		101	15	219	335	65.9
Total	n	128	20	360	508	100.0
	%	25.2	3.9	70.9	100.0	

Table 6.34: Investigations (abdominal CT and DPL) for patients who subsequently underwent non-therapeutic laparotomy, Liverpool Hospital, 1995-2004 (n=97)

Abdominal CT result		DPL result				
		DPL positive	DPL negative	No DPL	Total n	%
CT positive		2	1	10	13	13.4
CT negative		3	2	6	11	11.3
No CT		8	5	60	73	75.3
Total	n	13	8	76	97	100.0
	%	13.4	8.2	78.4	100.0	

Table 6.35: Investigations performed out prior to therapeutic and non-therapeutic laparotomy Liverpool Hospital, 1995-2004 (n=605)

Investigations prior to laparotomy	Total laparotomies (n=605)	Therapeutic laparotomy (n=508)	Non-therapeutic laparotomy (n=97)
Abdominal CT	197	173	24
DPL	169	148	21
FAST	146	122	24
Laparoscopy	46	25	21

Abdominal injury patients: injury descriptions and scores

Injuries to the abdomen totalled 2543 for the group of 1666 patients with abdominal injury. The following table presents a summary of abdominal injury site and type of trauma (blunt or penetrating). The following tables present the AIS scores for blunt and penetrating trauma respectively.

Table 6.36: Abdominal injury* site and trauma type (blunt or penetrating), Liverpool Hospital, major data category, 1995-2004

Anatomic structure / injury	Blunt		Penetrating		Total	
	n	%	n	%	n	%
Skin abrasion, contusion, laceration, avulsion	605	30.7	31	5.4	636	25.0
Liver	239	12.1	69	12.1	308	12.1
Spleen	255	12.9	23	4.0	278	10.9
Kidney	167	8.5	31	5.4	198	7.8
Penetrating injury not further specified	7	0.4	169	29.5	176	6.9
Jejunum-ileum	116	5.9	51	8.9	167	6.6
Mesentery	111	5.6	20	3.5	131	5.2
Colon	81	4.1	37	6.5	118	4.6
Artery or vein (including abdominal aorta)	57	2.9	35	6.1	92	3.6
Perineum, rectum, anus, vulva, vagina, scrotum, penis, testes	72	3.7	18	3.1	90	3.5
Retroperitoneum haemorrhage	66	3.3	9	1.6	75	2.9
Pancreas	39	2.0	9	1.6	48	1.9
Duodenum	36	1.8	9	1.6	45	1.8
Omentum	22	1.1	20	3.5	42	1.7
Bladder	33	1.7	3	0.5	36	1.4
Stomach	2	0.1	31	5.4	33	1.3
Ureter / urethra	27	1.4	4	0.7	31	1.2
Adrenal gland	18	0.9	1	0.2	19	0.7
Uterus / placenta	13	0.7	0		13	0.5
Gall bladder	4	0.2	2	0.3	6	0.2
Ovary	1	0.1	0		1	0.0
Total	1971	100.0	572	100.0	2543	100.0

* Diaphragm injuries were included in the thoracic injuries section

Table 6.37: Abdominal injury* description and score, penetrating trauma only, Liverpool Hospital, major data category, 1995-2004

Anatomic structure / injury	AIS Score						Total	
	1	2	3	4	5	6	n	%
Penetrating injury not further specified	139	22	8				169	29.5
Liver		45	13	5	5	1	69	12.1
Jejunum - ileum		17	30	4			51	8.9
Colon		9	20	8			37	6.5
Artery or vein (including abdominal aorta)			22	11	2		35	6.1
Kidney		19	5	6	1		31	5.4
Stomach		8	19	4			31	5.4
Skin abrasion, contusion, laceration, avulsion	26	5					31	5.4
Spleen		9	3	5	6		23	4.0
Mesentery		16	4				20	3.5
Omentum		19	1				20	3.5
Perineum, rectum, anus, vulva, vagina, scrotum, penis, testes	6	5	6	1			18	3.1
Duodenum		2	2	2	3		9	1.6
Pancreas		5		3	1		9	1.6
Retroperitoneum haemorrhage			9				9	1.6
Ureter / urethra		1	3				4	0.7
Bladder				3			3	0.5
Gall bladder		1	1				2	0.3
Adrenal gland	1						1	0.2
Total	172	183	146	52	18	1	572	100.0

* Diaphragm injuries were included in the thoracic injuries section

Table 6.38: Abdominal injury* description and score, blunt trauma only, Liverpool Hospital, major data category, 1995-2004

Anatomic structure / injury	AIS Score						Total	
	1	2	3	4	5	6	n	%
Skin abrasion, contusion, laceration, avulsion	589	14	2				605	30.7
Spleen		125	34	53	43		255	12.9
Liver		165	29	26	15	4	239	12.1
Kidney		124	21	11	11		167	8.5
Jejunum - ileum		35	74	7			116	5.9
Mesentery		80	21	10			111	5.6
Colon		53	20	8			81	4.1
Perineum, rectum, anus, vulva, vagina, scrotum, penis, testes	48	20	3	0	1	0	72	3.7
Retroperitoneum haemorrhage			66				66	3.3
Artery or vein (including abdominal aorta)			27	29	1		57	2.9
Pancreas		27	3	3	6		39	2.0
Duodenum		17	3	10	6		36	1.8
Bladder		13	1	19			33	1.7
Ureter / urethra		8	18	1			27	1.4
Omentum		15	7				22	1.1
Adrenal gland	12	5	1				18	0.9
Uterus / placenta	1	2	5	4	1		13	0.7
Penetrating injury	7						7	0.4
Gall bladder		4					4	0.2
Stomach		2					2	0.1
Ovary			1				1	0.1
Total	657	709	336	181	84	4	1971	100.0

Diaphragm injuries were included in the thoracic injuries section

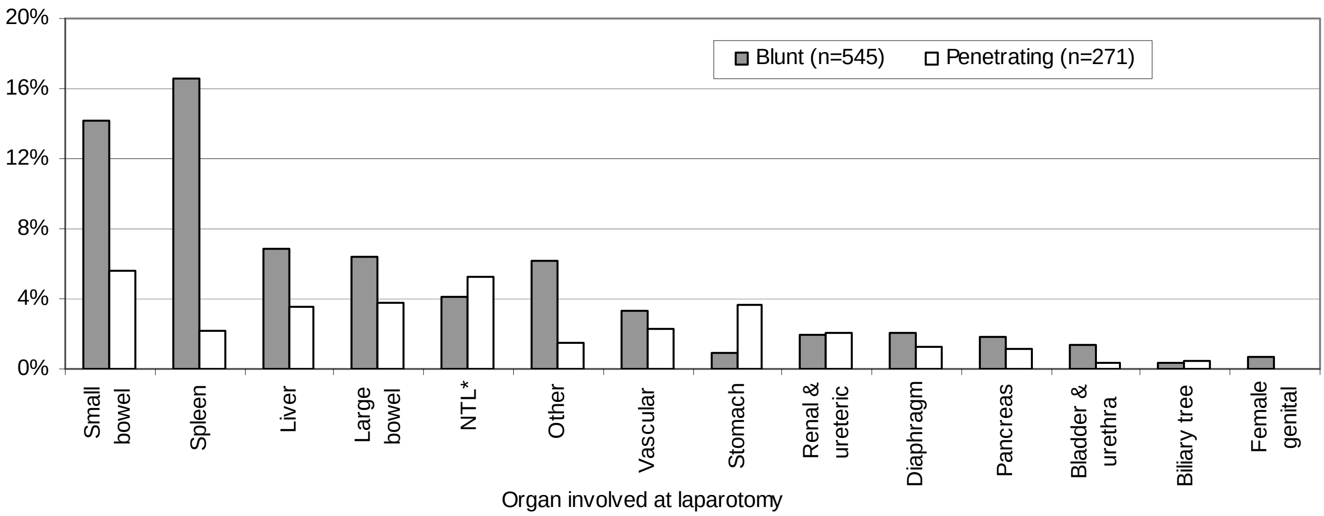
Abdominal injury patients: organs involved at laparotomy

545 patients undergoing laparotomy had a confirmed injury. The following table presents the organ injured and type of trauma (blunt or penetrating). As expected the number of organs involved (816) exceeds the number of patients as some patients sustain injuries to multiple organs.

Table 6.39: Abdominal injury patients: organs involved at laparotomy, Liverpool Hospital, 1995-2004

Organ injured	Blunt		Penetrating		Total	
	n	%	n	%	n	%
Small bowel	116	14.2	46	5.6	162	19.9
Spleen	135	16.5	18	2.2	153	18.8
Liver	56	6.9	29	3.6	85	10.4
Large bowel	52	6.4	31	3.8	83	10.2
Other	50	6.1	12	1.5	62	7.6
Vascular	27	3.3	19	2.3	46	5.6
Stomach	7	0.9	30	3.7	37	4.5
Renal and ureteric	16	2.0	17	2.1	33	4.0
Diaphragm	17	2.1	10	1.2	27	3.3
Pancreas	15	1.8	9	1.1	24	2.9
Bladder and urethra	11	1.3	3	0.4	14	1.7
Biliary tree	3	0.4	4	0.5	7	0.9
Female genital	6	0.7	0		6	0.7
Total	545	66.8	271	33.2	816	100.0

Figure 6.8: Organs involved at laparotomy for blunt and penetrating trauma, Liverpool Hospital, 1995-2004 (n=816)



*NTL = non-therapeutic laparotomy

Splenic injuries

At Liverpool Hospital between 1995-2004, 215 patients were admitted with a splenic laceration (AIS codes 544220.2 to 544240.3). Of these, 135 (62.8%) patients underwent operative management. The remaining 80 (37.2%) patients received non-operative management. 195 (90.7%) of splenic lacerations resulted from blunt trauma.

Table 6.40: Splenic lacerations* for blunt and penetrating trauma, Liverpool Hospital, 1995-2004

Year	Blunt		Penetrating		Total
	n	%	n	%	
1995	13	92.9	1	7.1	14
1996	19	86.4	3	13.6	22
1997	22	84.6	4	15.4	26
1998	12	80.0	3	20.0	15
1999	24	92.3	2	7.7	26
2000	34	97.1	1	2.9	35
2001	16	84.2	3	15.8	19
2002	15	93.8	1	6.3	16
2003	20	95.2	1	4.8	21
2004	20	95.2	1	4.8	21
Total	195	90.7	20	9.3	215

*AIS code range 544220.2 to 544240.3

Table 6.41: Management of splenic lacerations*, Liverpool Hospital, 1995-2004

Year	Splenic lacerations*	Non-operative management		Splenectomy		Splenorrhaphy	
		n	%	n	%	n	%
1995	14	3	21.4	9	64.3	2	14.3
1996	22	7	31.8	10	45.5	5	22.7
1997	26	6	23.1	15	57.7	5	19.2
1998	15	5	33.3	8	53.3	2	13.3
1999	26	10	38.5	9	34.6	7	26.9
2000	35	13	37.1	17	48.6	5	14.3
2001	19	6	31.6	10	52.6	3	15.8
2002	16	8	50.0	8	50.0	0	*
2003	21	10	47.6	9	42.9	2	9.5
2004	21	12	57.1	8	38.1	1	4.8
Total	215	80	37.2	103	47.9	32	14.9

*AIS code range 544220.2 to 544240.3

Abdominal Injury Patients: Laparoscopy

128 patients underwent one or more laparoscopy procedures. The following table presents the total number of laparoscopies for blunt and penetrating trauma, and also for therapeutic and non-therapeutic laparotomies.

Table 6.42: Abdominal injury patients: laparoscopy, Liverpool Hospital, 1995-2004

Year	Blunt			Penetrating					Total
	Proceed to TL*	Did not proceed to laparotomy	Total	Proceed to NTL†	Proceed to TL*	Did not proceed to laparotomy	Proceed to thoracotomy	Total	
1995						6		6	6
1996		1	1			4		4	5
1997				1	1	7		9	9
1998		1	1		4	7		11	12
1999				2		1		3	3
2000		1	1	4	4	6	1	15	16
2001		1	1	4	6	11	1	22	23
2002				4	4	15		23	23
2003	1	2	3	3	3	7		13	16
2004				3	2	10		15	15
Total	1	6	7	21	24	74	2	121	128

* TL = therapeutic laparotomy

† NTL = non-therapeutic laparotomy

The 1666 patients with abdominal injury sustained a total of 8079 injuries over all body regions. The following table presents the number and type of all injuries sustained by patient with abdominal injury. Patients are included in the table if they have one or more AIS coded injuries (score 1-6) in the abdomen body region.

Table 6.43: Abdominal injury patients: injury description and score for all injuries, major data category, Liverpool Hospital, 1995-2004

AIS description		AIS Score						Total
Region	Subregion	1	2	3	4	5	6	
Head	Internal organs			143	97	113	1	354
	Level of consciousness	27	260	37	13	8		345
	Nerves - cranial		9					9
	Skeletal		26	57	18			101
	Vessels - intracranial			2	3	3		8
	Whole area	166	24	3		1	2	196
Head total		193	319	242	131	125	3	1013
Face	Internal organs	44	2					46
	Nerves							0
	Skeletal	123	124	19	4			270
	Vessels	2						2
	Whole area	360	36					396
Face total		529	162	19	4			714
Neck	Internal organs	1	6	2	1			10
	Skeletal		2					2
	Vessels	2	1	2	2			7
	Whole area	59	5	1				65
Neck total		62	14	5	3			84
Spine	Cervical spine	41	52	20	2	1	5	121
	Lumbar spine	7	156	37	2			202
	Thoracic spine	14	64	17		1		96
Spine total		62	272	74	4	2	5	419
Thorax	Internal organs	20	8	225	57	31	4	345
	Skeletal	110	236	110	85	34		575
	Vessels		3	6	11	11	1	32
	Whole area	228	4	31	3			266
Thorax total		358	251	372	156	76	5	1218
Abdomen and pelvic	Internal organs	68	851	423	193	99	5	1639
	Vessels			49	40	3		92
	Whole area	761	41	10				812
Abdomen and pelvic total		829	892	482	233	102	5	2543
Lower extremity	Muscle / tendons / ligaments		18	3				21
	Nerves		6					6
	Skeletal - bones	12	352	263	29	33		689
	Skeletal - joints	49	33					82
	Vessels	2	2	9	3			16
	Whole area	245	48	11	2			306
Lower extremity total		308	459	286	34	33		1120
Upper extremity	Muscle / tendons / ligaments	15	8					23
	Nerves	7	7					14
	Skeletal - bones	15	255	92				362
	Skeletal - joints	53	19					72
	Vessels	2		5				7
	Whole area	209	27	4				240
Upper extremity total		301	316	101				718
External / burns / other	Burns	4		1		2		7
	Skin and subcutaneous tissue	243						243
External / burns / other total		247		1		2		250
Total		2889	2685	1582	565	340	18	8079

6.5 Vascular injuries

- 353 patients with vascular injuries were admitted to Liverpool Hospital during the 10-year period 1995-2004
- Patients with vascular injuries were defined as patients who had an AIS-98 coded injury with sub-region '2' in the following regions: head, face, neck, thorax, abdomen and pelvic contents, upper and lower extremities
- 305 (86.4%) were male and 48(13.6%) were female; the mean age was 33.9 (± 16.1) years (range 2-88)
- 282 (79.9%) survived and 71(20.1%) died
- 226 (64.0%) of patients with vascular injury sustained blunt trauma
- The average length of stay (ALOS) in hospital was 15.4 (± 37.3) days (range 1-578)
- 154 (46.4%) of patients went to ICU. Of these patients, 39 (25.3%) were in ICU for 1 day and 103 (66.9%) were in ICU for 1-5 days
- ICU length of stay (LOS) for the group ranged between 1-84 days
- 305 (86.4%) of patients were delivered directly to Liverpool Hospital and 48 (13.6%) were transferred in from another hospital
- For the 305 patients delivered directly to Liverpool Hospital, 281 (92.1%) received pre-hospital care

Table 6.44: Vascular injuries sex and age distribution, Liverpool Hospital, major data category, 1995-2004

Year	Total	Sex distribution				Age distribution		
		Male		Female		Mean		sd
		n	%	n	%			
1995	28	22	78.6	6	21.4	32.9	±	12.8
1996	33	30	90.9	3	9.1	32.3	±	19.4
1997	38	36	94.7	2	5.3	30.4	±	14.8
1998	34	30	88.2	4	11.8	33.7	±	15.8
1999	36	31	86.1	5	13.9	33.5	±	16.6
2000	38	33	86.8	5	13.2	33.2	±	15.6
2001	52	44	84.6	8	15.4	37.8	±	18.0
2002	36	30	83.3	6	16.7	35.3	±	13.8
2003	27	23	85.2	4	14.8	33.8	±	14.5
2004	31	26	83.9%	5	16.1	34.4	±	17.9
Total	353	305	86.4	48	13.6	33.9	±	16.1

Figure 6.9: Vascular injury age and sex distribution, Liverpool major data category 1995-2004 (n=353)

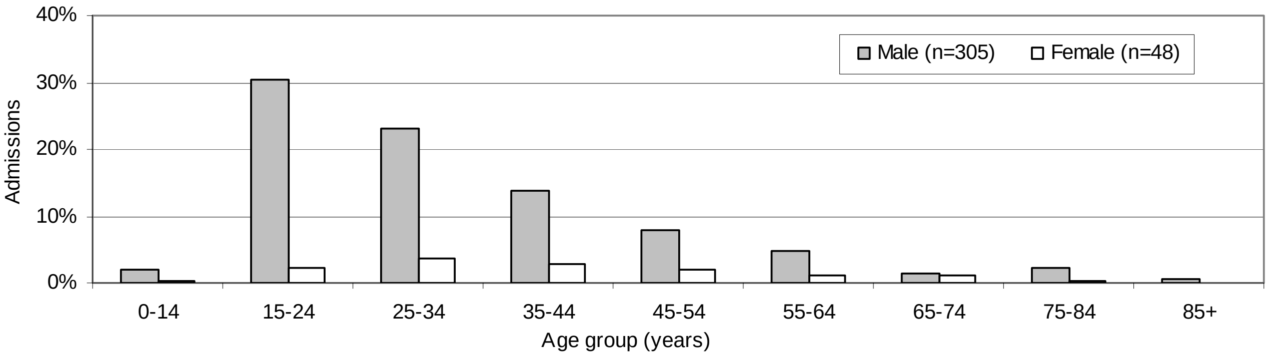


Table 6.45: Vascular injury by ISS, Liverpool Hospital, major data category, 1995-2004

Year	Total	ISS < 16		ISS ≥ 16		Mean		sd	Range
		n	%	n	%				
1995	28	15	53.6	13	46.4	19.6	±	16.8	1-75
1996	33	16	48.5	17	51.5	22.5	±	20.5	1-75
1997	38	15	39.5	23	60.5	20.7	±	13.5	4-59
1998	34	17	50.0	17	50.0	24.0	±	21.8	1-75
1999	36	14	38.9	22	61.1	29.8	±	23.4	5-75
2000	38	20	52.6	18	47.4	22.0	±	18.1	2-75
2001	52	29	55.8	23	44.2	20.4	±	18.1	2-75
2002	36	18	50.0	18	50.0	18.2	±	12.9	4-66
2003	27	15	55.6	12	44.4	17.9	±	16.4	3-75
2004	31	15	48.4	16	51.6	22.7	±	19.0	4-75
Total	353	174	49.3	179	50.7	21.8	±	18.4	1-75

Table 6.46: Vascular injury by ISS range, Liverpool Hospital, major data category, 1995-2004

Year	ISS 4-8		ISS 9-15		ISS 16-24		ISS 25-49		ISS 50-74		ISS 75		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
1995	4	14.3	11	39.3	3	10.7	8	28.6	1	3.6	1	3.6	28
1996	9	27.3	7	21.2	3	9.1	9	27.3	4	12.1	1	3.0	33
1997	4	10.5	11	28.9	8	21.1	13	34.2	2	5.3	0		38
1998	3	8.8	14	41.2	4	11.8	6	17.6	4	11.8	3	8.8	34
1999	1	2.8	13	36.1	6	16.7	7	19.4	6	16.7	3	8.3	36
2000	3	7.9	17	44.7	4	10.5	9	23.7	4	10.5	1	2.6	38
2001	7	13.5	22	42.3	5	9.6	13	25.0	3	5.8	2	3.8	52
2002	3	8.3	15	41.7	6	16.7	11	30.6	1	2.8		0.0	36
2003	4	14.8	11	40.7	4	14.8	6	22.2	1	3.7	1	3.7	27
2004	4	12.9	11	35.5	3	9.7	10	32.3	1	3.2	2	6.5	31
Total	42	11.9	132	37.4	46	13.0	92	26.1	27	7.6	14	4.0	353

Table 6.47: Vascular injury, blunt versus penetrating trauma, Liverpool Hospital, major data category, 1995-2004

Year	Blunt		Penetrating		Total
	n	%	n	%	
1995	15	53.6	13	46.4	28
1996	19	57.6	14	42.4	33
1997	22	57.9	16	42.1	38
1998	22	64.7	12	35.3	34
1999	26	72.2	10	27.8	36
2000	24	63.2	14	36.8	38
2001	37	71.2	15	28.8	52
2002	24	66.7	12	33.3	36
2003	17	63.0	10	37.0	27
2004	20	64.5	11	35.5	31
Total	226	64.0	127	36.0	353

Table 6.48: Vascular injury mechanism of injury, Liverpool Hospital, major data category, 1995-2004

Mechanism		Outcome					
		Survived		Died		Total	
		n	%	n	%	n	%
Road trauma	MVC driver	37	66.1	19	33.9	56	15.9
	MBC rider	21	75.0	7	25.0	28	7.9
	MVC front passenger	14	66.7	7	33.3	21	5.9
	Pedestrian	9	52.9	8	47.1	17	4.8
	MVC back passenger	3	42.9	4	57.1	7	2.0
	Cyclist vs. vehicle	2	100.0	0	-	2	0.6
	MBC pillion	1	100.0	0	-	1	0.3
	Road trauma total	87	65.9	45	34.1	132	37.4
Interpersonal violence	Stabbing	75	90.4	8	9.6	83	23.5
	Gunshot	15	65.2	8	34.8	23	6.5
	Blunt assault	14	87.5	2	12.5	16	4.5
	I/P violence total	104	85.2	18	14.8	122	34.6
Industrial total		35	97.2	1	2.8	36	10.2
Limb through glass total		27	100.0	0	-	27	7.6
Other	Other mechanism	10	100.0	0	-	10	2.8
	Cyclist not vs. vehicle	8	100.0	0	-	8	2.3
	Burns	1	100.0	0	-	1	0.3
	Other total	19	100.0	0	-	19	5.4
Falls	Fall < 1m	8	80.0	2	20.0	10	2.8
	Fall 1-5m	1	25.0	3	75.0	4	1.1
	Fall > 5m	1	33.3	2	66.7	3	0.8
	Falls total	10	58.8	7	41.2	17	4.8
Total		282	79.9	71	20.1	353	100.0

Table 6.49: Vascular injury origin of arrival and pre-hospital intervention, Liverpool Hospital, major data category, 1995-2004

Year	Direct - pre-hospital care		Direct - private transport		Transfer from other hospital		Total
	n	%	n	%	n	%	
1995	23	82.1	4	14.3	1	3.6	28
1996	29	87.9	3	9.1	1	3.0	33
1997	33	86.8	1	2.6	4	10.5	38
1998	28	82.4	3	8.8	3	8.8	34
1999	30	83.3	2	5.6	4	11.1	36
2000	30	78.9	1	2.6	7	18.4	38
2001	38	73.1	3	5.8	11	21.2	52
2002	24	66.7	4	11.1	8	22.2	36
2003	23	85.2	1	3.7	3	11.1	27
2004	23	74.2	2	6.5	6	19.4	31
Total	281	79.6	24	6.8	48	13.6	353

Table 6.50: Vascular injury survival outcome, Liverpool Hospital, major data category, 1995-2004

Year	Survived		Died		Total
	n	%	n	%	
1995	22	78.6	6	21.4	28
1996	21	63.6	12	36.4	33
1997	29	76.3	9	23.7	38
1998	26	76.5	8	23.5	34
1999	26	72.2	10	27.8	36
2000	31	81.6	7	18.4	38
2001	43	82.7	9	17.3	52
2002	33	91.7	3	8.3	36
2003	25	92.6	2	7.4	27
2004	26	83.9	5	16.1	31
Total	282	79.9	71	20.1	353

Vascular injury patients: injury description and score

The 353 patients with vascular injury sustained a total of 409 specific vascular injuries. The following table presents the 409 vascular injuries by AIS body region, score and anatomic site of injury.

Table 6.51: Vascular injury patients: injury description and score for vascular injuries, major data category, Liverpool Hospital, 1995-2004

AIS description		AIS score						Total
Region	Site	1	2	3	4	5	6	
Head	Basilar artery					2		2
	Internal carotid artery			1	2	2		5
	Middle cerebral artery				1	2		3
	Other artery			1	3			4
	Posterior cerebral artery			1		1		2
	Sinus or major vein NFS			1				1
	Vertebral artery			1		2		3
Head total				5	6	9		20
Face	External carotid	8		2				10
Face total		8		2				10
Neck	Internal common carotid			4	4			8
	External carotid		1	2				3
	Jugular vein	5	5	3				13
	Vertebral artery		1	1				2
Neck total		5	7	10	4			26
Thorax	Aorta, thoracic				8	17	3	28
	Brachiocephalic artery / vein			3	6			9
	Coronary artery					1		1
	Other named artery / vein		7	10				17
	Pulmonary artery / vein			3	9			12
	Subclavian artery / vein			4	3			7
	Vena cava, superior and thoracic			1	2	4	0	7
Thorax total			7	21	28	22	3	81
Abdomen and pelvic	Aorta, abdominal				1	2		3
	Coeliac artery / vein			1		1		2
	Iliac artery / vein			7	10			17
	Other named artery / vein			36	22			58
	Vena cava, inferior			3	7			10
Abdomen and pelvic total				47	40	3		90
Lower extremity	Femoral artery / vein		2	8	8			18
	Other named artery / vein	19		21				40
	Popliteal artery / vein		7	12				19
Lower extremity total		19	9	41	8			77
Upper extremity	Axillary artery / vein		1	4				5
	Brachial artery / vein		5	22				27
	Other named artery / vein	32		41				73
Upper extremity total		32	6	67				105
Total		64	29	193	86	34	3	409

The 353 patients who sustained vascular injury had a total of 1846 injuries over all body regions. The following table presents these 1846 injuries by AIS score, body region and location of injury.

Table 6.52: Vascular injury patients: injury description and score for all injuries, major data category, Liverpool Hospital, 1995-2004

AIS description		AIS score						Total
Region	Subregion	1	2	3	4	5	6	
Head	Internal organs			45	16	29		90
	Level of consciousness	1	20	5	2	2		30
	Nerves - cranial		8					8
	Skeletal		2	12	3			17
	Vessels - intracranial			5	6	9		20
	Whole area	32	6	1		1		40
Head total		33	36	68	27	41		205
Face	Internal organs	2	2					4
	Nerves							0
	Skeletal	18	12	5	1			36
	Vessels	8		2				10
	Whole area	34	10					44
Face total		62	24	7	1			94
Neck	Internal organs		6		1	1		8
	Skeletal							0
	Vessels	5	7	10	4			26
	Whole area	20	3	4				27
Neck total		25	16	14	5	1		61
Spine	Cervical spine	1	7	8		1	2	19
	Lumbar spine		17	6				23
	Thoracic spine		9			2		11
Spine total		1	33	14		3	2	53
Thorax	Internal organs	5	7	54	25	25	3	119
	Skeletal	6	15	18	17	14		70
	Vessels		7	21	28	22	3	81
	Whole area	18	1	11	3			33
Thorax total		29	30	104	73	61	6	303
Abdomen and pelvic	Internal organs	4	80	63	46	26	2	221
	Vessels			47	40	3		90
	Whole area	14	6	2				22
Abdomen and pelvic total		18	86	112	86	29	2	333
Lower extremity	Muscle / tendons / ligaments		16	2				18
	Nerves		14	1				15
	Skeletal - bones	1	77	85	7	13		183
	Skeletal - joints	5	10					15
	Vessels	19	9	41	8			77
	Whole area	31	14	8				53
Lower extremity total		56	140	137	15	13		361
Upper extremity	Muscle / tendons / ligaments	39	21					60
	Nerves	9	58					67
	Skeletal - bones	3	45	37				85
	Skeletal - joints	7	3	1				11
	Vessels	32	6	67				105
	Whole area	36	25	17				78
Upper extremity total		126	158	122				406
External / burns / other	Burns							0
	Skin and subcutaneous tissue	30						30
External / burns / other total		30						30
Total		380	523	578	207	148	10	1846

6.6 Orthopaedic injuries

Overview

Between 1995 and 2004, 31215 (64.3%) of the 48509 SWSAHS injury admissions involved one or more orthopaedic injuries.

Within the minor data category, 24050 (71.6%) of patients sustained an orthopaedic injury. The patients in this group sustained an isolated orthopaedic injury to a single body region: either a fracture of the upper extremity (any part), fracture of the lower extremity below ankle level, or an isolated fracture of the patella or fibula. All other long bone fractures of the lower extremity are included in the major data category.

Within the major data category, 7165 (48.0%) of all patients sustained one or more orthopaedic injuries. Orthopaedic injuries were identified using specific AIS codes from the upper extremity and lower extremity chapter. These AIS codes consisted of injuries to muscles, tendons, ligaments, joints, bones along with amputations and crush injuries. AIS codes relating to the skin & subcutaneous tissue, vessels, nerves and all other 'whole area' injuries were excluded.
Patients only required at least one orthopaedic injury to be included, regardless of whether other non-orthopaedic injuries were also present.

Table 6.53: Total admissions with orthopaedic injuries, SWSAHS hospitals, 1995-2004

Data category	Year	Liverpool	Bankstown	Campbelltown	Fairfield	Bowral	Camden	Total
Major	1995	326	73	55	28	27	3	512
	1996	330	42	78	32	21	8	511
	1997	372	108	108	49	50	23	710
	1998	381	131	112	69	60	17	770
	1999	375	143	120	52	63	12	765
	2000	444	116	128	65	42	8	803
	2001	503	106	134	56	57	24	880
	2002	523	122	115	70	53	17	900
	2003	457	79	63	41	33	8	681
	2004	496	59	28	11	38	1	633
	Total	4207	979	941	473	444	121	7165
Minor	1995	673	575	462	307	145	42	2204
	1996	674	515	561	332	199	41	2322
	1997	649	675	438	320	209	82	2373
	1998	652	678	522	394	181	111	2538
	1999	663	689	585	374	190	86	2587
	2000	702	612	573	364	216	80	2547
	2001	685	538	610	349	224	105	2511
	2002	814	622	527	357	220	89	2629
	2003	757	573	432	258	201	31	2252
	2004	777	556	422	105	223	4	2087
	Total	7046	6033	5132	3160	2008	671	24050
Total	1995	999	648	517	335	172	45	2716
	1996	1004	557	639	364	220	49	2833
	1997	1021	783	546	369	259	105	3083
	1998	1033	809	634	463	241	128	3308
	1999	1038	832	705	426	253	98	3352
	2000	1146	728	701	429	258	88	3350
	2001	1188	644	744	405	281	129	3391
	2002	1337	744	642	427	273	106	3529
	2003	1214	652	495	299	234	39	2933
	2004	1273	615	450	116	261	5	2720
Grand total		11253	7012	6073	3633	2452	792	31215

Liverpool Hospital orthopaedic injuries – origin of patients

Patients may arrive directly at Liverpool Hospital or be transferred in from another hospital. Often stable patients are transferred from an urban SWSAHS hospital to Liverpool Hospital for their orthopaedic procedure, and remain at Liverpool until discharge, or are transferred back to their original hospital post-operatively. The latter is particularly common for patients with uncomplicated fractures who require a lengthy inpatient stay for recovery and rehabilitation, eg. elderly patients.

Table 6.54: Origin of arrival for orthopaedic admissions, Liverpool Hospital, major data category, 1995-2004

Year	Direct		Transfer in		Total
	n	%	n	%	
1995	297	91.1	29	8.9	326
1996	293	88.8	37	11.2	330
1997	341	91.7	31	8.3	372
1998	344	90.3	37	9.7	381
1999	327	87.2	48	12.8	375
2000	383	86.3	61	13.7	444
2001	396	78.7	107	21.3	503
2002	413	79.0	110	21.0	523
2003	375	82.1	82	17.9	457
2004	364	73.4	132	26.6	496
Total	3533	84.0	674	16.0	4207

Table 6.55: Origin of arrival for orthopaedic admissions, Liverpool Hospital, minor data category, 1995-2004

Year	Direct		Transfer in		Total
	n	%	n	%	
1995	662	98.4	11	1.6	673
1996	644	95.5	30	4.5	674
1997	610	94.0	39	6.0	649
1998	605	92.8	47	7.2	652
1999	639	96.4	24	3.6	663
2000	648	92.3	54	7.7	702
2001	585	85.4	100	14.6	685
2002	629	77.3	185	22.7	814
2003	549	72.5	208	27.5	757
2004	586	75.4	191	24.6	777
Total	6157	87.4	889	12.6	7046

SWSAHS hospitals orthopaedic injuries – total admissions compared to other specialties

Table 6.56: Orthopaedic versus non-orthopaedic admissions, Liverpool Hospital, 1995-2004

Year	Orthopaedic				Non-orthopaedic				Total injury admissions		
	Major	Minor	Total n	Total %	Major	Minor	Total n	Total %	Major	Minor	Total
1995	326	673	999	58.8	337	364	701	41.2	663	1037	1700
1996	330	674	1004	54.3	409	435	844	45.7	739	1109	1848
1997	372	649	1021	56.7	364	417	781	43.3	736	1066	1802
1998	381	652	1033	53.3	436	470	906	46.7	817	1122	1939
1999	375	663	1038	54.3	458	415	873	45.7	833	1078	1911
2000	444	702	1146	52.5	558	480	1038	47.5	1002	1182	2184
2001	503	685	1188	49.6	650	555	1205	50.4	1153	1240	2393
2002	523	814	1337	50.5	623	688	1311	49.5	1146	1502	2648
2003	457	757	1214	50.0	556	659	1215	50.0	1013	1416	2429
2004	496	777	1273	53.3	525	591	1116	46.7	1021	1368	2389
Total	4207	7046	11253	53.0	4916	5074	9990	47.0	9123	12120	21243

Table 6.57: Orthopaedic versus non-orthopaedic admissions, Bankstown Hospital, 1995-2004

Year	Orthopaedic				Non-orthopaedic				Total		
	Major	Minor	Total n	Total %	Major	Minor	Total n	Total %	Major	Minor	Total
1995	73	575	648	64.1	44	319	363	35.9	117	894	1011
1996	42	515	557	68.5	52	204	256	31.5	94	719	813
1997	108	675	783	72.2	120	181	301	27.8	228	856	1084
1998	131	678	809	81.0	106	84	190	19.0	237	762	999
1999	143	689	832	82.6	101	74	175	17.4	244	763	1007
2000	116	612	728	81.6	86	78	164	18.4	202	690	892
2001	106	538	644	81.5	85	61	146	18.5	191	599	790
2002	122	622	744	82.8	78	77	155	17.2	200	699	899
2003	79	573	652	77.3	62	130	192	22.7	141	703	844
2004	59	556	615	76.9	60	125	185	23.1	119	681	800
Total	979	6033	7012	76.7	794	1333	2127	23.3	1773	7366	9139

Table 6.58: Orthopaedic versus non-orthopaedic admissions, Campbelltown Hospital, 1995-2004

Year	Orthopaedic				Non-orthopaedic				Total		
	Major	Minor	Total n	Total %	Major	Minor	Total n	Total %	Major	Minor	Total
1995	55	462	517	66.5	57	204	261	33.5	112	666	778
1996	78	561	639	69.8	60	216	276	30.2	138	777	915
1997	108	438	546	69.0	83	162	245	31.0	191	600	791
1998	112	522	634	74.1	103	119	222	25.9	215	641	856
1999	120	585	705	79.2	107	78	185	20.8	227	663	890
2000	128	573	701	77.5	98	106	204	22.5	226	679	905
2001	134	610	744	78.6	123	79	202	21.4	257	689	946
2002	115	527	642	79.4	89	78	167	20.6	204	605	809
2003	63	432	495	69.4	77	141	218	30.6	140	573	713
2004	28	422	450	65.3	111	128	239	34.7	139	550	689
Total	941	5132	6073	73.2	908	1311	2219	26.8	1849	6443	8292

Table 6.59: Orthopaedic versus non-orthopaedic admissions, Fairfield Hospital, 1995-2004

Year	Orthopaedic				Non-orthopaedic				Total		
	Major	Minor	Total n	Total %	Major	Minor	Total n	Total %	Major	Minor	Total
1995	28	307	335	63.7	45	146	191	36.3	73	453	526
1996	32	332	364	68.3	37	132	169	31.7	69	464	533
1997	49	320	369	66.5	64	122	186	33.5	113	442	555
1998	69	394	463	79.4	45	75	120	20.6	114	469	583
1999	52	374	426	80.4	52	52	104	19.6	104	426	530
2000	65	364	429	80.6	59	44	103	19.4	124	408	532
2001	56	349	405	80.4	54	45	99	19.6	110	394	504
2002	70	357	427	85.1	33	42	75	14.9	103	399	502
2003	41	258	299	78.5	22	60	82	21.5	63	318	381
2004	11	105	116	41.0	93	74	167	59.0	104	179	283
Total	473	3160	3633	73.7	504	792	1296	26.3	977	3952	4929

Table 6.60: Orthopaedic versus non-orthopaedic admissions, Bowral Hospital, 1995-2004

Year	Orthopaedic				Non-orthopaedic				Total		
	Major	Minor	Total n	Total %	Major	Minor	Total n	Total %	Major	Minor	Total
1995	27	145	172	57.5	45	82	127	42.5	72	227	299
1996	21	199	220	72.1	14	71	85	27.9	35	270	305
1997	50	209	259	73.4	43	51	94	26.6	93	260	353
1998	60	181	241	70.5	52	49	101	29.5	112	230	342
1999	63	190	253	71.9	59	40	99	28.1	122	230	352
2000	42	216	258	74.4	52	37	89	25.6	94	253	347
2001	57	224	281	75.5	46	45	91	24.5	103	269	372
2002	53	220	273	75.0	44	47	91	25.0	97	267	364
2003	33	201	234	65.7	33	89	122	34.3	66	290	356
2004	38	223	261	65.4	64	74	138	34.6	102	297	399
Total	444	2008	2452	70.3	452	585	1037	29.7	896	2593	3489

Table 6.61: Orthopaedic versus non-orthopaedic admissions, Camden Hospital, 1995-2004

Year	Orthopaedic				Non-orthopaedic				Total		
	Major	Minor	Total n	Total %	Major	Minor	Total n	Total %	Major	Minor	Total
1995	3	42	45	26.6	13	111	124	73.4	16	153	169
1996	8	41	49	35.3	12	78	90	64.7	20	119	139
1997	23	82	105	48.4	33	79	112	51.6	56	161	217
1998	17	111	128	67.0	23	40	63	33.0	40	151	191
1999	12	86	98	76.0	12	19	31	24.0	24	105	129
2000	8	80	88	70.4	22	15	37	29.6	30	95	125
2001	24	105	129	77.7	19	18	37	22.3	43	123	166
2002	17	89	106	76.3	15	18	33	23.7	32	107	139
2003	8	31	39	44.3	10	39	49	55.7	18	70	88
2004	1	4	5	9.3	20	29	49	90.7	21	33	54
Total	121	671	792	55.9	179	446	625	44.1	300	1117	1417

Orthopaedic injury disposition for SWSAHS urban and rural hospitals

The following table presents data major category orthopaedic admissions to SWSAHS urban and rural hospitals (that is, all SWSAHS hospitals excluding Liverpool), and whether the patient remained at the urban or rural hospital or was transferred out. 2514 (78.8%) of these patients remained at the admitting SWSAHS urban or rural hospital.

Table 6.62: ED disposal for orthopaedic admissions, SWSAHS urban and rural hospitals, major data category, 1995-2004

Hospital	Remained in a SWSAHS hospital		Transfer out		Total
	n	%	n	%	
Bankstown	948	96.8	31	3.2	979
Campbelltown	742	78.9	199	21.1	941
Fairfield	369	78.0	104	22.0	473
Bowral	319	71.8	125	28.2	444
Camden	25	20.7	96	79.3	121
Total	2403	81.2	555	18.8	2958

555 (18.8%) of all SWSAHS urban or rural hospital orthopaedic admissions were transferred to another hospital for definitive care. Of the transfers out 400 (72.1%) patients were transferred to another SWSAHS hospital; 64 (11.5%) patients were transferred to a hospital outside of SWSAHS; and 91 (16.4%) were transferred to a private hospital.

Table 6.63: Orthopaedic transfers out to other hospitals, SWSAHS urban and rural hospitals, major data category, 1995-2004

Hospital	Transfer to other SWSAHS hospital		Transfer to other area health service		Transfer to private hospital		Total transfers out
	n	%	n	%	n	%	
Bankstown	16	51.6	11	35.5	4	12.9	31
Campbelltown	167	83.9	28	14.1	4	2.0	199
Fairfield	95	91.3	8	7.7	1	1.0	104
Bowral	87	90.6	2	2.1	7	7.3	96
Camden	35	28.0	15	12.0	75	60.0	125
Total	400	72.1	64	11.5	91	16.4	555

6.7 Road trauma - SWSAHS hospitals

'Road trauma' was defined as one of the following mechanisms of injury: motor vehicle crash; motorbike crash; cyclist hit by vehicle; and pedestrian hit by vehicle. The most common place of injury for road trauma is the street. Occasionally the injury is sustained in off-road activities, for example, during motor-cross racing; trail biking; or when a pedestrian is hit by vehicle in a driveway, car park or similar.

Table 6.64: Road trauma sex distribution, SWSAHS hospitals, 1995-2004

Year	Male		Female		Total
	n	%	n	%	
1995	487	66.1	250	33.9	737
1996	464	67.0	229	33.0	693
1997	517	68.5	238	31.5	755
1998	523	68.8	237	31.2	760
1999	529	69.8	229	30.2	758
2000	571	71.3	230	28.7	801
2001	532	67.9	251	32.1	783
2002	501	67.7	239	32.3	740
2003	460	66.9	228	33.1	688
2004	530	70.1	226	29.9	756
Total	5114	68.5	2357	31.5	7471

Table 6.65: Road trauma mechanism and sex distribution, SWSAHS hospitals, 1995-2004

Mechanism	Male		Female		Total
	n	%	n	%	
MVC driver	1794	64.7	979	35.3	2774
MBC rider	1609	95.5	72	4.3	1685
Pedestrian	782	64.1	432	35.4	1220
MVC front passenger	431	43.3	562	56.5	995
MVC back passenger	229	48.2	243	51.2	475
Cyclist vs. vehicle	234	85.4	33	12.0	274
MBC pillion	35	46.1	36	47.4	76
Total	5114	68.5	2357	31.5	7471

Figure 6.10: Road trauma mechanism and sex distribution, SWSAHS hospitals, 1995-2004 (n=7471)

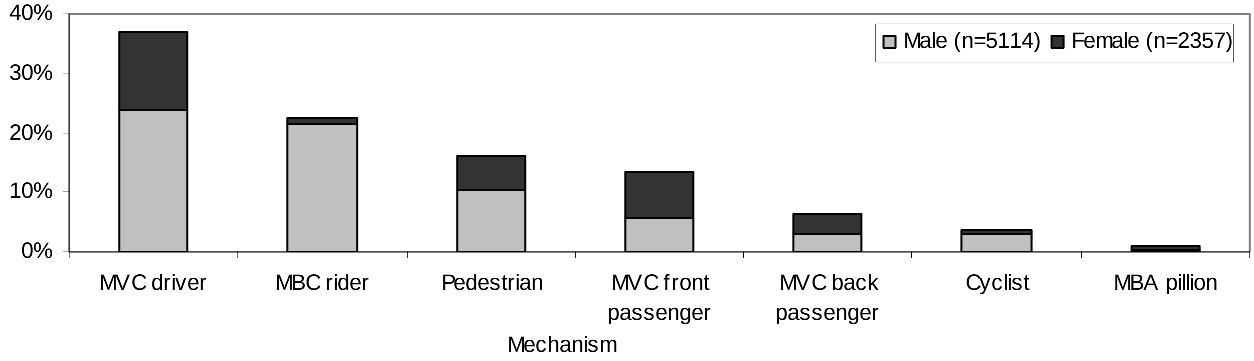


Figure 6.11: Road trauma age and sex distribution, SWSAHS hospitals, 1995-2004 (n=7471)

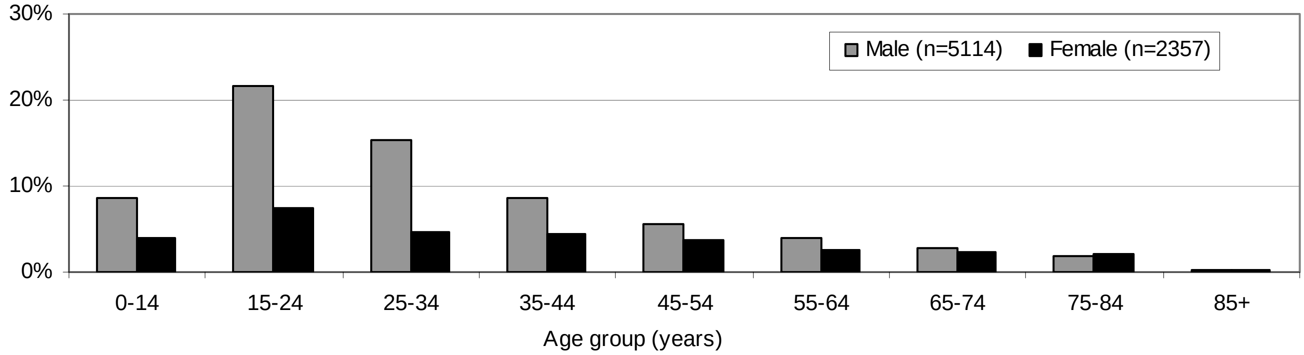


Table 6.66: Road trauma age / sex distribution and mechanism, SWSAHS hospitals, 1995-2004

Mechanism	Sex	Age group (years)										
		0-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+	Total	
MVC driver	Male	14	542	440	269	203	161	104	57	4	1794	
	Female	4	272	190	195	141	82	53	40	2	979	37.1%
	Total	18	814	630	464	344	243	157	97	6	2773	
MBC rider	Male	177	605	464	226	86	31	12	8	0	1609	
	Female	24	22	11	9	5	1	0	0	0	72	22.5%
	Total	201	627	475	235	91	32	12	8	0	1681	
Pedestrian	Male	221	130	106	73	65	66	67	50	4	782	
	Female	115	46	39	41	41	36	51	55	8	432	16.2%
	Total	336	176	145	114	106	102	118	105	12	1214	
MVC front passenger	Male	46	164	78	47	37	21	21	15	2	431	
	Female	50	139	77	69	70	46	61	39	11	562	13.3%
	Total	96	303	155	116	107	67	82	54	13	993	
MVC back passenger	Male	90	88	28	9	6	2	3	3	0	229	
	Female	85	63	18	10	14	21	14	16	2	243	6.3%
	Total	175	151	46	19	20	23	17	19	2	472	
Cyclist vs. vehicle	Male	87	65	29	18	16	13	4	2	0	234	
	Female	19	6	3	4	1		0	0	0	33	3.6%
	Total	106	71	32	22	17	13	4	2	0	267	
MBC pillion	Male	8	16	5	4	1	1	0	0	0	35	
	Female	6	10	9	7	1	2	1	0	0	36	1.0%
	Total	14	26	14	11	2	3	1	0	0	71	
Total	Male	643	1610	1150	646	414	295	211	135	10	5114	
	Female	303	558	347	335	273	188	180	150	23	2357	100.0%
	Total	946	2168	1497	981	687	483	391	285	33	7471	

Table 6.67: Road trauma ISS and mechanism, SWSAHS hospitals, 1995-2004

Mechanism	ISS < 16		ISS ≥ 16		Total	
	n	%	n	%	n	%
MVC driver	2283	30.6	490	6.6	2774	37.1
MBC rider	1489	19.9	192	2.6	1685	22.6
Pedestrian	945	12.6	269	3.6	1220	16.3
MVC front passenger	801	10.7	192	2.6	995	13.3
MVC back passenger	393	5.3	79	1.1	475	6.4
Cyclist vs. vehicle	228	3.1	39	0.5	274	3.7
MBC pillion	62	0.8	9	0.1	76	1.0
Total	6201	83.0	1270	17.0	7471	100.0

Figure 6.12: Road trauma ISS and mechanism, SWSAHS hospitals, 1995-2004 (n=7471)

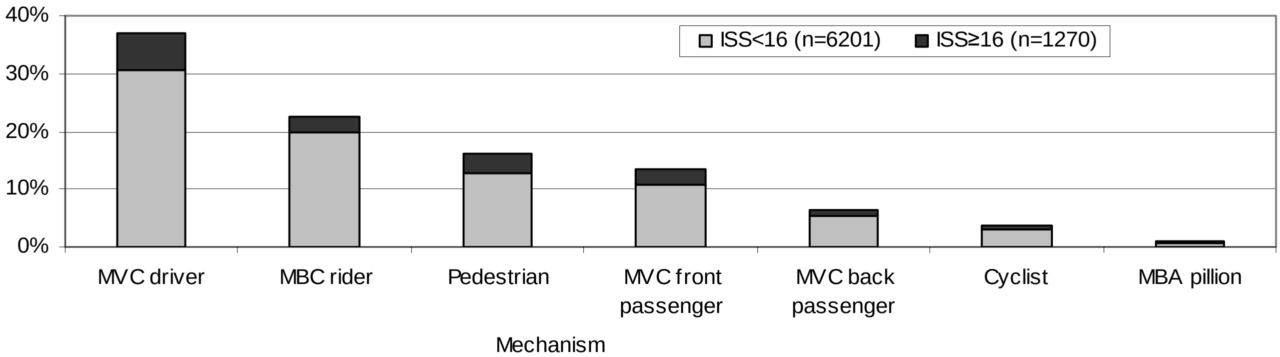


Table 6.68: Road trauma by ISS range, SWSAHS hospitals, 1995-2004

Mechanism	ISS 1-15		ISS 16-24		ISS 25-49		ISS 50-74		ISS 75		Total
	n	%	n	%	n	%	n	%	n	%	
MVC driver	2283	82.3	291	10.5	133	4.8	56	2.0	10	0.4	2773
MBC rider	1489	88.6	101	6.0	64	3.8	24	1.4	3	0.2	1681
Pedestrian	945	77.8	112	9.2	102	8.4	44	3.6	11	0.9	1214
MVC front passenger	801	80.7	108	10.9	61	6.1	23	2.3	0	-	993
MVC back passenger	393	83.3	35	7.4	30	6.4	10	2.1	4	0.8	472
Cyclist vs. vehicle	228	85.4	19	7.1	14	5.2	6	2.2	0	-	267
MBC pillion	62	87.3	4	5.6	5	7.0	0	-	0	-	71
Total	6201	83.0	670	9.0	409	5.5	163	2.2	28	0.4	7471

Table 6.69: Road trauma survival outcome by mechanism, SWSAHS hospitals, 1995-2004

Mechanism	Survived		Died		Total	
	n	%	n	%	n	%
MVC driver	2698	97.3	75	2.7	2773	37.1
MBC rider	971	97.8	22	2.2	993	22.6
Pedestrian	457	96.8	15	3.2	472	16.3
MVC front passenger	1659	98.7	22	1.3	1681	13.3
MVC back passenger	71	100.0	0	-	71	6.4
Cyclist vs. vehicle	1147	94.5	67	5.5	1214	3.7
MBC pillion	262	98.1	5	1.9	267	1.0
Total	7265	97.2	206	2.8	7471	100.0

Figure 6.13: Road trauma deaths: by mechanism of injury, SWSAHS hospitals, 1995-2004 (n=206)

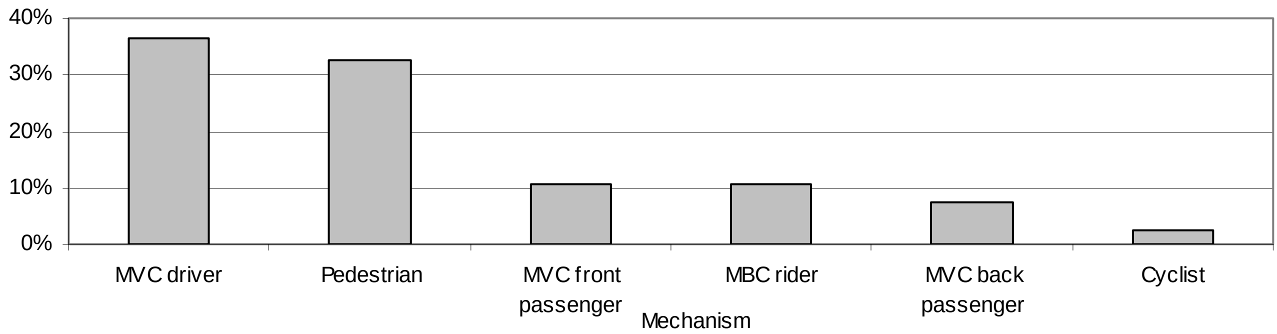


Table 6.70: Road trauma discharge status, SWSAHS hospitals, 1995-2004

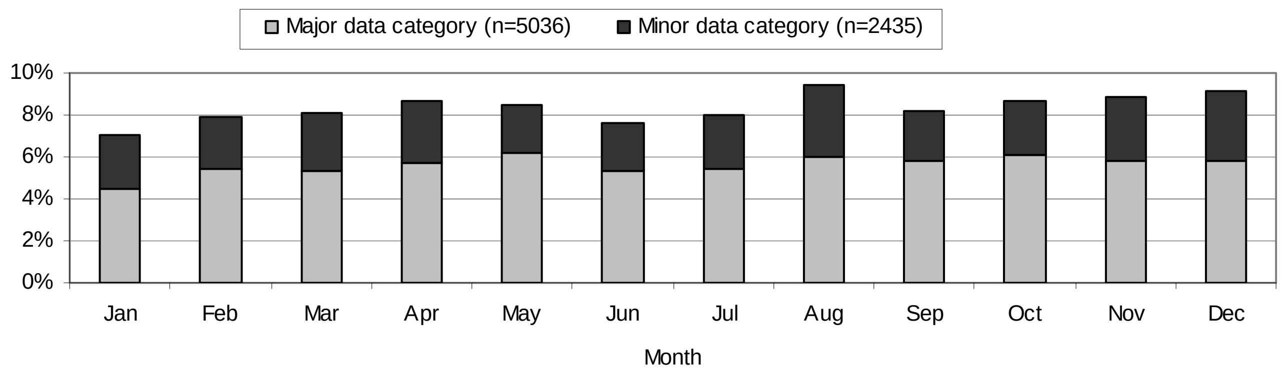
Discharge status	Patients	%
Full recovery	6052	81.0
Transfer to other facility	427	5.7
Rehabilitation (includes Brain Injury Unit)	297	4.0
Rehabilitation and home help	249	3.3
Died	206	2.8
Home help	119	1.6
Discharged self against medical advice	80	1.1
Brain Injury Unit outpatients*	37	0.5
Nursing home	4	0.1
Total	7471	100.0

*Brain Injury Unit (BIU) outpatient data collection began in 1999. It is speculated that the percentage of patients may be higher than reported in the above table.

Road trauma monthly trends

Over the ten years 1995-2004, the highest number of monthly road trauma admissions to SWSAHS hospitals occurred in August.

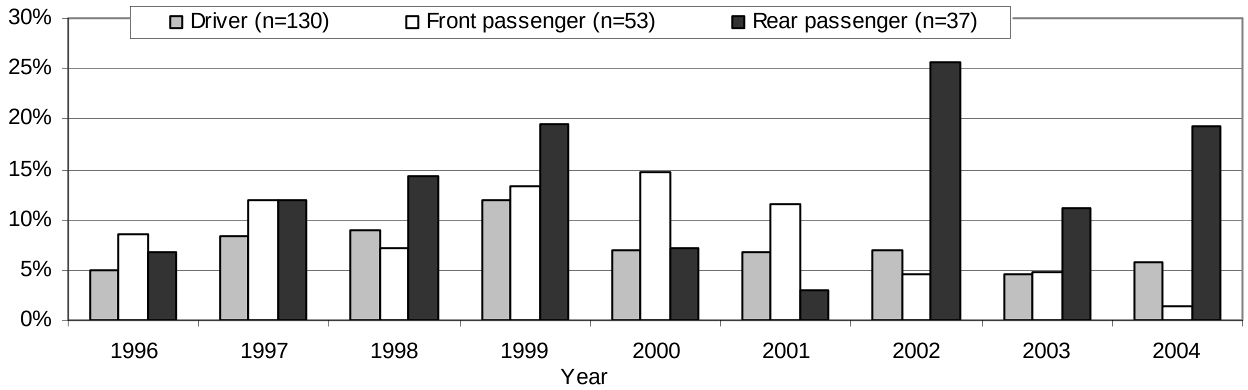
Figure 6.14: Road trauma admissions by month, SWSAHS hospitals, 1995-2004 (n=7471)



Seat belts

Seat belt use data is collected for all major data category patients from 1996 onwards. Between 1996 and 2004, 220 (8.3%) of all admitted MVC patients were unrestrained: 130 (7.3%) drivers, 53 (8.6%) front passengers and 37 (13.6%) rear passengers.

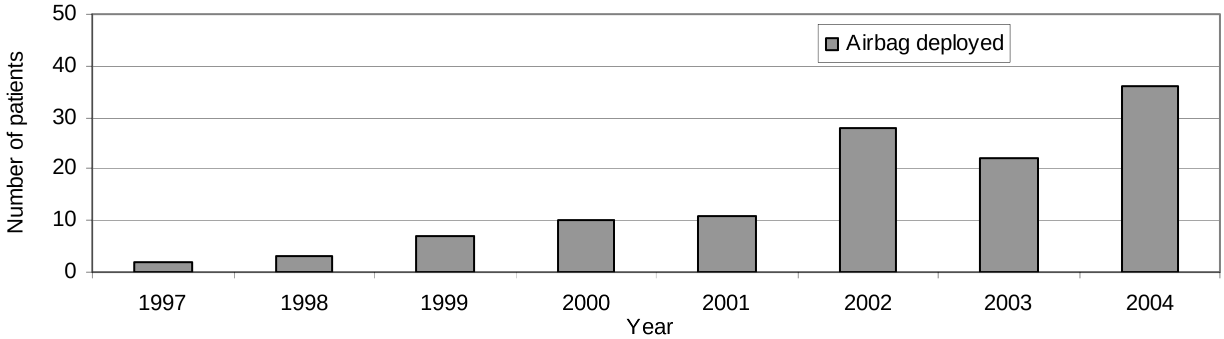
Figure 6.15: Patients not wearing seat belts, SWSAHS hospitals, major data category,1995-2004 (n=2665)



Airbags

Airbag data has been collected since 1997 for all major data category patients involved in a motor vehicle crash. Airbag use is recorded if an airbag deployed in the vicinity of the patient. In NSW, many registered vehicles over approximately 7 years old do not have airbags installed.

Figure 6.16: MVC with airbag deployed, SWSAHS hospitals, major data category,1995-2004 (n=2665)



Helmet use by motor and pedal cyclists

- 933 patients were admitted to SWSAHS hospitals between 1996 and 2004 for injuries sustained in a MBC or pedal cyclist vs. vehicle
- Of these, 252 (21.6%) patients were not wearing a helmet at the time of injury (143 (15.3%) motorbike riders, 99 (51.0%) pedal cyclists)
- For the MBC group, a higher percentage wore their helmet on-road compared to off-road
- Of the off-road motorbike crashes, helmet use was much higher in motor-cross sports compared to those riding for other purposes, such as recreation or farm work
- Rates of helmet use in motor bike pillion passengers and cyclists are not presented due to insufficient numbers
- Data for helmet use is not available for many patients due to documentation limitations
- NB. The 'road trauma cyclist' group excludes falls from cycles that occur at low-medium speed without colliding with another vehicle

Figure 6.17: Percentage of all patients involved in motorbike crashes and cyclist collisions who were not wearing a helmet
SWSAHS major data category,1995-2004 (n=252)

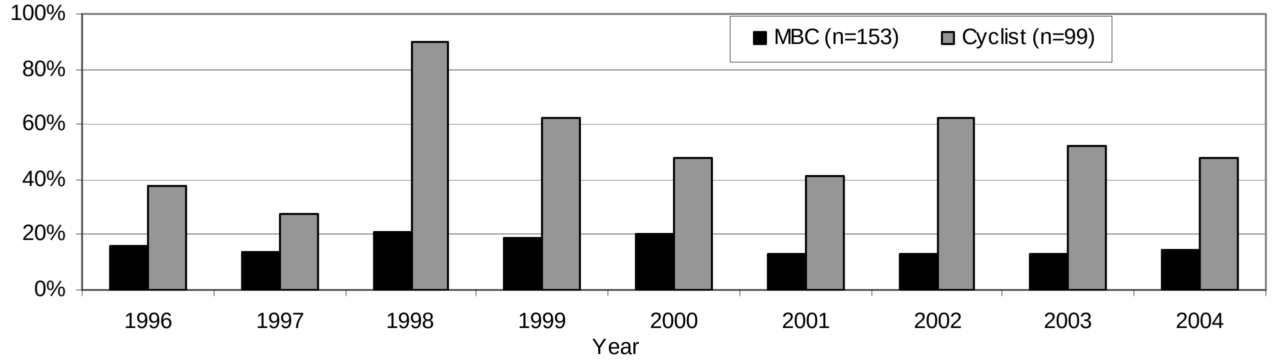
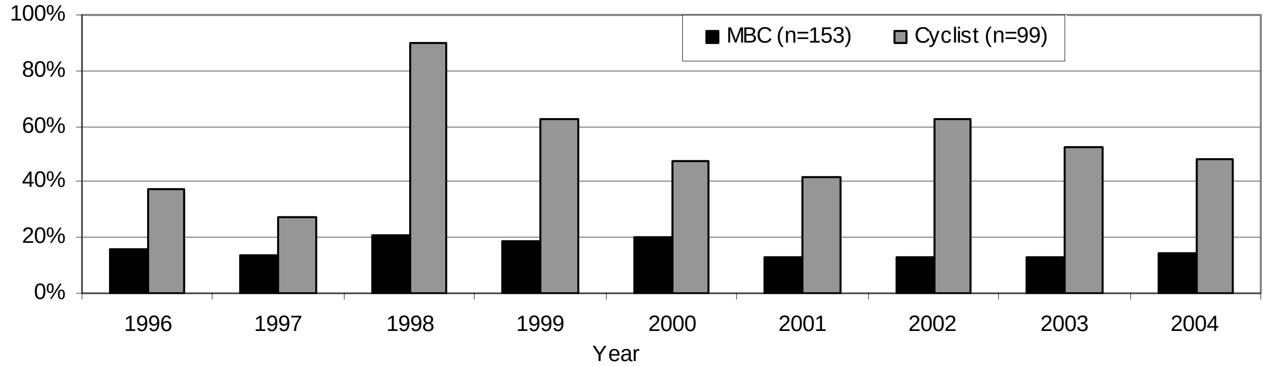


Figure 6.18: Percentage of motor bike crash patients not wearing a helmet, on-road versus off-road
SWSAHS major data category,1995-2004 (n=143)



6.8 Child pedestrians

- A total of 231 children between the ages of 0 and 9 were admitted to SWSAHS hospitals after being hit by a car or other vehicle
- Of these, 146 (63.2%) patients were in the major data category 85 (36.8%) patients were in the minor data category
- 162 (70.1%) child pedestrians were injured on the street, 56 (24.2%) were injured at home (usually in the driveway), 13 (5.7%) of patients were injured at another location, including facilities, organised sports, schools, farms or unknown location
- The mean age was 4.8 ($\pm$ 2.6) years (range 0-9 years)
- 143 (61.9%) of patients were treated at Liverpool Hospital
- 155 (67.1%) of patients were male and 76 (32.9%) were female
- 29 (12.6%) of patients were seriously injured with an ISS $\geq$ 16
- Five (2.2%) of patients died. Four patients died in the ED, and one patient died en route to a paediatric major trauma service
- 78 (33.8%) of patients were transferred to a paediatric major trauma service

Table 6.71: Child pedestrians by age and place of injury, SWSAHS hospitals, 1995-2004

Age (years)	Place of injury							
	Street	Home	Facility	Organised sport	School	Farm	Not documented	Total
0	1	1						2
1	7	18						25
2	12	15				1		28
3	20	5				1	2	28
4	24	4	4				1	33
5	21	4						25
6	12	2				1		15
7	25	3		1				29
8	18	2			1			21
9	22	2			1			25
Total	162	56	4	1	2	3	3	231

Table 6.72: Child pedestrians by hospital attended and place of injury, SWSAHS hospitals, 1995-2004

Hospital	Place of injury							
	Street	Home	Facility	Organised sport	School	Farm	Not documented	Total
Liverpool	113	24	1		1	3	1	143
Campbelltown	21	15		1	1		1	39
Bankstown	21	5						26
Fairfield	3	7					1	11
Bowral	3	2	3					8
Camden	1	3						4
Total	162	56	4	1	2	3	3	231

Table 6.73: Annual trends for child pedestrians by place of injury, SWSAHS hospitals, 1995-2004

Year	Place of Injury							
	Street	Home	Facility	Organised sport	School	Farm	Not documented	Total
1995	28	8				1	1	38
1996	20	5				1		26
1997	20	10						30
1998	23	4						27
1999	16	8	1					25
2000	12	4		1	1			18
2001	14	4	1					19
2002	9	5	1		1	1	1	18
2003	9	4						13
2004	11	4	1				1	17
Total	162	56	4	1	2	3	3	231

Table 6.74: Child pedestrians survival outcome and ISS, SWSAHS hospitals, 1995-2004

ISS group	Survived	Died*	Total n	Total %
1-9	179		179	77.5
10-15	23		23	10.0
16-24	13		13	5.6
25-49	9	3	12	5.2
50-74	1		1	0.4
75	1	2	3	1.3
Total	226	5	231	100.0

*Four patients died in the Emergency Department and one patient died en route to a paediatric major trauma service

Table 6.75: Child pedestrians emergency department disposition, SWSAHS hospitals, 1995-2004

Emergency department disposition	Place of injury							
	Street	Home	Facility	Organised sport	School	Farm	Not documented	Total
Ward	97	25	2		2	2	2	130
Transfer to other hospital	49	26	1	1		1	1	79
Operating theatre	14	3	1					18
Died in ED	2	2						4
Total	162	56	4	1	2	3	3	231

6.9 Burns

- A total of 1188 patients were admitted to SWSAHS hospitals after sustaining burns
- 272 (22.9%) patients were in the major data category and 916 (77.1%) patients were in the minor data category
- Burns were most common in males aged 0-4 years, followed by females 0-4 years and males 15-24 years
- The mean age was 20.9 (± 21.4) years (range 0-98 years)
- 825 (69.4%) patients were male, and 363 (30.6%) were female
- 83 (7.0%) of patients were seriously injured with an ISS ≥ 16, and 7 (0.6%) patients died
- 579 (48.7%) of patients were treated at Liverpool Hospital, and 316 (56.1%) were transferred to dedicated adult or paediatric burn units

Table 6.76: Burns sex distribution, SWSAHS hospitals, 1995-2004

Year	Male n	Male %	Female n	Female %	Total
1995	83	68.6	38	31.4	121
1996	82	66.7	41	33.3	123
1997	80	64.5	44	35.5	124
1998	110	76.4	34	23.6	144
1999	81	68.6	37	31.4	118
2000	70	68.0	33	32.0	103
2001	77	64.2	43	35.8	120
2002	84	71.2	34	28.8	118
2003	75	78.1	21	21.9	96
2004	83	68.6	38	31.4	121
Total	825	69.4	363	30.6	1188

Figure 6.19: Burns age and sex distribution, SWSAHS hospitals, 1995-2004 (n=1188)

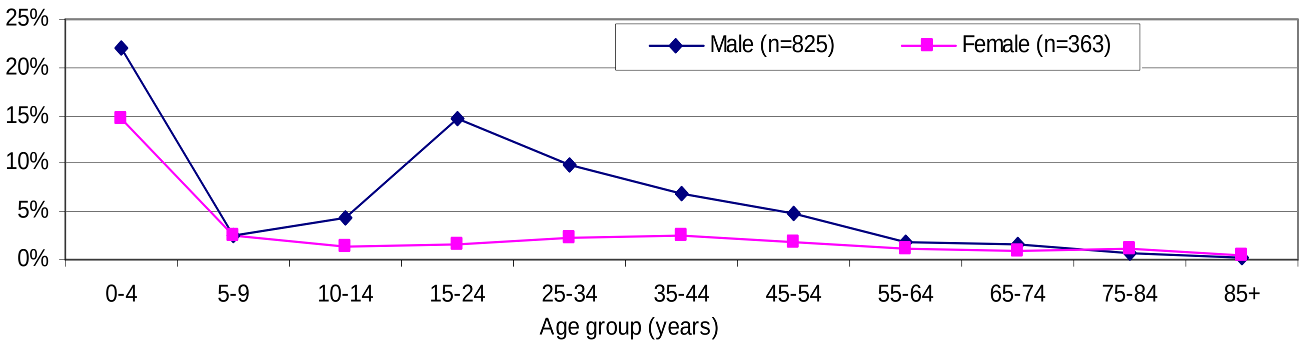


Table 6.77: Burns annual admissions, SWSAHS hospitals, 1995-2004

Year	Liverpool	Campbelltown	Bankstown	Fairfield	Bowral	Camden	Total	
							n	%
1995	57	28	20	10	2	4	121	10.2
1996	56	17	31	13	4	2	123	10.4
1997	42	18	23	23	12	6	124	10.4
1998	62	23	24	17	12	6	144	12.1
1999	57	19	19	12	10	1	118	9.9
2000	49	21	21	7	4	1	103	8.7
2001	67	17	16	13	5	2	120	10.1
2002	73	14	15	7	6	3	118	9.9
2003	57	19	8	3	7	2	96	8.1
2004	59	21	16	11	12	2	121	10.2
Total	579	197	193	116	74	29	1188	100.0

Table 6.78: Burns in adults and children, SWSAHS hospitals, 1995-2004

Age group	Data category		Liverpool	Campbelltown	Bankstown	Fairfield	Bowral	Camden	Total
Children (0-14 years)	Major		42	7	9	12	8	1	79
	Minor		184	124	78	59	26	13	484
	Total	n	226	131	87	71	34	14	563
		%	39.0	66.5	45.1	61.2	45.9	48.3	47.4
Adults (≥15 years)	Major		146	11	21	6	7	2	193
	Minor		207	55	85	39	33	13	432
	Total	n	353	66	106	45	40	15	625
		%	61.0	33.5	54.9	38.8	54.1	51.7	52.6
Total	Major		188	18	30	18	15	3	272
	Minor		391	179	163	98	59	26	916
	Total	n	579	197	193	116	74	29	1188
		%	48.7	16.6	16.2	9.8	6.2	2.4	100.0

Table 6.79: Burns by ISS and age group (adults and children), SWSAHS hospitals, 1995-2004

Age group (years)	ISS < 16		ISS ≥ 16		Total
	n	%	n	%	
Child	549	97.5	14	2.5	563
Adult	556	89.0	69	11.0	625
Total	1105	93.0	83	7.0	1188

Table 6.80: Burns patients kept in SWSAHS hospitals or transferred out to other hospital, age **≥ 14 years**, SWSAHS hospitals, 1995-2004

Year	Remained in SWSAHS hospital		Transferred to other hospital		Total
	n	%	n	%	
1995	52	76.5	16	23.5	68
1996	41	71.9	16	28.1	57
1997	52	77.6	15	22.4	67
1998	63	77.8	18	22.2	81
1999	43	71.7	17	28.3	60
2000	38	65.5	20	34.5	58
2001	45	73.8	16	26.2	61
2002	52	76.5	16	23.5	68
2003	40	78.4	11	21.6	51
2004	36	66.7	18	33.3	54
Total	462	73.9	163	26.1	625

Table 6.81: Burns survival outcome (at time of discharge or transfer to another hospital), SWSAHS hospitals, 1995-2004

Age group	Survived		Died		Total
	n	%	n	%	
Child	562	99.8%	1	0.2%	563
Adult	619	99.0%	6	1.0%	625
Total	1181	99.4%	7	0.6%	1188

Table 6.82: Burns ED disposition, SWSAHS hospitals, 1995-2004

Year	Remained in SWSAHS hospital		Transferred to other AHS		Total
	n	%	n	%	
1995	35	66.0	18	34.0	53
1996	34	51.5	32	48.5	66
1997	27	47.4	30	52.6	57
1998	30	47.6	33	52.4	63
1999	27	46.6	31	53.4	58
2000	24	53.3	21	46.7	45
2001	25	42.4	34	57.6	59
2002	17	34.0	33	66.0	50
2003	14	31.1	31	68.9	45
2004	14	20.9	53	79.1	67
Total	247	43.9	316	56.1	563

6.10 Fractured ribs in older patients

Between 1995 and 2004, 1975 major data category patients aged ≥ 55 years were admitted to Liverpool Hospital following injury. Of these, 662 (33.5%) sustained fractured ribs, either as an isolated injury or in combination with other injuries. Fractured ribs are captured within the major data category.

Table 6.83: All injuries aged ≥ 55 years, major data category, Liverpool Hospital, 1995-2004

Statistic:	Survived		Died		Total
	n	%	n	%	
Total patients	1757	89.0%	218	11.0%	1975
ISS ≥ 16	445	22.5%	134	6.8%	579
Age ≥ 70 years	881	44.6%	166	8.4%	1047
Mean age	70.0 ± 10.0 (55-99)		76.8 ± 10.5 (55-99)		70.8 ± 10.3 (55-99)
Mean ISS	11.2 ± 8.0 (1-75)		25.0 ± 18.9 (4-75)		12.7 ± 10.7 (1-75)

Table 6.84: Patients with fractured ribs aged ≥ 55 years, major data category, Liverpool Hospital, 1995-2004

Statistic:	Survived		Died		Total
	N	%	n	%	
Patients	594	89.7	68	10.3	662
ISS ≥ 16	176	26.6	62	9.4	238
Age ≥ 70 years	285	43.1	41	6.2	326
Mean age	69.2 ± 9.5 (55-99)		71.7 ± 10.2		69.5 ± 9.6 (55-99)
Mean ISS	12.2 ± 9.7 (1-57)		39.5 ± 20.8 (8-75)		15.0 ± 14.0 (1-75)

Table 6.85: Patients with fractured ribs aged ≥ 55 years by mechanism of injury, major data category, Liverpool Hospital, 1995-2004

Mechanism	Survived		Died		Total	
	n	%	n	%	n	%
MVC	227	88.0	31	12.0	258	100.0
Fall < 5m	243	94.9	13	5.1	256	100.0
Pedestrian	59	74.7	20	25.3	79	100.0
Assault	18	100.0	0	0.0	18	100.0
Fall > 5m	10	71.4	4	28.6	14	100.0
MBC	13	100.0	0	-	13	100.0
Industrial	9	100.0	0	-	9	100.0
Other	7	100.0	0	-	7	100.0
Cyclist	4	100.0	0	-	4	100.0
Fall from horse	2	100.0	0	-	2	100.0
Recreation	2	100.0	0	-	2	100.0
Total	594	89.7	68	10.3	662	100.0

6.11 Penetrating injury

- Of the 9123 major data category patients admitted to Liverpool Hospital between 1995-2004, 722 (7.9%) sustained penetrating injuries (penetrating injury data is collected for major data category patients only)
- Patients with both blunt and penetrating injuries are categorised according to the nature of their most serious injury
- The proportion of patients sustaining penetrating injuries remained relatively constant over the 10-year period 1995-2004
- 633 (87.7%) of patients with penetrating injuries were male and 89 (12.3%) were female
- A higher proportion of males sustain penetrating trauma, in comparison to blunt trauma
- Male patients between 15-29 years of age represent a large proportion of all penetrating trauma admissions
- The mean age for penetrating injuries was 31.4 (± 13.2) years (range 5-90)
- The most common injury mechanism for penetrating trauma is stabbing, followed by gunshot wounds
- Less common mechanisms of injury for penetrating trauma include falls, motor vehicle crashes and industrial accidents
- The most common injury intent is assault, followed by self-harm
- 8.2% of penetrating injuries were accidental in nature, and this figure includes injuries sustained in road trauma and industrial accidents
- The injury intent was self harm in 115 (15.9%) patients: 95 (82.6%) were stabbings, 12 (10.4%) were gunshots and 8 (7.0%) were due to other mechanisms
- 680 (94.2%) patients survived and 42 (5.8%) of patients died
- 155 (21.5%) patients were seriously injured with an ISS ≥ 16
- 593 (82.1%) patients received pre-hospital intervention and the remaining 129 (17.9%) arrived via private transport
- 646 (89.5%) patients were admitted directly to Liverpool Hospital and 76 (10.5%) patients were transferred in from another hospital
- The 3 most common predominant body regions of injury were the abdomen (226 patients / 31.3%), chest (192 patients / 26.6%) and extremities (147 patients / 20.4%)
- 31 (4.3%) of patients sustained significant injury in more than one body region
- 199 (27.6%) patients with penetrating trauma underwent laparotomy
- 55 (7.6%) patients underwent thoracotomy, with 15 (2.1%) of these undergoing an urgent thoracotomy in the ED
- 1024 separate operations were carried out for the 722 major data category patients that sustained penetrating trauma
- Chapter 8 (Performance Indicators) contains further data for therapeutic and non-therapeutic laparotomy in penetrating vs. blunt trauma

Table 6.86: Blunt versus penetrating injury, major data category, Liverpool Hospital, 1995-2004

Year	Blunt		Penetrating		Total
	n	%	n	%	
1995	609	91.9	54	8.1	663
1996	670	90.7	69	9.3	739
1997	666	90.5	70	9.5	736
1998	740	90.6	77	9.4	817
1999	780	93.6	53	6.4	833
2000	916	91.4	86	8.6	1002
2001	1062	92.1	91	7.9	1153
2002	1053	91.9	93	8.1	1146
2003	943	93.1	70	6.9	1013
2004	962	94.2	59	5.8	1021
Total	8401	92.1	722	7.9	9123

The proportion of male patients is much higher in penetrating trauma (87.7% male) than in blunt trauma (70.8% male).

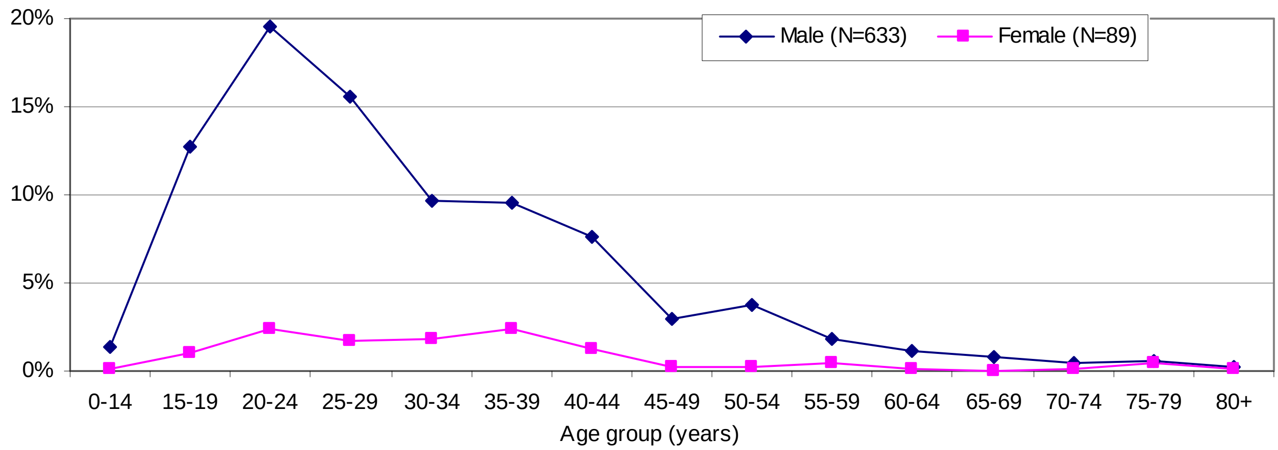
Table 6.87: Blunt versus penetrating injury, by sex, major data category, Liverpool Hospital, 1995-2004

Year	Blunt						Penetrating					
	Male		Female		Total		Male		Female		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
1995	419	68.8	190	31.2	609	100.0	49	90.7	5	9.3	54	100.0
1996	488	72.8	182	27.2	670	100.0	59	85.5	10	14.5	69	100.0
1997	482	72.4	184	27.6	666	100.0	63	90.0	7	10.0	70	100.0
1998	516	69.7	224	30.3	740	100.0	71	92.2	6	7.8	77	100.0
1999	544	69.7	236	30.3	780	100.0	47	88.7	6	11.3	53	100.0
2000	671	73.3	245	26.7	916	100.0	73	84.9	13	15.1	86	100.0
2001	757	71.3	305	28.7	1062	100.0	80	87.9	11	12.1	91	100.0
2002	738	70.1	315	29.9	1053	100.0	84	90.3	9	9.7	93	100.0
2003	653	69.2	290	30.8	943	100.0	55	78.6	15	21.4	70	100.0
2004	682	70.9	280	29.1	962	100.0	52	88.1	7	11.9	59	100.0
Total	5950	70.8	2451	29.2	8401	100.0	633	87.7	89	12.3	722	100.0

Table 6.88: Penetrating injury sex and age distribution, major data category, Liverpool Hospital, 1995-2004

Year	Total	Sex distribution				Age distribution			
		Male		Female		Mean		sd	Range
		n	%	n	%				
1995	54	49	90.7	5	9.3	29.6	±	10.7	14-65
1996	69	59	85.5	10	14.5	32.0	±	13.5	15-78
1997	70	63	90.0	7	10.0	30.6	±	13.3	13-79
1998	77	71	92.2	6	7.8	29.5	±	11.0	13-64
1999	53	47	88.7	6	11.3	31.5	±	14.2	12-71
2000	86	73	84.9	13	15.1	32.3	±	14.5	15-84
2001	91	80	87.9	11	12.1	31.5	±	13.7	15-90
2002	93	84	90.3	9	9.7	31.0	±	11.4	9-67
2003	70	55	78.6	15	21.4	33.8	±	15.5	15-84
2004	59	52	88.1	7	11.9	32.1	±	13.9	5-66
Total	722	633	87.7	89	12.3	31.4	±	13.2	5-90

Figure 6.20: Penetrating injury age and sex distribution, SWSAHS hospitals, 1995-2004 (n=722)



The following table presents the mechanism of injury for penetrating injuries, in descending order of frequency. 92.5% of all penetrating injury is the result of interpersonal violence, especially stabbing and gunshot wounds.

Table 6.89: Mechanism of injury for penetrating injury, major data category, Liverpool Hospital, 1995-2004

Mechanism		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Stabbing	n	37	42	49	59	35	61	67	58	50	38	496
	%	68.5	60.9	70.0	76.6%	66.0	70.9	73.6	62.4	71.4	64.4	68.7
Gunshot	n	9	13	9	16	13	23	21	30	14	8	156
	%	16.7	18.8	12.9	20.8%	24.5	26.7	23.1	32.3	20.0	13.6	21.6
Other assault	n	2	7	4	0	1	0	1	1	0	0	16
	%	3.7	10.1	5.7	-	1.9	-	1.1	1.1	-	-	2.2
Industrial	n	3	5	3	1	1	1	0	1	0	6	21
	%	5.6	7.2	4.3	1.3%	1.9	1.2	-	1.1	-	10.2	2.9
Other	n	2	1	1	0	1	1	2	3	2	5	18
	%	3.7	1.4	1.4	-	1.9	1.2	2.2	3.2	2.9	8.5	2.5
Road trauma	n	1	0	3	1	1	0	0	0	2	1	9
	%	1.9	-	4.3	1.3%	1.9	-	-	-	2.9	1.7	1.2
Fall	n	0	1	1	0	1	0	0	0	2	1	6
	%	-	1.4	1.4	-	1.9	-	-	-	2.9	1.7	0.8
Total		54	69	70	77	53	86	91	93	70	59	722

Overall, most injuries are accidental in nature (refer to Chapter 3 and Chapter 4 for further information). However, this is not the case for penetrating trauma, where the most common injury intent is assault (74.7%), followed by self-harm (15.9%) and then accidents (9.4%) .

Table 6.90: Injury intent for penetrating injury, major data category, Liverpool Hospital, 1995-2004

Year	Assault		Self harm		Accident		Total
	n	%	n	%	n	%	
1995	45	83.3	3	5.6	6	11.1	54
1996	51	73.9	11	15.9	7	10.1	69
1997	57	81.4	4	5.7	9	12.9	70
1998	64	83.1	11	14.3	2	2.6	77
1999	43	81.1	6	11.3	4	7.5	53
2000	67	77.9	15	17.4	4	4.7	86
2001	66	72.5	18	19.8	7	7.7	91
2002	65	69.9	20	21.5	8	8.6	93
2003	44	62.9	19	27.1	7	10.0	70
2004	37	62.7	8	13.6	14	23.7	59
Total	539	74.7	115	15.9	68	9.4	722

Table 6.91: Origin of arrival for penetrating injury, major data category, Liverpool Hospital, 1995-2004

Year	Direct - pre-hospital care		Direct - private transport		Transfer from other hospital		Total
	n	%	n	%	n	%	
1995	42	77.8	9	16.7	3	5.6	54
1996	57	82.6	9	13.0	3	4.3	69
1997	58	82.9	8	11.4	4	5.7	70
1998	61	79.2	9	11.7	7	9.1	77
1999	38	71.7	6	11.3	9	17.0	53
2000	71	82.6	7	8.1	8	9.3	86
2001	65	71.4	12	13.2	14	15.4	91
2002	76	81.7	3	3.2	14	15.1	93
2003	56	80.0	9	12.9	5	7.1	70
2004	40	67.8	10	16.9	9	15.3	59
Total	564	78.1	82	11.4	76	10.5	722

Table 6.92: Penetrating injury by ISS, Liverpool Hospital, major data category, 1995-2004

Year	Total	ISS < 16		ISS ≥ 16		Mean		sd	Range
		n	%	n	%				
1995	54	48	88.9	6	11.1	8.1	±	6.9	1-34
1996	69	48	69.6	21	30.4	13.2	±	14.1	1-75
1997	70	48	68.6	22	31.4	13.7	±	11.8	1-75
1998	77	66	85.7	11	14.3	9.5	±	10.3	1-75
1999	53	40	75.5	13	24.5	13.5	±	17.0	1-75
2000	86	66	76.7	20	23.3	11.7	±	12.1	1-75
2001	91	73	80.2	18	19.8	12.8	±	14.9	1-75
2002	93	73	78.5	20	21.5	10.7	±	12.0	1-75
2003	70	56	80.0	14	20.0	9.5	±	11.2	1-75
2004	59	49	83.1	10	16.9	10.2	±	11.1	1-75
Total	722	567	78.5	155	21.5	11.3	±	12.5	1-75

Table 6.93: Predominant body region of injury for penetrating injury, major data category, Liverpool Hospital, 1995-2004

Body region	Patients	%
Abdomen and pelvic contents	226	31.3
Chest	192	26.6
Extremities	147	20.4
Head / neck	82	11.4
Face	24	3.3
External	19	2.6
Chest and abdomen	16	2.2
Abdomen and extremities	6	0.8
Head and chest	3	0.4
Head and extremities	3	0.4
Chest and extremities	2	0.3
Spinal	1	0.1
Head and abdomen	1	0.1
Total	722	100.0

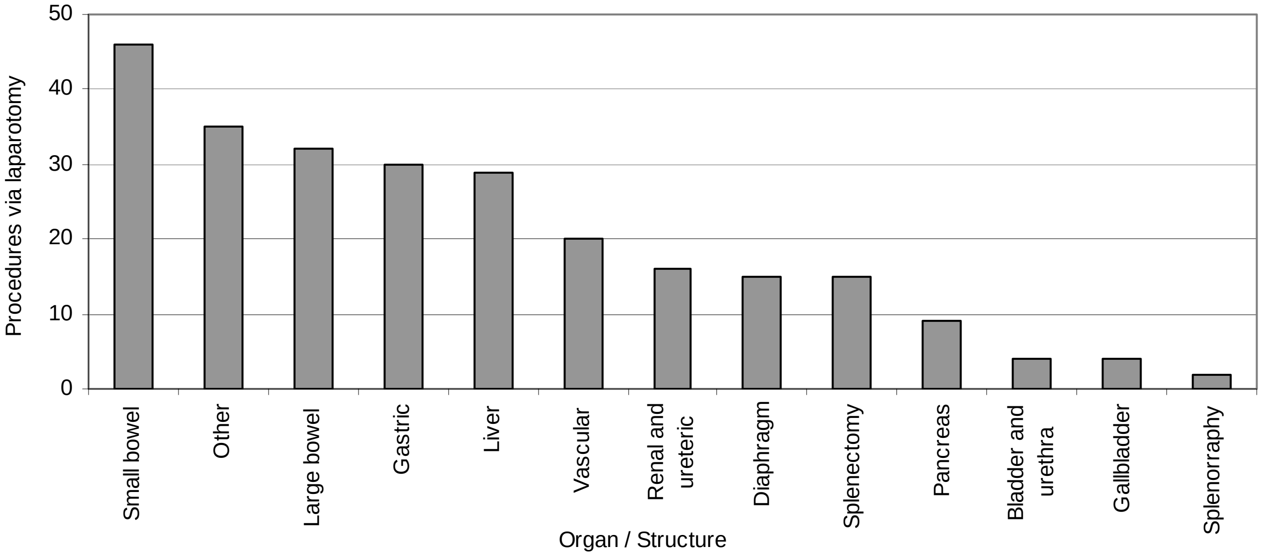
Table 6.94: Penetrating injury survival outcome, major data category, Liverpool Hospital 1995-2004

Year	Survived		Died		Total
	n	%	n	%	
1995	52	96.3	2	3.7	54
1996	62	89.9	7	10.1	69
1997	64	91.4	6	8.6	70
1998	75	97.4	2	2.6	77
1999	49	92.5	4	7.5	53
2000	82	95.3	4	4.7	86
2001	85	93.4	6	6.6	91
2002	86	92.5	7	7.5	93
2003	67	95.7	3	4.3	70
2004	58	98.3	1	1.7	59
Total	680	94.2	42	5.8	722

Penetrating abdominal injury undergoing laparotomy

Of the 722 major data category patients who sustained penetrating injury, 199 (27.6%) underwent therapeutic laparotomy

Figure 6.21: Penetrating injury, organ or structure repaired at laparotomy, Liverpool Hospital, 1995-2004 (patients=199, injuries=1024)



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7 Management and Diagnostic Work-up

Executive comment

The trauma team is an integral part of trauma care. Of the over 21243 admissions to Liverpool Hospital, 6112 were trauma team activations and a further 647 (7.1%) met trauma team activation but were not called. Failure to activate the trauma team despite meeting criteria was more likely in patients who sustained blunt trauma, compared with penetrating trauma. 31% of trauma team activations had an ISS ≥ 16. For patients who failed to have trauma team activation despite meeting criteria, 27% had an ISS ≥ 16. Of note, failure to activate was more likely to occur with elderly patients aged ≥ 65 years.

The resuscitation phase of patient care involves many interventions ranging from intubation through to the administration of blood. Diagnostic interventions were commonly utilised in trauma patients, with 19% of all major data category patients undergoing a head CT during the resuscitative phase of care. The increasing use of FAST has accounted, in part, for the reduction in diagnostic peritoneal lavage and the stabilising of the number of CTs for abdominal evaluation performed. Despite its long tradition and international decrease in use, diagnostic peritoneal lavage remains part of the armamentarium of the evaluation of trauma patients at Liverpool Hospital. The non-therapeutic laparotomy rate fell below 10% in 2000 but in later years rose to 23%, of which 21.4% were blunt trauma and 26.7% penetrating trauma.
Over the time period 130 patients underwent emergency or urgent thoracotomy with a survival rate of 46%.

Recommendations

1. Enhanced triage education for calling trauma team activations needs to be developed, as trauma team response is known to affect survival outcome.

2. Clinical practice guidelines need to be developed for the in hospital management of the trauma patient. This will ensure minimal standards of care are maintained, regardless of the hospital level and location of the treating hospital

3. Monitoring and reporting of non-therapeutic laparotomies should be implemented across the trauma services. The non-therapeutic laparotomy rate should be a key performance indicator for trauma services at local level and should be reported in the first instance at state level, with a view to national monitoring as the system matures.

4. Advances in radiology and information technologies must be readily incorporated into the initial assessment and management of the injured patient for the advancement of trauma care within Australia.

7.1 Activation of trauma team response at Liverpool Hospital

The trauma team consists of key members of medical, nursing and paramedical personnel who are summoned to the emergency resuscitation room to receive, assess and provide early resuscitative treatment for patients with serious injuries. The criteria for trauma team activation (TTA) may be based on history, vital signs or injuries, and is presented in the table below. [1,2,3]

Table 7.1: Liverpool Hospital Trauma Team Activation (TTA) criteria

Mechanism	• Motor vehicle crash with ejection • Pedal cyclist, motorcyclist or pedestrian hit by vehicle > 30 km/h • Fall > 5 metres • Fatality in same vehicle • Inter-hospital trauma transfer meeting activation criteria
Anatomical	• Injury to two or more body regions • Injury to two or more long bones • Spinal cord injury • Amputation of a limb • Penetrating injury to head, neck, torso, or proximal limb • Burns BSA > 15% in adults, BSA > 10% in children, or airway burns • Airway obstruction
Physiological	• Systolic blood pressure < 90mmHg or pulse > 130 bpm • Respiratory rate < 10 or > 30 breaths per minute • Depressed level of consciousness or fitting • Deterioration in the Emergency Department • Age > 70 years with chest injury • Pregnancy > 24 weeks with torso injury
NOTIFY CONSULTANT SURGEON IF SYSTOLIC BP < 90mmHg	

The registry has three possible values for TTA:

1. Trauma team attended	The patient met TTA criteria, and a TTA was called
2. Trauma team not called	The patient failed to have a TTA, despite meeting criteria
3. Not applicable	The patient did not meet TTA criteria (for patients who meet registry criteria but not TTA criteria)

Table 7.2: TTA response, Liverpool Hospital, major data category, 1995-2004

Year	Trauma team attended		Trauma team not called		Not applicable		Total	
	n	%	n	%	n	%	n	%
1995	456	68.8	52	7.8	155	23.4	663	100.0
1996	500	67.7	56	7.6	183	24.8	739	100.0
1997	509	69.2	52	7.1	175	23.8	736	100.0
1998	576	70.5	65	8.0	176	21.5	817	100.0
1999	555	66.6	75	9.0	203	24.4	833	100.0
2000	704	70.3	79	7.9	219	21.9	1002	100.0
2001	767	66.5	80	6.9	306	26.5	1153	100.0
2002	742	64.7	87	7.6	317	27.7	1146	100.0
2003	652	64.4	61	6.0	300	29.6	1013	100.0
2004	651	63.8	40	3.9	330	32.3	1021	100.0
Total	6112	67.0	647	7.1	2364	25.9	9123	100.0

Table 7.3: TTA response for blunt trauma, Liverpool Hospital, major data category, 1995-2004

Year	Trauma team attended		Trauma team not called		Not applicable		Total	
	n	%	n	%	n	%	n	%
1995	406	66.7	50	8.2	153	25.1	609	100.0
1996	436	65.1	53	7.9	181	27.0	670	100.0
1997	443	66.5	48	7.2	175	26.3	666	100.0
1998	501	67.7	64	8.6	175	23.6	740	100.0
1999	504	64.6	74	9.5	202	25.9	780	100.0
2000	620	67.7	78	8.5	218	23.8	916	100.0
2001	680	64.0	80	7.5	302	28.4	1062	100.0
2002	656	62.3	84	8.0	313	29.7	1053	100.0
2003	585	62.0	61	6.5	297	31.5	943	100.0
2004	598	62.2	40	4.2	324	33.7	962	100.0
Total	5429	64.6	632	7.5	2340	27.9	8401	100.0

Table 7.4: TTA response for penetrating trauma, Liverpool Hospital, major data category, 1995-2004

Year	Trauma team attended		Trauma team not called		Not applicable		Total	
	n	%	n	%	n	%	n	%
1995	50	92.6	2	3.7	2	3.7	54	100.0
1996	64	92.8	3	4.3	2	2.9	69	100.0
1997	66	94.3	4	5.7	0	-	70	100.0
1998	75	97.4	1	1.3	1	1.3	77	100.0
1999	51	96.2	1	1.9	1	1.9	53	100.0
2000	84	97.7	1	1.2	1	1.2	86	100.0
2001	87	95.6	0	-	4	4.4	91	100.0
2002	86	92.5	3	3.2	4	4.3	93	100.0
2003	67	95.7	0	-	3	4.3	70	100.0
2004	53	89.8	0	-	6	10.2	59	100.0
Total	683	94.6	15	2.1	24	3.3	722	100.0

Table 7.5: TTA response for serious injury (ISS ≥ 16), Liverpool Hospital, major data category, 1995-2004

Year	Trauma team attended		Trauma team not called		Not applicable		Total	
	n	%	n	%	n	%	n	%
1995	127	84.1	13	8.6	11	7.3	151	100.0
1996	169	86.2	12	6.1	15	7.7	196	100.0
1997	175	85.0	12	5.8	19	9.2	206	100.0
1998	165	81.3	23	11.3	15	7.4	203	100.0
1999	186	84.2	18	8.1	17	7.7	221	100.0
2000	233	82.9	24	8.5	24	8.5	281	100.0
2001	196	79.7	16	6.5	34	13.8	246	100.0
2002	208	81.3	23	9.0	25	9.8	256	100.0
2003	215	76.5	22	7.8	44	15.7	281	100.0
2004	208	77.6	12	4.5	48	17.9	268	100.0
Total	1882	81.5	175	7.6	252	10.9	2309	100.0

Table 7.6: TTA response for less serious injury (ISS < 16), Liverpool Hospital, major data category, 1995-2004

Year	Trauma team attended		Trauma team not called		Not applicable		Total	
	n	%	n	%	n	%	n	%
1995	329	64.3	39	7.6	144	28.1	512	100.0
1996	331	61.0	44	8.1	168	30.9	543	100.0
1997	334	63.0	40	7.5	156	29.4	530	100.0
1998	411	66.9	42	6.8	161	26.2	614	100.0
1999	369	60.3	57	9.3	186	30.4	612	100.0
2000	471	65.3	55	7.6	195	27.0	721	100.0
2001	571	63.0	64	7.1	272	30.0	907	100.0
2002	534	60.0	64	7.2	292	32.8	890	100.0
2003	437	59.7	39	5.3	256	35.0	732	100.0
2004	443	58.8	28	3.7	282	37.5	753	100.0
Total	4230	62.1	472	6.9	2112	31.0	6814	100.0

Table 7.7: TTA by age (< 65 years or ≥ 65 years), Liverpool Hospital, major data category, 1995-2004.

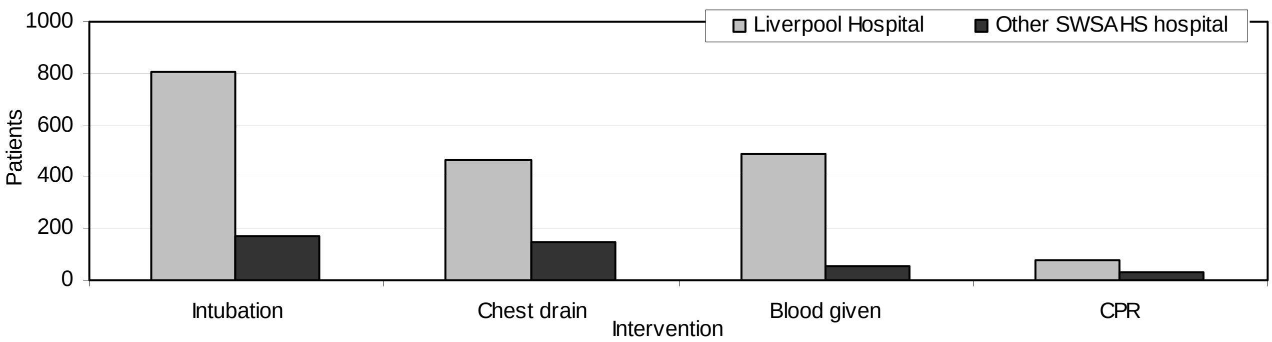
Trauma team activation	Age < 65 years		Age ≥ 65 years		Total patients
	n	%	n	%	
Trauma team attended	5576	71.4	536	40.8	6112
Trauma team not called	503	6.4	144	11.0	647
Not applicable	1729	22.1	635	48.3	2364
Total	7808	100.0	1315	100.0	9123

7.2 Interventions during resuscitative phase

Table 7.8: Number of resuscitative interventions (intubation, chest drain, blood given, CPR) in the ED, SWSAHS hospitals, 1995-2004

Hospital	Intubation	Chest drain	Blood given	CPR
Liverpool	809	466	490	79
Bankstown	49	47	17	10
Campbelltown	68	44	20	11
Fairfield	11	19	4	3
Bowral	37	29	8	5
Camden	6	5	3	4
Total	980	610	542	112

Figure 7.1: Number of resuscitative interventions in the ED, SWSAHS hospitals, 1995-2004



7.3 Cardiopulmonary resuscitation

The table below summarises data for the 112 patients who received CPR in the ED of SWSAHS hospitals between 1995-2004. Also shown is whether the trauma was blunt or penetrating. Of the 112 patients, 79 (70.5%) were admitted to Liverpool Hospital. 101 (90.2%) of patients who received CPR in the ED died. Many were undergoing pre-hospital CPR as they were wheeled into the ED.

Many trauma registries exclude patients who receive pre-hospital and ED CPR and subsequently die in the ED. However, these patients are included in the SWSAHS registry, based on the fact that the patient had a trauma team activation and active intervention in the ED. This is important to note if the data is to be used for benchmarking, as their inclusion in outcome analysis may potentially result in a higher mortality rate when compared to registries that do not include this group of patients.

Table 7.9: CPR in the ED and survival outcome, for blunt and penetrating trauma, SWSAHS hospitals, 1995-2004

Hospital	Total patients			Blunt trauma			Penetrating trauma		
	Survived	Died	Total	Survived	Died	Total	Survived	Died	Total
Liverpool	5	74	79	4	51	55	1	23	24
Bankstown	3	7	10	3	3	6	0	4	4
Campbelltown	2	9	11	2	7	9	0	2	2
Fairfield	0	5	5	0	3	3	0	2	2
Bowral	1	2	3	1	2	3	0	0	0
Camden	0	4	4	0	4	4	0	0	0
Total	11	101	112	10	70	80	1	31	32

7.4 Airway intervention

Table 7.10: Patients receiving airway intervention in the ED, for blunt and penetrating trauma, SWSAHS hospitals, 1995-2004

Hospital	Oxygen	Guedel; Bag / mask	ETT	Surgical airway	No airway intervention	Not recorded	Prior intubation	Total
Liverpool	4823	16	809	7	2544	409	270	8878
Bankstown	492	1	49	1	1025	191	9	1768
Campbelltown	429	1	68	1	740	599	9	1847
Fairfield	273	4	11	0	429	256	3	976
Bowral	334	1	37	0	211	298	1	882
Camden	55	3	6	0	81	155	2	302
Total	6406	26	980	9	5030	1908	294	14653

7.5 Diagnostic interventions during resuscitative phase

Head CT

2819 (19.2%) of SWSAHS major data category patients had a head CT during the resuscitative phase (for inter-hospital trauma transfers, the figures are calculated based on the first SWSAHS hospital that the patient is treated at). 2444 (86.7%) of these head CTs were performed at Liverpool Hospital. Over the reporting period, not all of the urban and rural trauma services in the Area had CT scanning available 24 hours a day.

Figure 7.2: Head CT performed during resuscitative phase, major data category, SWSAHS hospitals, 1995-2004 (n=2819)

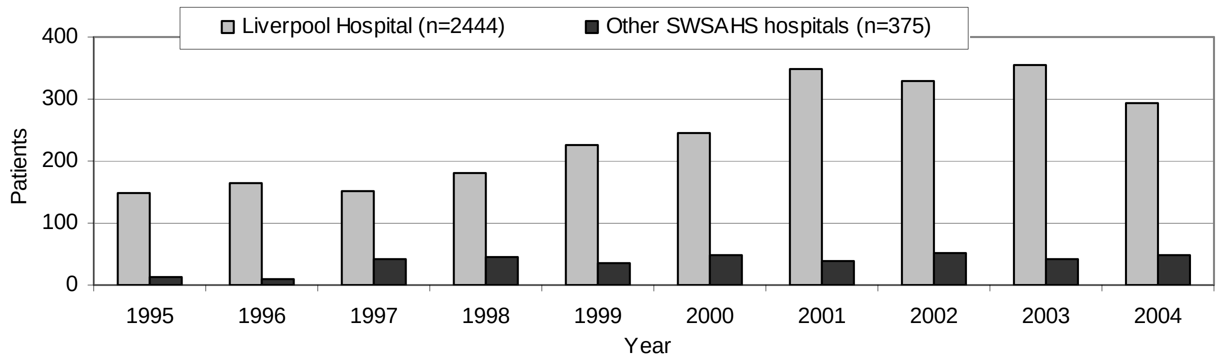


Figure 7.3: Results for head CT during resuscitative phase, major data category, SWSAHS hospitals, 1995-2004 (n=2819)

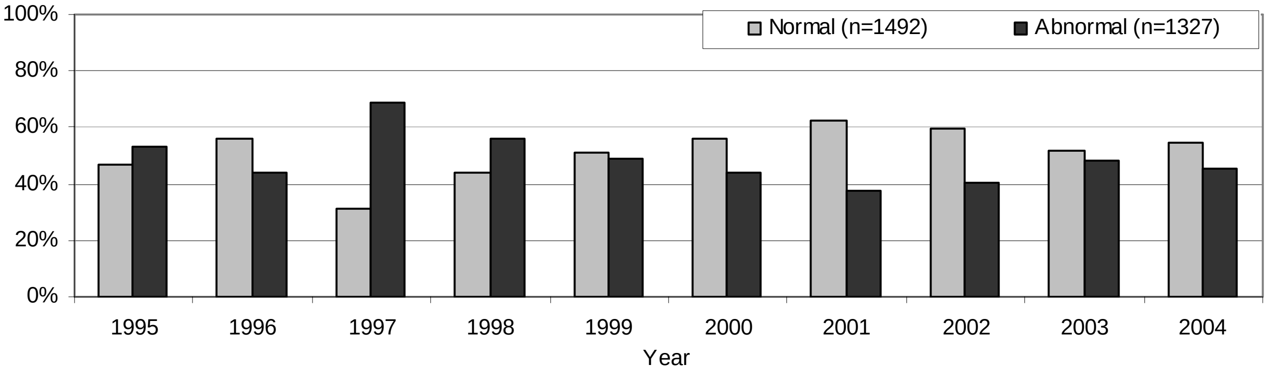
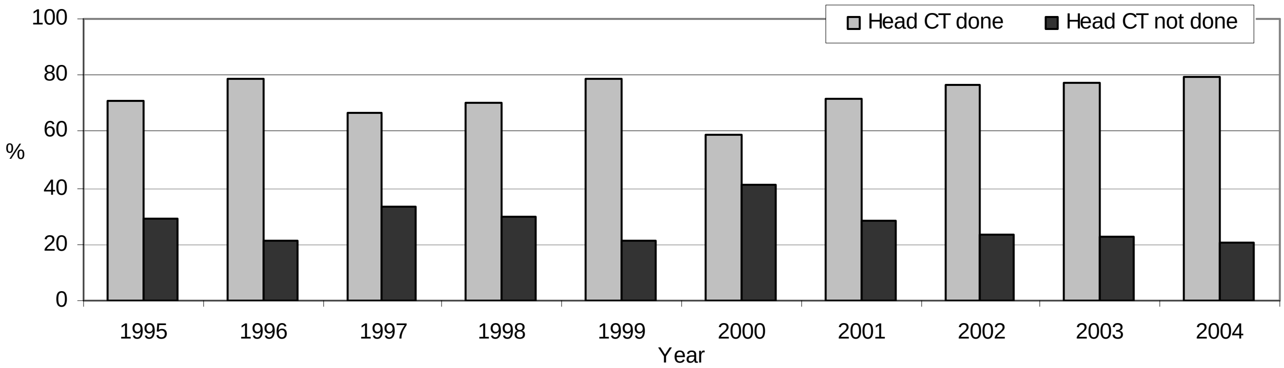


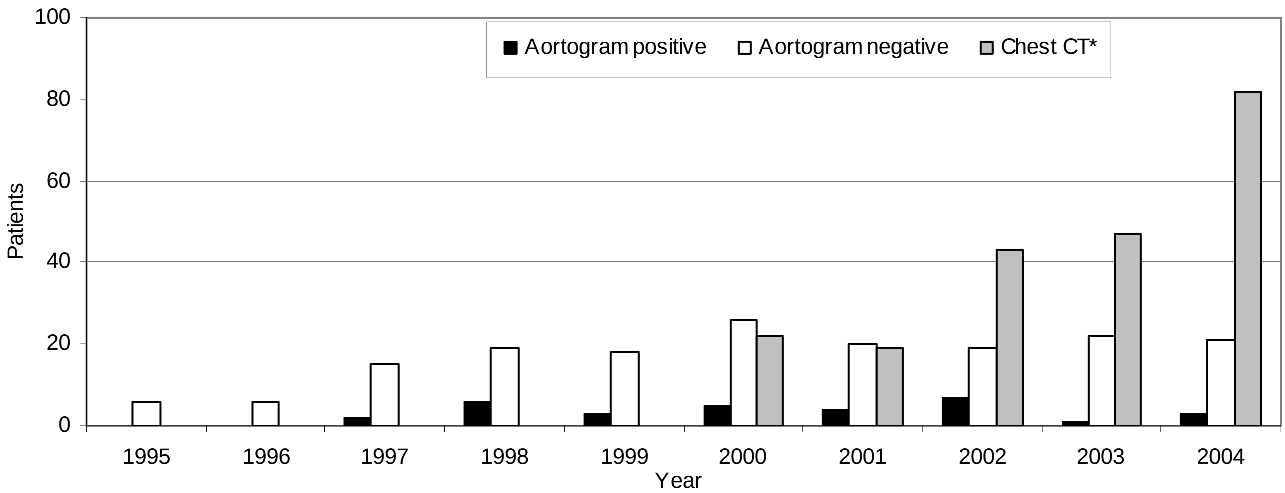
Figure 7.4: Percentage of GCS ≤8 patients who had a head CT in the resuscitative phase of care, Liverpool Hospital, 1995-2004 (n=525)



Arch aortogram and chest CT

A total of 203 trauma patients admitted to Liverpool Hospital underwent arch aortogram during the resuscitative phase of care.
Data collection for chest CT commenced in the year 2000. Between 2000-2004, 213 patients underwent chest CT.

Figure 7.5: Number of trauma patients undergoing arch aortogram or chest CT, Liverpool Hospital, 1995-2004 (n=416)



*Chest CT data collection commenced in 2000

7.6 Diagnostic tests for abdominal trauma, Liverpool Hospital

Abdominal CT, diagnostic peritoneal lavage (DPL) and focussed assessment with sonography in trauma (FAST) may be used individually or in combination to diagnose abdominal trauma. 2309 patients admitted to Liverpool Hospital between 1995 and 2004 underwent either abdominal CT or DPL.

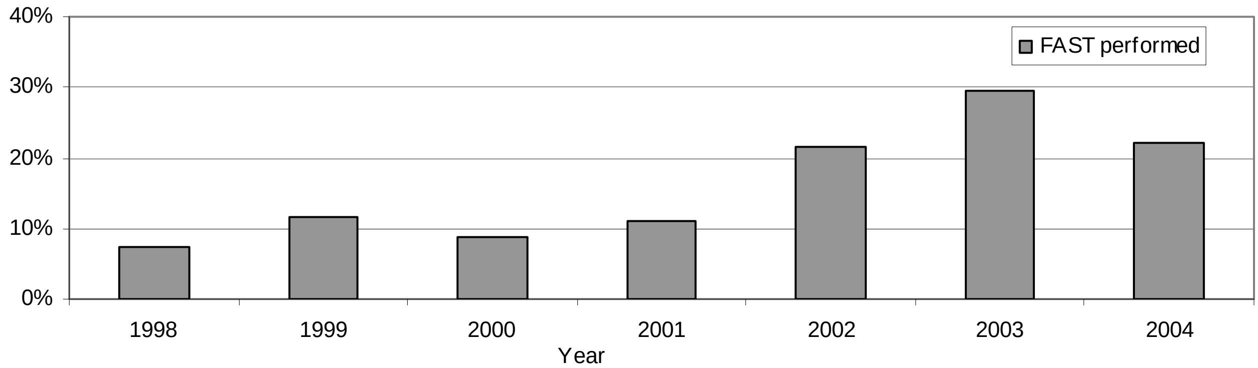
Focussed assessment with sonography in trauma

A total of 1144 patients underwent FAST. FAST has been increasingly used as a diagnostic tool since 1998. Since the introduction of FAST, the use of DPL has decreased, whilst the use of FAST in suspected abdominal trauma continues to increase. [4,5]
The registry captures the total number of patients undergoing FAST (the actual result is not captured).
From 2002, over 20% of major data category patients had a FAST performed in the ED during the resuscitative phase of care. Smith et al. compared abdominal trauma at Liverpool Hospital for two periods: 1996-1999 and 2000-2003, and found a 46% decrease in the use of DPL, with a 40% increase in computed tomography and a 325% increase in FAST in the 2000-2003 group. [6]

Table 7.11: Trauma patients undergoing FAST in the ED, major data category, Liverpool Hospital, 1995-2004

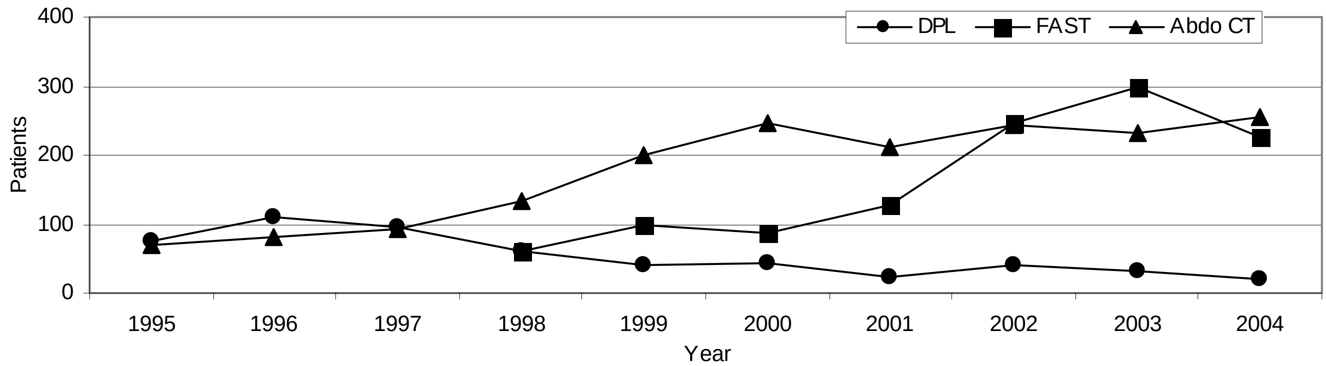
Year	Patients admitted	FAST performed	% patients had FAST
1998	817	60	7.3
1999	833	98	11.8
2000	1002	87	8.7
2001	1153	127	11.0
2002	1146	246	21.5
2003	1013	299	29.5
2004	1021	227	22.2
Total	6985	1144	16.4

Figure 7.6: Trauma patients who underwent FAST in the ED, major data category, Liverpool Hospital, 1998-2004 (n=6985, FAST=1144)



The following figure presents relative usage of DPL, FAST and abdominal CT during 1995-2004. The use of abdominal CT is steadily increasing, whilst the use of FAST and DPL are inversely proportional. The graph includes patients who had one or more of DPL, FAST and abdominal CT.

Figure 7.7: DPL, FAST and abdominal CT during resuscitative phase, major data category, Liverpool Hospital, 1995-2004



Recent data presented at the 2006 Western Trauma Association (WTA) meeting from Toschlog, Goettler and Bard et al [7] shows that the reliance on CT alone without using DPL may result in a 50% non-therapeutic laparotomy rate. Whilst DPL is less indicated than previously, its use should not be discarded.

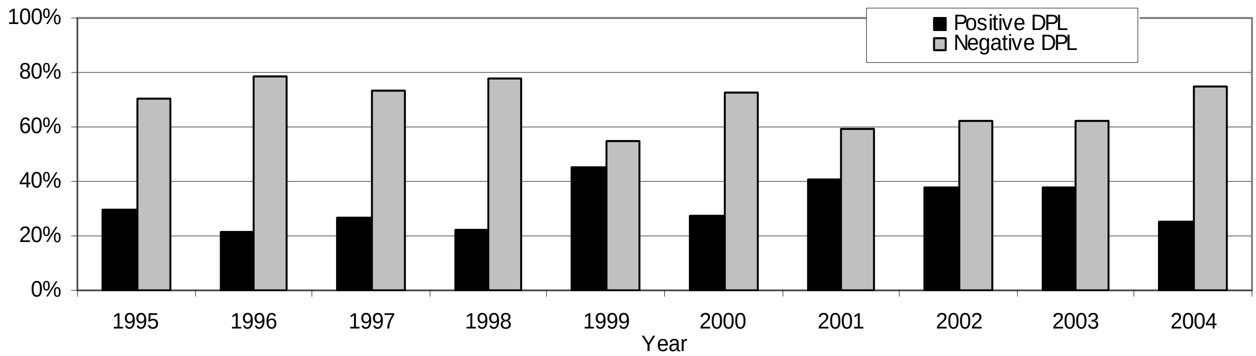
Diagnostic peritoneal lavage

The following data presents the total number of patients undergoing DPL in the ED, and the DPL result for these patients.

Table 7.12: DPL in ED, major data category, Liverpool Hospital, 1995-2004

Year	DPL performed		Positive DPL		Total patients
	n	%	n	%	
1995	75	11.3	22	29.3	663
1996	110	14.9	24	21.8	739
1997	95	12.9	25	26.3	736
1998	62	7.6	14	22.6	817
1999	40	4.8	18	45.0	833
2000	44	4.4	12	27.3	1002
2001	22	1.9	9	40.9	1153
2002	42	3.7	16	38.1	1146
2003	32	3.2	12	37.5	1013
2004	20	2.0	5	25.0	1021
Total	542	5.9	157	29.0	9123

Figure 7.8: DPL in the ED, major data category, Liverpool Hospital, 1995-2004



Diagnostic peritoneal aspiration

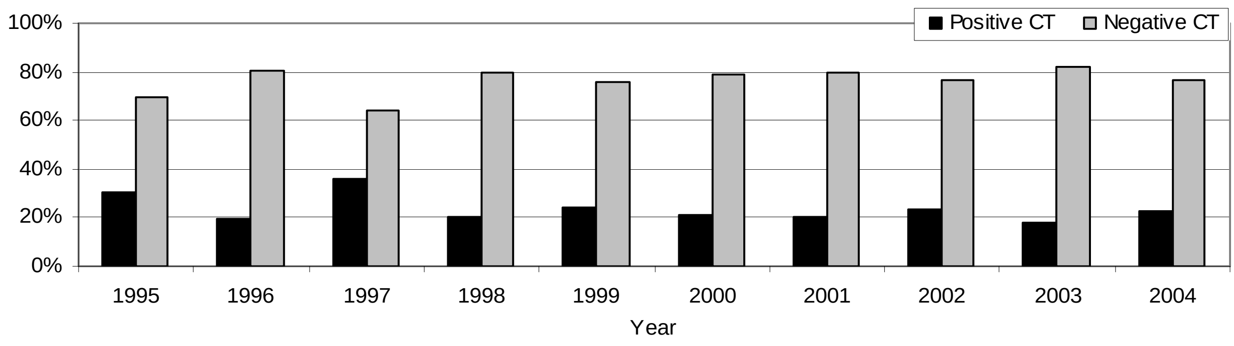
Increasingly we use diagnostic peritoneal aspiration (DPA) as a rapid means of assessing the presence or absence of free blood, when access to FAST is not available, or where FAST is not reliable, such as in surgical emphysema.

Abdominal CT

Table 7.13: Patients undergoing early abdominal CT, major data category, Liverpool Hospital, 1995-2004

Year	Patients admitted	Abdominal CT performed		Positive abdominal CT	
		n	%	n	%
1995	663	69	10.4	21	30.4
1996	739	82	11.1	16	19.5
1997	736	94	12.8	34	36.2
1998	817	134	16.4	27	20.1
1999	833	200	24.0	49	24.5
2000	1002	245	24.5	51	20.8
2001	1153	211	18.3	43	20.4
2002	1146	244	21.3	58	23.8
2003	1013	232	22.9	42	18.1
2004	1021	256	25.1	59	23.0
Total	9123	1767	19.4	400	22.6

Figure 7.9: Result for patients undergoing early abdominal CT, major data category, Liverpool Hospital, 1995-2004



Diagnostic peritoneal lavage and abdominal CT

Table 7.14: Patients undergoing both DPL in the ED and early abdominal CT, major data category, Liverpool Hospital, 1995-2004

Year	DPL in ED and early abdominal CT	
	Patients	% total patients
1995	8	1.2
1996	23	3.1
1997	24	3.3
1998	18	2.2
1999	15	1.8
2000	24	2.4
2001	11	1.0
2002	26	2.3
2003	16	1.6
2004	11	1.1
Total	176	1.9

7.7 Investigations performed prior to laparotomy

A total of 605 trauma laparotomies were carried out at Liverpool Hospital between 1995-2004. Of these, there were 508 (84.0%) therapeutic laparotomies and 97 (16.0%) non-therapeutic laparotomies. The laparotomy was considered to be therapeutic if surgical intervention was required to treat an acute injury. Chapter 8 (Performance Indicators) contains further information on therapeutic versus non-therapeutic laparotomy. Chapter 6 (Types of Injury) contains further information on abdominal injuries and the organs involved at laparotomy. The tables below present the investigations performed prior to therapeutic and non-therapeutic laparotomy.

Table 7.15: Investigations performed prior to therapeutic laparotomy, Liverpool Hospital, 1995-2004 (n=508)

Abdominal CT result		DPL result				
		DPL positive	DPL negative	No DPL	Total therapeutic laparotomy patients	%
CT positive		16	4	124	144	28.3
CT negative		11	1	17	29	5.7
No CT		101	15	219	335	65.9
Total	n	128	20	360	508	100.0
	%	25.2	3.9	70.9	100.0	

Table 7.16: Investigations performed prior to non-therapeutic laparotomy, Liverpool Hospital, 1995-2004 (n=97)

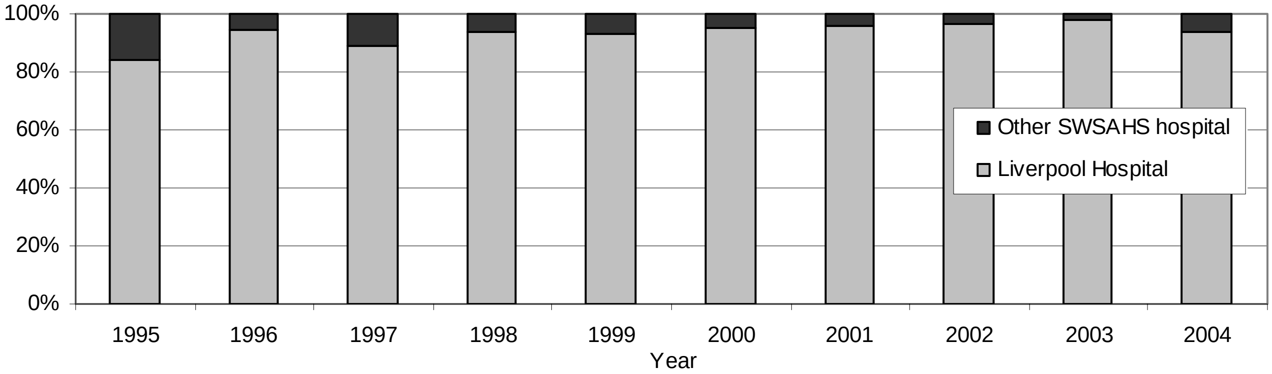
Abdominal CT result		DPL result				
		DPL positive	DPL negative	No DPL	Total non-therapeutic laparotomy patients	%
CT positive		2	1	10	13	13.4
CT negative		3	2	6	11	11.3
No CT		8	5	60	73	75.3
Total	n	13	8	76	97	100.0
	%	13.4	8.2	78.4	100.0	

7.8 Operations

Laparotomy

Of the 649 trauma laparotomies carried out in SWSAHS hospitals between 1995 and 2004, 605 (93.2%) were performed at Liverpool Hospital and 44 (6.8%) were performed at other SWSAHS hospitals. Further data regarding non-therapeutic and therapeutic laparotomies at Liverpool Hospital are available in Chapter 8 (Performance Indicators).

Figure 7.10: Trauma laparotomies, Liverpool versus other SWSAHS hospitals, 1995-2004 (n=649)



Thoracotomy

In SWSAHS hospitals between 1995-2004, 130 patients underwent urgent thoracotomy following trauma. Of these patients, 60 (46.2%) had sustained blunt trauma, and 70 (52.8%) had sustained penetrating trauma. 128 (98.5%) of the thoracotomies were undertaken at Liverpool Hospital. The remaining two thoracotomies (1.5%) were undertaken at Campbelltown and Bankstown Hospitals on patients with penetrating trauma. 77 (59.2%) of the patients who underwent urgent thoracotomy survived, and the survival rate was higher for penetrating trauma compared to blunt trauma.

Figure 7.11: Urgent thoracotomy by type of injury (blunt or penetrating), SWSAHS hospitals, 1995-2004

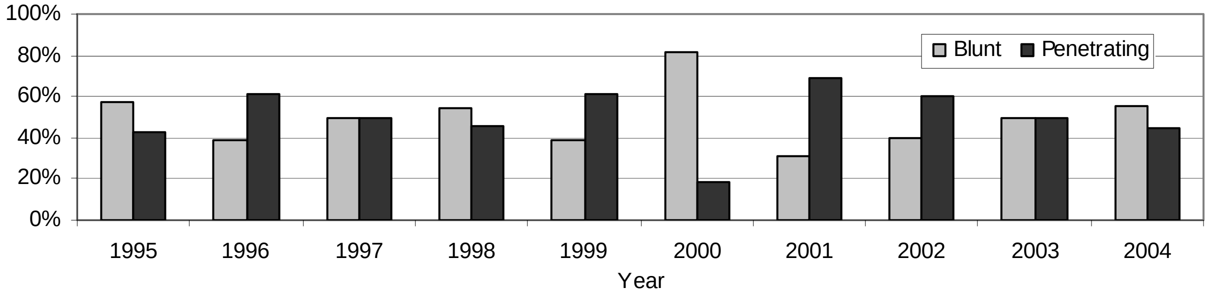
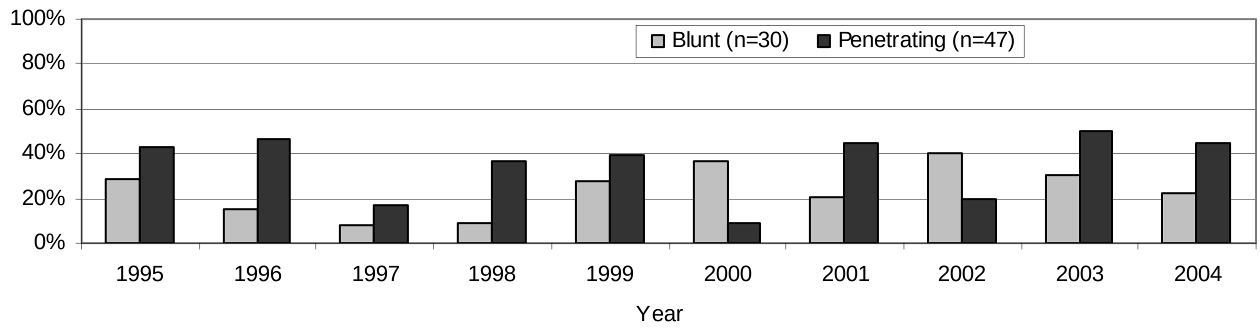


Figure 7.12: Urgent thoracotomy patients who survived, by type of trauma (blunt versus penetrating), SWSAHS hospitals, 1995-2004 (n=77)



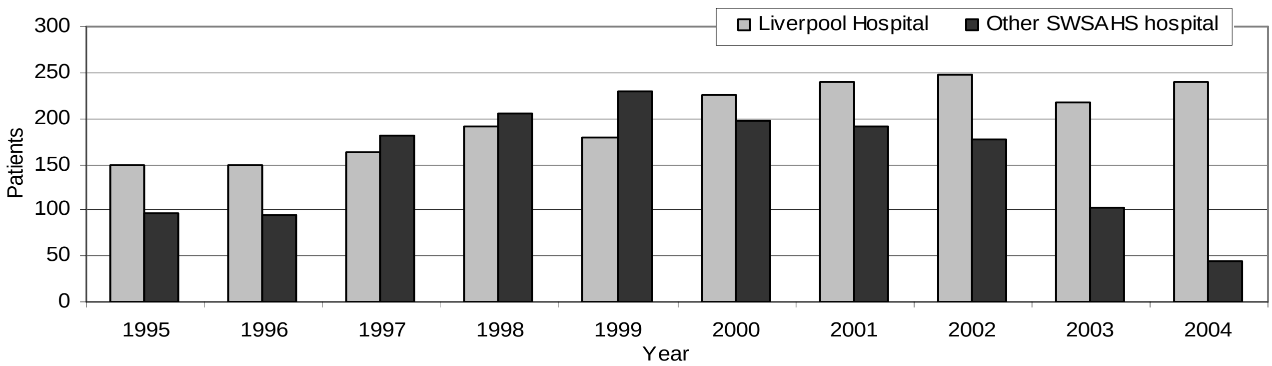
Craniotomy for acute extradural or subdural haemorrhage

At Liverpool Hospital between 1995-2004, 229 craniotomies were performed for acute traumatic extradural or subdural haemorrhage. Further data regarding this is available in Chapter 8 (Performance Indicators).

Long bone fixation

A total of 3522 major data category patients underwent reduction / fixation of long bone fractures. 1519 (56.9%) of these were performed at Liverpool Hospital. Long bone fixation data is not captured for minor data category patients.

Figure 7.13: Long bone fracture fixation procedures, major data category, SWSAHS hospitals, 1995-2004



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8 Performance Indicators

Executive comment

- Performance monitoring throughout delivery of care is crucial to optimal outcomes.
- Performance indicators themselves are conceptually attractive but do have limitations.

During the period of this registry report we aimed to keep the performance indicators consistent recognising, as far back as the late 90's, that some were not ideal reflections of the quality of care provided. Indicators provide three key areas of interest in this report:

1. An evaluation of the process of delivery of care
2. The potential to monitor outcome
3. Provide benchmarks for standards of care

Reporting on the validity of performance indicators, in relation to outcome, would be preferable; however this is beyond the scope of this report.

In examining the three key areas of acute trauma management: pre-hospital, resuscitation and definitive care, this chapter provides an insight into the status of the delivery of care in a trauma system and a major trauma service. This is a measure of the effectiveness of the system and the hospital trauma service. Rehabilitation, injury morbidity outcomes and return to the community were not assessed.

Pre-hospital care phase

The rigorous application of the trauma triage tool (Protocol 4) by the Ambulance Service of New South Wales is reflected by the correct bypass decision being made in 95.1% of trauma patients over the reporting period. The number of patients incorrectly triaged is very small; the implications for these incorrectly triaged patients, however, is significant and secondary transfer is then required.

Pre-hospital intubation in patients with a GCS < 9 has become an extremely controversial area and is subject to several current prospective randomised controlled trials to determine efficacy. The results of these research projects will help determine the appropriateness of this indicator.

Scene time has not decreased during the period of study, given that one of the hallmarks in trauma management is time to definitive care, especially in patients who are bleeding; this needs to be prospectively evaluated.

One of the most fascinating alterations in care is that of pre-hospital intravenous fluid replacement. There has been a striking reduction in pre-hospital fluid administration, as advocated in the landmark studies from the Houston group, in the late 1990's, who identified the presence of adverse outcomes in patients receiving large volumes of pre-hospital fluid.

Resuscitative management phase

In the resuscitative phase the medical retrieval turn around time remains above 30 minutes in 60% of retrieval transfers. This is unacceptably high and needs to be evaluated. A turn-around time of greater than 30 minutes reflects many aspects of care and may be due to the effects of local organisation, the transfer communication process between the trauma centres and retrieval teams or the interaction between the retrieval team and the transferring clinicians.

The total time at the referring hospitals, for seriously injured patients, remains too long. Only 41% of patients spend less than 3 hours at an urban hospital prior to transfer. The implementation of the inter-hospital trauma transfer guidelines must be prioritised in an effort to improve this aspect of the trauma system.

The number of patients who have their penetrating trauma explored within 1 hour of arrival has shown a gradual improvement over the last few years of the reporting period. It is extremely important that this momentum is maintained. While penetrating trauma is infrequent compared to blunt trauma these are the occasions where senior experienced clinicians must be readily available and the resources for emergent operative management accessible.

Definitive care phase

The number of patients re-presenting to the hospital after discharge is extremely low; this is a reflection of an excellent discharge planning process. The introduction of the trauma case manager, subsequent staff education and the improved use of clinical pathways, has contributed to the more efficient use of thromboembolic prophylaxis.

Missed fractures are an interesting concept and in reality reflect delayed diagnosis. The fact that the number decreased by 5.5.% in 2004 may reflect a more thorough evaluation of patients through the use of the tertiary survey and in house follow-up. However it may also indicate the need for improvements in clinical examinations throughout the initial assessment and management phase coupled with improvements radiological technology.

Non-therapeutic laparotomy in blunt and penetrating trauma is 0% and 16.3% respectively for trauma surgeons and 13.6 and 27.4% for general surgeons.

For urgent laparotomy, which occurs within 45 minutes of arrival in the hospital, in patients with intra-abdominal bleeding, the number of patients not meeting this criteria approaches 35%. In an ideal trauma service this figure is 0%. While the numbers are small these are the patients who need to system to be at its most effective as these patients are the ones most likely to die as a result of uncontrolled haemorrhage.

Notably the time to re-vascularisation of the ischaemic limb has improved slightly over the reporting period.

Recommendations:

1. A national quality care index in trauma should be developed using the more robust performance indicators. This would allow identification of specific areas in need of improvement.

2. There should be mandatory reporting of such quality data with independent assessment through a transparent trauma verification / accreditation process run by the learned colleges and health departments

Concept of performance indicators

As trauma systems have evolved and improved, with a demonstrable reduction in preventable death rate, the focus of quality improvement programs has shifted towards monitoring of complications and the efficiency of care through trauma audits, trauma filters and performance indicator analysis.
We undertook the development and analysis of performance indicators to allow our process of trauma care and outcomes to be evaluated. We wanted to identify the functionality of our evolving trauma system using performance indicators in three key phases of hospital care.

We initially developed trauma performance indicators in April 1994 based on concepts of optimal care at the time, utilising a selection of clinical indicators from The Australian Council on HealthCare Standards (ACHS) and American College of Surgeons. We have modified our performance indicators twice since then using our current ones since September 1994. A number of additions were made after the National Performance Indicator Forum in July 1995, held at Liverpool Hospital, Sydney.

The indicators chosen were felt, at the outset, to be a valid group reflecting important processes and outcome in each key area of trauma care. It has become apparent that not all indicators we chose were useful. For example ‘IV cannula < 500ml’, which recorded when an intravenous cannula had been inserted by ambulance personal and categorised the quantity of fluid administered pre-hospital. It did not take into account other variables such as the administration of analgesia or drugs, distance from the hospital or the circulatory status of the patient.

The indicators are not in this audit filters per se, but certainly can identify subgroups of patients that may be at risk for subsequent adverse process of care or outcomes. Due to resource limitations, it is only possible to collect performance indicator data on patients in the major data category of the regional trauma registry.

8.1 List of performance indicators

Table 8.1: Performance indicator summary, major data category, Liverpool Hospital, 1995-2004

Pre-hospital care phase	Applies	Indicator met		Indicator not met	
		n	%	n	%
Correct decision to bypass nearer urban hospital	2601	2474	95.1	127	4.9
GCS < 9 intubated pre-hospital	507	150	29.6	357	70.4
Ambulance officer scene time ≤ 20 minutes	6648	4126	62.1	2522	37.9
IV cannula inserted and volume administered	3468	Refer to detailed results			
Resuscitative management phase	Applies	Indicator met		Indicator not met	
		n	%	n	%
MRT turn-around at referring hospital ≤ 30 minutes	145	57	39.3	88	60.7
Time at referring SWSAHS hospital ≤ 3 hours	1276	531	41.6	745	58.4
Blood products administered promptly when > 2L resuscitation fluids required	805	487	60.5	318	39.5
Explore penetrating trauma ≤ 1 hour of arrival in ED	480	277	57.7	203	42.3
Patient in CT for ≤ 1 hour	3316	3045	91.8	271	8.2
Head CT for patients with GCS < 13	872	817	93.7	55	6.3
GCS < 9 intubated ≤ 10 minutes in ED	469	407	86.8	62	13.2
Definitive care phase	Applies	Indicator met		Indicator not met	
		n	%	n	%
Re-present within 72 hours of discharge	9113	178	2.0	8935	98.0
Thrombo-embolic prophylaxis instituted appropriately	5595	4715	84.3	880	15.7
Clinical pathway commenced	945	723	76.5	222	23.5
Missed fractures	6256	207	3.3	6049	96.7
Hypothermia	8981	816	9.1	8165	90.9
Long bone fracture fixed or reduced ≤ 24 hours of arrival	1993	1519	76.2	474	23.8
Open long bone fracture fixed ≤ 6 hours of injury	511	319	62.4	192	37.6
Non-therapeutic laparotomy	605	97	16.1	508	83.9
Craniotomy < 1 hour of arrival for acute extradural or subdural haemorrhage	229	57	24.9	172	75.1
Craniotomy ≤ 4 hours of injury for acute extradural or subdural haemorrhage	225	113	50.2	112	49.8
Patient transferred out to another major trauma service	9104	438	4.8	8666	95.2
Dislocated joint reduced ≤ 1 hour of arrival in ED	226	122	54.0	104	46.0
Urgent laparotomy in ≤ 45 minutes to arrest haemorrhage in an unstable patient	138	90	65.2	48	34.8
Ischaemic limb re-vascularised ≤ 4 hours of injury	84	66	78.6	18	21.4
Unplanned return to operating theatre	3891	143	3.7	3748	96.3
Unplanned admission to ICU	1850	150	8.1	1700	91.9
Patient temperature in OT documented in the medical record	3346	997	29.8	2349	70.2
Haemoglobin > 85mg / dL at all times	7888	7267	92.1	621	7.9
All injuries diagnosed	8292	7914	95.4	378	4.6

8.2 Pre-hospital phase

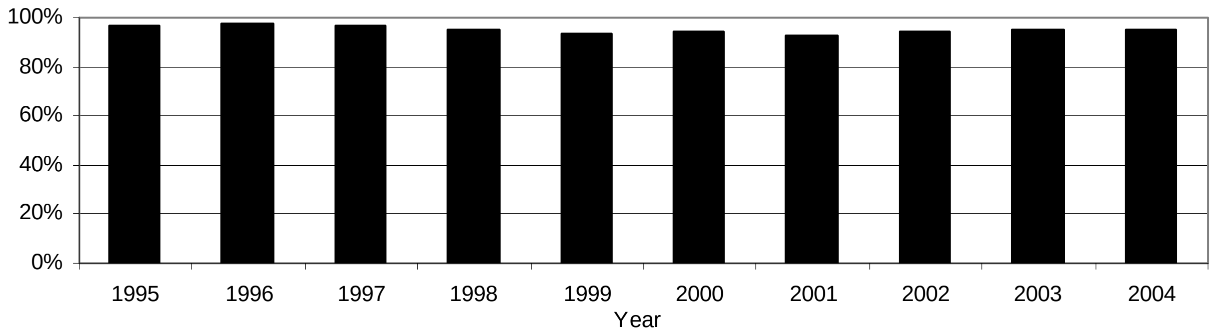
Correct decision to bypass nearer urban hospital

This indicator monitors whether patients were delivered to the appropriate trauma service according to the Ambulance Service of NSW Protocol 4 (see Chapter 5 and Appendix 1). It applies to all patients who meet Protocol 4 bypass criteria. The indicator does not apply if Liverpool Hospital is the closest hospital, or the place of injury is unknown.

Table 8.2: Correct decision to bypass nearer urban hospital, major data category, Liverpool Hospital, 1995-2004 (n=2601)

Year	Applies	Correct bypass		Fail to bypass	
		n	%	n	%
1995	202	196	97.0	6	3.0
1996	194	190	97.9	4	2.1
1997	219	212	96.8	7	3.2
1998	247	235	95.1	12	4.9
1999	241	226	93.8	15	6.2
2000	270	255	94.4	15	5.6
2001	285	264	92.6	21	7.4
2002	323	305	94.4	18	5.6
2003	326	311	95.4	15	4.6
2004	294	280	95.2	14	4.8
Total	2601	2474	95.1	127	4.9

Figure 8.1: Correct decision to bypass nearer urban hospital, major data category, Liverpool Hospital, 1995-2004 (N=2601)



GCS < 9 intubated pre-hospital

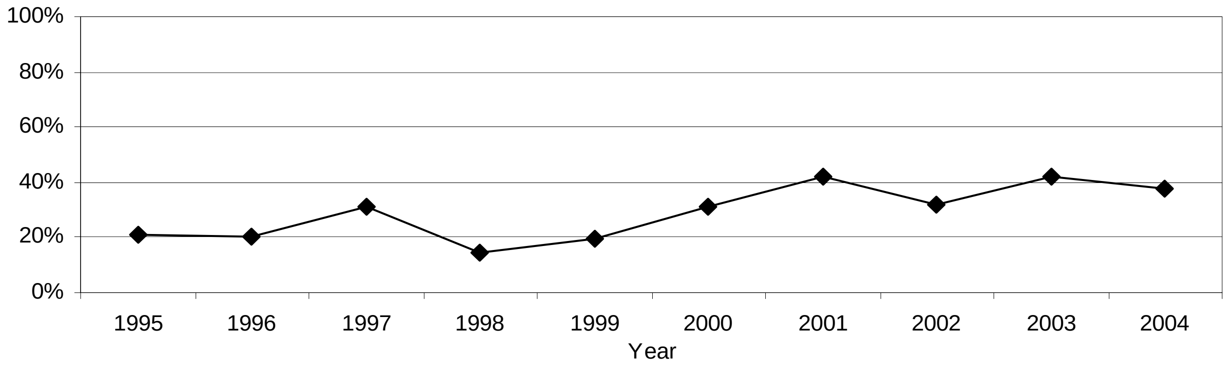
This indicator monitors whether patients with GCS < 9 were intubated pre-hospital. Patients with GCS < 9 are not able to protect their own airway and are therefore potentially at risk of secondary brain injury. It is important to note that in NSW both paramedics and MRT are trained to intubate, but only MRT are trained to administer paralysing and induction agents. (General duties ambulance officers are not trained to intubate). When interpreting this performance indicator, it is also important to remember that sometimes intubation is not possible, for example, if the patient has trismus.

A total of 651 patients who received pre-hospital care had pre-hospital GCS < 9. Of these, 507 (77.9%) were transported by pre-hospital personnel who are trained to intubate: 462 (91.1%) by paramedics, and 45 (8.9%) by MRT.

Table 8.3: GCS < 9 intubated pre-hospital, major data category, Liverpool Hospital, 1995-2004

Year	Total			Paramedics			Medical Retrieval Team		
	Applies	Intubated		Applies	Intubated		Applies	Intubated	
		n	%		n	%		n	%
1995	52	11	21.2	51	10	19.6	1	1	100.0
1996	45	9	20.0	45	9	20.0	0	-	-
1997	54	17	31.5	51	14	27.5	3	3	100.0
1998	49	7	14.3	45	4	8.9	4	3	75.0
1999	46	9	19.6	43	6	14.0	3	3	100.0
2000	54	17	31.5	50	13	26.0	4	4	100.0
2001	50	21	42.0	40	11	27.5	10	10	100.0
2002	47	15	31.9	41	9	22.0	6	6	100.0
2003	62	26	41.9	52	16	30.8	10	10	100.0
2004	48	18	37.5	44	15	34.1	4	3	75.0
Total	507	150	29.6	462	107	23.2	45	43	95.6

Figure 8.2: GCS < 9 intubated pre-hospital, major data category, Liverpool Hospital, 1995-2004 (n=507)



Ambulance officer scene time ≤ 20 minutes

This indicator categorises whether ambulance officers spent ≤ 20 minutes or > 20 minutes at the scene. Time at scene is defined as the difference between 'at scene' and 'depart scene' times. Time at scene data was available for 6648 (90.2%) of patients admitted to Liverpool Hospital. The figure includes patients taken directly to Liverpool Hospital and patients transferred in to Liverpool Hospital from another SWSAHS hospital.

Scene time is potentially prolonged if a patient is trapped at the scene. Entrapment data was collected from 1997. Of all the major data category patients admitted to Liverpool Hospital between 1997-2004, both scene time and entrapment data were available for 600 patients.

Table 8.4: Pre-hospital scene time, major data category, Liverpool Hospital, 1995-2004

Year	Applies	At scene ≤ 20 minutes		At scene > 20 minutes	
		n	%	n	%
1995	537	313	58.3	224	41.7
1996	613	409	66.7	204	33.3
1997	601	372	61.9	229	38.1
1998	659	373	56.6	286	43.4
1999	609	368	60.4	241	39.6
2000	722	461	63.9	261	36.1
2001	685	418	61.0	267	39.0
2002	822	551	67.0	271	33.0
2003	703	447	63.6	256	36.4
2004	697	414	59.4	283	40.6
Total	6648	4126	62.1	2522	37.9

Table 8.5: Pre-hospital scene time for entrapped patients, major data category, Liverpool Hospital 1995-2004

Year	Applies	Entrapped ≤ 20 minutes		Entrapped > 20 minutes	
		n	%	n	%
1997	65	14	21.5	51	78.5
1998	83	10	12.0	73	88.0
1999	76	14	18.4	62	81.6
2000	70	13	18.6	57	81.4
2001	63	11	17.5	52	82.5
2002	81	19	23.5	62	76.5
2003	81	21	25.9	60	74.1
2004	81	23	28.4	58	71.6
Total	600	125	20.8	475	79.2

Figure 8.3: Pre-hospital scene time (including entrapped patients), major data category, Liverpool Hospital, 1995-2004 (n=6648)

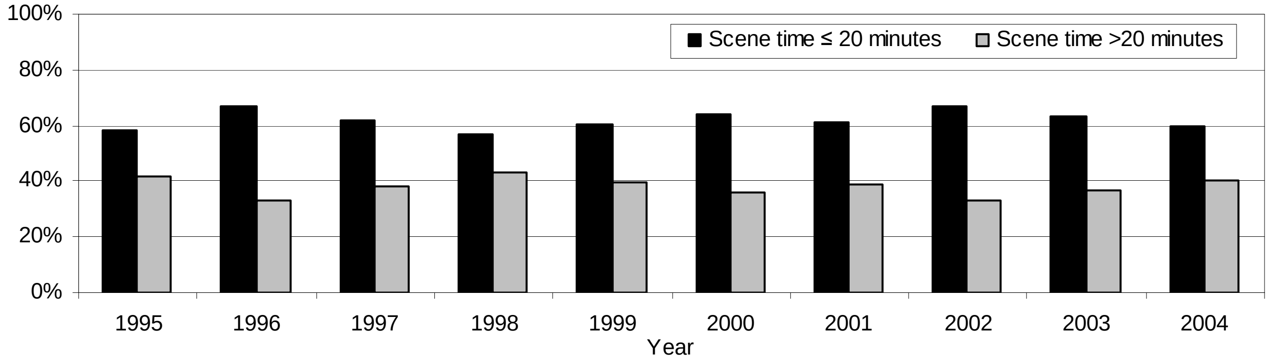
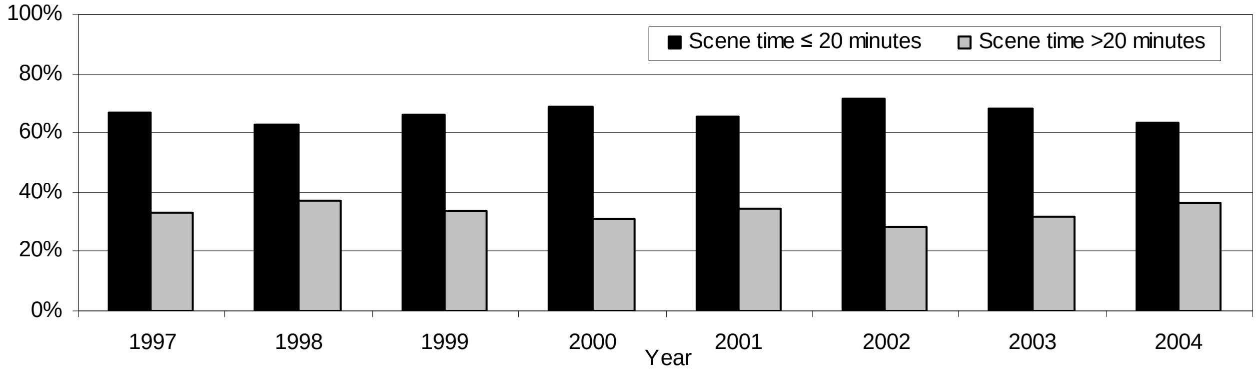


Figure 8.4: Pre-hospital scene time, excluding entrapped patients, major data category, Liverpool Hospital, 1995-2004 (n=6648)



IV cannula inserted and volume administered

This indicator categories the volume of pre-hospital fluid administered (< 500ml or ≥ 500ml). It applies to all patients who have a pre-hospital intravenous cannula inserted. Of the 3468 patients who had an IV cannula inserted pre-hospital, 3075 sustained blunt trauma and 393 sustained penetrating trauma.

Table 8.6: Blunt trauma, IV cannula inserted and volume of fluid pre-hospital, major data category, Liverpool Hospital, 1995-2004

Year	Applies	IV fluid < 500ml		IV fluid ≥ 500ml	
		n	%	n	%
1995	259	110	42.5	149	57.5
1996	234	115	49.1	119	50.9
1997	246	117	47.6	129	52.4
1998	313	161	51.4	152	48.6
1999	309	160	51.8	149	48.2
2000	271	122	45.0	149	55.0
2001	290	156	53.8	134	46.2
2002	316	219	69.3	97	30.7
2003	448	363	81.0	85	19.0
2004	389	314	80.7	75	19.3
Total	3075	1837	59.7	1238	40.3

Table 8.7: Penetrating trauma, IV cannula inserted and volume of fluid pre-hospital, major data category, Liverpool Hospital, 1995-2004

Year	Applies	IV fluid < 500ml		IV fluid ≥ 500ml	
		n	%	n	%
1995	34	9	26.5	25	73.5
1996	44	8	18.2	36	81.8
1997	38	11	28.9	27	71.1
1998	50	13	26.0	37	74.0
1999	23	7	30.4	16	69.6
2000	54	13	24.1	41	75.9
2001	51	22	43.1	29	56.9
2002	39	33	84.6	6	15.4
2003	32	22	68.8	10	31.3
2004	28	20	71.4	8	28.6
Total	393	158	40.2	235	59.8

Figure 8.5: Blunt trauma, IV cannula inserted and volume of fluid pre-hospital, major data category, Liverpool Hospital, 1995-2004 (n=3075)

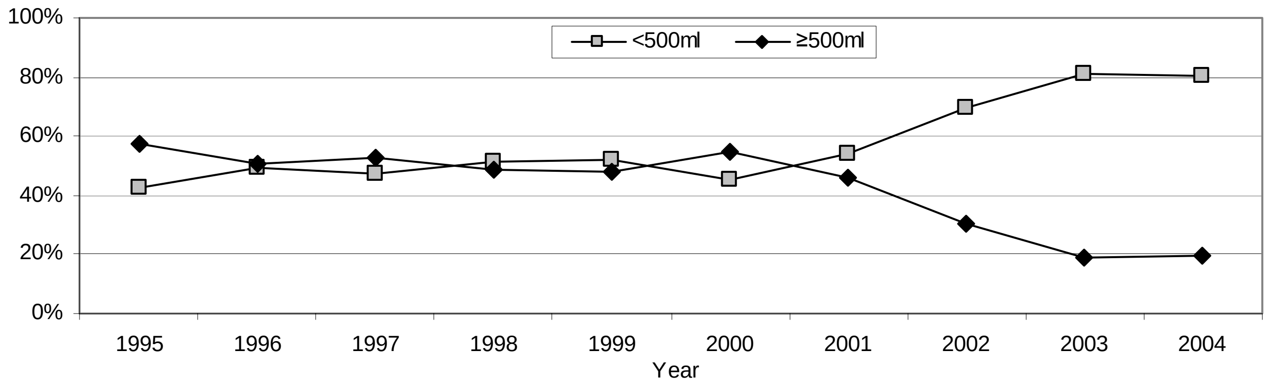
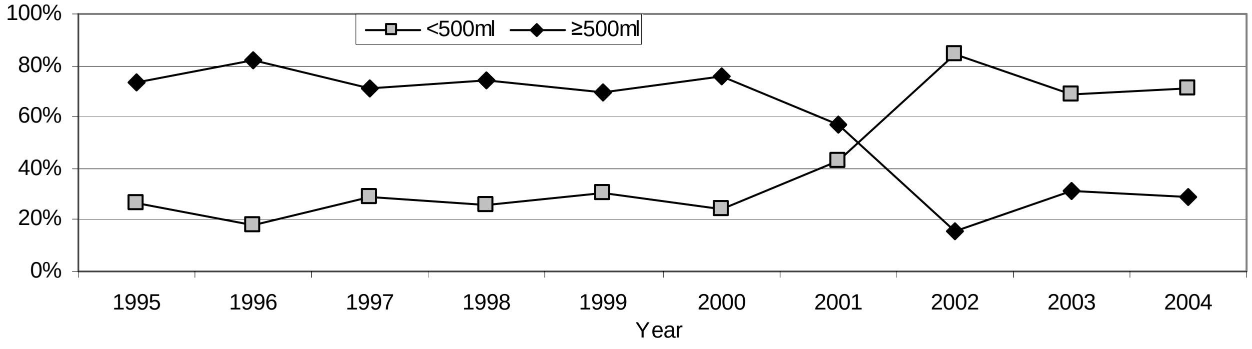


Figure 8.6: Penetrating trauma, IV cannula inserted and volume of fluid pre-hospital, major data category, Liverpool Hospital, 1995-2004 (n=393)

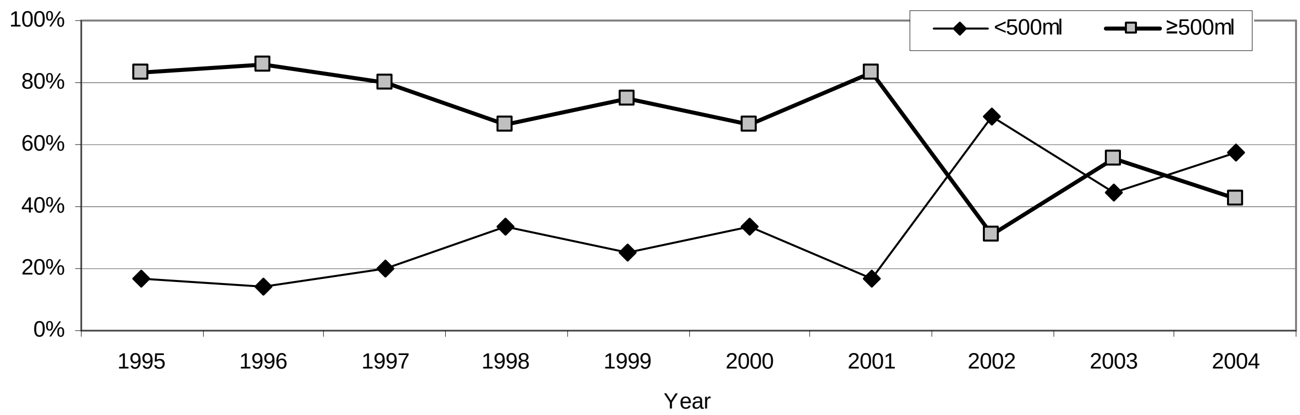


Of the 393 penetrating trauma who had an IV cannula inserted pre-hospital, 108 (27.5%) had ISS ≥ 16.

Table 8.8: Penetrating trauma, ISS ≥ 16, IV cannula inserted and volume of fluid administered pre-hospital, major data category, Liverpool Hospital, 1995-2004

Year	Applies	IV fluid < 500ml		IV fluid ≥ 500ml	
		n	%	n	%
1995	6	1	16.7	5	83.3
1996	14	2	14.3	12	85.7
1997	15	3	20.0	12	80.0
1998	9	3	33.3	6	66.7
1999	8	2	25.0	6	75.0
2000	15	5	33.3	10	66.7
2001	12	2	16.7	10	83.3
2002	13	9	69.2	4	30.8
2003	9	4	44.4	5	55.6
2004	7	4	57.1	3	42.9
Total	108	35	16.7	73	83.3

Figure 8.7: Penetrating trauma, ISS ≥ 16, IV cannula inserted and volume of fluid administered pre-hospital, major data category, Liverpool Hospital, 1995-2004 (n=108)



8.3 Resuscitative management phase

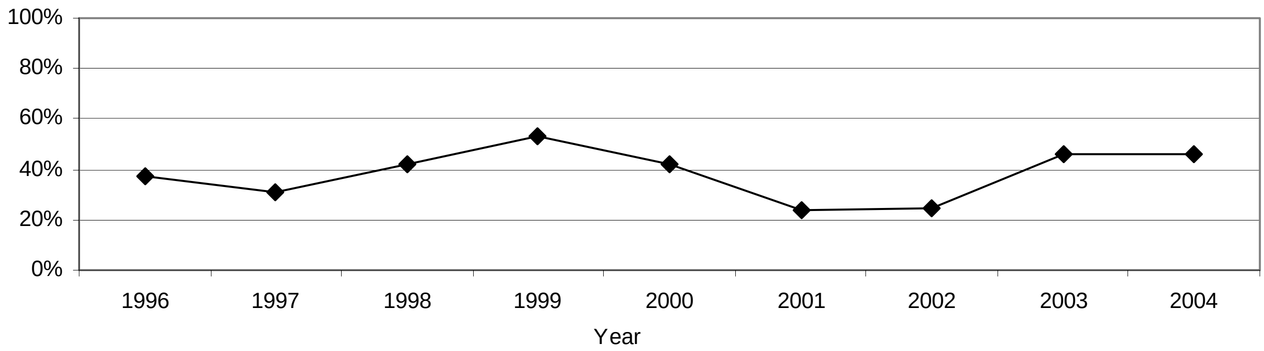
Medical Retrieval Team turn-around time at referring hospital ≤ 30 minutes

Inter-hospital trauma transfers from a SWSAHS hospital to Liverpool Hospital are sometimes carried out by a Medical Retrieval Team (MRT). The indicator is met if the MRT turnaround time for an SWSAHS inter-hospital trauma transfer to Liverpool Hospital is ≤ 30 minutes.
Inter-hospital trauma transfers from non-SWSAHS hospitals to Liverpool Hospital are excluded from this indicator.

Table 8.9: MRT turnaround time at referring hospital ≤ 30 minutes, major data category, Liverpool Hospital, 1995-2004

Year	Applies	MRT turnaround ≤ 30 minutes		MRT turnaround > 30 minutes	
		n	%	n	%
1996	16	6	37.5	10	62.5
1997	13	4	30.8	9	69.2
1998	12	5	41.7	7	58.3
1999	17	9	52.9	8	47.1
2000	19	8	42.1	11	57.9
2001	17	4	23.5	13	76.5
2002	12	3	25.0	9	75.0
2003	13	6	46.2	7	53.8
2004	26	12	46.2	14	53.8
Total	145	57	39.3	88	60.7

Figure 8.8: MRT turnaround time at referring hospital ≤ 30 minutes, major data category, Liverpool Hospital, 1995-2004 (n=57)



Time at referring SWSAHS hospital ≤ 3 hours

This indicator reflects the time the patient spent at an urban SWSAHS hospital prior to transfer to Liverpool Hospital. Patients transferred to Liverpool Hospital from a hospital outside of SWSAHS are excluded. In 2002, the N.E.W.S. checklist [(1)] and clinical practice guidelines for inter-hospital trauma transfer [(2)] were introduced to help expedite transfer of trauma patients to Liverpool Hospital.
This performance indicator does not differentiate with regards to timeliness of transfer request or transport delays.

Table 8.10: Time at referring hospital ≤ 3 hours, major data category, Liverpool Hospital, 1995-2004

Year	Applies	At referring hospital ≤ 3 hours		At referring hospital > 3 hours	
		n	%	N	%
1995	63	36	57.1	27	42.9
1996	72	38	52.8	34	47.2
1997	66	36	54.5	30	45.5
1998	80	46	57.5	34	42.5
1999	119	57	47.9	62	52.1
2000	161	78	48.4	83	51.6
2001	203	71	35.0	132	65.0
2002	183	58	31.7	125	68.3
2003	140	46	32.9	94	67.1
2004	189	65	34.4	124	65.6
Total	1276	531	41.6	745	58.4

Figure 8.9: Time at referring SWSAHS hospital ≤ 3 hours, major data category, Liverpool Hospital, 1995-2004 (n=531)

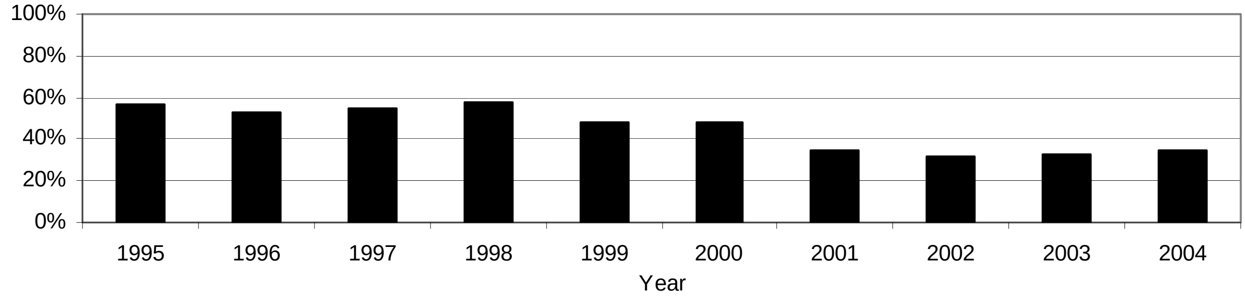


Table 8.11: Time at referring hospital ≤ 3 hours, ISS ≥ 16, Liverpool Hospital, 1995-2004

Year	Applies	At referring hospital ≤ 3 hours		At referring hospital > 3 hours	
		n	%	n	%
1995	22	11	50.0	11	50.0
1996	18	10	55.6	8	44.4
1997	19	11	57.9	8	42.1
1998	28	16	57.1	12	42.9
1999	36	22	61.1	14	38.9
2000	46	27	58.7	19	41.3
2001	45	17	37.8	28	62.2
2002	26	10	38.5	16	61.5
2003	39	14	35.9	25	64.1
2004	47	19	40.4	28	59.6
Total	326	157	48.2	169	51.8

Figure 8.10: Time at referring SWSAHS hospital ≤ 3 hours, ISS ≥ 16, Liverpool Hospital, 1995-2004 (n=157)

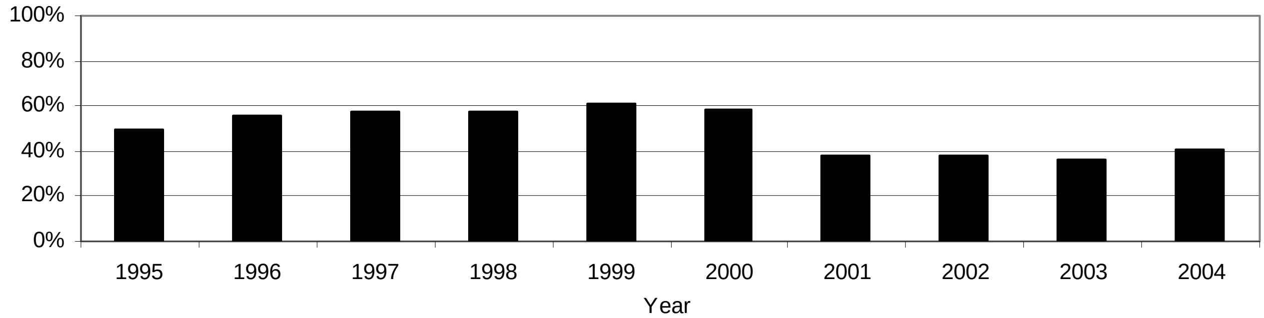
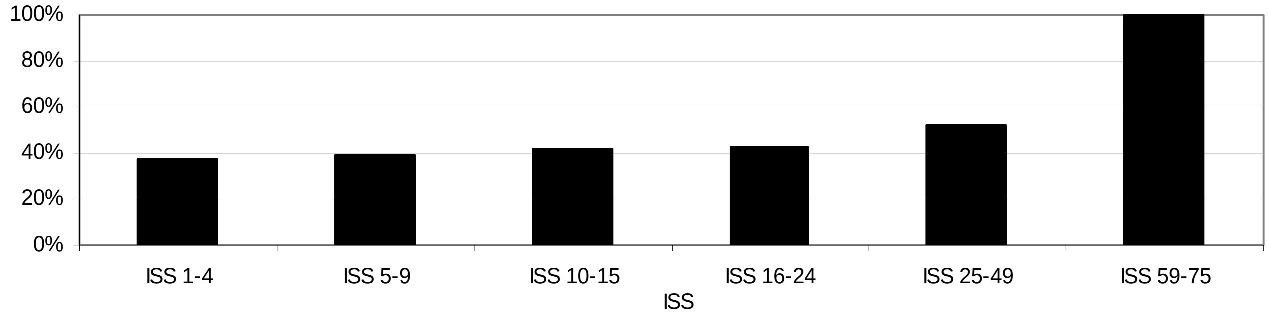


Figure 8.11: Time at referring SWSAHS hospital ≤ 3 hours, by ISS range, Liverpool Hospital, 1995-2004 (n=531)



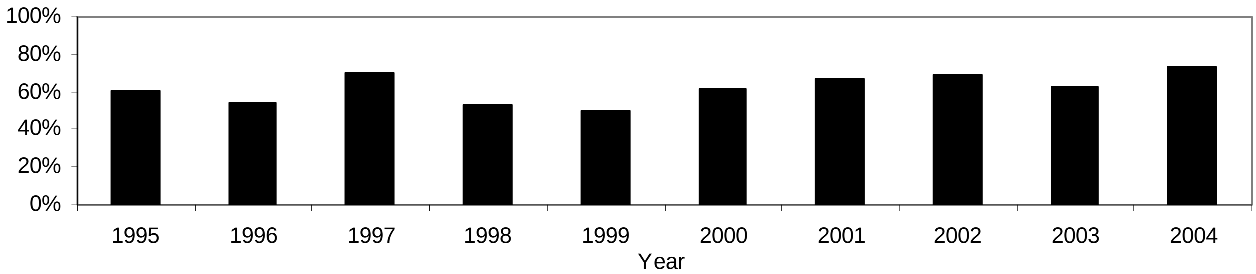
Blood products administered promptly when > 2L resuscitation fluids required

When a patient requires fluid resuscitation for blood loss, blood products are preferred over a high volume of crystalloid and colloid, as haemodilution reduces the oxygen carrying capacity of the patients blood volume. This indicator monitors whether blood products were administered promptly in patients who require > of 2L of resuscitation fluids. The indicator is met if blood products are administered promptly prior to exceeding > 2L of fluids during the resuscitative phase of care. Burns patients are excluded due to their special fluid requirements.

Table 8.12: Blood products administered promptly when > 2L resuscitation fluids required, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Met		Not met	
		n	%	n	%
1995	106	64	60.4	42	39.6
1996	119	64	53.8	55	46.2
1997	97	68	70.1	29	29.9
1998	95	51	53.7	44	46.3
1999	102	51	50.0	51	50.0
2000	81	50	61.7	31	38.3
2001	63	42	66.7	21	33.3
2002	49	34	69.4	15	30.6
2003	51	32	62.7	19	37.3
2004	42	31	73.8	11	26.2
Total	805	487	60.5	318	39.5

Figure 8.12: Blood products administered promptly when > 2L resuscitation fluids required, major data category, Liverpool Hospital, 1995-2004 (n=487)



Explore penetrating trauma ≤ 1 hour of arrival in ED

This indicator measures the number of patients requiring formal exploration of a penetrating injury in the ED or OT. This requires a local (or general) anaesthetic and sterile procedure. It only applies to penetrating injuries to the neck, torso or groin where the severity of the wound necessitates exploration.

Table 8.13: Penetrating trauma explored ≤ 1 hour of arrival in ED, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Explored ≤ 1 hour		Not explored ≤ 1 hour	
		n	%	n	%
1995	46	24	52.2	22	47.8
1996	52	33	63.5	19	36.5
1997	38	20	52.6	18	47.4
1998	44	27	61.4	17	38.6
1999	26	18	69.2	8	30.8
2000	63	34	54.0	29	46.0
2001	62	36	58.1	26	41.9
2002	63	30	47.6	33	52.4
2003	41	23	56.1	18	43.9
2004	45	32	71.1	13	28.9
Total	480	277	57.7	203	42.3

Figure 8.13: Penetrating trauma explored ≤ 1 hour of arrival in ED, major data category, Liverpool Hospital, 1995-2004 (n=277)

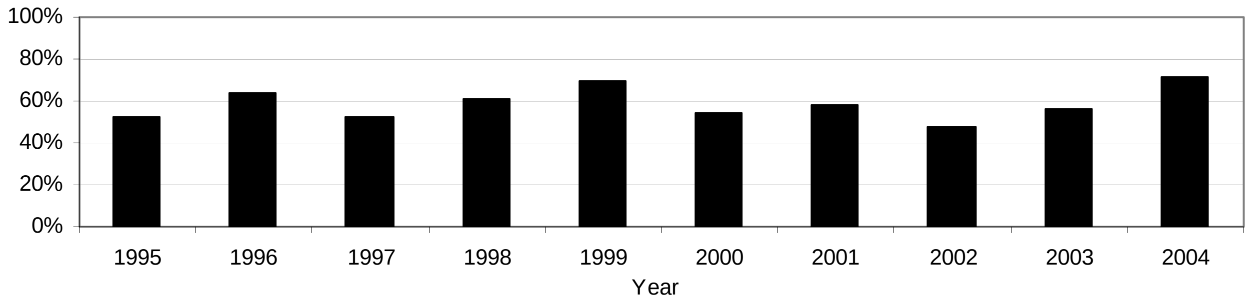
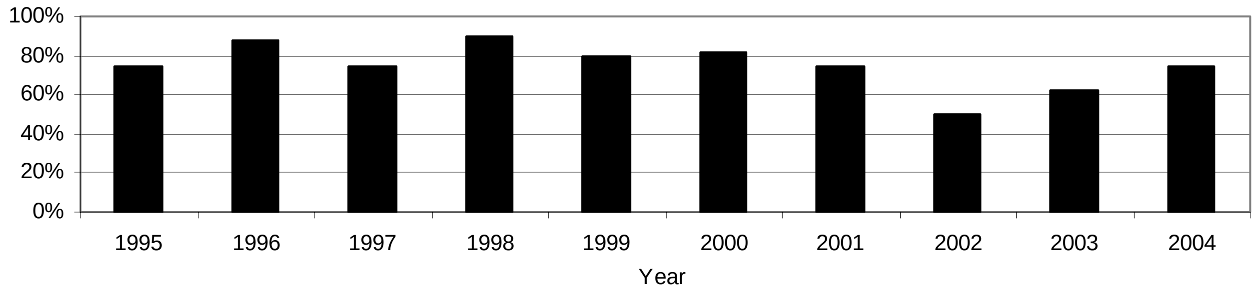


Figure 8.14: Penetrating trauma explored within 1 hour of arrival in ED, ISS ≥ 16, Liverpool Hospital, 1995-2004 (n=88)



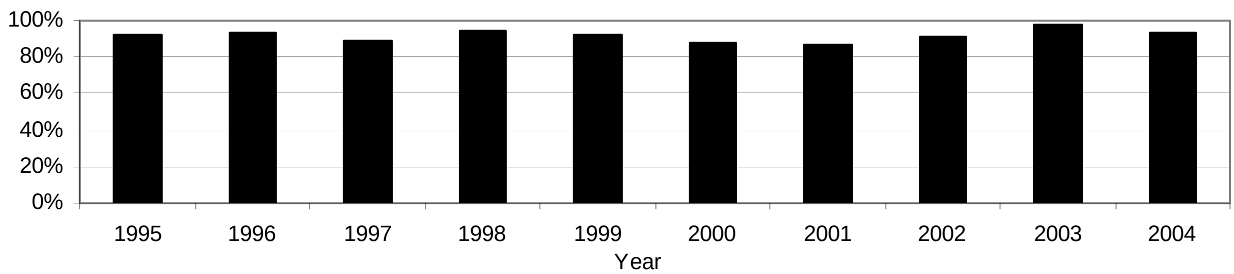
Patient in CT for ≤ 1 hour

This indicator monitors length of time spent in the CT scanner (≤ 1 hour or > 1 hour), for any type of CT scan (head, abdominal cervical, thoracic or other). Ideally patients are scanned and exit the scanner within 1 hour. The data is obtained from the patient's Emergency Department notes. The completion time printed on the CT films may also assist in calculating the time spent in CT. The indicator only applies to CTs undertaken during the resuscitative phase of care.

Table 8.14: Patient time in CT scanner, major data category, Liverpool Hospital, 1995-2004

Year	Applies	In CT ≤ 1 hour		In CT > 1 hour	
		n	%	n	%
1995	167	155	92.8	12	7.2
1996	205	191	93.2	14	6.8
1997	207	185	89.4	22	10.6
1998	259	245	94.6	14	5.4
1999	363	335	92.3	28	7.7
2000	389	342	87.9	47	12.1
2001	429	372	86.7	57	13.3
2002	411	375	91.2	36	8.8
2003	465	453	97.4	12	2.6
2004	421	392	93.1	29	6.9
Total	3316	3045	91.8	271	8.2

Figure 8.15: Patient in CT scanner ≤ 1 hour, major data category, Liverpool Hospital, 1995-2004 (n=3045)



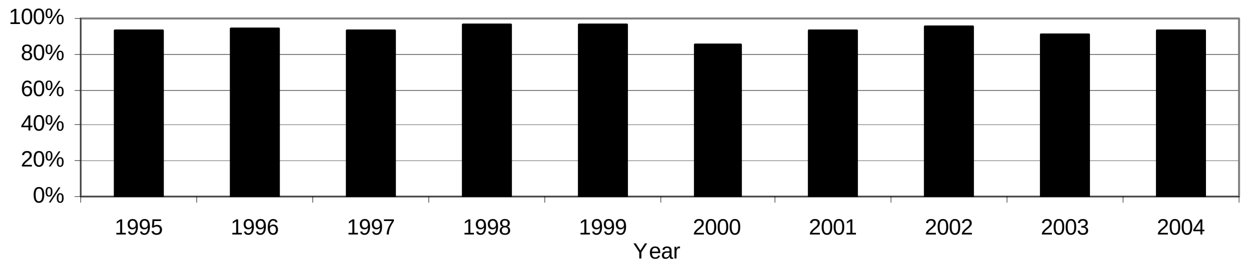
Head CT for patients with GCS < 13

This indicator reflects whether patients with GCS < 13 requiring head CT had this done in a timely manner. It applies to patients with a GCS < 13 at any stage during the resuscitation phase. Patients are excluded if they had a CT prior to arrival or a GCS < 13 which is due to sedation, eg. burns patients. The indicator is met when a patient with GCS < 13 has a head CT carried out within 4 hours of arrival in ED.

Table 8.15: Head CT carried out ≤ 4 hours for patients with GCS < 13, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Head CT ≤ 4 hours		No head CT ≤ 4 hours	
		n	%	n	%
1995	81	76	93.8	5	6.2
1996	116	109	94.0	7	6.0
1997	89	83	93.3	6	6.7
1998	93	90	96.8	3	3.2
1999	101	98	97.0	3	3.0
2000	69	59	85.5	10	14.5
2001	80	75	93.8	5	6.3
2002	85	81	95.3	4	4.7
2003	66	60	90.9	6	9.1
2004	92	86	93.5	6	6.5
Total	872	817	93.7	55	6.3

Figure 8.16: Head CT ≤ 4 hours for patients with GCS < 13, major data category, Liverpool Hospital, 1995-2004 (n=817)



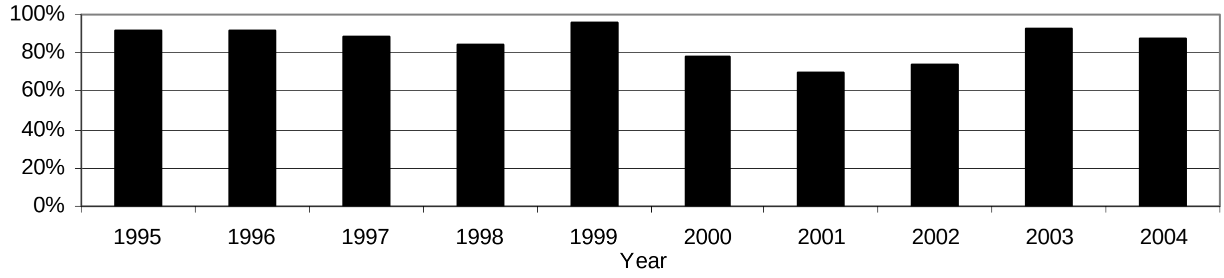
GCS < 9 intubated ≤ 10 minutes in ED

Patients with GCS < 9 are unable to protect their airway and may require airway intervention and support. This indicator is met when a patient is intubated with 10 with GCS < 9 is intubated within 10 minutes of arrival to ED, or when a patient 10 minutes of their GCS decreasing to < 9 whilst in the ED. Patients intubated prior to arrival are excluded.

Table 8.16: GCS < 9 intubated ≤ 10 minutes, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Intubated ≤ 10 minutes		Not intubated ≤ 10 minutes	
		n	%	n	%
1995	47	43	91.5	4	8.5
1996	59	54	91.5	5	8.5
1997	53	47	88.7	6	11.3
1998	52	44	84.6	8	15.4
1999	50	48	96.0	2	4.0
2000	28	22	78.6	6	21.4
2001	37	26	70.3	11	29.7
2002	38	28	73.7	10	26.3
2003	57	53	93.0	4	7.0
2004	48	42	87.5	6	12.5
Total	469	407	86.8	62	13.2

Figure 8.17: GCS < 9 intubated ≤ 10 minutes, major data category, Liverpool Hospital, 1995-2004 (n=407)



8.4 Definitive care phase

Re-present within 72 hours of discharge

This indicator is met if a patient re-presents within 72 hours of discharge from hospital for a condition relating to their original injury. Re-presentations for planned reviews and dressing changes are excluded.

Table 8.17: Re-present within 72 hours of discharge, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Re-present ≤ 72 hours		Did not re-present	
		n	%	n	%
1995	663	10	1.5	653	98.5
1996	738	20	2.7	718	97.3
1997	735	7	1.0	728	99.0
1998	817	20	2.4	797	97.6
1999	832	11	1.3	821	98.7
2000	1000	18	1.8	982	98.2
2001	1148	41	3.6	1107	96.4
2002	1146	13	1.1	1133	98.9
2003	1013	20	2.0	993	98.0
2004	1021	18	1.8	1003	98.2
Total	9113	178	2.0	8935	98.0

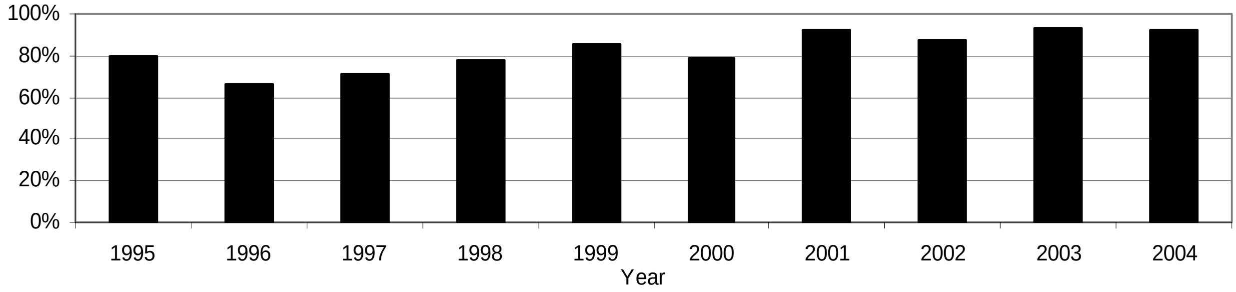
Thrombo-embolic prophylaxis instituted appropriately

This indicator is met if appropriate thrombo-embolic prophylaxis (TEP) was instituted within the first 24 hours of admission. One or more of three regimes may be used: anti-embolic stockings; subcutaneous heparin or clexane; and / or sequential compression device. The indicator applies to patients > 16 years who are going to be immobilised for ≥ 24 hours, and excludes patients who are not immobilised.

Table 8.18: Thrombo-embolic prophylaxis (TEP) instituted appropriately, major data category, Liverpool Hospital, 1995-2004

Year	Applies	TEP		No TEP	
		n	%	n	%
1995	307	244	79.5	63	20.5
1996	385	256	66.5	129	33.5
1997	445	317	71.2	128	28.8
1998	480	373	77.7	107	22.3
1999	536	456	85.1	80	14.9
2000	665	527	79.2	138	20.8
2001	682	629	92.2	53	7.8
2002	652	571	87.6	81	12.4
2003	728	679	93.3	49	6.7
2004	715	663	92.7	52	7.3
Total	5595	4715	84.3	880	15.7

Figure 8.18: Thrombo-embolic prophylaxis instituted appropriately, major data category, Liverpool Hospital, 1995-2004 (n=4715)



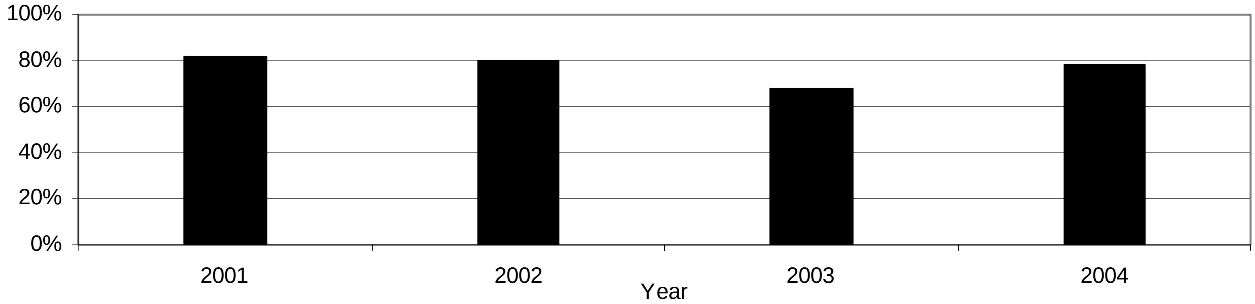
Clinical pathway commenced

Clinical pathways were instituted in 2000. Pathways exist for severe head injury, fractured ribs, blunt abdominal trauma, fractured shaft of femur and fractured pelvis. [3,4] This indicator applies to all patients with these injuries, except those where it would be inappropriate to commence the clinical pathway, for example, if there are significant injuries to multiple body regions. The indicator is met if patient has one of the above injuries and the relevant clinical pathway is commenced.

Table 8.19: Clinical pathway commenced, major data category, Liverpool Hospital, 2001-2004

Year	Applies	Pathway commenced		Pathway not commenced	
		n	%	n	%
2001	159	130	81.8	29	18.2
2002	225	180	80.0	45	20.0
2003	252	170	67.5	82	32.5
2004	309	243	78.6	66	21.4
Total	945	723	76.5	222	23.5

Figure 8.19: Clinical pathway commenced, major data category, Liverpool Hospital, 2001-2004 (n=723)



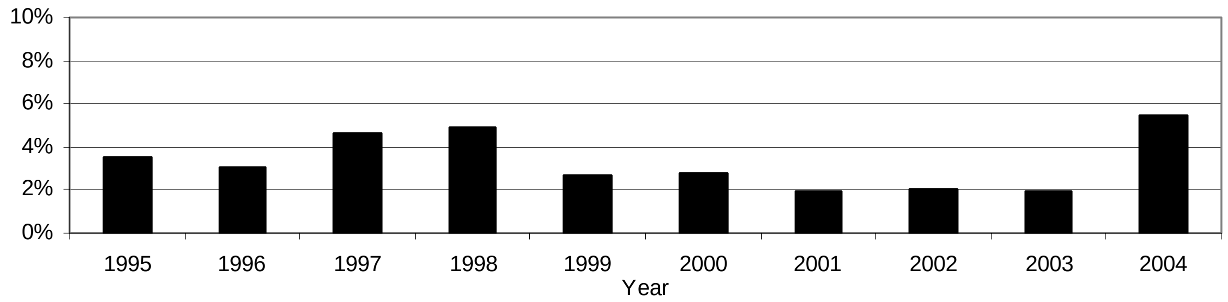
Missed fractures

Ideally all injuries are diagnosed during the initial assessment in the Emergency Department. This indicator applies to all patients with one or more fractures of any type or site. The indicator is met when all fractures are not diagnosed within 24 hours of arrival.

Table 8.20: Missed fractures, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Missed fracture		No missed fracture	
		n	%	n	%
1995	622	22	3.5	600	96.5
1996	622	19	3.1	603	96.9
1997	563	26	4.6	537	95.4
1998	577	28	4.9	549	95.1
1999	594	16	2.7	578	97.3
2000	668	19	2.8	649	97.2
2001	670	13	1.9	657	98.1
2002	587	12	2.0	575	98.0
2003	620	12	1.9	608	98.1
2004	733	40	5.5	693	94.5
Total	6256	207	3.3	6049	96.7

Figure 8.20: Missed fractures, major data category, Liverpool Hospital, 1995-2004 (n=207)



Hypothermia

This indicator monitors the number of patients whose temperature was ≤ 35°C at any time during admission, including hypothermia on arrival in ED. Hypothermia is associated with a poor outcome for patients. It may occur as a result of prolonged scene time, blood loss, prolonged exposure or rapid infusion of cold intravenous fluid.

Table 8.21: Hypothermia, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Hypothermia		No hypothermia	
		n	%	n	%
1995	654	60	9.2	594	90.8
1996	725	70	9.7	655	90.3
1997	724	58	8.0	666	92.0
1998	801	69	8.6	732	91.4
1999	819	73	8.9	746	91.1
2000	986	107	10.9	879	89.1
2001	1132	190	16.8	942	83.2
2002	1144	105	9.2	1039	90.8
2003	998	45	4.5	953	95.5
2004	998	39	3.9	959	96.1
Total	8981	816	9.1	8165	90.9

Figure 8.21: Hypothermia, major data category, Liverpool Hospital, 1995-2004 (n=816)

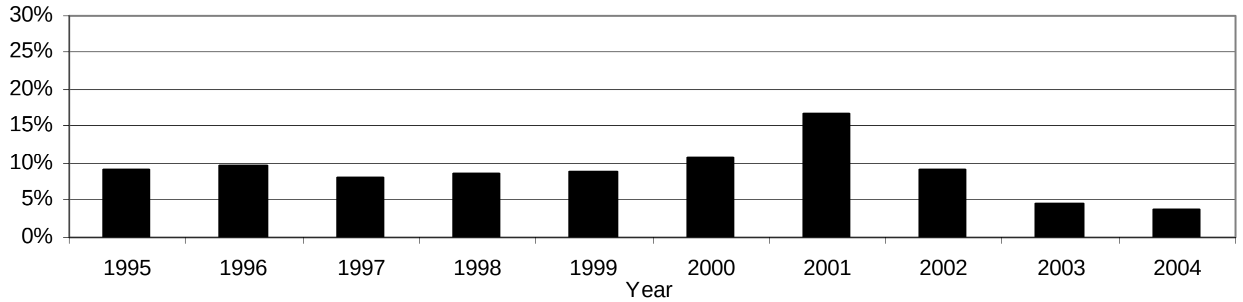
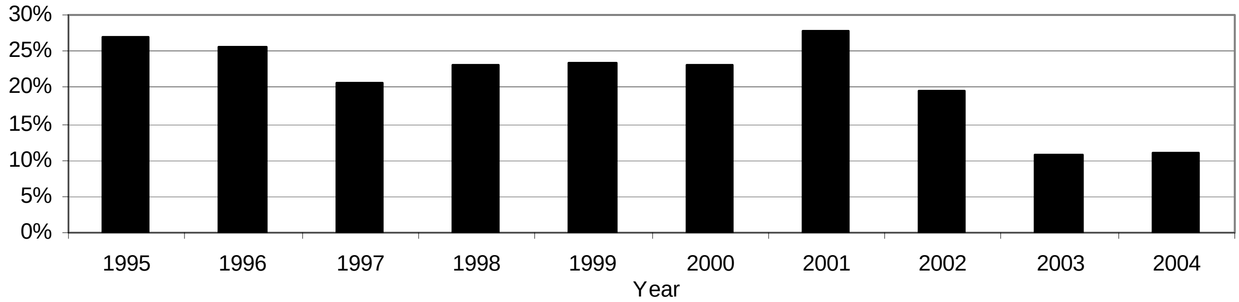


Table 8.22: Hypothermia, ISS ≥ 16, Liverpool Hospital, 1995-2004

Year	Applies	Hypothermia		No hypothermia	
		n	%	n	%
1995	149	40	26.8	109	73.2
1996	188	48	25.5	140	74.5
1997	198	41	20.7	157	79.3
1998	191	44	23.0	147	77.0
1999	214	50	23.4	164	76.6
2000	271	63	23.2	208	76.8
2001	238	66	27.7	172	72.3
2002	256	50	19.5	206	80.5
2003	278	30	10.8	248	89.2
2004	257	28	10.9	229	89.1
Total	2240	460	20.5	1780	79.5

Figure 8.22: Hypothermia, ISS ≥ 16, Liverpool Hospital, 1995-2004 (n=460)



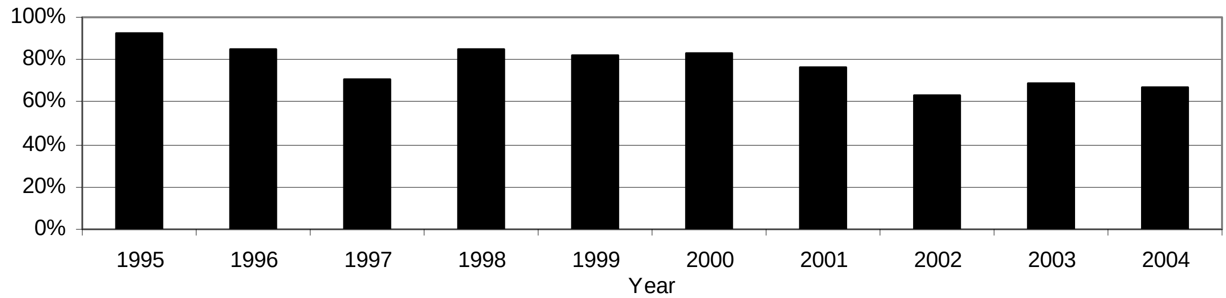
Long bone fracture fixed or reduced ≤ 24 hours of arrival

This indicator monitors whether patients with long bone fractures (i.e. femur, tibia, fibula, radius, ulna, humerus) have their fracture fixed or reduced within 24 hours of arrival to ED. It applies to all patients with long bone fractures that require fixation or reduction. The indicator is met if all the patient's long bone fractures are fixed within 24 hours of arrival. For patients with multiple long bone fractures, all fractures must be fixed within 24 hours in order for the indicator to be met.

Table 8.23: Long bone fracture fixed or reduced ≤ 24 hours, major data category, Liverpool Hospital, 1995-2004

Year	Applies	≤ 24 hours		> 24 hours	
		n	%	n	%
1995	150	138	92.0	12	8.0
1996	150	127	84.7	23	15.3
1997	163	115	70.6	48	29.4
1998	189	161	85.2	28	14.8
1999	178	146	82.0	32	18.0
2000	226	187	82.7	39	17.3
2001	237	181	76.4	56	23.6
2002	245	155	63.3	90	36.7
2003	217	150	69.1	67	30.9
2004	238	159	66.8	79	33.2
Total	1993	1519	76.2	474	23.8

Figure 8.23: Long bone fracture fixed or reduced ≤ 24 hours, major data category, Liverpool Hospital, 1995-2004 (n=1519)



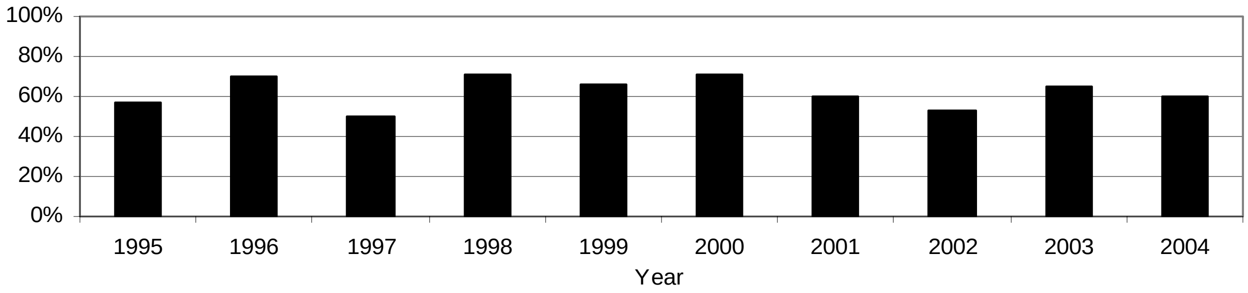
Open long bone fracture fixed ≤ 6 hours of injury

Early fixation of open long bone fractures is associated with a lower incidence of orthopaedic complications. This indicator measures whether compound long bone fractures are fixed ≤ 6 hours post-injury.

Table 8.24: Open long bone fracture fixed ≤ 6 hours of injury, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Fixed ≤ 6 hours		Not fixed ≤ 6 hours	
		n	%	n	%
1995	40	23	57.5	17	42.5
1996	43	30	69.8	13	30.2
1997	34	17	50.0	17	50.0
1998	49	35	71.4	14	28.6
1999	47	31	66.0	16	34.0
2000	52	37	71.2	15	28.8
2001	62	37	59.7	25	40.3
2002	64	34	53.1	30	46.9
2003	63	41	65.1	22	34.9
2004	57	34	59.6	23	40.4
Total	511	319	62.4	192	37.6

Figure 8.24: Open long bone fracture fixed ≤ 6 hours of injury, major data category, Liverpool Hospital, 1995-2004 (n=319)



Non-therapeutic laparotomy

This indicator reflects which patients undergoing laparotomy required no surgical intervention. In general, non-therapeutic laparotomy is to be avoided, since any surgery carries the risk of complication. However, patients with penetrating injury where the peritoneum is breached generally undergo exploratory laparotomy.

Table 8.25: Non-therapeutic laparotomy, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Non-therapeutic laparotomy		Therapeutic laparotomy	
		n	%	n	%
1995	58	12	20.7	46	79.3
1996	65	9	13.8	56	86.2
1997	64	9	14.1	55	85.9
1998	48	7	14.6	41	85.4
1999	66	13	19.7	53	80.3
2000	84	8	9.5	76	90.5
2001	75	14	18.7	61	81.3
2002	52	8	15.4	44	84.6
2003	50	7	14.0	43	86.0
2004	43	10	23.3	33	76.7
Total	605	97	16.1	508	83.9

Figure 8.25: Non-therapeutic laparotomy, major data category, Liverpool Hospital, 1995-2004 (n=97)

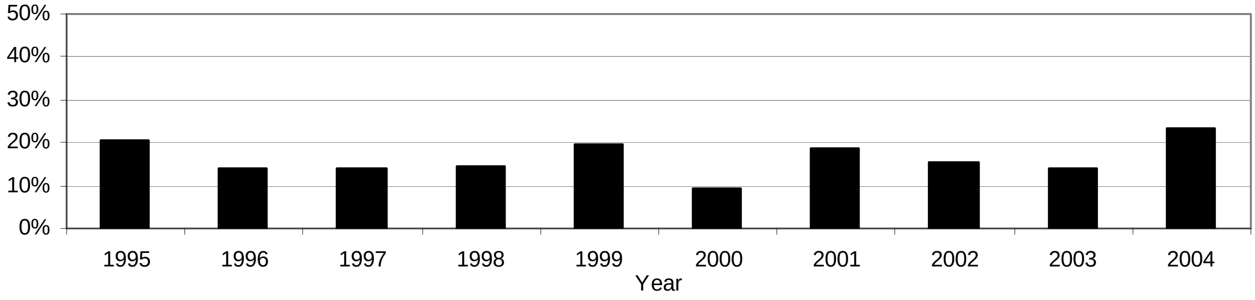


Table 8.26: Non-therapeutic laparotomy: blunt trauma, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Non-therapeutic laparotomy		Therapeutic laparotomy	
		n	%	n	%
1995	42	8	19.0	34	81.0
1996	44	4	9.1	40	90.9
1997	47	6	12.8	41	87.2
1998	28	3	10.7	25	89.3
1999	53	7	13.2	46	86.8
2000	50	4	8.0	46	92.0
2001	46	4	8.7	42	91.3
2002	30	3	10.0	27	90.0
2003	35	2	5.7	33	94.3
2004	28	6	21.4	22	78.6
Total	403	47	11.7	356	88.3

Figure 8.26: Non-therapeutic laparotomy: blunt trauma, major data category, Liverpool Hospital, 1995-2004 (n=47)

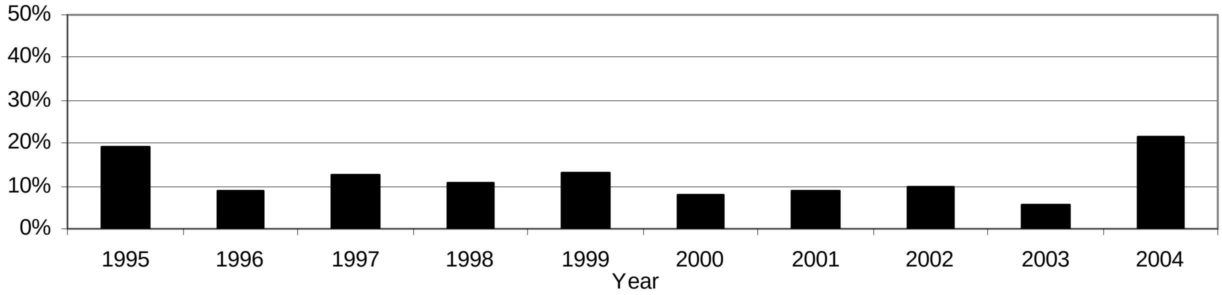


Table 8.27: Non-therapeutic laparotomy: penetrating trauma, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Non-therapeutic laparotomy		Therapeutic laparotomy	
		n	%	n	%
1995	16	4	25.0	12	75.0
1996	21	5	23.8	16	76.2
1997	17	3	17.6	14	82.4
1998	20	4	20.0	16	80.0
1999	13	6	46.2	7	53.8
2000	34	4	11.8	30	88.2
2001	29	10	34.5	19	65.5
2002	22	5	22.7	17	77.3
2003	15	5	33.3	10	66.7
2004	15	4	26.7	11	73.3
Total	202	50	24.8	152	75.2

Figure 8.27: Non-therapeutic laparotomy: penetrating trauma, major data category, Liverpool Hospital, 1995-2004 (n=50)

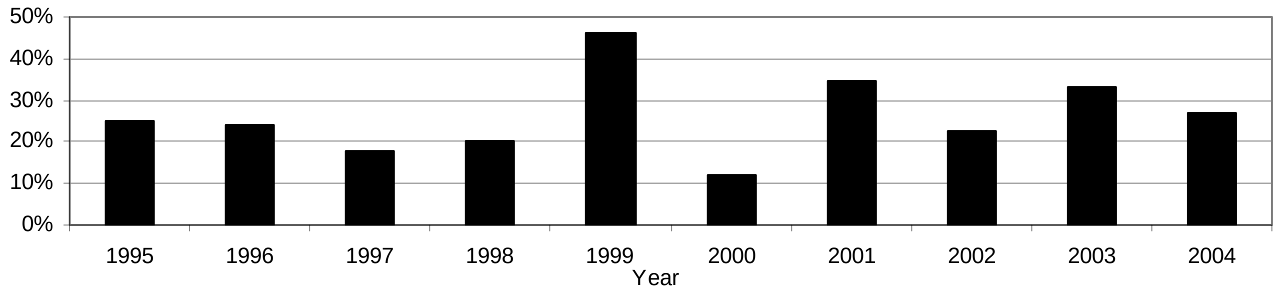


Table 8.28: Non-therapeutic laparotomy (NTL) rate for trauma surgeons, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Blunt			Penetrating		
		Total laparotomies	NTL	NTL rate %	Total laparotomies	NTL	NTL rate %
1995	12	8	0	-	4	1	25.0
1996	9	6	0	-	3	0	-
1997	10	5	0	-	5	0	-
1998	12	6	0	-	6	1	16.7
1999	14	8	0	-	6	1	16.7
2000	13	6	0	-	7	2	28.6
2001	8	7	0	-	1	0	-
2002	6	2	0	-	4	0	-
2003	9	6	0	-	3	1	33.3
2004	10	6	0	-	4	1	25.0
Total	103	60	0	-	43	7	16.3

Table 8.29: Non-therapeutic laparotomy (NTL) rate for non-trauma surgeons, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Blunt			Penetrating		
		Total laparotomies	NTL	NTL rate %	Total laparotomies	NTL	NTL rate %
1995	46	34	8	23.5	12	3	25.0
1996	56	38	4	10.5	18	5	27.8
1997	54	42	6	14.3	12	3	25.0
1998	35	21	2	9.5	14	3	21.4
1999	52	46	7	15.2	6	5	83.3
2000	70	43	4	9.3	27	2	7.4
2001	63	36	4	11.1	27	10	37.0
2002	46	28	3	10.7	18	5	27.8
2003	41	29	2	6.9	12	4	33.3
2004	33	22	6	27.3	11	3	27.3
Total	496	339	46	13.6	157	43	27.4

Craniotomy < 1 hour of arrival in ED for acute extradural or subdural haemorrhage

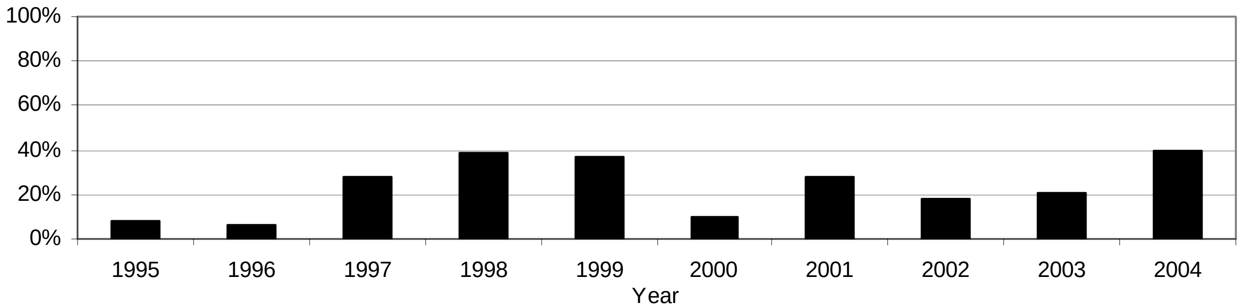
This indicator monitors time from arrival in the ED to commencement of craniotomy for drainage of an acute, operable EDH or SDH. Calculating time from arrival in the ED to craniotomy facilitates the analysis of the in-hospital response, regardless of whether the patient was directly admitted to Liverpool Hospital or transferred in from another hospital.

The indicator is met if craniotomy is undertaken within 1 hour of arrival in the ED. The indicator is not met if craniotomy is not undertaken within 1 hour of arrival, and for these patients there are two subcategories: craniotomy within 1-4 hours or craniotomy > 4 hours. The indicator excludes ICP monitor insertion; elevation of depressed skull fractures; chronic or late EDH/SDH and lesions not requiring drainage.

Table 8.30: Craniotomy < 1 hour of arrival in ED for acute EDH or SDH, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Craniotomy < 1 hour		Craniotomy 1-4 hours		Craniotomy > 4 hours	
		n	%	n	%	n	%
1995	13	1	7.7	7	53.8	5	38.5
1996	16	1	6.3	6	37.5	9	56.3
1997	32	9	28.1	17	53.1	6	18.8
1998	26	10	38.5	13	50.0	3	11.5
1999	19	7	36.8	7	36.8	5	26.3
2000	20	2	10.0	11	55.0	7	35.0
2001	25	7	28.0	8	32.0	10	40.0
2002	34	6	17.6	22	64.7	6	17.6
2003	19	4	21.1	9	47.4	6	31.6
2004	25	10	40.0	12	48.0	3	12.0
Total	229	57	24.9	112	48.9	60	26.2

Figure 8.28: Craniotomy < 1 hour of arrival in ED for acute EDH or SDH, major data category, Liverpool Hospital, 1995-2004 (n=57)



Craniotomy ≤ 4 hours of injury for acute extradural or subdural haemorrhage

This indicator monitors time from injury to commencement of craniotomy for drainage of an acute, operable EDH or SDH. Calculating time from injury to craniotomy facilitates the analysis of time to definitive care for both direct admissions and transfers in from other hospitals.

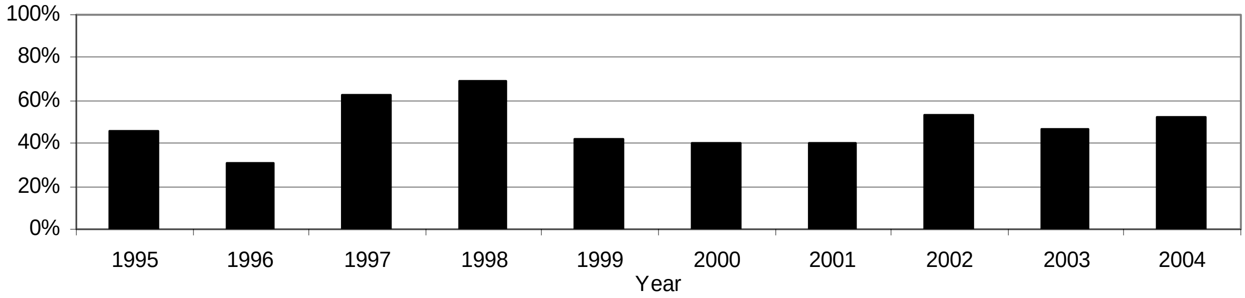
The indicator is met if craniotomy is undertaken within 2 hours of injury. The indicator is not met if craniotomy is not undertaken within 2 hours of injury, and for these patients there are two subcategories: craniotomy within 2-4 hours or craniotomy > 4 hours. The indicator excludes ICP monitor insertion; elevation of depressed skull fractures; chronic or late EDH/SDH and lesions not requiring drainage.

NB: Four patients undergoing craniotomy were excluded as the time of injury was unable to be established.

Table 8.31: Craniotomy ≤ 4 hours of injury for acute EDH or SDH, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Craniotomy < 2 hours		Craniotomy 2-4 hours		Craniotomy > 4 hours	
		n	%	n	%	n	%
1995	13	2	15.4	4	30.8	7	53.8
1996	16	0	-	5	31.3	11	68.8
1997	32	11	34.4	9	28.1	12	37.5
1998	26	9	34.6	9	34.6	8	30.8
1999	19	1	5.3	7	36.8	11	57.9
2000	20	2	10.0	6	30.0	12	60.0
2001	25	3	12.0	7	28.0	15	60.0
2002	32	8	25.0	9	28.1	15	46.9
2003	17	3	17.6	5	29.4	9	52.9
2004	25	8	32.0	5	20.0	12	48.0
Total	225	47	20.9	66	29.3	112	49.8

Figure 8.29: Craniotomy ≤ 4 hours of injury for acute EDH or SDH, major data category, Liverpool Hospital, 1995-2004 (n=113)



Patient transferred out to another major trauma service

This indicator monitors the outflow of all trauma patients transferred out from Liverpool Hospital to another major trauma service (MTS). The information provided by this indicator facilitates follow-up of transferred trauma patients, and can monitor deficits in service provision, for example, bed shortages in ICU or specialist burns and spinal units.

The indicator applies to all major data category patients, and is met if a patient is transferred out to another MTS during the acute phase of care. The indicator excludes transfers out for rehabilitation or non-acute care.

Table 8.32: Patient transferred out to another MTS, major data category, Liverpool Hospital 1995-2004

Year	Applies	Transferred out		Not transferred out	
		n	%	n	%
1995	662	45	6.8	617	93.2
1996	734	47	6.4	687	93.6
1997	735	37	5.0	698	95.0
1998	813	27	3.3	786	96.7
1999	832	35	4.2	797	95.8
2000	1000	35	3.5	965	96.5
2001	1152	35	3.0	1117	97.0
2002	1142	59	5.2	1083	94.8
2003	1013	63	6.2	950	93.8
2004	1021	55	5.4	966	94.6
Total	9104	438	4.8	8666	95.2

Table 8.33: Patient transferred to another MTS: reason for transfer, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Reason for transfer out to another MTS						
		Specialist service not available at Liverpool Hospital:					No ICU bed	
		Burns	Paediatrics	Spinal	Total n	%	n	%
1995	45	14	13	4	31	68.9	14	31.1
1996	47	4	16	9	29	61.7	18	38.3
1997	37	5	21	1	27	73.0	10	27.0
1998	27	6	10	5	21	77.8	6	22.2
1999	35	10	18	2	30	85.7	5	14.3
2000	35	9	22	1	32	91.4	3	8.6
2001	35	7	25	3	35	100.0	0	-
2002	59	11	46	2	59	100.0	0	-
2003	63	10	51	1	62	98.4	1	1.6
2004	55	6	42	4	52	94.5	3	5.5
Total	438	82	264	32	378	86.3	60	13.7

Figure 8.30: Patient transferred out to another MTS, major data category, Liverpool Hospital 1995-2004 (n=438)

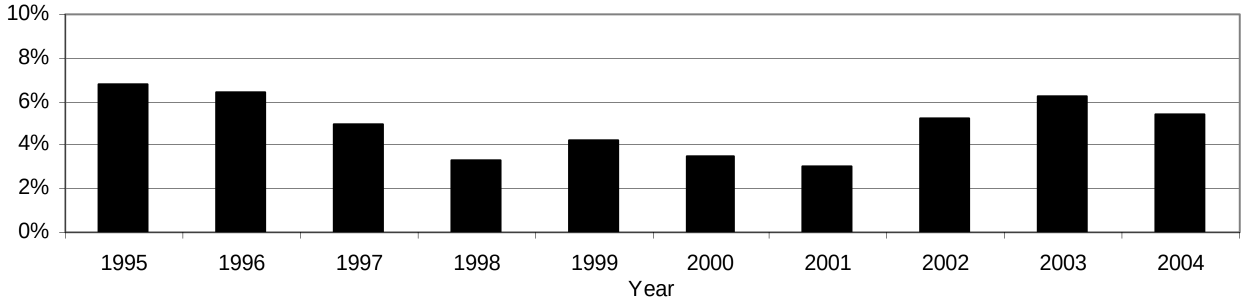
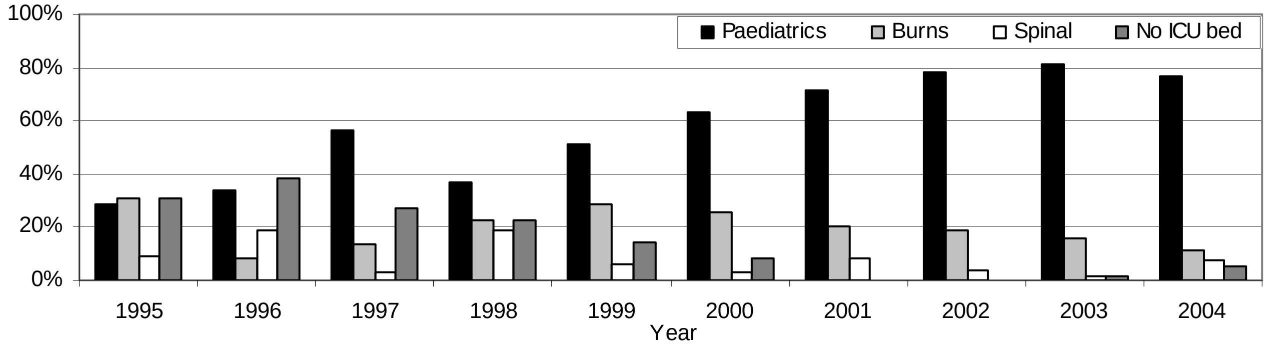


Figure 8.31: Patient transferred to another MTS: reason for transfer, major data category, Liverpool Hospital, 1995-2004 (n=438)



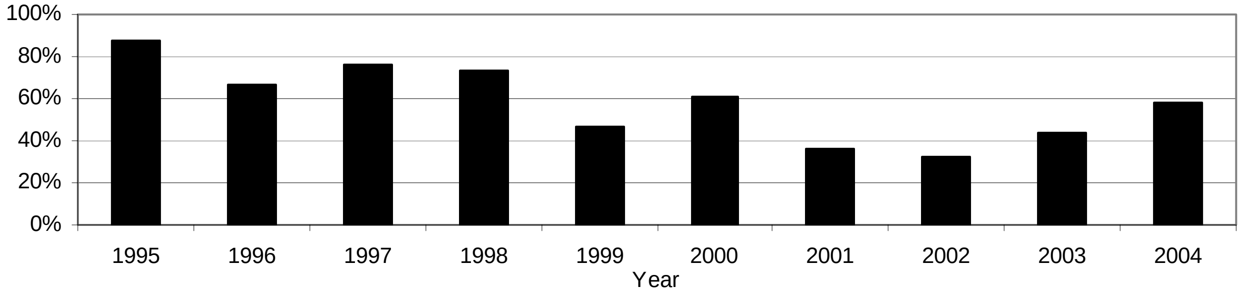
Dislocated joint reduced ≤ 1 hour of arrival in ED

Joint dislocations need prompt reduction to avoid avascular necrosis and functional impairment. This indicator applies to all patients with a dislocated joint and is met if the dislocated joint is successfully reduced ≤ 1 hour of arrival in ED

Table 8.34: Dislocated joint reduced ≤ 1 hour of arrival in ED, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Reduced ≤ 1 hour		Not reduced ≤ 1 hour	
		n	%	n	%
1995	16	14	87.5	2	12.5
1996	15	10	66.7	5	33.3
1997	17	13	76.5	4	23.5
1998	15	11	73.3	4	26.7
1999	13	6	46.2	7	53.8
2000	18	11	61.1	7	38.9
2001	22	8	36.4	14	63.6
2002	40	13	32.5	27	67.5
2003	34	15	44.1	19	55.9
2004	36	21	58.3	15	41.7
Total	226	122	54.0	104	46.0

Figure 8.32: Dislocated joint reduced ≤ 1 hour of arrival in ED, major data category, Liverpool Hospital, 1995-2004 (n=122)



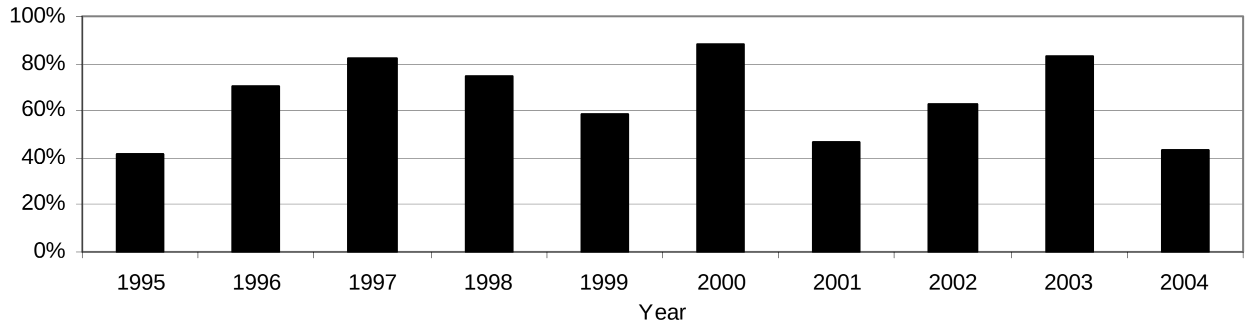
Urgent laparotomy ≤ 45 minutes to arrest haemorrhage in an unstable patient

This indicator monitors time to urgent laparotomy, and only applies to patients with proven intra-abdominal bleeding causing hypotension. ‘Unstable’ is defined as SBP < 90mmHg. For patients who are hypotensive on arrival, the indicator is met if laparotomy is commenced within 45 minutes of arrival. For patients who are normotensive on arrival and subsequently become hypotensive, the indicator is met if laparotomy is commenced within 45 minutes of the onset of hypotension.

Table 8.35: Urgent laparotomy ≤ 45 minutes to arrest haemorrhage in an unstable patient, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Laparotomy ≤ 45 minutes		No laparotomy ≤ 45 minutes	
		n	%	n	%
1995	12	5	41.7	7	58.3
1996	17	12	70.6	5	29.4
1997	11	9	81.8	2	18.2
1998	4	3	75.0	1	25.0
1999	24	14	58.3	10	41.7
2000	17	15	88.2	2	11.8
2001	13	6	46.2	7	53.8
2002	8	5	62.5	3	37.5
2003	18	15	83.3	3	16.7
2004	14	6	42.9	8	57.1
Total	138	90	65.2	48	34.8

Figure 8.33: Urgent laparotomy ≤ 45 minutes to arrest haemorrhage in an unstable patient, major data category, Liverpool Hospital, 1995-2004 (n=90)



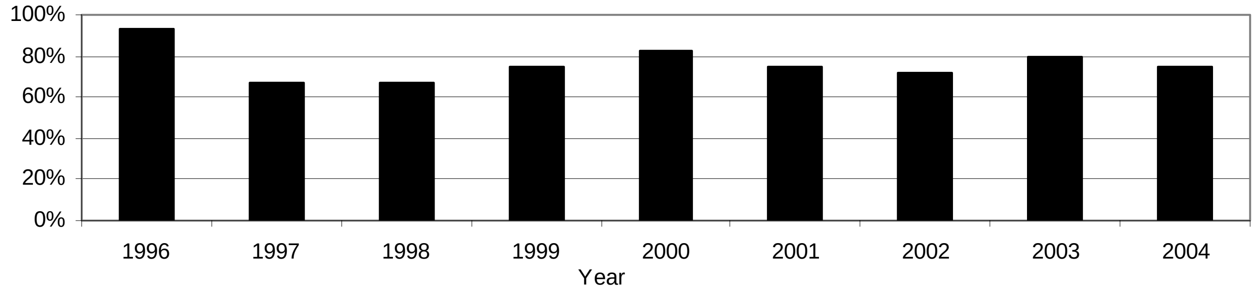
Ischaemic limb re-vascularised ≤ 4 hours of injury

This indicator monitors whether re-vascularisation of an ischaemic limb occurs within 4 hours of injury. The indicator applies to all patients with an ischaemic limb and is met if the limb is re-vascularised within 4 hours of injury.

Table 8.36: Ischaemic limb re-vascularised ≤ 4 hours of injury, major data category, Liverpool Hospital, 1996-2004

Year	Applies	≤ 4 hours		> 4 hours	
		n	%	n	%
1996	14	13	92.9	1	7.1
1997	3	2	66.7	1	33.3
1998	9	6	66.7	3	33.3
1999	4	3	75.0	1	25.0
2000	17	14	82.4	3	17.6
2001	8	6	75.0	2	25.0
2002	7	5	71.4	2	28.6
2003	10	8	80.0	2	20.0
2004	12	9	75.0	3	25.0
Total	84	66	78.6	18	21.4

Figure 8.34: Ischaemic limb re-vascularised ≤ 4 hours of injury, major data category, Liverpool Hospital, 1996-2004 (n=66)



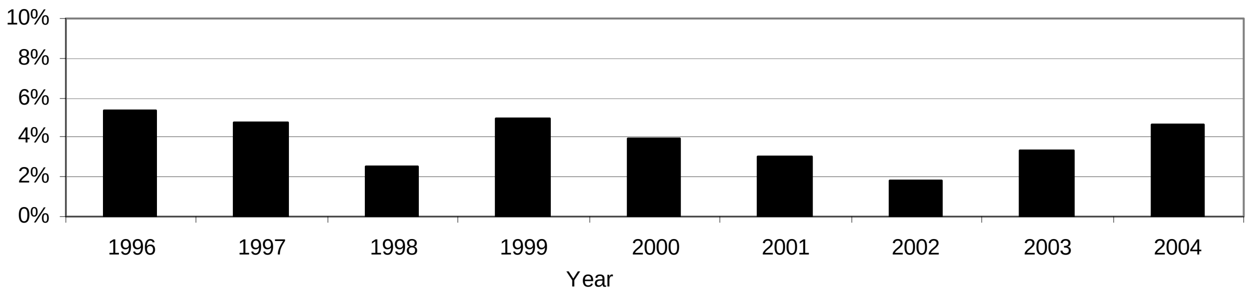
Unplanned return to operating theatre

Ideally all operations are anticipated and planned following ED assessment of the patient's injuries. This indicator monitors patients who had an unplanned return to the OT for reasons such as post-operative haemorrhage, unexpected deterioration, or treatment of previously missed injuries. It applies to all patients who have one or more procedures carried out in the operating theatre. It excludes planned returns to theatre and staged procedures.

Table 8.37: Unplanned return to operating theatre, major data category, Liverpool Hospital, 1996-2004

Year	Applies	Unplanned return to OT		No unplanned return to OT	
		n	%	n	%
1996	331	18	5.4	313	94.6
1997	340	16	4.7	324	95.3
1998	367	9	2.5	358	97.5
1999	364	18	4.9	346	95.1
2000	485	19	3.9	466	96.1
2001	526	16	3.0	510	97.0
2002	549	10	1.8	539	98.2
2003	454	15	3.3	439	96.7
2004	475	22	4.6	453	95.4
Total	3891	143	3.7	3748	96.3

Figure 8.35: Unplanned return to operating theatre, major data category, Liverpool Hospital, 1996-2004 (n=143)



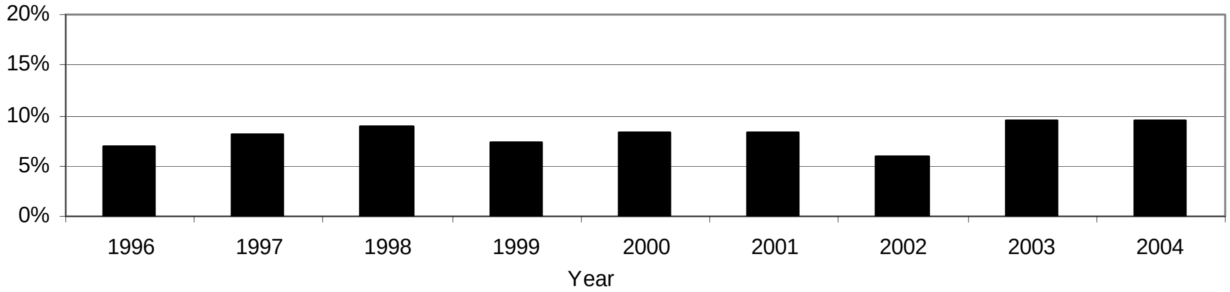
Unplanned admission to ICU

This indicator identifies patients who went to (and were intended to go to) the ward from recovery but then deteriorated and required admission to ICU or HDU. The indicator applies to all patients admitted to ICU / HDU during their admission.

Table 8.38: Unplanned admission to ICU, major data category, Liverpool Hospital, 1996-2004

Year	Applies	Unplanned ICU		Planned ICU	
		n	%	n	%
1996	231	16	6.9	215	93.1
1997	209	17	8.1	192	91.9
1998	210	19	9.0	191	91.0
1999	205	15	7.3	190	92.7
2000	215	18	8.4	197	91.6
2001	225	19	8.4	206	91.6
2002	199	12	6.0	187	94.0
2003	188	18	9.6	170	90.4
2004	168	16	9.5	152	90.5
Total	1850	150	8.1	1700	91.9

Figure 8.36: Unplanned admission to ICU, major data category, Liverpool Hospital, 1996-2004 (n=150)



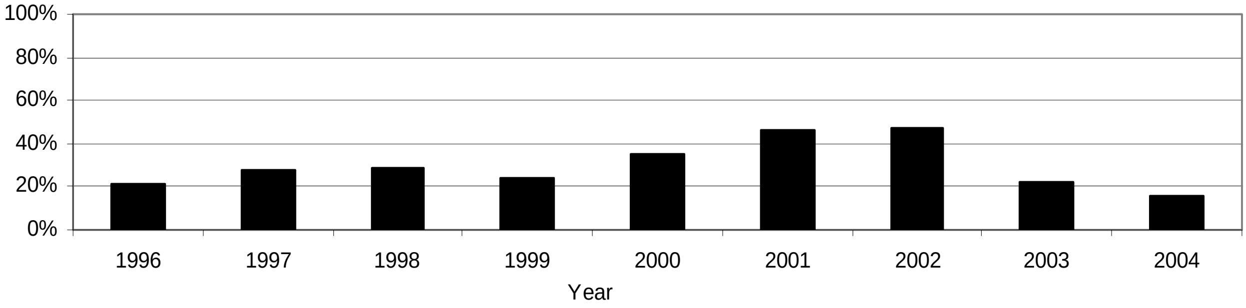
Patient temperature in OT documented in the medical record

This indicator monitors whether the patient's temperature in OT was documented on the anaesthetic chart. Where there are multiple operations, the anaesthetic chart from the first operation is used to determine whether the indicator has been met. The indicator is not a measure of whether temperature was taken and monitored, but rather whether this information is available in the medical record.
The indicator applies to all patients who have a procedure in the operating theatre.

Table 8.39: Patient temperature in OT documented in the medical record, major data category, Liverpool Hospital 1996-2004

Year	Applies	Temperature documented		Temperature not documented	
		n	%	n	%
1996	290	62	21.4	228	78.6
1997	357	100	28.0	257	72.0
1998	354	103	29.1	251	70.9
1999	339	83	24.5	256	75.5
2000	428	152	35.5	276	64.5
2001	390	181	46.4	209	53.6
2002	322	152	47.2	170	52.8
2003	406	90	22.2	316	77.8
2004	460	74	16.1	386	83.9
Total	3346	997	29.8	2349	70.2

Figure 8.37: Patient temperature in OT is documented in the medical record, major data category, Liverpool Hospital, 1996-2004 (n=997)



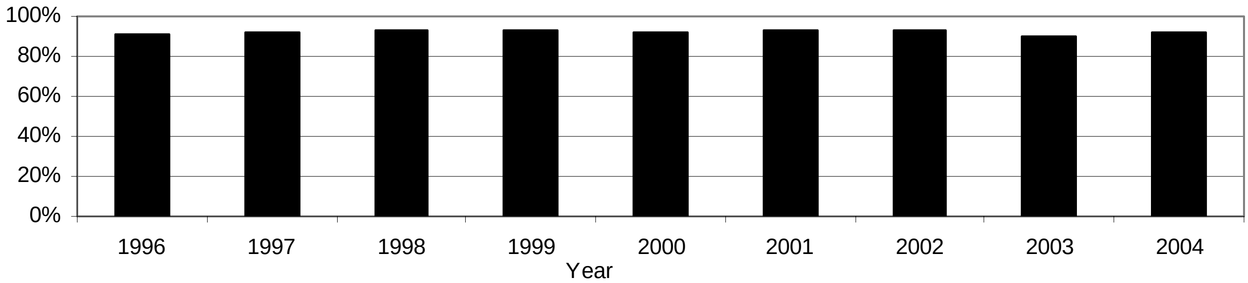
Haemoglobin > 85mg / dL at all times

Anaemia is associated with a poor outcome for injured patients. This indicator applies to all major data category patients, and is met if the patient has haemoglobin ≤ 85 mg / dL at all times throughout their admission (including on arrival).

Table 8.40: Haemoglobin > 85mg / dL at all times, major data category, Liverpool Hospital 1996-2004

Year	Applies	Hb > 85mg / dL		Hb ≤ 85mg / dL	
		n	%	n	%
1996	635	579	91.2	56	8.8
1997	720	657	91.3	63	8.8
1998	796	729	91.6	67	8.4
1999	814	754	92.6	60	7.4
2000	962	899	93.5	63	6.5
2001	1039	958	92.2	81	7.8
2002	1090	1015	93.1	75	6.9
2003	917	853	93.0	64	7.0
2004	915	823	89.9	92	10.1
Total	7888	7267	92.1	621	7.9

Figure 8.38: Haemoglobin > 85mg/dL at all times, major data category, Liverpool Hospital, 1996-2004 (n=7267)



All injuries diagnosed

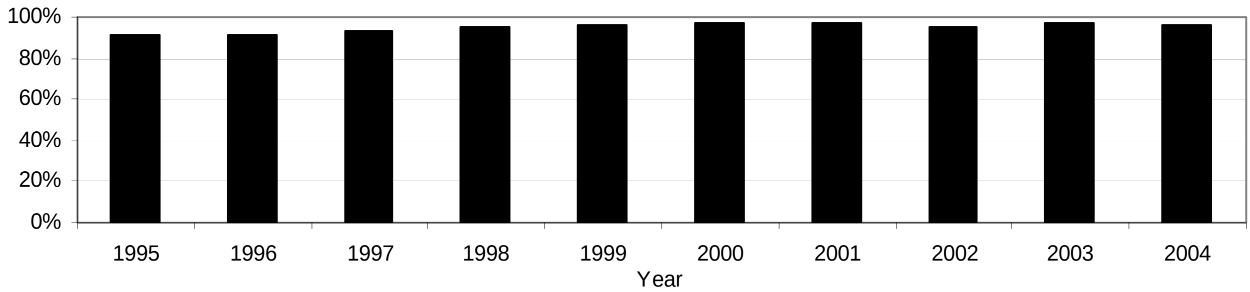
Ideally all injuries are diagnosed during initial assessment in ED. The tertiary survey is designed to be undertaken within 24 hours to ensure all injuries are identified early. This indicator applies to all major data category patients, and is met if all injuries are diagnosed with the first 24 hours of arrival.

The indicator excludes patients who within 24 hours of arrival, and patients who are transferred out to another hospital prior to having a tertiary survey. These patients may have additional injuries that would have been diagnosed had they survived or remained at Liverpool. Of the 378 patients with a missed injury, 147 (38.9%) patients had a missed fracture.

Table 8.41: All injuries diagnosed within 24 hours, major data category, Liverpool Hospital, 1996-2004

Year	Applies	Diagnosed ≤ 24 hours		Not diagnosed ≤ 24 hours	
		n	%	n	%
1996	724	658	90.9	66	9.1
1997	722	675	93.5	47	6.5
1998	803	765	95.3	38	4.7
1999	822	792	96.4	30	3.6
2000	982	949	96.6	33	3.4
2001	1133	1095	96.6	38	3.4
2002	1129	1075	95.2	54	4.8
2003	994	962	96.8	32	3.2
2004	983	943	95.9	40	4.1
Total	8292	7914	95.4	378	4.6

Figure 8.39: All injuries diagnosed ≤ 24 hours of admission, major data category, Liverpool Hospital, 1996-2004 (n=7914)



8.5 Performance index

The performance index summarises how often the performance indicators for each phase of care are met. A performance index of 0 indicates that the performance indicator is never met. On the other hand, a performance index of 1 indicates optimal care, with the performance indicator being met 100% of the time.

Performance indices are provided below for each of the phases of care: pre-hospital; resuscitative management and definitive care.

The pre-hospital performance index is calculated by combining data from two pre-hospital performance indicators:

1. Correct decision to bypass urban hospital
2. Ambulance scene time ≤ 20 minutes, excluding entrapped patients

The pre-hospital performance indicators ‘intubation with GCS<9’ and ‘IV cannula and volume of fluid administered’ are excluded, as these indicators have complex information that is not appropriate to incorporate into the pre-hospital performance index.

Table 8.42: Performance index: pre-hospital care, major data category, Liverpool Hospital 1997-2004

Year	Applies	Indicator met		Indicator not met	
		n	%	n	%
1997	761	574	75.4	187	24.6
1998	834	602	72.2	232	27.8
1999	784	587	74.9	197	25.1
2000	929	704	75.8	225	24.2
2001	908	671	73.9	237	26.1
2002	1063	833	78.4	230	21.6
2003	947	732	77.3	215	22.7
2004	914	669	73.2	245	26.8
Total	7536	5758	76.4	1778	23.6

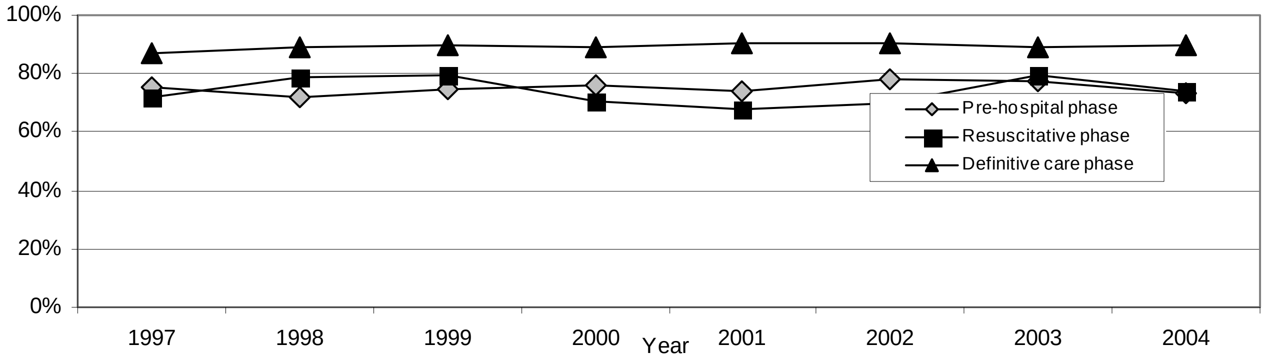
Table 8.43: Performance index: resuscitative management, major data category, Liverpool Hospital 1995-2004

Year	Applies	Indicator met		Indicator not met	
		n	%	n	%
1995	516	376	72.9	140	27.1
1996	639	486	76.1	153	23.9
1997	563	404	71.8	159	28.2
1998	635	501	78.9	134	21.1
1999	778	616	79.2	162	20.8
2000	810	574	70.9	236	29.1
2001	891	605	67.9	286	32.1
2002	841	590	70.2	251	29.8
2003	833	660	79.2	173	20.8
2004	863	640	74.2	223	25.8
Total	7369	5452	74.0	1917	26.0

Table 8.44: Performance index: definitive care, major data category, Liverpool Hospital, 1995-2004

Year	Applies	Indicator met		Indicator not met	
		n	%	n	%
1995	3845	3520	325	91.5	8.5
1996	5836	5078	758	87.0	13.0
1997	5981	5206	775	87.0	13.0
1998	6402	5693	709	88.9	11.1
1999	6675	5976	699	89.5	10.5
2000	7920	7074	846	89.3	10.7
2001	8770	7905	865	90.1	9.9
2002	8492	7666	826	90.3	9.7
2003	8007	7121	886	88.9	11.1
2004	15216	13699	1517	90.0	10.0
Total	61368	54404	6964	88.7	11.3

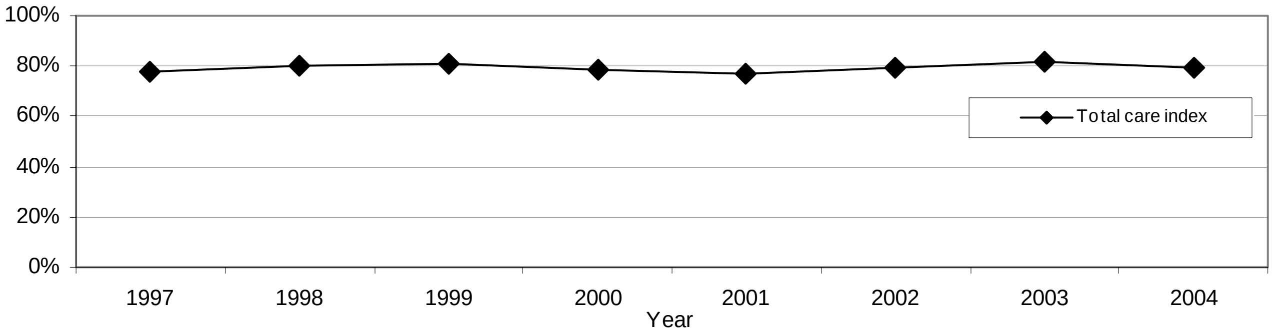
Figure 8.40: Performance index, major data category, Liverpool Hospital, 1995-2004



8.6 Total care index

The total care index is defined as the mean of the pre-hospital, resuscitative and definitive care performance indices. It facilitates trend analysis of performance indicator data.

Figure 8.41: Total care index, major data category, Liverpool Hospital, 1995-2004



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9 Injury Severity Scores

Executive comment

Injury severity scoring has provided a benchmark in understanding injury severity both at global body level and individual body region. While there are limitations to the overall scoring system identified by publications from ours and other units, the Abbreviated Injury Scale has stood the test of time as being the most accepted descriptor of injury in the trauma population.

There has been a gradual increase in the number of trauma patients over the last ten years admitted to Liverpool Hospital with injury severity scores 16 or greater. It is particularly pleasing to note the reduction in mortality in the severely injured patient, with mortality flowing from 18.5% to 13.4% in 2004 for those patients with an injury severity score of 16 or greater.

9.1 Background to injury severity scores

Each of the injuries sustained by patients in the major data category are coded and scored using the Abbreviated Injury Scale 1990 Revision (AIS-90), Update 98 [(1)]. (The next AIS version, AIS-2005, is soon to be released in Australia). The AIS is a consensus derived, anatomically based system that classifies individual injuries by body region on a 6-point ordinal severity scale. The AIS severity code descriptions are:

- Minor 1
- Moderate 2
- Serious 3
- Severe 4
- Critical 5
- Maximum 6

The AIS scores injuries, not the consequences of injuries, it does not measure impairment or disability resulting from injury. It was originally developed by the Association for the Advancement of Automotive Medicine (AAAM) as a means for crash investigators to standardise data on frequency and severity of motor vehicle related injuries. Since that time, the use of the AIS has grown and it is now the most frequently used international standardised system for categorising injury type and severity.

An individual AIS code is assigned for each injury. AIS scores are used to calculate the injury severity score (ISS), an overall measure of combined severity of injuries sustained by a patient. The ISS is the sum of the squares of the highest AIS score in each of the three most seriously injured body regions. The six body regions of injuries used in the ISS are: head or neck; face; chest; abdominal or pelvic contents; extremities or pelvic girdle, and external. ISS scores range from 1 to 75. A score of 75 results in one of two ways, either with three AIS 5 injuries, or with at least one AIS 6 injury. It is commonly accepted that an ISS ≥ 16 constitutes ‘serious injury’. Conversely, an ISS < 16 is often termed ‘less serious injury’. At Liverpool Hospital between 1995-2004, 2309 (10.9%) of all injury admissions sustained serious trauma with ISS ≥ 16.

One limitation of the ISS is that it does not assess the combined effects of multiple injuries, that is, if there are multiple injuries to one body region, only the injury with the highest AIS score is included in the ISS calculation. Whilst the ISS is the most commonly used measure of injury severity, several other scales have been developed, many of which aim to address the shortcomings of the ISS system. The bibliography at the conclusion of Chapter 8 includes references on this and related topics.

Here are two typical examples of calculating an ISS. Patient A has an ISS of 22. Patient B has an ISS of 16.

Patient A sustained injuries to multiple body regions, specifically, facial abrasions, diaphragm rupture, a single rib fracture, a minor liver laceration, open fracture of the radius, and a fractured femoral shaft. The three body regions with the highest AIS scores are the chest (AIS 3), abdomen (AIS 2) and extremities (AIS 3). The facial injury is ignored because it is not one of the three most serious injuries. Each of these numbers are squared and then added together to obtain the ISS: $(3^2 + 2^2 + 3^2) = 22$:

AIS body region	Injury description	AIS code	AIS score	Highest AIS	AIS^2
Face	Facial abrasions	210202.1	1	1	
Chest	Diaphragm rupture	440604.3	3	3	9
	Rib fracture	450212.1	1		
Abdomen and pelvic contents	Liver laceration minor	541822.2	2	2	4
Extremities	Radius fractured open	752804.3	3		
	Femur fractured shaft	851814.3	3	3	9
ISS					22

Patient B sustained multiple moderate to severe head injuries. All injuries occur in a single body region, so ISS calculation simply involves squaring the AIS score for the most serious injury, in this case, the cerebral subdural haematoma: ISS = $4^2 = 16$:

AIS body region	Injury Description	AIS code	AIS score	Highest AIS	AIS^2
Head / neck	Cerebrum - small subdural haematoma	140652.4	4	4	16
	Cerebrum - multiple contusions	140614.3	3		
	Skull vault fracture – undisplaced	150402.2	2		
	Cervical spine – odontoid dislocation	650206.3	3		
ISS					16

9.2 ISS summary

This chapter presents ISS data based on admissions to each SWSAHS hospital. The number of SWSAHS admissions is greater than the number of SWSAHS patients due to inter-hospital trauma transfers. Patients undergoing inter-hospital trauma transfer are counted twice, once at the initial presenting hospital (eg. Bankstown Hospital) and once at the receiving hospital (eg. Liverpool Hospital).

The following tables summarise the severity of injury for major data category patients admitted to SWSAHS hospitals. Liverpool Hospital is the designated major trauma service for SWSAHS. Bankstown, Campbelltown, Fairfield and Camden hospitals are designated urban trauma services, and Bowral hospital is the designated rural trauma service.

Table 9.1: Liverpool Hospital ISS summary, major data category, 1995-2004

Year	1-4 Minor		5-8 Minor		9-15 Moderate		16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
1995	170	25.6	106	16.0	236	35.6	73	11.0	66	10.0	5	0.8	7	1.1	663
1996	173	23.4	115	15.6	255	34.5	91	12.3	91	12.3	8	1.1	6	0.8	739
1997	162	22.0	113	15.4	255	34.6	96	13.0	94	12.8	11	1.5	5	0.7	736
1998	160	19.6	136	16.6	318	38.9	99	12.1	92	11.3	7	0.9	5	0.6	817
1999	157	18.8	124	14.9	331	39.7	107	12.8	101	12.1	8	1.0	5	0.6	833
2000	206	20.6	141	14.1	374	37.3	144	14.4	114	11.4	17	1.7	6	0.6	1002
2001	252	21.9	188	16.3	467	40.5	133	11.5	100	8.7	8	0.7	5	0.4	1153
2002	256	22.3	197	17.2	437	38.1	152	13.3	94	8.2	4	0.3	6	0.5	1146
2003	217	21.4	145	14.3	370	36.5	164	16.2	105	10.4	8	0.8	4	0.4	1013
2004	188	18.4	165	16.2	400	39.2	150	14.7	106	10.4	8	0.8	4	0.4	1021
Total	1941	21.3	1430	15.7	3443	37.7	1209	13.3	963	10.6	84	0.9	53	0.6	9123

Table 9.2: Urban hospitals ISS summary (Bankstown, Campbelltown, Fairfield and Camden Hospitals), major data category, 1995-2004

Year	1-4 Minor		5-8 Minor		9-15 Moderate		16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
1995	140	44.0	37	11.6	113	35.5	18	5.7	9	2.8	1	0.3	0	-	318
1996	148	46.1	34	10.6	108	33.6	17	5.3	10	3.1	2	0.6	2	0.6	321
1997	280	47.6	78	13.3	199	33.8	16	2.7	14	2.4	0	-	1	0.2	588
1998	209	34.5	78	12.9	270	44.6	34	5.6	14	2.3	0	-	1	0.2	606
1999	227	37.9	68	11.4	250	41.7	28	4.7	26	4.3	0	-	0	-	599
2000	222	38.1	54	9.3	255	43.8	23	4.0	27	4.6	0	-	1	0.2	582
2001	238	39.6	58	9.7	247	41.1	34	5.7	21	3.5	1	0.2	2	0.3	601
2002	201	37.3	56	10.4	249	46.2	18	3.3	14	2.6	0	-	1	0.2	539
2003	124	34.3	45	12.4	153	42.3	26	7.2	12	3.3	0	-	2	0.6	362
2004	146	38.1	41	10.7	142	37.1	35	9.1	17	4.4	1	0.3	1	0.3	383
Total	1935	39.5	549	11.2	1986	40.5	249	5.1	164	3.3	5	0.1	11	0.2	4899

Table 9.3: Bowral Hospital (rural hospital) ISS summary, major data category, 1995-2004

Year	1-4 Minor		5-8 Minor		9-15 Moderate		16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
1995	27	37.5	13	18.1	17	23.6	11	15.3	4	5.6	0	-	0	-	72
1996	19	54.3	4	11.4	9	25.7	3	8.6	0	-	0	-	0	-	35
1997	31	33.3	13	14.0	34	36.6	8	8.6	7	7.5	0	-	0	-	93
1998	31	27.7	18	16.1	48	42.9	9	8.0	6	5.4	0	-	0	-	112
1999	45	36.9	14	11.5	56	45.9	5	4.1	2	1.6	0	-	0	-	122
2000	30	31.9	12	12.8	38	40.4	8	8.5	6	6.4	0	-	0	-	94
2001	39	37.9	13	12.6	40	38.8	7	6.8	4	3.9	0	-	0	-	103
2002	34	35.1	19	19.6	35	36.1	6	6.2	2	2.1	1	1.0	0	-	97
2003	24	36.4	8	12.1	24	36.4	7	10.6	3	4.5	0	-	0	-	66
2004	32	31.4	20	19.6	29	28.4	11	10.8	10	9.8	0	-	0	-	102
Total	312	34.8	134	15.0	330	36.8	75	8.4	44	4.9	1	0.1	0	-	896

9.3 AIS body regions summary

The following tables present a summary of the AIS scores for to each injury body region.

Table 9.4: AIS scores for body regions, Liverpool Hospital, major data category, 1995-2004 (patients=9123)

AIS body region		AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	AIS 6	Total n	Total %
Head		1189	2357	1874	933	728	14	7095	21.7
Face		2881	1264	185	10			4340	13.3
Neck		237	69	31	8	5		350	1.1
Thorax		1090	1165	1091	377	163	14	3900	11.9
Abdomen and pelvic contents		829	892	482	233	102	5	2543	7.8
Spine		393	1259	468	24	31	8	2183	6.7
Upper extremity		1423	1713	643				3779	11.6
Lower extremity		1381	3316	1967	70	44		6778	20.8
External / burns / other		1470	43	94	21	39	5	1672	5.1
Total injuries	n	10893	12078	6835	1676	1112	46	32640	100.0
	%	33.4	37.0	20.9	5.2	3.4	0.1	100.0	

Table 9.5: AIS scores for body regions, Bankstown Hospital, major data category, 1995-2004 (patients=1773)

AIS body region		AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	AIS 6	Total n	Total %
Head		167	268	139	54	41	3	672	16.8
Face		353	124	14				491	12.3
Neck		9	9	1				19	0.5
Thorax		10	162	33		2	2	209	5.2
Abdomen and pelvic contents		118	151	124	30	8	1	432	10.8
Spine		66	48	18	7			139	3.5
Upper extremity		203	279	97				579	14.5
Lower extremity		152	694	460	2			1308	32.8
External / burns / other		113	5	15	7			140	3.5
Total injuries	n	1191	1740	901	100	51	6	3989	100.0
	%	29.9	43.6	22.5	2.5	1.3	0.2	100.0	

Table 9.6: AIS scores for body regions, Campbelltown Hospital, major data category, 1995-2004 (patients=1849)

AIS body region		AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	AIS 6	Total n	Total %
Head		191	386	158	63	47	2	847	20.2
Face		353	106	15				474	11.3
Neck		31	6	5				42	1.0
Thorax		123	94	116	22	8	1	364	8.7
Abdomen and pelvic contents		108	56	34	15	9		222	5.3
Spine		33	102	54	2	2		193	4.6
Upper extremity		189	275	94				558	13.3
Lower extremity		188	727	409	1			1325	31.5
External / burns / other		148	12	13	4			177	4.2
Total injuries	n	1364	1764	898	107	66	3	4202	100.0
	%	32.5	42.0	21.3	2.5	1.6	0.1	100.0	

Table 9.7: AIS scores for body regions, Fairfield Hospital, major data category, 1995-2004 (patients=977)

AIS body region		AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	AIS 6	Total n	Total %
Head		98	143	48	19	19		327	16.4
Face		147	44	4				195	9.8
Neck		12						12	0.6
Thorax		77	95	67	14	3		256	12.9
Abdomen and pelvic contents		59	38	15	7	3		122	6.1
Spine		17	85	19	2	2		125	6.3
Upper extremity		103	117	55				275	13.8
Lower extremity		81	329	195	2	1		608	30.6
External / burns / other		51	4	10	1	2	1	69	3.5
Total injuries	n	645	855	413	45	30	1	1989	100.0
	%	32.4	43.0	20.7	2.3	1.5	0.1	100.0	

Table 9.8: AIS scores for body regions, Camden Hospital, major data category, 1995-2004 (patients=300)

AIS body region		AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	AIS 6	Total n	Total %
Head		29	51	24	15	9		128	17.7
Face		66	18					84	11.6
Neck		5	1			1		7	1.0
Thorax		28	27	32	8			95	13.2
Abdomen and pelvic contents		25	28	9	1	1		64	8.9
Spine		4	31	17				52	7.2
Upper extremity		51	39	11				101	14.0
Lower extremity		38	88	32				158	21.9
Externa / burns / other		26	1	3	2		1	33	4.6
Total injuries	n	272	284	128	26	11	1	722	100.0
	%	37.7	39.3	17.8	3.6	1.5	0.1	100.0	

Table 9.9: AIS scores for body regions, Bowral Hospital, major data category, 1995-2004 (patients=896)

AIS body region		AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	AIS 6	Total n	Total %
Head		129	216	92	43	21		501	21.0
Face		220	57	6				283	11.9
Neck		11	1	2				14	0.6
Thorax		97	72	90	22	4		285	11.9
Abdomen and pelvic contents		45	34	8	4	3		94	3.9
Spine		11	102	34	4			151	6.3
Upper extremity		127	174	37				338	14.2
Lower extremity		134	316	172		1		623	26.1
External / burns / other		80	6	8	2			96	4.0
Total injuries	n	854	978	449	75	29	-	2385	100.0
	%	35.8	41.0	18.9	3.1	1.2	-	100.0	

9.4 Annual trends for serious injury

Table 9.10: Annual trends for ISS ≥ 16, Liverpool Hospital, 1995-2004

Year	16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total	
	n	%	n	%	N	%	n	%	n	%
1995	73	48.3	66	43.7	5	3.3	7	4.6	151	100.0
1996	91	46.4	91	46.4	8	4.1	6	3.1	196	100.0
1997	96	46.6	94	45.6	11	5.3	5	2.4	206	100.0
1998	99	48.8	92	45.3	7	3.4	5	2.5	203	100.0
1999	107	48.4	101	45.7	8	3.6	5	2.3	221	100.0
2000	144	51.2	114	40.6	17	6.0	6	2.1	281	100.0
2001	133	54.1	100	40.7	8	3.3	5	2.0	246	100.0
2002	152	59.4	94	36.7	4	1.6	6	2.3	256	100.0
2003	164	58.4	105	37.4	8	2.8	4	1.4	281	100.0
2004	150	56.0	106	39.6	8	3.0	4	1.5	268	100.0
Total	1209	52.4	963	41.7	84	3.6	53	2.3	2309	100.0

Table 9.11: Annual trends for ISS ≥ 16, Bankstown Hospital, 1995-2004

Year	16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total	
	n	%	n	%	n	%	n	%	n	%
1995	7	100.0	0	-	0	-	0	-	7	100.0
1996	4	36.4	4	36.4	1	9.1	2	18.2	11	100.0
1997	9	56.3	6	37.5	0	-	1	6.3	16	100.0
1998	13	81.3	3	18.8	0	-	0	-	16	100.0
1999	15	55.6	12	44.4	0	-	0	-	27	100.0
2000	12	60.0	7	35.0	0	-	1	5.0	20	100.0
2001	11	61.1	7	38.9	0	-	0	-	18	100.0
2002	10	58.8	6	35.3	0	-	1	5.9	17	100.0
2003	5	71.4	1	14.3	0	-	1	14.3	7	100.0
2004	16	76.2	5	23.8	0	-	0	-	21	100.0
Total	102	63.8	51	31.8	1	0.6	6	3.8	160	100.0

Table 9.12: Annual trends for ISS ≥ 16, Campbelltown Hospital, 1995-2004

Year	16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total	
	n	%	n	%	n	%	n	%	n	%
1995	7	53.8	6	46.2	0	-	0	-	13	100.0
1996	8	80.0	1	10.0	0	10.0	0	-	10	100.0
1997	2	22.2	7	77.8	0	-	0	-	9	100.0
1998	13	59.1	9	40.9	0	-	0	-	22	100.0
1999	7	38.9	11	61.1	0	-	0	-	18	100.0
2000	7	50.0	7	50.0	0	-	0	-	14	100.0
2001	16	59.3	8	29.6	1	3.7	2	7.4	27	100.0
2002	7	58.3	5	41.7	0	-	0	-	12	100.0
2003	16	72.7	6	27.3	0	-	0	-	22	100.0
2004	7	36.8	10	52.6	1	5.3	1	5.3	19	100.0
Total	90	54.2	70	42.2	3	1.8	3	1.8	166	100.0

Table 9.13: Annual trends for ISS ≥ 16, Fairfield Hospital, 1995-2004

Year	16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total	
	n	%	n	%	n	%	n	%	n	%
1995	3	42.9	3	42.9	1	14.3	0	-	7	100.0
1996	2	28.6	5	71.4	0	-	0	-	7	100.0
1997	4	80.0	1	20.0	0	-	0	-	5	100.0
1998	4	57.1	2	28.6	0	-	1	14.3	7	100.0
1999	4	80.0	1	20.0	0	-	0	-	5	100.0
2000	3	30.0	7	70.0	0	-	0	-	10	100.0
2001	6	60.0	4	40.0	0	-	0	-	10	100.0
2002	1	33.3	2	66.7	0	-	0	-	3	100.0
2003	3	42.9	4	57.1	0	-	0	-	7	100.0
2004	9	90.0	1	10.0	0	-	0	-	10	100.0
Total	39	54.9	30	42.3	1	1.4	1	1.4	71	100.0

Table 9.14: Annual trends for ISS ≥ 16, Camden Hospital, 1995-2004

Year	16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total	
	n	%	n	%	n	%	n	%	n	%
1995	1	100.0	0	-	0	-	0	-	1	100.0
1996	3	100.0	0	-	0	-	0	-	3	100.0
1997	1	100.0	0	-	0	-	0	-	1	100.0
1998	4	100.0	0	-	0	-	0	-	4	100.0
1999	2	50.0	2	50.0	0	-	0	-	4	100.0
2000	1	14.3	6	85.7	0	-	0	-	7	100.0
2001	1	33.3	2	66.7	0	-	0	-	3	100.0
2002	0	-	1	100.0	0	-	0	-	1	100.0
2003	2	50.0	1	25.0	0	-	1	25.0	4	100.0
2004	3	75.0	1	25.0	0	-	0	-	4	100.0
Total	18	56.3	13	40.6	0	-	1	3.1	32	100.0

Table 9.15: Annual trends for ISS ≥ 16, Bowral Hospital, 1995-2004

Year	16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total	
	n	%	n	%	n	%	n	%	n	%
1995	11	73.3	4	26.7	0	-	0	-	15	100.0
1996	3	100.0	0	-	0		0	-	3	100.0
1997	8	53.3	7	46.7	0	-	0	-	15	100.0
1998	9	60.0	6	40.0	0	-	0	-	15	100.0
1999	5	71.4	2	28.6	0	-	0	-	7	100.0
2000	8	57.1	6	42.9	0	-	0	-	14	100.0
2001	7	63.6	4	36.4	0	-	0	-	11	100.0
2002	6	66.7	2	22.2	1	11.1	0	-	9	100.0
2003	7	70.0	3	30.0	0	-	0	-	10	100.0
2004	11	52.4	10	47.6	0	-	0	-	21	100.0
Total	75	62.5	44	36.7	1	0.8	0	-	120	100.0

9.5 Survival outcome for less serious injury

Table 9.16: Survival outcome for ISS ≤ 16, Liverpool Hospital, major data category, 1995-2004

Year	Total patients	Survived		Died	
		n	%	n	%
1995	512	498	97.3	14	2.7
1996	543	539	99.3	4	0.7
1997	530	524	98.9	6	1.1
1998	614	604	98.4	10	1.6
1999	612	597	97.5	15	2.5
2000	721	713	98.9	8	1.1
2001	907	900	99.2	7	0.8
2002	890	876	98.4	14	1.6
2003	732	727	99.3	5	0.7
2004	753	747	99.2	6	0.8
Total	6814	6725	98.7	89	1.3

Table 9.17: Death classification for ISS ≤16, Liverpool Hospital, 1995-2004

Year	CNS	Non-CNS	Fractured NOF	Total
1995	1	4	9	14
1996	0	0	4	4
1997	0	2	4	6
1998	0	4	6	10
1999	0	2	13	15
2000	1	1	6	8
2001	1	2	4	7
2002	0	8	6	14
2003	1	2	2	5
2004	1	3	2	6
Total	5	28	56	89

9.6 Survival outcome for serious injury

The following section presents survival outcome for patients with ISS ≥16. The same group of patients is then presented according to whether the trauma was blunt and penetrating, followed by the respective survival outcomes for these groups.

Table 9.18: Mortality for patients with ISS ≥ 16, Liverpool Hospital, 1995-2004

Year	Patients	Died	
		n	%
1995	151	28	18.5
1996	196	51	26.0
1997	206	37	18.0
1998	203	37	18.2
1999	221	28	12.7
2000	281	37	13.2
2001	246	37	15.0
2002	256	29	11.3
2003	281	33	11.7
2004	268	36	13.4
Total	2309	353	15.3

Table 9.19: Percentage of blunt versus penetrating trauma, ISS ≥ 16, Liverpool Hospital, 1995-2004

Year	Total patients	Blunt trauma		Penetrating trauma	
		n	%	n	%
1995	151	145	96.0	6	4.0
1996	196	175	89.3	21	10.7
1997	206	184	89.3	22	10.7
1998	203	192	94.6	11	5.4
1999	221	208	94.1	13	5.9
2000	281	261	92.9	20	7.1
2001	246	228	92.7	18	7.3
2002	256	236	92.2	20	7.8
2003	281	267	95.0	14	5.0
2004	268	258	96.3	10	3.7
Total	2309	2154	93.3	155	6.7

Table 9.20: Annual trends for blunt and penetrating trauma by survival outcome, ISS ≥ 16, Liverpool Hospital, 1995-2004

Year	Total patients	Blunt trauma				Penetrating trauma			
		Survived		Died		Survived		Died	
		n	%	n	%	n	%	n	%
1995	151	119	78.8	26	17.2	4	2.6	2	1.3
1996	196	131	66.8	44	22.4	14	7.1	7	3.6
1997	206	153	74.3	31	15.0	16	7.8	6	2.9
1998	203	157	77.3	35	17.2	9	4.4	2	1.0
1999	221	184	83.3	24	10.9	9	4.1	4	1.8
2000	281	228	81.1	33	11.7	16	5.7	4	1.4
2001	246	197	80.1	31	12.6	12	4.9	6	2.4
2002	256	214	83.6	22	8.6	13	5.1	7	2.7
2003	281	237	84.3	30	10.7	11	3.9	3	1.1
2004	268	223	83.2	35	13.1	9	3.4	1	0.4
Total	2309	1843	79.8	311	13.5	113	4.9	42	1.8

9.7 Urban and rural hospitals

There were 11 patients with ISS 75. Of these, 3 patients initially survived and died shortly after being transferred out to another hospital, and 2 patients were transferred to a paediatric MTS. Both had sustained cervical spinal cord laceration. One patient, with a gunshot wound to the head, was transferred to Liverpool Hospital.

There were 6 patients with an ISS between 50-74. Three patients died at the first hospital and the other 3 were transferred to Liverpool Hospital where 2 died in the intensive care unit and 1 died in the operating theatre.

Table 9.21: Age distribution by ISS range, SWSAHS urban and rural hospitals, major data category, 1995-2004

Age group (years)	ISS															
	1-4 Minor		5-8 Minor		9-15 Moderate		16-24 Serious		25-49 Severe		50-74 Critical		75 Maximum		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0-14	653	11.3	114	2.0	308	5.3	29	0.5	26	0.4	1	<0.5	3	0.1	1134	19.6
15-24	296	5.1	123	2.1	375	6.5	47	0.8	37	0.6	2	<0.5	3	0.1	883	15.2
25-34	225	3.9	108	1.9	302	5.2	42	0.7	32	0.6	0	-	0	-	709	12.2
35-44	174	3.0	100	1.7	246	4.2	41	0.7	16	0.3	1	<0.5	3	0.1	581	10.0
45-54	171	3.0	50	0.9	211	3.6	37	0.6	19	0.3	0	-	0	-	488	8.4
55-64	138	2.4	40	0.7	198	3.4	38	0.7	16	0.3	2	<0.5	0	-	432	7.5
65-74	178	3.1	53	0.9	196	3.4	34	0.6	17	0.3	0	-	2	<0.5	480	8.3
75-84	265	4.6	64	1.1	283	4.9	36	0.6	31	0.5	0	-	0	-	679	11.7
85+	147	2.5	31	0.5	197	3.4	20	0.3	14	0.2	0	-	0	-	409	7.1
Total	2247	38.8	683	11.7	2316	40.0	324	5.6	208	3.6	6	0.1	11	0.2	5795	100.0

Table 9.22: Annual admissions with ISS ≥ 16, SWSAHS urban and rural hospitals, 1995-2004

Year	Total patients	Bankstown		Campbelltown		Fairfield		Camden		Bowral	
		n	%	n	%	n	%	n	%	n	%
1995	43	7	16.3	13	30.2	7	16.3	1	2.3	15	34.9
1996	34	11	32.4	10	29.4	7	20.6	3	8.8	3	8.8
1997	46	16	34.8	9	19.6	5	10.9	1	2.2	15	32.6
1998	61	15	24.6	22	36.1	6	9.8	4	6.6	14	23.0
1999	59	25	42.4	18	30.5	5	8.5	4	6.8	7	11.9
2000	65	20	30.8	14	21.5	10	15.4	7	10.8	14	21.5
2001	69	18	26.1	27	39.1	10	14.5	3	4.3	11	15.9
2002	42	17	40.5	12	28.6	3	7.1	1	2.4	9	21.4
2003	50	7	14.0	22	44.0	7	14.0	4	8.0	10	20.0
2004	25	14	56.0	4	16.0	2	8.0	1	4.0	4	16.0
Total	494	150	30.4	151	30.6	62	12.6	29	5.9	102	20.6

Table 9.23: Survival outcome and ISS, SWSAHS urban and rural hospitals, major data category, 1995-2004

Hospital	Total patients	Died		ISS	
		n	%	Total patients	Died
Bankstown	1773	82	4.6	8.1 ± 6.5 (1-75)	13.2 ± 14.3 (1-75)
Campbelltown	1849	39	2.1	8.1 ± 6.5 (1-75)	17.3 ± 19.1 (4-75)
Fairfield	977	29	3.0	7.7 ± 5.9 (1-75)	15.3 ± 16.4 (4-75)
Camden	300	5	1.7	8.3 ± 7.2 (1-75)	42.6 ± 19.3 (26-75)
Bowral	896	14	1.6	8.8 ± 6.6 (1-57)	16.6 ± 12.4 (4-43)
Total	5795	169	2.9	8.1 ± 6.4 (1-75)	15.6 ± 16.5 (1-75)

Table 9.24: Admissions by age group and survival outcome, SWSAHS urban and rural hospitals, major data category, 1995-2004

Age group (years)	Total patients	Survived		Died	
		n	%	n	%
0-14	1134	1128	99.5	6	0.5
15-24	883	876	99.2	7	0.8
25-34	709	705	99.4	4	0.6
35-44	581	574	98.8	7	1.2
45-54	488	485	99.4	3	0.6
55-64	432	429	99.3	3	0.7
65-74	480	461	96.0	19	4.0
75-84	679	626	92.2	53	7.8
85+	409	342	83.6	67	16.4
Total	5795	5626	97.1	169	2.9

Deaths – Injury Body Region and AIS Score

Table 9.25: Injury body region and AIS score for patients who died, SWSAHS urban and rural hospitals, 1995-2004 (n=169)

AIS description		AIS Score						Total
Region	Sub region	1	2	3	4	5	6	
Head	Internal organs			10	7	12	1	30
	Level of consciousness			1		3		4
	Skeletal		4	3	2			9
	Whole area	11					3	14
Head total		11	4	14	9	15	4	57
Face	Internal organs	1						1
	Skeletal	3	4					7
	Whole area	14						14
Face total		18	4					22
Neck	Vessels			3				3
	Whole area	2	1					3
Neck total		2	1	3				6
Spine	Cervical spine					2		2
	Lumbar spine		3	1				4
	Thoracic spine					2		2
Spine total			3	1		4		8
Thorax	Internal organs		3	8	8	4	2	25
	Skeletal	2	3	2	6	3		16
	Vessels				4	1		5
	Whole area	7	1	3				11
Thorax total		9	7	13	18	8	2	57
Abdomen and pelvic contents	Internal organs		4	6	11	1		22
	Vessels				2	2		4
	Whole area	1		2				3
Abdomen and pelvic contents total		1	4	8	13	3		29
Upper extremity	Muscle-tendons-ligaments	1						1
	Skeletal-bones		9	4				13
	Skeletal-joints	3						3
	Vessels	1						1
	Whole area	13	1					14
Upper extremity total		18	10	4				32
Lower extremity	Skeletal-bones		19	116	1	1		137
	Skeletal-joints	2						2
	Vessels			1	1			2
	Whole area	14		2				16
Lower extremity total		16	19	119	2	1		157
External,/ burns / other	Burns	1					1	2
	Skin and subcutaneous tissue	11						11
	Other trauma						1	1
External / burns / other total		12					2	14
Grand total		87	52	162	42	31	8	382

References

1. Association for the Advancement of Automotive Medicine. The Abbreviated Injury Scale 1990 Revision, Update 98. Barrington (IL) USA: Association for the Advancement of Automotive Medicine; 2001.

10 Outcome Measures

Executive comment

The outcome measures captured by the registry include length of stay, intensive care stay and mortality. It is recognised internationally that while these are crude outcome measures they are none the less the most measurable outcome measures currently available. Ideally functional outcomes should be recorded for each injury event however until standardised outcome measures are agreed upon and the data collection process is resourced to record these the resource limitations are prohibitive for such data collection.

It is clear from the data presented that survival is improving but further improvements in survival are going to require the development of new and innovative systems and clinical strategies for the delivery of trauma care. In addition, it is pleasing to note that both the Z scores and standardised mortality rates, compared to major trauma outcome studies of the North American continent, (albeit some years old now) show a favourable mortality outcome for South West Sydney Area Health Service.

Outcome analysis is fraught with lack of statistical power and it is encouraging that we have been in a position to have large volumes of patients captured in the registry enabling some meaningful analysis.

Recommendations

1. National trauma outcome measures need to be defined and reported.
2. Functional outcome measures are essential for the future enhancement and improvement of the trauma service.

10.1 Survival outcome summary

Table 10.1: Trauma patients survival outcome, SWSAHS hospitals, 1995-2004

Year	Total Patients	Survived		Died	
		n	%	n	%
1995	4404	4349	98.8	55	1.2
1996	4426	4362	98.6	64	1.4
1997	4647	4593	98.8	54	1.2
1998	4742	4676	98.6	66	1.4
1999	4639	4570	98.5	69	1.5
2000	4710	4644	98.6	66	1.4
2001	4740	4678	98.7	62	1.3
2002	4773	4702	98.5	71	1.5
2003	4145	4089	98.6	56	1.4
2004	4052	4006	98.9	46	1.1
Total	45278	44669	98.7	609	1.3

Table 10.2: Trauma patients survival outcome, Liverpool Hospital, 1995-2004

Year	Total Patients	Survived		Died	
		n	%	n	%
1995	1700	1658	97.5	42	2.5
1996	1848	1793	97.0	55	3.0
1997	1802	1759	97.6	43	2.4
1998	1939	1892	97.6	47	2.4
1999	1911	1868	97.7	43	2.3
2000	2184	2139	97.9	45	2.1
2001	2393	2349	98.2	44	1.8
2002	2648	2605	98.4	43	1.6
2003	2429	2391	98.4	38	1.6
2004	2389	2347	98.2	42	1.8
Total	21243	20801	97.9	442	2.1

10.2 Survival outcome by mechanism of injury

Table 10.3: Survival outcome by mechanism of injury, SWSAHS hospitals, 1995-2004

Mechanism	Patients		Died		Survived ISS				Died ISS			
	n	%	n	%	mean		sd	range	mean		sd	range
Fall < 5m	17522	38.7	279	45.8	5.5	±	3.8	(1-59)	13.5	±	9.5	(1-75)
Recreation	4640	10.2	3	0.5	4.3	±	2.8	(1-43)	28.3	±	4.9	(25-34)
Other	4482	9.9	4	0.7	2.8	±	2.9	(1-48)	29.0	±	8.0	(25-41)
Industrial	4094	9.0	12	2.0	3.3	±	3.4	(1-50)	60.2	±	21.3	(26-75)
MVC driver	2773	6.1	75	12.3	8.2	±	8.3	(1-66)	42.5	±	20.0	(5-75)
Assault	2186	4.8	22	3.6	6.0	±	6.1	(1-41)	30.5	±	16.3	(9-75)
MBC rider	1681	3.7	22	3.6	7.8	±	7.4	(1-75*)	44.7	±	13.2	(27-75)
Pedestrian	1214	2.7	67	11.0	9.8	±	9.7	(1-75*)	43.2	±	19.0	(5-75)
Burns	1119	2.5	5	0.8	3.3	±	6.1	(1-75*)	30.0	±	26.0	(9-75)
Cyclist not vs. vehicle	1047	2.3	0	-	4.3	±	3.9	(1-75*)	-		-	-
MVC front passenger	993	2.2	22	3.6	8.6	±	8.8	(1-57)	40.6	±	15.0	(13-66)
Stabbing	806	1.8	16	2.6	6.5	±	6.9	(1-35)	47.6	±	26.0	(17-75)
Not known	555	1.2	0	-	3.4	±	2.8	(1-26)	-	±	-	-
MVC back passenger	472	1.0	15	2.5	7.9	±	9.2	(1-75*)	45.7	±	17.4	(14-75)
Fall ≥ 5m	367	0.8	18	3.0	10.0	±	8.4	(1-43)	36.5	±	16.7	(8-75)
Dog bite	354	0.8	0	-	1.2	±	1.0	(1-14)	-		-	-
Fall from horse	349	0.8	1	0.2	6.6	±	5.0	(1-34)	38.0		-	-
Cyclist vs. vehicle	267	0.6	5	0.8	9.1	±	8.1	(1-59)	46.6	±	10.5	(38-59)
Gunshot	236	0.5	31	5.1	7.3	±	7.0	(1-35)	45.3	±	23.0	(16-75)
MBC pillion	71	0.2	0	-	7.8	±	7.1	(1-35)	-		-	-
Hanging	50	0.1	12	2.0	8.7	±	7.2	(1-26)	25.2	±	0.4	(25-26)
Total	45278	100.0	609	100.0	5.3	±	5.3	(1-75*)	28.8	±	21.1	(1-75)

* These patients sustained unsurvivable injuries, however were alive when transferred out to another major trauma service (eg. burns or paediatrics)

Table 10.4: Survival outcome by mechanism of injury, Liverpool Hospital, 1995-2004

Mechanism	Patients		Died		Survived ISS				Died ISS			
	n	%	n	%	mean		sd	range	mean		sd	range
Fall < 5m	6226	29.3	143	32.4	6.1	±	4.8	(1-59)	17.3	±	11.4	(4-75)
MVC driver	2151	10.1	74	16.7	9.1	±	8.7	(1-66)	42.5	±	20.2	(5-75)
Industrial	1882	8.9	10	2.3	3.8	±	4.5	(1-50)	62.1	±	19.9	(26-75)
Other	1741	8.2	3	0.7	2.9	±	3.7	(1-48)	25.0		-	-
Recreation	1675	7.9	3	0.7	4.7	±	3.9	(1-43)	28.3	±	4.9	(25-34)
Assault	1444	6.8	18	4.1	7.1	±	6.8	(1-41)	29.3	±	12.4	(16-75)
MBC rider	1013	4.8	20	4.5	9.6	±	8.6	(1-75*)	45.1	±	13.9	(27-75)
Pedestrian	899	4.2	56	12.7	11.2	±	10.4	(1-75*)	43.3	±	17.8	(9-75)
MVC front passenger	791	3.7	22	5.0	9.4	±	9.3	(1-57)	40.6	±	15.0	(13-66)
Stabbing	651	3.1	14	3.2	7.0	±	7.2	(1-35)	47.7	±	25.6	(17-75)
Burns	567	2.7	5	1.1	4.5	±	7.8	(1-75*)	30.0	±	26.0	(9-75)
Cyclist not vs. vehicle	386	1.8	0	-	5.0	±	5.5	(1-75*)	-		-	-
MVC back passenger	360	1.7	15	3.4	8.7	±	9.3	(1-75*)	45.7	±	17.4	(14-75)
Fall ≥ 5m	324	1.5	17	3.8	10.6	±	8.6	(1-43)	35.7	±	16.9	(8-75)
Not known	305	1.4	0	-	3.4	±	3.3	(1-26)	-	±	-	-
Cyclist vs. vehicle	209	1.0	5	1.1	9.4	±	8.6	(1-59)	46.6	±	10.5	(38-59)
Gunshot	195	0.9	26	5.9	8.0	±	7.1	(1-35)	46.6	±	23.6	(16-75)
Dog bite	175	0.8	0	-	1.2	±	0.7	(1-4)	-		-	-
Fall from horse	158	0.7	1	0.2	7.9	±	5.8	(1-34)	38.0	±	-	-
MBC pillion	48	0.2	0	-	9.2	±	7.4	(1-35)	-		-	-
Hanging	43	0.2	10	2.3	9.5	±	7.4	(1-26)	25.2	±	0.4	(25-26)
Total	21243	100.0	442	100.0	6.5	±	6.8	(1-75*)	33.9	±	20.6	(4-75)

* These patients sustained unsurvivable injuries, however were alive when transferred out to another major trauma service (eg. burns or paediatrics)

Figure 10.1: Deaths following trauma by mechanism of injury, SWSAHS, 1995-2004 (n=609)

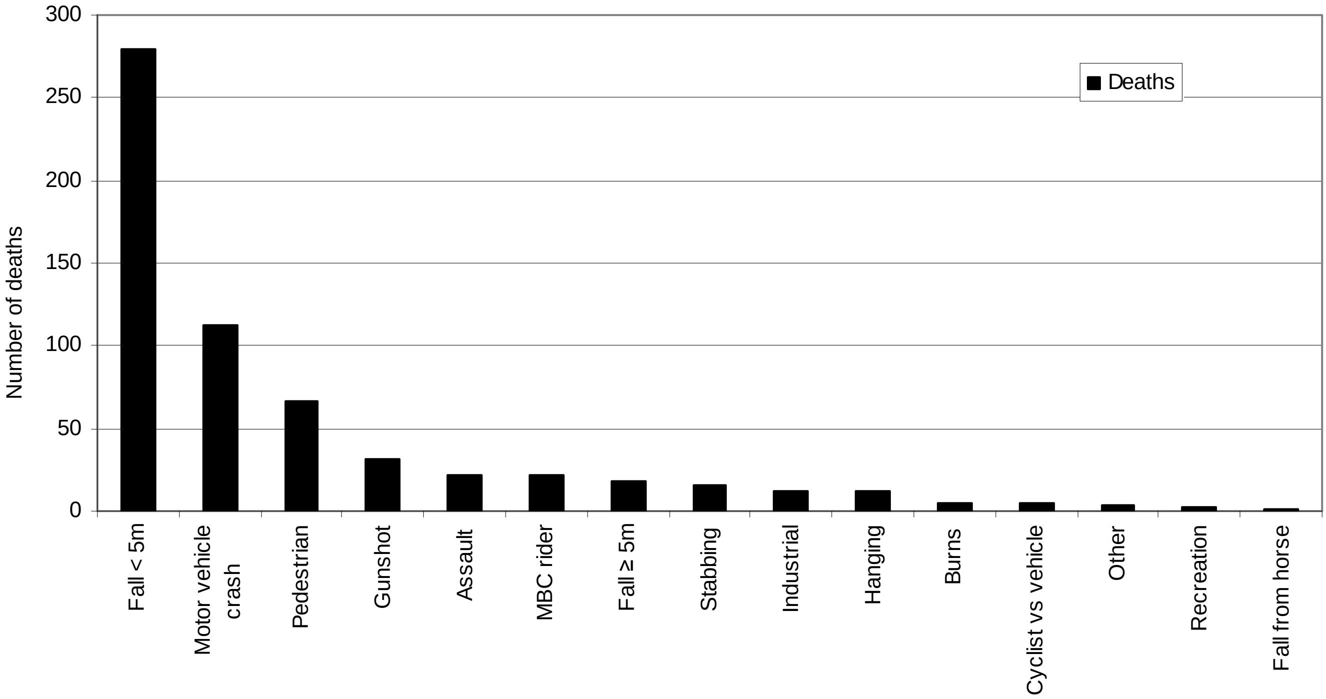
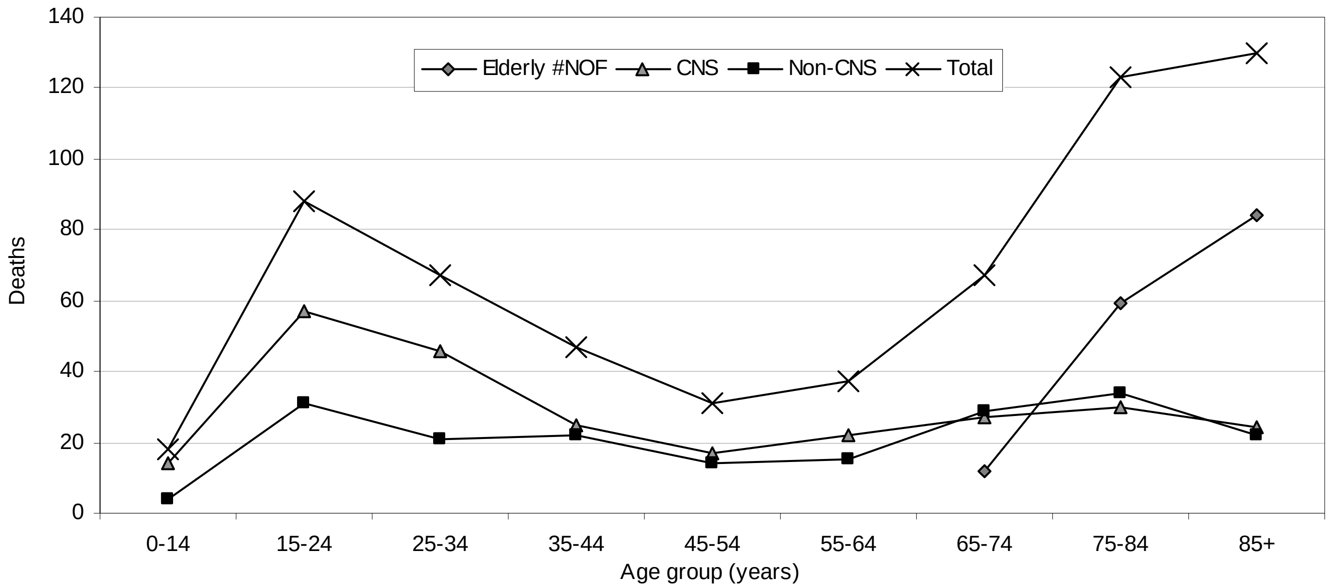


Figure 10.2: Deaths following trauma by age group and type of injury, SWSAHS, 1995-2004 (n=609)

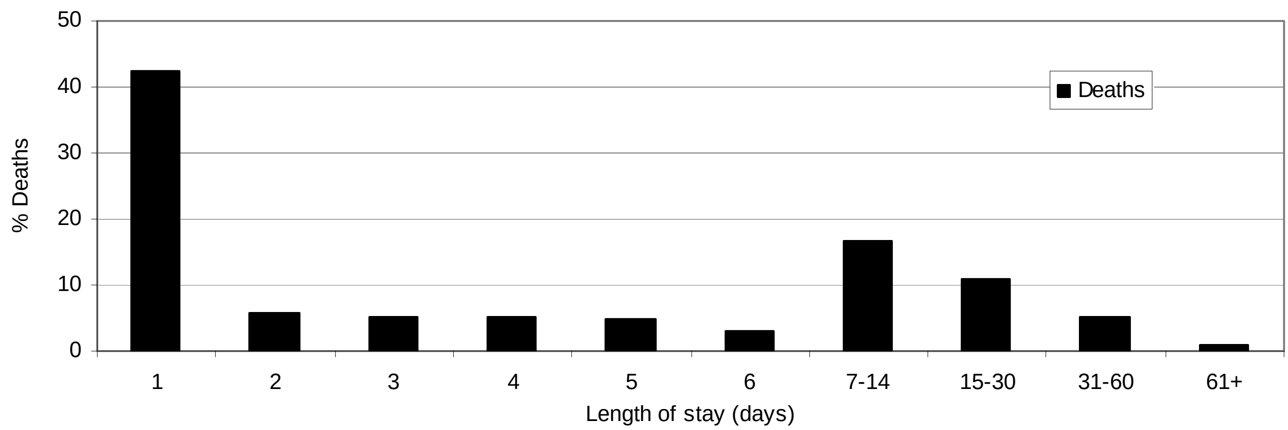


Elderly #NOF: Patient aged ≥ 65 years with an isolated fractured neck of femur following a fall < 1m.

CNS: Death following trauma as a result of head or spinal injuries

Non-CNS: Death following trauma as a result of all other injuries excluding CNS and #NOF.

Figure 10.3: Length of stay (LOS) for trauma deaths, SWSAHS hospitals, 1995-2004 (n=609)



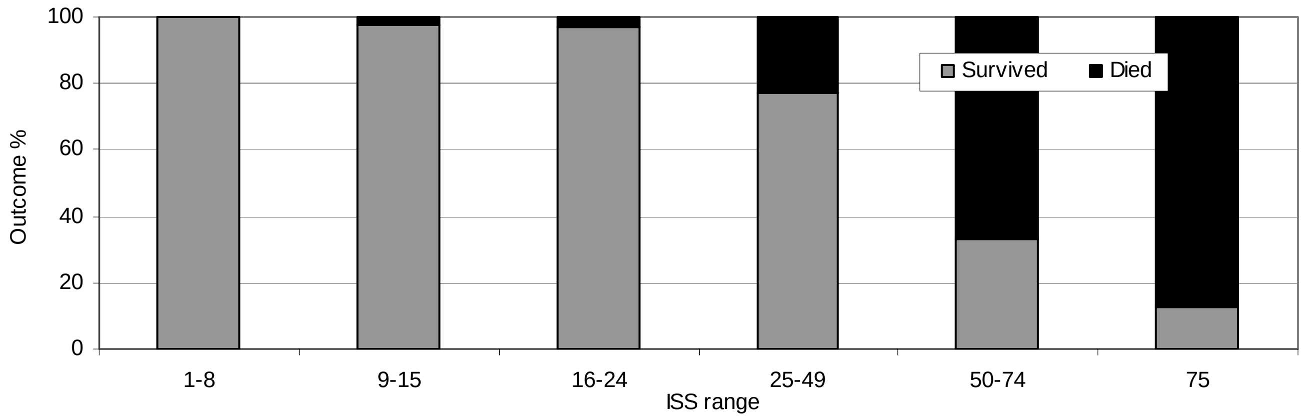
10.3 ISS trends and survival outcome

Table 10.5: ISS range and survival outcome, SWSAHS, 1995-2004

ISS range	Total patients	Survived		Died	
		n	%	n	%
1-8	33800	33773	99.9	27	0.1
9-15	8926	8735	97.9	191	2.1
16-24	1363	1323	97.1	40	2.9
25-49	1040	801	77.0	239	23.0
50-74	87	29	33.3	58	66.7
75*	62	8*	12.9	54	87.1
Total	45278	44669	98.7	609	1.3

*Eight patients with an ISS of 75 (unsurvivable injury) initially survived. They died following transfer out to another major trauma service.

Figure 10.4: Survival outcome* by ISS range, SWSAHS hospitals, 1995-2004 (n=45278)



*Eight patients with an ISS of 75 (unsurvivable injury) initially survived. They died following transfer out to another major trauma service.

Table 10.6: ISS Annual trends for survival outcome by ISS, all injuries, SWSAHS hospitals, 1995-2004

Year	All patients			Survived ISS			Died ISS		
	mean		sd	mean		sd	mean		sd
1995	4.9	±	5.9	4.6	±	4.8	35.7	±	21.4
1996	5.2	±	6.3	4.8	±	4.7	38.0	±	17.9
1997	5.4	±	6.4	5.1	±	5.0	41.1	±	20.8
1998	5.6	±	5.9	5.3	±	4.8	34.0	±	19.7
1999	5.8	±	6.2	5.5	±	5.2	36.1	±	20.5
2000	6.0	±	6.7	5.7	±	5.6	37.0	±	21.8
2001	5.8	±	6.3	5.5	±	5.1	37.0	±	20.6
2002	5.7	±	5.9	5.5	±	5.0	30.5	±	23.0
2003	5.9	±	6.4	5.7	±	5.7	29.8	±	18.6
2004	6.0	±	6.5	5.7	±	5.4	36.2	±	19.7
Total	5.6	±	6.3	5.3	±	5.2	35.6	±	20.4

Figure 10.5: Annual death rate for patients with ISS ≥ 16, SWSAHS hospitals, 1995-2004 (n=2552, deaths=391)

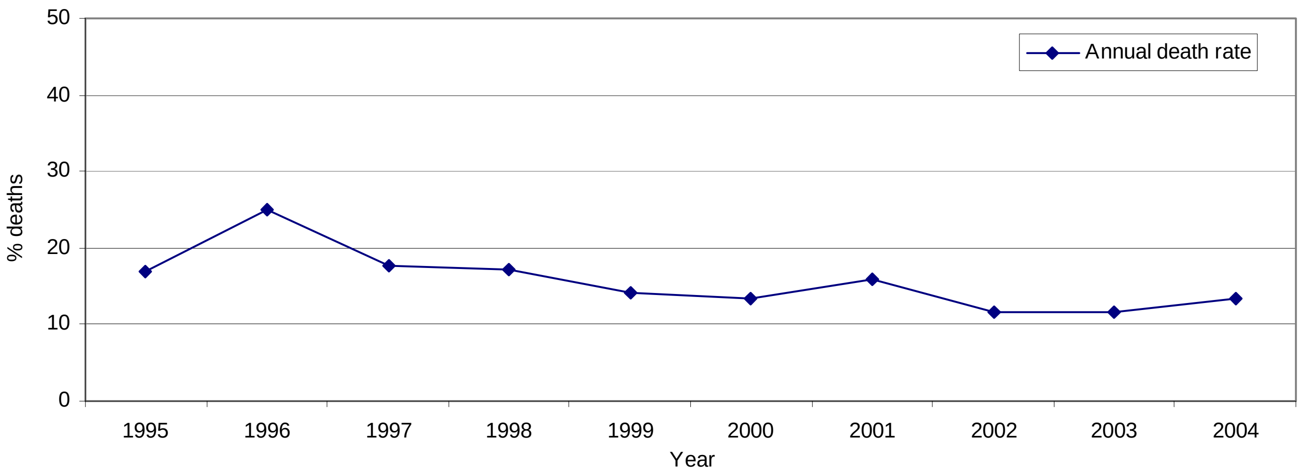
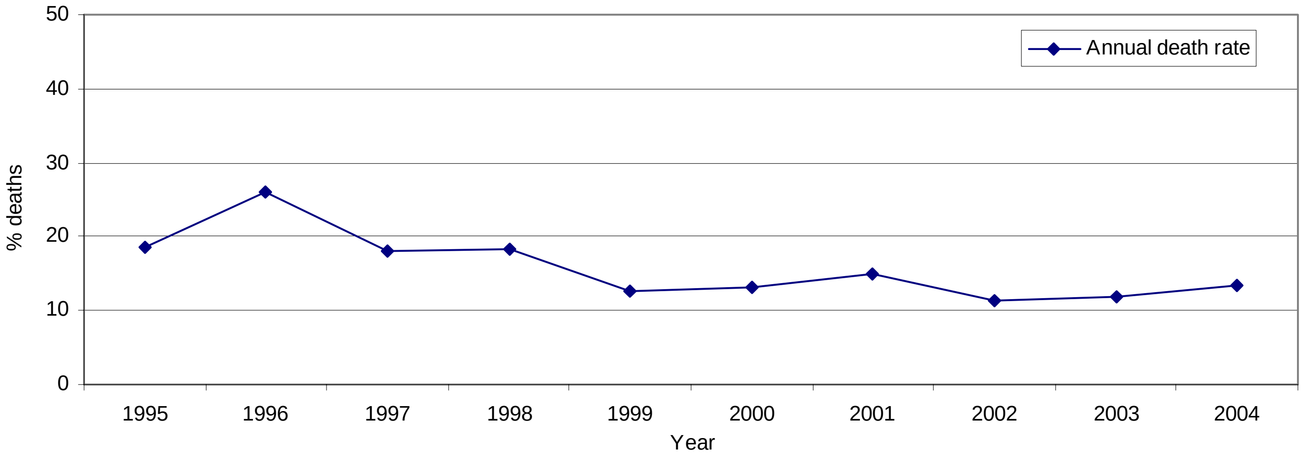


Table 10.7: Annual trends for survival outcome by ISS, all injuries, Liverpool Hospital, 1995-2004

Year	All patients			Survived ISS			Died ISS		
	mean		sd	mean		sd	mean		sd
1995	6.7	±	8.3	6.1	±	6.5	36.8	±	21.1
1996	7.0	±	8.7	6.1	±	6.4	37.9	±	17.2
1997	7.3	±	9.1	6.5	±	6.9	42.9	±	19.9
1998	7.0	±	8.2	6.3	±	6.5	36.3	±	18.6
1999	7.4	±	8.7	6.8	±	7.2	42.3	±	19.5
2000	7.6	±	9.0	7.0	±	7.4	40.8	±	20.8
2001	7.1	±	8.0	6.6	±	6.6	36.8	±	19.3
2002	6.6	±	7.4	6.3	±	6.3	32.5	±	22.2
2003	7.1	±	8.0	6.7	±	7.1	32.9	±	18.3
2004	7.3	±	8.0	6.8	±	6.7	36.4	±	18.9
Total	7.1	±	8.3	6.5	±	6.8	37.5	±	19.6

Figure 10.6: Annual trends in survival outcome for patients with ISS ≥ 16, Liverpool Hospital, 1995-2004 (n=2309, deaths=353)



10.4 Statistical models for evaluating injury severity

Several scales have been developed to quantify injury severity.

Trauma Score

The trauma score (TS) is a modification of the mathematically derived triage index. TS is based on the Glasgow Coma Scale (GCS), as well as on assessments of cardiovascular status (capillary return and systolic blood pressure) and respiratory status (rate and effort). Weighted values assigned to the variable are added to obtain the TS.

Revised Trauma Score

The revised trauma score (RTS) is based on GCS, systolic blood pressure (SBP), and respiratory rate (RR). Variables are assigned coded values from 0 to 4 (normal). A coded value of 1 to 3 indicates the need for care in a designated trauma centre. (1) For evaluation of in-hospital outcome, coded values of GCS, SBP and RR are weighted and summed to yield the RTS which take values from 0 to 7.84. Higher values are associated with a better prognosis. RTS provides more accurate predictions for patients with serious head injury and is more reliable for predicting outcome than TS. (1)

RTS:	GCS	SBP (mmHg)	RR (per minute)	Coded Value
	13-15	>89	10-29	4
	9-12	76-89	>29	3
	6-8	50-75	6-9	2
	4-5	1-49	1-5	1
	3	0	0	0

RTS = (0.9368 GCS[c]) + (0.7326 SBP[c]) + (0.2908 RR[c]) where [c] is the coded value. (1)

Abbreviated Injury Scale

Early work characterising the severity of individual injuries was conducted by De Haven at Cornell in the 1950s. Work on The Abbreviated Injury Scale (AIS) [2] began in 1969. The AIS lists several hundred injuries, each of which is assigned a score of 1 (minor injuries) to 6 (unsurvivable injury). AIS has been revised several times. The most recent revision in use in Australia AIS-90, 98 revision. The next version AIS 2005, is due for release in Australia shortly. The 1985 version, for the first time, provided severity scores for penetrating injuries. In addition to the severity score, the AIS also assigns a five-digit code as an injury descriptor, in a similar manner to other clinical classification systems such as The International Classification of Diseases (ICD).

The AIS is an ordinal scale, that is, the difference in injury severity between AIS scores 1 and 2 is not the same as the difference between scores 4 and 5. [2]

Injury Severity Score

The ISS is the sum of the squares of the highest AIS code in each of the three most severely injured body regions. [2] The ISS is the mainstay of anatomical scoring systems. It has strong predictive power for morbidity. The ISS takes values from 1 to 75, however within this range there are 31 values that are not mathematically possible due to the way AIS scores are structured. All patients with AIS 6 (that is, an unsurvivable injury) are assigned an ISS of 75. Chapter 9 contains two examples of how the ISS is calculated from AIS codes.

ISS correlates with mortality, but has documented limitations. It only considers the highest AIS score from the 3 most seriously injured body regions, and considers injuries with equal AIS scores to be of equal severity, regardless of body region. Despite it’s shortcomings, the ISS is straightforward to calculate and provides meaningful, standardised information, and therefore remains the most frequently used summary measure of injury severity. ‘Mean ISS’ is a statistic frequently reported in trauma literature and presentations. Whilst this only provides an approximate value (as the variables used to calculate the ISS are ordinal, and not continuous), it does provide useful information and is therefore included in this report.

Major Trauma Outcome Study and the Trauma Injury Severity Score

Much of our recent knowledge on trauma indices has come from the Major Trauma Outcome Study (MTOS) [3], which began in 1982 to refine methods for injury severity scoring, to establish national normative outcomes for trauma, and to provide trauma care institutions with objective evaluations of quality assurance and outcome.

The RTS, assessed at admission and at other times, provides physiological information that can be used for pre-hospital and inter-hospital triage. When combined with an ISS, patient age, and type of injury, the resulting indices can be used for quality assurance and benchmarking of patient outcome. This process results in the trauma injury severity score, or TRISS.

TRISS[4] is based on RTS, ISS, age and type of injury in a regression formula (using a retrospective injured patients database and a logistical model). Values for these factors are weighted and summed in order to yield TRISS, which has a value between 0 and 1. The TRISS methodology is used to calculate the probability of survival (Ps) of an injured patient. Using available TRISS we can calculate the number of patients who would be expected to die following trauma in a group of patients. Not all admitted patients have a TRISS score, as all factors must be presented in order for TRISS to be calculated.

Ps = 1 / (1 + (e-b))
Where Ps = probability of survival
e = 2.7183 (base of Naperian logarithms)
b = b0 + b1(RTS) + b2 (ISS) + b3 (age)

TRISS regression weights:

Trauma Type	b0	b1 (RTS)	b2 (ISS)	b3 (Age)
Blunt	-1.3054	0.9756	-0.0807	-1.9829
Penetrating	-1.8973	1.0069	-0.0885	-1.1422

Where RTS = Revised Trauma Score on ED admission
ISS = Injury Severity Score
A = 1 if Age > 54 years
A = 0 if Age ≤ 54 years

10.5 Statistical models for evaluating trauma care

Standardised mortality ratio

The standardised mortality ratio (SMR) is estimated using the TRISS generated survival probabilities. It is the ratio of observed to expected deaths. An SMR > 1 indicates decreased performance, and < 1 increased performance, compared to MTOS norms. [4,5]

Standardised mortality ratio = Observed / expected deaths

Z statistic

TRISS methodology is used to calculate the Z statistic [6,7] which gives a comparison of outcome compared to a baseline population data established by the Major Trauma Outcome Study (MTOS). A Z statistic value outside –1.96 and +1.96 indicates that the difference between the test population and the base line population in the number of survivors or deaths is significant at P<0.05 level. As it is a mortality analysis a negative value is desired. The formula for the Z statistic when considering mortality is:

Z = Actual deaths - predicted deaths / square root (pred deaths x pred survivors)

W statistic

Because clinically unimportant deviations from the norm can still result in a Z statistic that appears significant, the W statistic was developed to quantify the clinical significance of statistically significant Z scores. W is the difference between the predicted number of survivors (given by summing the predicted survival probabilities for each patient) and the actual number of survivors, divided by the total number of patients divided by 100. This is the number of excess survivors per 100 patients, compared with the predictions.
A W score > 1 is desirable, as it indicates that more patients survived than predicted by TRISS.

$$W = \left(\frac{\text{Actual survivors - predicted survivors x 100}}{\text{Number of patients}} \right)$$

Further reading

Many attempts have been made to evaluate injury severity and best practice for trauma care. Each system of evaluation has its own strengths and limitations. TRISS, for example, tends to have limitations with certain sub-groups of patients, especially penetrating trauma and major blunt trauma. A great deal of literature is available in this area. Suggestions for further reading are provided in the bibliography at the conclusion of this chapter.

10.6 Mortality outcome analysis

Summary

TRISS is calculated for major data category patients. The tables below present all major data category patients with a TRISS score. TRISS is unable to be calculated if the necessary physiological data (GCS, SBP, RR) are missing.

- A negative Z score is desirable as it reflects less patients died than predicted by TRISS
- A positive W score is desirable as it reflects more patients survived than predicted by TRISS.

NB. This section excludes patients aged ≥ 65 years who sustained an isolated fractured neck of femur following a fall < 1m.

Table 10.8: Patients with TRISS, SWSAHS hospitals, 1995-2004

Year	n with TRISS	Death	Pdeath*	Z	SMR†	W
1995	878	37	42.00	-1.12	0.88	0.57
1996	956	55	57.98	-0.58	0.95	0.31
1997	1152	45	63.61	-3.48	0.71	1.62
1998	1282	49	59.64	-2.00	0.82	0.83
1999	1256	41	61.80	-4.03	0.66	1.66
2000	1348	45	58.45	-2.58	0.77	1.00
2001	1503	48	59.54	-2.14	0.81	0.77
2002	1426	44	53.77	-1.87	0.82	0.69
2003	1183	43	56.08	-2.55	0.77	1.11
2004	1120	42	54.07	-2.35	0.78	1.08
Total	12104	449	566.95	-7.23	0.79	0.97

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Table 10.9: Patients with TRISS, Liverpool Hospital, 1995-2004

Year	n with TRISS	Death	Pdeath*	Z	SMR†	W
1995	636	33	35.17	-0.56	0.94	0.34
1996	722	51	50.57	0.09	1.01	-0.06
1997	722	39	52.98	-3.09	0.74	1.94
1998	797	41	50.49	-2.09	0.81	1.19
1999	807	30	51.44	-4.71	0.58	2.66
2000	972	39	51.32	-2.59	0.76	1.27
2001	1114	40	49.58	-1.95	0.81	0.86
2002	1091	37	47.14	-2.12	0.78	0.93
2003	949	36	50.17	-2.95	0.72	1.49
2004	926	39	48.99	-2.06	0.80	1.08
Total	8736	385	487.86	-7.00	0.79	1.18

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Table 10.10: Patients with TRISS, SWSAHS urban and rural hospitals (Bankstown, Campbelltown, Fairfield, Camden, Bowral), 1995-2004

Year	n with TRISS	Death	Pdeath*	Z	SMR†	W
1995	242	4	6.83	-1.33	0.59	1.17
1996	234	4	7.41	-1.75	0.54	1.46
1997	430	6	10.63	-1.61	0.56	1.08
1998	485	8	9.15	-0.42	0.87	0.24
1999	449	11	10.36	0.26	1.06	-0.14
2000	376	6	7.13	-0.53	0.84	0.30
2001	389	8	9.96	-0.88	0.80	0.50
2002	335	7	6.63	0.17	1.06	-0.11
2003	234	7	5.91	0.61	1.19	-0.47
2004	194	3	5.09	-1.23	0.59	1.08
Total	3368	64	79.10	-2.13	0.81	0.45

* Pdeath = Probability of death

† SMR = standardised mortality ratio

10.7 2004 Snapshot

In 2004, four patients died following trauma at a SWSAHS urban or rural hospital (ie. hospitals other than Liverpool). A closer examination of these patients reveals that two patients were ambulance transport category 7, that is, a dying patient and/or a patient with a threatened or obstructed airway. The first Category 7 patient sustained a gunshot wound, received CPR en-route to hospital and subsequently died in the operating theatre. The second Category 7 patient sustained an unsurvivable head injury, also received CPR en-route and died in the Emergency Department.

The remaining two patients were both elderly. Both had significant co-morbidities. One sustained a subdural haemorrhage and the other fractured ribs.

NB. This section excludes patients aged ≥ 65 years who sustained an isolated fractured neck of femur following a fall < 1m.

Table 10.11: Deaths following trauma, SWSAHS urban and rural hospitals (Bankstown, Campbelltown, Fairfield, Camden, Bowral), 2004

Age	Description	ISS	TRISS
38	Ambulance category 7. Gunshot wound. Pre-hospital and ED CPR. Died in operating theatre.	32	Unavailable*
73	Fall < 1m. Fractured ribs. Multiple co-morbidities, previous CVA. For palliative care.	4	0.9827
19	Ambulance category 7. Pedestrian hit by car, unsurvivable head injury. Pre-hospital CPR. Died in ED.	75	0
86	Fall < 1m at nursing home. Acute on chronic SDH up to 3cm. On warfarin. Died in ED.	25	0.2121

* Unavailable = TRISS unable to be calculated due to insufficient data

10.8 MTOS criteria

This section includes patients admitted to Liverpool Hospital meeting MTOS inclusion criteria, that is:

- All trauma deaths, including patients who died in the Emergency Department
- All trauma patients admitted for 72 hours or more due to injury
- All inter-hospital transfers for treatment of acute injury
- All injured patients treated in Intensive Care (patient to nurse ratio 2:1 or greater)

NB. Patients aged ≥ 65 years who sustained an isolated fractured neck of femur following a fall < 1m have been excluded from this section.

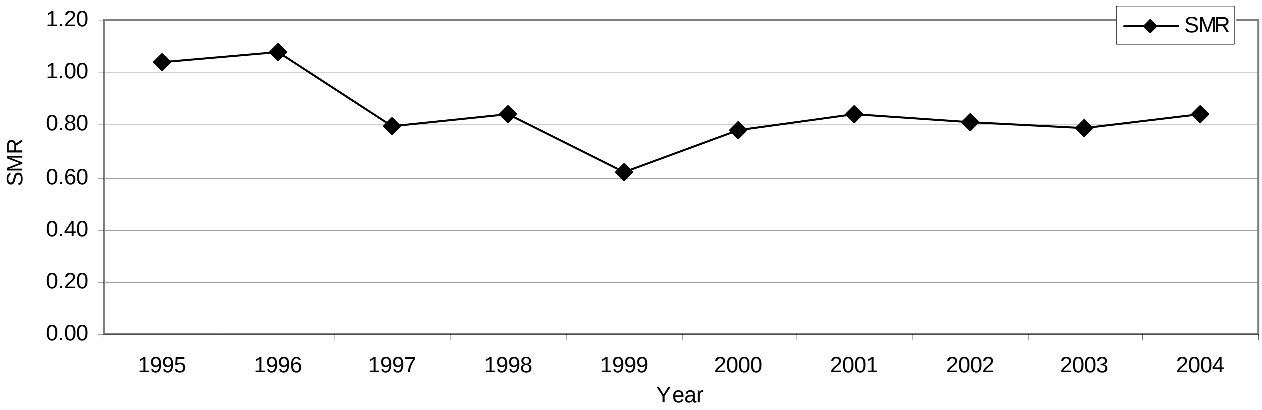
Table 10.12: Patients meeting MTOS criteria, Liverpool Hospital, 1995-2004

Year	n with TRISS	Death	Pdeath*	Z	SMR†	W
1995	526	33	31.84	0.32	1.04	-0.22
1996	600	51	47.49	0.79	1.07	-0.58
1997	581	39	48.85	-2.33	0.80	1.70
1998	640	41	48.97	-1.82	0.84	1.24
1999	686	30	48.72	-4.27	0.62	2.73
2000	812	39	50.22	-2.41	0.78	1.38
2001	872	40	47.78	-1.64	0.84	0.89
2002	859	37	45.54	-1.85	0.81	0.99
2003	741	36	45.89	-2.16	0.78	1.34
2004	760	39	46.50	-1.61	0.84	0.99
Total	7077	385	461.81	-5.47	0.83	1.09

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Figure 10.7: SMR for patients meeting MTOS criteria, Liverpool Hospital, 1995-2004 (total patients=7077, deaths=385)



10.9 Another mortality outcome analysis – MTOS criteria or ISS ≥ 12

Another analysis is provided here which includes both patients who met MTOS criteria, and patients with ISS≥12 who did not meet MTOS criteria. This demonstrates the power of the statistical analysis with slightly different data sets.
NB. Patients aged ≥ 65 years who sustained an isolated fractured neck of femur following a fall < 1m are excluded from this section.

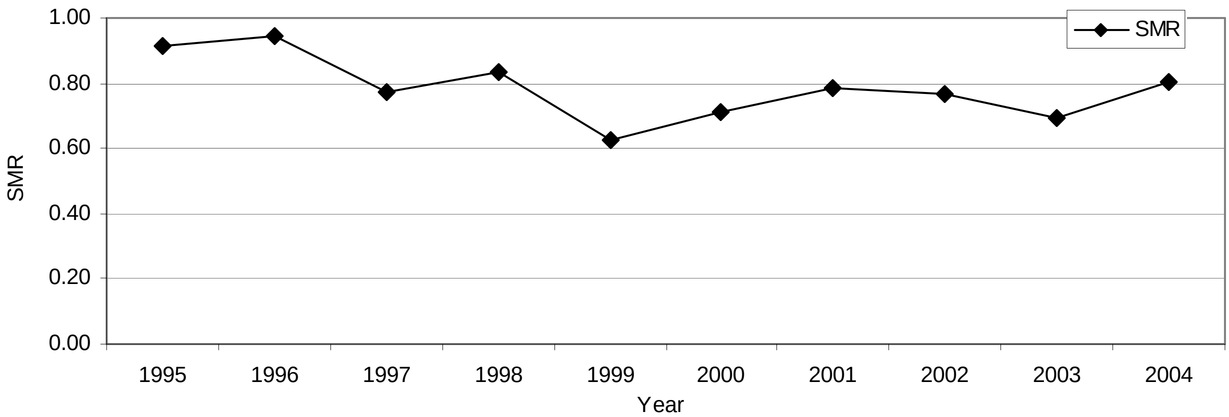
Table 10.13: Patients meeting MTOS criteria or with ISS ≥ 12, Liverpool Hospital, 1995-2004

Year	N with TRISS	Death	Pdeath*	Z	SMR†	W
1995	601	35	38.35	-0.83	0.91	0.56
1996	669	54	57.29	-0.69	0.94	0.49
1997	662	44	57.02	-2.78	0.77	1.97
1998	745	46	54.96	-1.86	0.84	1.20
1999	789	38	60.53	-4.63	0.63	2.85
2000	922	41	57.83	-3.31	0.71	1.83
2001	973	46	58.38	-2.37	0.79	1.27
2002	952	39	50.98	-2.44	0.76	1.26
2003	839	38	54.70	-3.41	0.69	1.99
2004	809	41	51.14	-2.08	0.80	1.25
Total	7961	422	541.17	-7.81	0.78	1.50

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Figure 10.8: SMR for patients meeting MTOS criteria or with ISS ≥ 12, Liverpool Hospital, 1995-2004 (patients=7961, deaths=422)



10.10 Outcome measures stratified by age and injury severity

NB. Patients aged ≥ 65 years who sustained an isolated fractured neck of femur following a fall < 1m are included in this section.

Blunt injury

The following two tables present outcome measures for blunt trauma stratified by age (0-64 or ≥65 years), where TRISS was available.

Table 10.14: Outcome measures for blunt injury in patients aged 0-64 years, Liverpool Hospital major data category, 1995-2004

ISS	n	Death	Pdeath*	Z	SMR†	LOS (days)				ISS				Age (years)			
						mean		sd	range	mean		sd	range	mean		sd	range
1-15	5084	7	42.1	-5.56	0.17	8.5	±	10.9	(1-157)	7.5	±	3.3	(1-14)	31.3	±	15.4	(0-64)
16-24	924	9	40.7	-5.73	0.22	14.0	±	16.1	(1-141)	18.6	±	2.3	(16-24)	32.8	±	15.0	(1-64)
25-49	694	134	165.0	-3.78	0.81	17.5	±	22.9	(1-278)	30.5	±	6.1	(25-48)	31.0	±	14.7	(0-64)
50-74	73	45	53.6	-3.12	0.84	26.0	±	76.2	(1-627)	57.0	±	6.0	(50-66)	31.0	±	14.5	(1-64)
75	30	24	30.0	*	0.80	4.4	±	11.7	(1-60)	75.0	±	0.0	(75)	33.6	±	16.8	(2-63)
Total	6805	219	331.4	-9.33	0.66	10.3	±	15.9	(1-627)	12.2	±	10.4	(1-75)	31.4	±	15.3	(0-64)

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Table 10.15: Outcome measures for blunt injury in patients aged ≥ 65 years, Liverpool Hospital major data category, 1995-2004

ISS	n	Death	Pdeath*	Z	SMR†	LOS (days)				ISS				Age (years)			
						mean		sd	range	mean		sd	range	mean		sd	range
1-15	858	48	24.6	4.96	1.95	14.1	±	15.1	(1-163)	7.4	±	3.3	(1-14)	76.4	±	7.7	(65-99)
16-24	196	22	15.9	1.72	1.38	21.6	±	22.0	(1-160)	18.2	±	2.3	(16-24)	75.9	±	7.2	(65-99)
25-49	168	60	52.8	1.53	1.14	21.0	±	26.2	(1-213)	28.6	±	5.6	(25-48)	76.8	±	6.9	(65-93)
50-74	10	9	9.2	-0.32	0.97	11.2	±	32.3	(1-103)	56.3	±	6.0	(50-66)	72.8	±	4.8	(65-81)
75	7	7	7.0	*	1.00	1.1	±	0.4	(1-2)	75.0	±	0.0	(75)	71.6	±	6.2	(67-85)
Total	1239	146	109.5	4.80	1.33	16.1	±	18.6	(1-213)	12.7	±	10.4	(1-75)	76.3	±	7.5	(65-99)

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Penetrating injury

The following tables present outcome measures for patients sustaining predominately penetrating trauma, stratified by age (0-64 or ≥65 years), where TRISS was available.

Table 10.16: Outcome measures for penetrating injury in patients aged 0-64 years, Liverpool Hospital major data category, 1995-2004

ISS	n	Death	Pdeath*	Z	SMR†	LOS (days)				ISS				Age (years)			
						mean		sd	range	mean		sd	range	mean		sd	range
1-15	546	0	5.2	-2.37	0.00	6.2	±	5.8	(1-66)	6.6	±	3.9	(1-14)	29.9	±	10.9	(5-64)
16-24	58	4	4.3	-0.29	0.92	11.1	±	9.0	(1-50)	17.7	±	1.7	(16-22)	30.2	±	10.0	(17-52)
25-49	73	19	18.6	0.14	1.02	20.3	±	67.7	(1-579)	27.6	±	3.9	(25-42)	32.1	±	13.2	(13-63)
50-74	1	1	0.9	0.33	1.11	2.0		*	*	50.0		*	*	37.0		*	(37)
75	16	16	16.0	*	1.00	1.0	±	0.0	(1)	75.0	±	0.0	(75)	32.7	±	14.9	(16-59)
Total	694	40	45.0	-1.43	0.89	8.0	±	23.0	(1-579)	11.4	±	12.6	(1-75)	30.2	±	11.2	(5-64)

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Table 10.17: Outcome measures for penetrating injury in patients aged ≥ 65 years, Liverpool Hospital major data category, 1995-2004

ISS	n	Death	Pdeath*	Z	SMR†	LOS (days)				ISS				Age (years)			
						mean		sd	range	mean		sd	range	mean		sd	range
1-15	13	0	0.3	-0.60	0.00	10.6	±	12.2	(1-47)	6.8	±	2.9	(2-10)	74.2	±	8.1	(65-90)
16-24	2	0	0.1	-0.26	0.00	4.5	±	4.9	(1-8)	17.0	±	0.0	(17)	72.0	±	5.7	(68-76)
25-49	5	2	2.1	-0.12	0.96	33.2	±	22.4	(1-55)	29.6	±	4.5	(25-34)	74.4	±	3.4	(69-78)
50-74	0	n/a															
75	0	n/a															
Total	20	2	2.5	-0.52	0.80	15.7	±	17.7	(1-55)	13.6	±	10.5	(2-34)	74.1	±	6.8	(65-90)

* Pdeath = Probability of death

† SMR = standardised mortality ratio

10.11 Road trauma

The following two tables present outcome measures for road trauma patients stratified by age (0-64 or ≥65 years), where TRISS was available. ‘Road trauma’ is defined as a mechanism of injury of: MVC, MBC, pedestrian or cyclist versus vehicle.

Table 10.18: Outcome measures for road trauma in patients aged 0-64 years, Liverpool Hospital major data category, 1995-2004

ISS	n	Death	Pdeath*	Z	SMR†	LOS (days)				ISS				Age (years)			
						mean		sd	range	mean		sd	range	mean		sd	range
1-15	2663	6	20.4	-3.27	0.29	9.0	±	11.2	(1-132)	7.7	±	3.4	(1-14)	30.2	±	14.9	(0-64)
16-24	534	6	24.4	-4.41	0.25	16.3	±	17.9	(1-141)	19.0	±	2.3	(16-24)	30.8	±	14.0	(2-64)
25-49	398	78	102.7	-3.95	0.76	20.8	±	26.0	(1-278)	32.4	±	6.4	(25-48)	28.2	±	13.3	(0-64)
50-74	66	40	48.8	-3.41	0.82	25.3	±	78.6	(1-627)	57.1	±	6.0	(50-66)	29.9	±	14.2	(1-64)
75	18	15	18.0	*	0.83	6.2	±	14.9	(1-60)	75.0	±	0.0	(75)	35.3	±	18.9	(2-63)
Total	3679	145	214.4	-7.63	0.68	11.6	±	18.5	(1-627)	13.3	±	11.6	(1-75)	30.1	±	14.6	(0-64)

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Table 10.19: Outcome measures for road trauma in patients aged ≥ 65 years, Liverpool Hospital major data category, 1995-2004

ISS	n	Death	Pdeath*	Z	SMR†	LOS (days)				ISS				Age (years)			
						mean		sd	range	mean		sd	range	mean		sd	range
1-15	254	5	6.7	-0.66	0.75	13.2	±	13.9	(1-116)	8.0	±	3.4	(1-14)	73.7	±	6.1	(65-98)
16-24	79	9	6.2	1.24	1.45	28.7	±	25.0	(5-160)	19.1	±	2.4	(16-24)	74.4	±	6.9	(65-99)
25-49	58	18	22.7	-1.62	0.79	28.4	±	27.6	(1-108)	33.3	±	6.7	(25-48)	73.8	±	5.3	(65-84)
50-74	10	9	9.2	-0.32	0.97	11.2	±	32.3	(1-103)	56.3	±	6.0	(50-66)	72.8	±	4.8	(65-81)
75	5	5	5.0	*	1.00	1.0	±	0.0	(1)	75.0		-	(75)	69.8	±	1.9	(67-72)
Total	406	46	49.8	-0.84	0.92	18.2	±	20.7	(1-160)	15.8	±	13.5	(1-75)	73.8	±	6.1	(65-99)

* Pdeath = Probability of death

† SMR = standardised mortality ratio

10.12 Falls

The following two tables present outcome measures for falls from any height, stratified by age (0-64 or ≥65 years), where TRISS was available.

Table 10.20: Outcome measures for falls in patients aged 0-64 years, Liverpool Hospital major data category, 1995-2004

ISS	n	Death	Pdeath*	Z	SMR†	LOS (days)				ISS				Age (years)			
						mean		sd	range	mean		sd	range	mean		sd	range
1-15	868	1	8.3	-2.58	0.12	9.9	±	12.5	(1-157)	7.2	±	3.2	(1-14)	37.1	±	17.8	(0-64)
16-24	168	2	8.1	-2.44	0.25	12.8	±	14.3	(1-116)	18.0	±	2.4	(16-24)	40.3	±	16.9	(1-64)
25-49	109	24	24.9	-0.26	0.96	15.3	±	19.8	(1-156)	28.8	±	5.1	(25-43)	41.8	±	16.4	(0-64)
50-74	4	3	2.9	0.18	1.05	42.0	±	72.2	(1-150)	57.5	±	6.6	(51-66)	49.8	±	5.6	(43-56)
75	2	2	2.0	*	1.00	1.0	±	0.0	(1)	75.0		*	(75)	37.0	±	29.7	(16-58)
Total	1151	32	46.2	-2.76	0.69	11.0	±	14.3	(1-157)	11.1	±	8.6	(1-75)	38.1	±	17.6	(0-64)

* Pdeath = Probability of death

† SMR = standardised mortality ratio

Table 10.21: Outcome measures for falls in patients aged ≥ 65 years, Liverpool Hospital major data category, 1995-2004

ISS	n	Death	Pdeath*	Z	SMR†	LOS (days)				ISS				Age (years)			
						mean		sd	range	mean		sd	range	mean		sd	range
1-15	551	42	15.8	6.97	2.66	14.6	±	15.6	(1-163)	7.1	±	3.1	(1-14)	78.1	±	8.0	(65-99)
16-24	100	12	8.7	1.32	1.39	16.7	±	18.6	(1-105)	17.7	±	2.1	(16-24)	77.5	±	6.9	(65-97)
25-49	97	39	27.9	3.17	1.40	17.6	±	26.0	(1-213)	26.1	±	2.5	(25-41)	79.0	±	7.0	(65-93)
50-74	0	0	n/a														
75	1	1	1.0	*	1.00	2.0		*	(2)	75.0		*	(75)	85.0		*	(85)
Total	749	94	53.3	7.10	1.76	15.2	±	17.7	(1-213)	11.1	±	7.8	(1-75)	78.1	±	7.7	(65-99)

* Pdeath = Probability of death

† SMR = standardised mortality ratio

10.13 Deaths at SWSAHS urban and rural hospitals

SWSAHS urban hospitals (Bankstown, Campbelltown, Fairfield and Camden hospitals):

- 23 patients were taken to the nearest urban hospital, as they were dying and would not have survived the journey to Liverpool Hospital
- 31 patients were taken to an urban or rural hospital with Transport Decision Category 1 (minor injury)
- 93 elderly patients were admitted after sustaining a fractured neck of femur
- 10 patients presented to the hospital via private transport

SWSAHS rural hospital (Bowral)

- 14 patients were admitted to Bowral Hospital, which is not subject to ambulance bypass criteria
- 11 patients received pre-hospital care, 3 arrived via private transport
- 4 elderly patients were admitted after sustaining a fractured neck of femur

Table 10.22: Ambulance transport decision, deaths following trauma at SWSAHS urban and rural hospitals, 1995-2004

Transport category	Total	Bankstown	Campbelltown	Fairfield	Camden	Bowral
Category 1 – minor	31	25	4	2	0	0
Category 7 – dying / threatened airway	23	7	9	5	2	0
Elderly #NOF	100	47	24	22	0	7
Rural	4	-	-	-	-	4
Private transport	10	3	2	0	2	3
Total	168	82	39	29	4	14

Outcome measures (Z score, SMR, W score) for urban and rural hospitals were not calculated as this would be inappropriate given the relatively small number of urban and rural hospital patients.

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11 Complications

Executive comment and recommendations

It is encouraging to see that the complication rate, despite the increased volume and severity of patients over the decade of the study has reduced. However, significant complications still occur.

New strategies in terms of patient safety and provider related performance need to be developed to ensure that, in particular, provider-related complications are reduced.

These include:

- Computerisation of notes and care plans to increase consistency
- Evolution of the Medical Emergency Team (MET) [(1)] and trauma team response
- Computerisation of segments of the trauma tertiary survey
- In-built safety links at different phases of care
- New clinical monitoring strategies including computerised monitoring of observation that includes pain scores
- New automated rapid reporting systems for abnormal results
- Implementation of practice guidelines across trauma care
- Dedicated trauma case managers with 24-hour coverage
- Computerised handover between shift teams with flagging and care plans for abnormal results

11.1 Annual complication rates

Complication data is collected for major data category patients, and was first collected in 1996. Between 1996-2004 at Liverpool Hospital, the annual percentage of patients with one or more complications fluctuates, with the lowest rate occurring in 2003 (15.0%), and the highest rate occurring in 1996 (25.3%). However, the general trend is downwards.

Capturing complication data is a challenging task. Data capture is greatly affected by available resources, namely, whether there are sufficient staff to review all complex or long stay patients throughout their entire hospital length of stay. For this reason, complication data focuses on those complications that occur during the acute phase of care. Complications occurring in rehabilitation or other non-acute care are not captured in the registry.

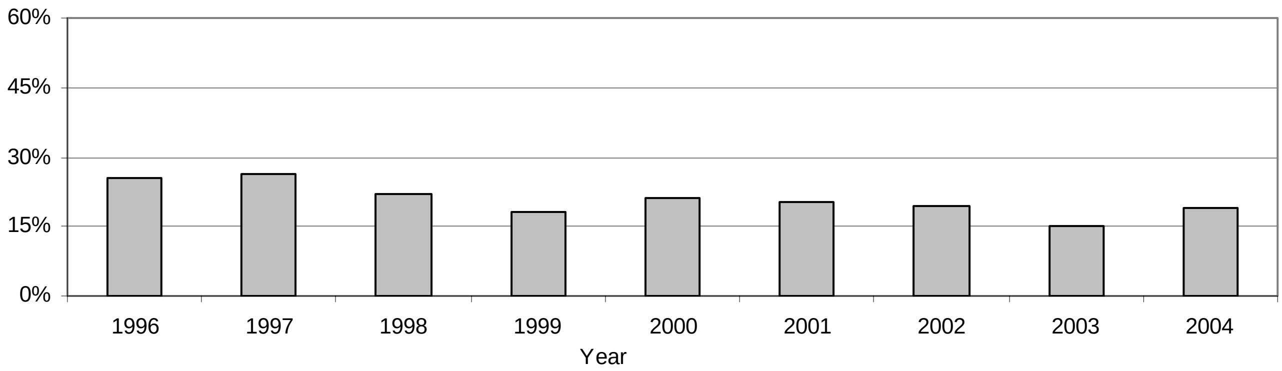
It is acknowledged that the complications listed in this chapter are a combination of disease-related and provider-related complications. As a result of this report, decisions will be made regarding the appropriateness of this cohort for future reporting.

The total number of major data category patients who had one or more complications during the acute phase of inpatient care at Liverpool Hospital between 1996-2004 is presented below.

Table 11.1: Annual trauma patients with complications, Liverpool Hospital, major data category, 1996-2004

Year	Total patients	Total patients with complications	% patients with complications	Mean no. of complications per patient
1996	739	187	25.3	2.1
1997	736	194	26.4	1.9
1998	817	180	22.0	2.1
1999	833	151	18.1	2.7
2000	1002	214	21.4	2.0
2001	1153	234	20.3	2.1
2002	1146	221	19.3	2.6
2003	1013	152	15.0	3.2
2004	1021	196	19.2	2.4
Total	8460	1729	20.4	2.3

Figure 11.1: Annual trauma patients with complications, Liverpool Hospital, major data category, 1996-2004 (n=8460)



11.2 Age-specific complication rates

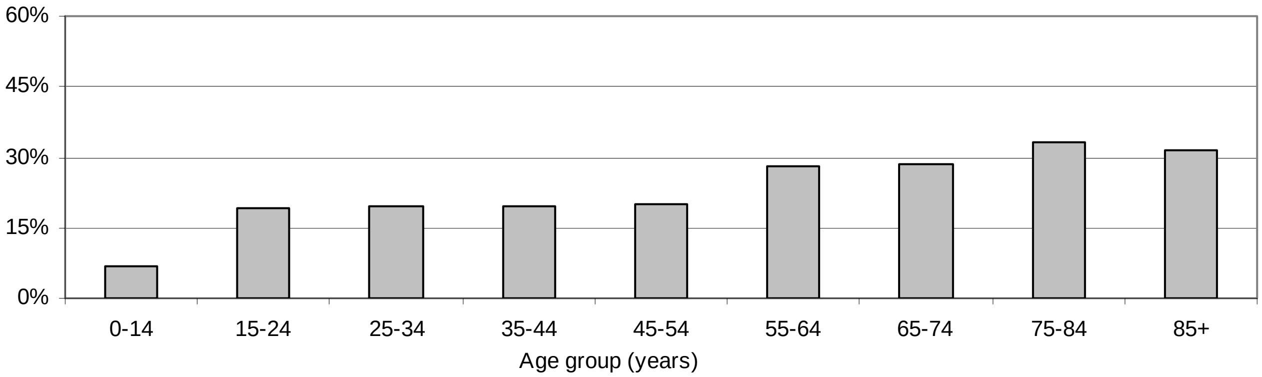
The percentage of patients experiencing complications increases markedly with age. Older patients are potentially more susceptible to complications, even with optimal care. Reasons for increased susceptibility to complications in older patients include pre-existing co-morbidities, frail health, a decreased ability to overcome complications such as infection, and the normal ageing process.

Furthermore, some older patients have a relatively long length of stay in hospital, which in itself can increase the risk of certain complications, such as pressure areas.

Table 11.2: Trauma patients with complications by age, Liverpool Hospital, major data category, 1996-2004

Age (years)	Patients with complications	Patients admitted	% patients with complications
0-14	60	885	6.8
15-24	376	1983	19.0
25-34	311	1586	19.6
35-44	241	1224	19.7
45-54	188	932	20.2
55-64	175	623	28.1
65-74	154	542	28.4
75-84	160	482	33.2
85+	64	203	31.5
Total	1729	8460	20.4

Figure 11.2: Trauma patients with complications by age, Liverpool Hospital, major data category 1996-2004 (n=8460)

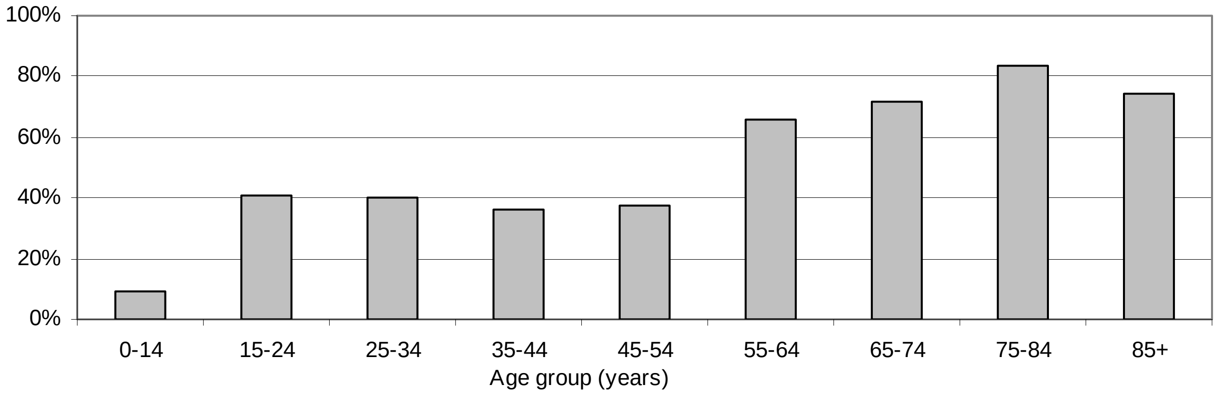


Both the percentage of patients with complications, and the overall complication rate increase with increasing age.

Table 11.3: Trauma complication rate by age, Liverpool Hospital, major data category, 1996-2004

Age (years)	Complications	Patients admitted	% complication rate
0-14	82	885	9.3
15-24	808	1983	40.7
25-34	634	1586	40.0
35-44	445	1224	36.4
45-54	350	932	37.6
55-64	408	623	65.5
65-74	388	542	71.6
75-84	403	482	83.6
85+	151	203	74.4
Total	3669	8460	43.4

Figure 11.3: Trauma complication rate by age, Liverpool Hospital, major data category 1996-2004 (n=8460)



11.3 Specific complications and age

Table 11.4: Specific complications by age group (years), Liverpool Hospital, major data category, 1996-2004

Complication		Age group (years)									
Type	Description	0-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+	Total
Pre-Hospital	Aspiration			1		1	1		1		4
	Oesophageal intubation			1	1	1					3
	Mainstem intubation		2	1	1	1		1			6
	Other		2	4	1	1				1	9
	Unable to intubate	3	14	11	3	7	1	4	1		44
	Inappropriate fluid management	1		1							2
	Other		1								1
	Unable to start IV	4	4	3	2	2			1		16
	Other pre-hospital		5	3	3	5	2	3	2		23
	Pre-hospital delay	2	6	2	6	2		2	2		22
	Pre-hospital total	10	34	27	17	20	4	10	7	1	130
Airway	Oesophageal intubation		3	2	1	2	2	3			13
	Extubation - unintentional	2	4	6	2	1	1		1	1	18
	Mainstem intubation	1	3	6	3	3		1	1	2	20
	Other airway	1	12	10	5	12	4	3	3	2	52
	Airway total	4	22	24	11	18	7	7	5	5	103
Pulmonary	Abscess		1	1		1			1		4
	ARDS	1	8	9	4	2	1	3			28
	Aspiration / pneumonia	2	22	13	3	3	7	1	8	3	62
	Atelectasis	4	73	76	73	59	48	40	36	7	416
	Empyema		4	4	2		2	1			13
	Fat embolus		6	3		1		2			12
	Haemothorax		1	3	1		1	1	1		8
	Other pulmonary	1	9	2	9	5	5	3	7		41
	Pleural effusion	6	63	46	46	29	40	29	29	8	296
	Pneumonia	2	40	29	20	6	21	19	24	13	174
	Pneumothorax (baro)		2		1			1			4
	Pneumothorax (iatrogenic)	1	7	3	2		1	1	1		16
	Pneumothorax (recurrent)		13	9	3	1	3	2			31
	Pneumothorax (tension)		4	4	1	2	1		1		13
	Pulmonary oedema	2	11	7		7	5	8	7	3	50
	Pulmonary embolus		11	4	4	6	4	9	8	2	48
	Respiratory failure / distress	2	22	10	9	1	13	16	17	8	98
	Upper airway obstruction	1	3			1		1	1		7
	Pulmonary total	22	300	223	178	124	152	137	141	44	1321
Cardiovascular	Arrhythmia	3	8	13	11	3	10	15	25	10	98
	Cardiac arrest	7	22	12	10	8	12	7	10	4	92
	Cardiogenic shock					1			3	2	6
	CHF (iatrogenic)		1					3		2	6
	Myocardial infarct						6	5	13	12	36
	Other CVS			1	3			2	5	3	14
	Pericardial effusion/ tamponade		1		1	1					3
	Pericarditis	1									1
	Shock		5	10	6	1	3	5	5	3	38
	Cardiovascular total	11	37	36	31	14	31	37	61	36	294

(continued) Table 11.4: Specific complications by age group (years), Liverpool Hospital, major data category, 1996-2004

Complication		Age group (years)									
Type	Description	0-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+	Total
Gastrointestinal	Bowel injury (iatrogenic)		1				1				2
	Dehiscence / evisceration		3		4			1			8
	Fistula (not pancreatic)		2		2		2				6
	Haemorrhage - lower		3	1							4
	Haemorrhage - upper				1		2	2	1	1	7
	Ileus	1	11	7	5	9	6	7	11		57
	Other GI		11	5	4	3	8	6	7	1	45
	Peritonitis		2	1	1	1	2				7
	Small bowel obstruction		3	4	1		2	1	3	1	15
	Ulcer- duodenal / gastric		2	1	1		3	1	2	2	12
	Gastrointestinal total	1	38	19	19	13	26	18	24	5	163
Hepatic / Pancreatic / Biliary / Splenic	Acalculous cholecystitis		1		1		1				3
	Hepatitis		1	3		1	1		1		7
	Liver failure		1	2	1		2	6		1	13
	Other hepatic / biliary	3	38	23	20	9	12	8	13	2	128
	Pancreatitis		1			1		1			3
	Splenic injury (iatrogenic)		1								1
	Hepatic / pancreatic / biliary / splenic total	3	43	28	22	11	16	15	14	3	155
Haematological	Coagulopathy (intra-operative)		16	13	10	2	3	1	3		48
	Coagulopathy (other)		12	9	4	1	8	7	4		45
	DIC			2	1			1	2		6
	Other haematological		4	10	2	5	7	4	3	3	38
	Rhabdomyolysis				1						1
	Serum sodium		5	1	2	1	1	4	3	1	18
	Transfusion complication		2	2			1	1			6
	Haematological total		39	37	20	9	20	18	15	4	162
Infection (excluding pulmonary and orthopaedic)	Cellulitis / traumatic injury		2		2	2	2	3	3	3	17
	Fungal sepsis						1				1
	Intra-abdominal abscess		6	5	3		1	1			16
	Line infection		13	11	5	1	9	6	6		51
	Necrotizing fasciitis				1						1
	Other infection		12	5	4	2	6	3	2	3	37
	Sepsis-like syndrome		5	5	3	2	3	1	2		21
	Septicaemia		13	10	7	4	12	11	10	5	72
	Sinusitis		2								2
	Wound infection	1	24	20	18	15	12	7	9	2	108
	Yeast infection		1				1				2
	Infection total	1	78	56	43	26	47	32	32	13	328
Renal / genitourinary	Other renal / genitourinary	2	14	5	5	5	6	8	6		51
	Renal failure		7	8	2	3	7	12	14	8	61
	Ureteral injury		1			1	1				3
	UTI - early		5	5		3	8	8	9	9	47
	UTI - late	2	9	12	6	7	10	11	9	6	72
	Renal / genitourinary total	4	36	30	13	19	32	39	38	23	234

(continued) Table 11.4: Specific complications by age group (years), Liverpool Hospital, major data category, 1996-2004

Complication		Age group (years)									
Type	Description	0-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+	Total
Musculoskeletal / Integumentary	Compartment syndrome	3	21	15	14	7	4	2	1		67
	Decubitus - blister		6	2	1	1	4	1	3	2	20
	Decubitus - deep	1	5	2		2	1	2			13
	Decubitus - minor	2	2	5	2	2		4	3		20
	Decubitus - open sore		3	3	3	2	3	2	6	1	23
	Loss of reduction / fixation	2	6	2	1	3	1	3	1		19
	Non-union	2	5	8	3	3	2	3		1	27
	Orthopaedic wound infection	3	19	28	17	13	10	10	6	2	108
	Osteomyelitis	2	6	8	3	3	2	4			28
	Other	2	7	5	5	6	5	1	1	1	33
	Musculoskeletal / integumentary total	17	80	78	49	42	32	32	21	7	358
Neurological	Alcohol withdrawal		1	4	7	9	5	7	2		35
	Anoxic encephalopathy						1				1
	Brain death		9	5	4	2					20
	Diabetes insipidus		15	4		3	1		1		24
	Meningitis		2	2	1	1		1			7
	Neuropraxia (iatrogenic)		1	2	2	2					7
	Non-operative SDH / EDH		2	2			1	2	3		10
	Other neurological		2	10	2	2	6	5	6	2	35
	Progression of original insult	2	13	14	5	9	9	7	14	2	75
	Seizure in hospital	7	28	14	6	8	8	5	5	2	83
	SIADH		1			2	2	1			6
	Stroke / CVA		3	1	2	2	1	4	6	1	20
	Ventriculitis - post surgical		1								1
	Neurological total	9	78	58	29	40	34	32	37	7	324
Vascular	Anastomosis haemorrhage						1				1
	DVT (lower extremity)		10	7	2	6	4	5	4	1	39
	Embolus (non-pulmonary)			1							1
	Gangrene					**1**					1
	Other vascular		2	1	1	1		1			6
	Thrombosis		3		2	1	1		1		8
	Vascular total		15	9	5	9	6	6	5	1	56
Psychiatric total			5	8	6	3	1	4	3	1	31
Anaesthetic complication total			3	1	2	2		1		1	10
Grand total		82	808	634	445	350	408	388	403	151	3669

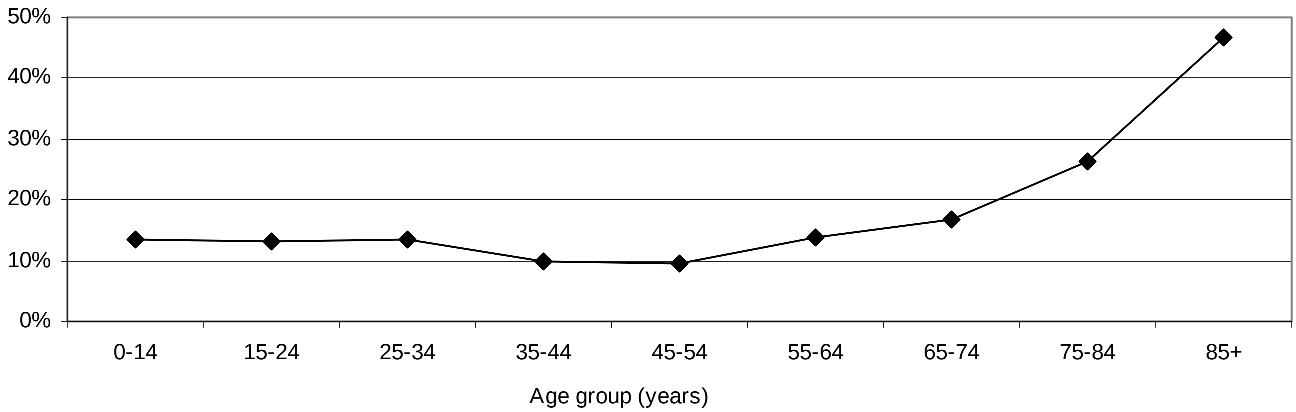
11.4 Survival outcome

The following data presents survival outcome for Liverpool Hospital major data category patients admitted between 1996-2004 who had one or more complications. The risk of mortality increases dramatically with increasing age. For all major data category patients with one or more complications, 13.3% of patients aged 0-14 years died, whereas 46.9% of patients aged 85 years or older died.

Table 11.5: Survival outcome in patients with complications, by age, Liverpool Hospital, major data category, 1996-2004

Age group (years)	Total patients	Survived		Died	
		n	%	n	%
0-14	60	52	86.7	8	13.3
15-24	376	327	87.0	49	13.0
25-34	311	269	86.5	42	13.5
35-44	241	217	90.0	24	10.0
45-54	188	170	90.4	18	9.6
55-64	175	151	86.3	24	13.7
65-74	154	128	83.1	26	16.9
75-84	160	118	73.8	42	26.3
85+	64	34	53.1	30	46.9
Total	1729	1466	84.8	263	15.2

Figure 11.4: Mortality rate in patients with ≥ 1 complication, by age, Liverpool Hospital, major data category, 1996-2004 (n=1729)



11.5 Possible association between complication type and survival outcome

The following table presents specific complications into related groups, and provides the survival outcome for each group. The association between complication type and survival outcome is described as ‘possible’ as many other factors, aside from complications, may affect a patient’s survival, eg. patient age and injury severity.

With complications that occurred in more than 100 patients, cardiovascular complications had a relatively high mortality rate of 58.2%, whilst musculoskeletal / integumentary complications had a much lower mortality rate of 4.5%. The latter includes complications that do not pose an immediate and serious threat to life (for example pressure areas), whereas some of the cardiovascular complications are life threatening. The data in the following table presents all patients with complications, including those where an underlying pre-existing condition may be present.

For example, patients with cardiovascular complications may have had pre-existing heart disease. As well, some of these patients will have had more than one complication and may fall into more than one complication type.

Table 11.6: Summary of complications and survival outcome, Liverpool Hospital, major data category, 1995-2004

Complication type	Total patients	Survived		Died	
		n	%	n	%
Pre-Hospital	130	91	70.0	39	30.0
Airway	103	87	84.5	16	15.5
Pulmonary	1321	1135	85.9	186	14.1
Cardiovascular	294	123	41.8	171	58.2
Gastrointestinal	163	147	90.2	16	9.8
Hepatic, Pancreatic, Biliary, Splenic	155	124	80.0	31	20.0
Haematological	162	100	61.7	62	38.3
Infection (excluding pulmonary and orthopaedic)	328	291	88.7	37	11.3
Renal / Genitourinary	234	190	81.2	44	18.8
Musculoskeletal / Integumentary	358	342	95.5	16	4.5
Neurologic	324	233	71.9	91	28.1
Vascular	56	54	96.4	2	3.6
Psychiatric	31	28	90.3	3	9.7
Anaesthetic Complication	10	10	100.0		0.0
Total	3669	2955	80.5	714	19.5

References

1. Hillman K, Alexandrou E, Brown D, Murphy J. Getting better all the time: implementing the MET system outcome indicators in your hospital. MET Research and Training Unit, c/- Simpson Centre for Health Service Innovation, South Western Sydney Area Health Service. Sydney, Australia, 2001.

12 Worldwide Trauma Registries

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This introduction will provide a starting point for those interested in trauma registries around the globe, ranging from the long established and large databanks, to new and smaller registries. Trauma registries are quickly becoming technologically more advanced, but their presence on the internet is unfortunately not. One example of an 'on-line trauma registry' is the American National Trauma Databank (NTDB Online), which has the ability to analyse nearly one million records and produce customised graphs and tables via online analytical processing. Another example is the Canadian National Trauma Registry, which permits contributing hospitals to access their own data, and interested researchers to either access standard publicly available reports, or to apply to access specific aggregate, de-identified data items. We hope that other registries will begin to follow suit, and that the next decade brings unrivalled on-line access to registry data. Obviously the privacy and protection of patient information is a key consideration when working towards providing on-line data.

The list of trauma registries presented consists of links to Australian and New Zealand national, state and individual hospital trauma registries which have information accessible via the internet. National trauma registry websites are listed for other countries, focussing on those available in the English language.

Though not a new concept, the number of trauma registries around the world has rapidly increased in the last decade, greatly increasing the scope for audit and improvement of trauma services. Comparing these national trauma registries allows us insight into societal trends in external injury and also into the health impact of completely distinct health care systems and philosophies. Standardisation of inclusion criteria and data points remains the key challenge for national trauma registries, but increased acceptance of data monitoring and improved software technology is making meaningful analysis of large volumes of patient data a more fruitful task.

Smaller registries are often challenged by a lack of resources with regards to information management and technology. Access to these resources is critical to achieving a well designed database, which facilitates efficient and accurate data capture, automated data quality checks, meaningful reports and the ability to develop the database as required. Advances in electronic data management provide an unprecedented opportunity to move forward and streamline manual processes. This in turn greatly improves a registries ability to provide quality and timely information to key users, including clinicians, researchers, and health decision-makers.

12.1 Australia and New Zealand

National Trauma Registry Consortium (Australia and New Zealand)
http://www.surgeons.org/Content/NavigationMenu/FellowshipandStandards/FellowshipServices/Trauma/Publications/NTRC_2002.pdf (soon to have its own website)
Having released it's first report in 2004, the National Trauma Registry Consortium collates data from four state registries and a number of individual hospitals, reporting on outcomes for over 5000 seriously injured patients. The link provided presents the 2004 report on 2002 data.

Australian state trauma registries

There are over 37 Australian hospitals with an on-site trauma registry. These hospitals submit data to their respective state trauma registries. State trauma registries are relatively new in Australia, and are developing at a rapid rate. The registries are constantly evolving in order to keep pace with clinical practice and trauma research. Minimum data set requirements may vary from state to state, however all registries capture seriously injured patients with ISS $\geq$ 16.

New South Wales Institute of Trauma and Injury Management (ITIM)
http://www.itim.nsw.gov.au/index.cfm
ITIM produces annual reports containing data on over 2000 seriously patients collected from 13 hospitals in the state of NSW (including Liverpool Hospital).

The South Australian Trauma Registry
Flinders University Research Centre for Injury Studies
http://www.nisu.flinders.edu.au/
Established in 1996, the registry is still in its infancy, but is rapidly expanding. The Flinders University Injury Issues Monitor presents trauma data from the state of South Australia, and reviews of nationwide data.

Queensland Trauma Registry (QTR)
Centre of National Research on Disability and Rehabilitation Medicine (CONROD)
http://www.uq.edu.au/conrod/index.html?page=11386
The QTR includes data from 14 trauma units in the state of Queensland, compiled since 1998.

Victorian State Trauma Registry (VSTORM)
http://www.health.vic.gov.au/trauma/vstorm.htm
http://www.med.monash.edu.au/epidemiology/traumaepi/traumareg.html
Now in it's fourth year, VSTORM collects trauma data from over 130 hospitals in the state of Victoria.

Western Australian Trauma Registry
http://www.health.wa.gov.au/publications/
With its inaugural report released last year, the WATR reports approximately 600 seriously injured patients from four hospitals in the state of Western Australia.

Australian Hospitals trauma registries with website access as at date of publication

Liverpool Hospital, Sydney, New South Wales
http://www.swsahs.nsw.gov.au/livtrauma/reg_stat/default.asp

Westmead Hospital, Sydney, New South Wales
http://www.westmeadtrauma.org/trauma_registry_data.php

The Alfred Hospital, Victoria
http://www.alfred.org.au/departments/trauma_surgery.html

The Royal Melbourne Hospital, Victoria
http://www.mh.org.au/Royal_Melbourne_Hospital/DEPARTMENTS/S-/Trauma_Service/Trauma_Registry/

Royal Perth Hospital, Western Australia
http://www.rph.wa.gov.au/traumaservices.html

New Zealand Hospitals trauma registries

Auckland City Hospital
Middlemore Hospital
Waikato Hospital

12.2 International trauma registries

Canada

National Trauma Registry, Canadian Institute for Health Information
www.cihi.ca/ntr
The Canadian registry collates information on around 200,000 major and minor injuries each year. 'Interactive' data is presented on the website allowing the uses to form their own reports.

Germany

The German Trauma Registry
http://www.traumaregister.de/ (website in German)

Israel

Israeli National Trauma Registry
http://www.health.gov.il/english/pagese/default.asp?pageid=36andparentid=15andcatid=13andmaincat=2
Since its conception in 1997, the Israeli registry has collected more than 100,000 patient records from 10 trauma centres.

Italy

Italian National Trauma Registry (RITG)
http://www.cgsi.it/rit/ (website in Italian)
A small registry created in 2004, containing data on approximately 800 patients.

Japan

Japan Trauma Data Bank
http://www.tororo.net/traumabank/dataroom/dataroom.htm (website in Japanese)
Newly established in 2003.

Netherlands

Dutch National Trauma Registry
http://www.trauma.nl/ (website in Dutch)

United Kingdom (UK)

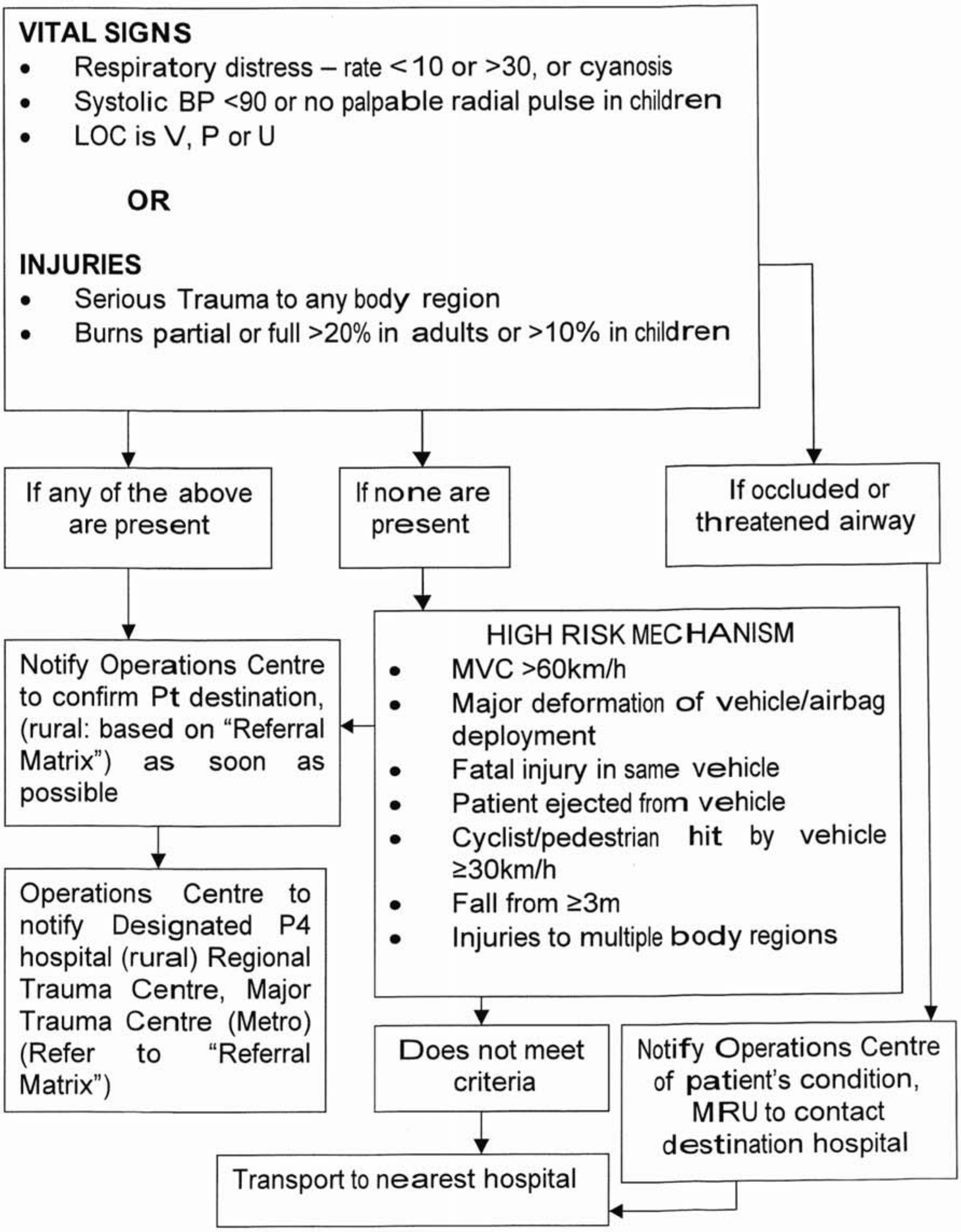
Trauma Audit and Research Network (TARN) http://www.tarn.ac.uk/
Largest trauma database in Europe, with participation of over 50% of UK trauma departments. It has recorded over 200,000 patient case records since 1991.

United States of America (USA)

National Trauma Data Bank (NTDB), American College of Surgeons
http://www.facs.org/trauma/ntdb.html
Established in 1982, the NTDB is the largest trauma registry in existence, containing over 1.5 million cases from 565 US trauma centres. The website allows the user to analyse the registry online and produce customised reports.

Ambulance Service of New South Wales

PRE-HOSPITAL TRIAGE TRAUMA PROTOCOL 4



Authorised by:
Dr Michael Flynn
Chair, Medical Advisory Committee

Issued: **September 2004**

Ambulance Service of New South Wales

PRE-HOSPITAL TRIAGE TRAUMA PROTOCOL 4

If an ambulance officer considers a seriously injured patient will not survive the time required to be transported to a Major Trauma Centre (MTC), Regional Trauma Centre (RTC) or designated Protocol 4 hospital (DP4) as defined, where this is not the closest, the patient may be taken to the nearest available hospital if there is airway obstruction which is unmanageable, for urgent resuscitation.

Some patients with serious injuries may be in complex circumstances eg difficult access, time delay on scene of over 30 minutes, trapped at the scene, road travel time to MTC, RTC or DP4 hospital after loading is ≥30 minutes or circumstances which the scene officer determines at their discretion, warrant assistance. In these situations the on-scene ambulance commander should notify the Operations Centre that complex circumstances apply and provide advice regarding the requirement for enhanced response including primary helicopter response, paramedic, ALS and/or a primary medical response team. (Protocol 68 - Helicopter Operations Severe Trauma – Primary Response, expands on this area).

OPERATIONS CENTRE TO CONTACT MEDICAL RETRIEVAL UNIT
Collaboration between the Operations Centre and MRU will determine the most appropriate available response to the scene.

While primary responsibility for generating the request for additional resources rests with the on-scene ambulance commander, Operations Centre personnel will need to be cognisant of the wider operational environment in order to determine the appropriate allocation of such additional resources. They should also be prepared to seek additional information from the on-scene ambulance commander, in order to "prompt" the need to upgrade the request for additional resources. The most senior officer on scene will assume the role of ambulance commander.

If the patient is apparently not seriously injured, but has been involved in an incident where the mechanism of injury is high risk, the officer should review the situation and decide at their discretion whether to take the patient to a MTC, RTC or DP4 hospital, or to the nearest hospital.

Ambulance Service of New South Wales

PRE-HOSPITAL TRIAGE TRAUMA PROTOCOL 4

DEFINITION OF SERIOUS INJURY

Penetrating injury of:

- Head
- Neck
- Chest
- Abdomen
- Perineum
- Back

Head:

- 1 or 2 dilated pupils
- Open head injury
- Severe facial injury

Chest:

- Subcutaneous emphysema
- Major flail segment
- Crush injury

Abdomen:

- Distension
- Rigidity
- Crush injury

Spinal:

- Weakness
- Sensory loss

Major Limb:

- Vascular injury with ischaemia of limb
- Amputation
- Crush injury of limb or trunk
- Bilateral femur fractures

Ambulance Service of New South Wales

PRE-HOSPITAL TRIAGE TRAUMA PROTOCOL 4

NOTIFYING THE HOSPITAL

Notify the Operations Centre of hospital destination and patient condition using the **MIST** criteria.

MIST

- M Mechanism of Injury
- I Injuries
- S Signs and Symptoms
- T Treatment and Time

RECORDING OF INFORMATION

The Bypass – Trauma Triage and Medical Bypass section on the PHCR, **MUST** be completed in order to provide accurate evidence based data for future research.

SWSAHS Regional Trauma Registry Condensed Data Dictionary

Last updated May 2006

Registry inclusion criteria

Patients are included in the registry if they are admitted to one of the six SWSAHS hospitals following acute injury. Patients who present to the Emergency Department (ED) with minor injuries but are not admitted to hospital are excluded. All patients meeting the inclusion criteria are sub-grouped into either the major data category or the minor data category using the criteria below.

Minor data category

Patients with an isolated injury to one body region, specifically:

- Upper limb fracture / dislocation at or below level of neck of humerus
- Lower limb fracture / dislocation at or below the level of the ankle
- Isolated fracture of fibula or patella
- Isolated fracture of neck of femur (#NOF) in an elderly patient (age ≥ 65 years)
- Soft tissue injury (includes dog bites; simple lacerations not significantly involving nerves or blood loss > 500ml; partial or complete amputation of a digit; minor crush injury to the distal extremities)
- Isolated tendon injury
- Minor burns: For adults < 20% body surface area (BSA). For children < 10% BSA
- Isolated mandibular fractures
- Minor scalp contusion or laceration with no previous LOC or decrease in GCS, and no neurological signs.

Major data category

Patients with injuries to more than one body region, or injuries not specified in the minor injury category, including:

- Injury to more than one body region
- Any skeletal or internal organ injury of the head, neck, chest, abdomen or extremities (including fractured ribs), excluding isolated fractures specified in the minor data category
- Any loss of consciousness
- ISS ≥ 16
- Deaths following injury
- Burns: Adults > 20% BSA; children > 10% BSA,; airway burns
- Patients undergoing trauma laparoscopy, laparotomy or DPL
- Fractured tibia / fibula above ankle level

Number of data items

The minor data category contains up to 23 data items per patient. AIS coding is not required. However all minor data category patients have an ISS between 1 and 9, and the majority have an ISS between 1 and 4.

The core major category data set contains 150 data items per patient. In addition, injuries, AIS codes and operation data are collected. There are another 40 data items available in addition to the core data set. These are used to capture additional data when patients are transferred, retrieved, die or have significant complications.
All major data category records are coded with the AIS.

All potentially identifying information is kept for the purposes of clinical care and review, and is protected by privacy legislation.

Minor data category

CRSID A unique identifier for each admission, created as the data is entered into the registry

Hospital:

1 Bankstown	4 Campbelltown
2 Bowral	5 Fairfield
3 Camden	6 Liverpool

MRN Medical record number

Surname Patient surname

First name Patient first name

Date of birth Patient date of birth (dd/mm/yyyy)

Postcode Patient's home postcode

Sex Patient sex

Age Patient age

Admitting specialty:

1	General surgery	3	Orthopaedics	5	Faxiomaxillary
2	Neurosurgery	4	Plastic	6	Other

Mechanism: mechanism of injury

1	MVC driver	13	Fall ≥ 5 metres
2	MVC front passenger	14	Recreation
3	MVC back passenger	15	Burns
4	MBC rider	16	Other
5	MBC pillion	17	Not documented
6	Pedestrian	18	Dog bite
7	Pedal cyclist	19	Fall 1m to 5m
8	Personal assault	20	Fall from horse
9	Stabbing	21	Hanging
10	Gunshot	22	Limb thru Glass
11	Industrial	23	Cyclist (not v car)
12	Fall < 5 metres		

Injury intent:

0	Accidental	4	Child neglect/abuse
1	Self harm intended	5	Undetermined
2	Assault by another with intent to harm	6	Legal intervention
3	Assault by partner		

Place of injury:

1	Street or highway	9	School or preschool
2	Home	10	Farm
3	Residential inst	11	Other
4	Industrial premises	12	Not documented
5	Facility inc railway	13	Not applicable
6	Hotel or club	14	Ladder
7	Recreational or unorganised sport	15	Work ladder
8	Organised sport		

ED disposition: The location the patient first went to after the ED

1	DOA (majors only)	12	ICU
2	Died in ED (majors only)	13	HDU
3	OT	14	Ward inappropriate
4	OT / ICU	15	Discharged from ward same day
5	OT / HDU	16	Transfer out later from ward to other hospital
6	Trauma ward	17	Transfer out later from ICU / HDU to other hospital
7	Ward	18	Died in OT
8	Transfer out to other hospital	19	Home from ED
9	Other (rarely used)	20	MTS Not Admit
10	OT - transfer out	21	Transferred to Liverpool Not Admit There
11	OT - home same day	22	Home not admitted

Name of hospital: Applies if patient is transferred out to another hospital

Trauma call: Was the trauma team response activated? Only applies to Liverpool Hospital.

1	Yes – TTA criteria met and trauma call activated
2	No – TTA criteria met but no trauma call activated
3	Not applicable – no criteria for activation of trauma team

Trauma team activation criteria:

If the trauma team was called, enter the criteria on which the call was made. If multiple criteria are met select the most life threatening.

Trauma team activation criteria may be based on history, vital signs or injuries.

History	1	MVC with ejection
	2	Pedal cyclist / MBC / pedestrian hit by vehicle > 30kmh
	3	Fall > 5 metres
	5	Inter-hospital trauma transfer meeting TTA criteria
Vital signs	6	Airway obstruction
	8	Age > 70 years with chest injury
	9	Pregnancy > 24 / 40 weeks with torso injury
	10	Systolic BP < 90mmHg
	11	Pulse > 130bpm
	12	Depressed LOC or FIT
	13	Respiratory rate <10/>30 per minute
	15	Deterioration in ED
Injuries	16	Injury ≥ 2 body regions
	17	Fracture > 2 long bones
	18	Spinal cord injury
	19	Limb amputation
	20	Penetrating injury head / neck / torso / proximal limb
	21	Burns: >15% BSA adults; >10% BSA children; to airway
	23	MVC with fatality in same vehicle
	24	Not documented

NB. Criteria 4, 7, 14, 22 are no longer used and have been deactivated.

Extra text field

Add a brief comment to summarise the mechanism and / or injury details.

Diagnosis:

1	# ankle and below	12	Burns
2	# upper limbs	13	Crush injury to digit
3	Isolated #NOF aged ≥ 65 years	14	Dog bite
4	Laceration upper extremity	15	Other
5	Laceration lower extremity	16	Isolated #mandible
6	Laceration to tendon upper	17	Digit amputation (all or partial)
7	Laceration to tendon lower	18	# patella
8	Soft tissue injury face / head / neck	19	Dislocation upper limbs
9	Soft tissue injury thorax	20	Dislocation lower limbs
10	Soft tissue injury abdomen	21	Isolated # fibula
11	Soft tissue injury extremities		

Admit date — Date of admission

Discharge / transfer date: Date of discharge from hospital, or of transfer out to another hospital (dd/mm/yyyy)

Is referred (Yes / No) — Was the patient transferred in from another hospital?

Referring hospital — If applicable, enter name of referring hospital

Transfer out hospital — If applicable, enter name of hospital patient was transferred to

Referring MRN — If applicable, enter MRN at referring hospital

Major data category

Demographics

CRSID — A unique identifier for each admission, created as the data is entered into the registry

Hospital:

1 Bankstown	4 Campbelltown
2 Bowral	5 Fairfield
3 Camden	6 Liverpool

MRN — Medical record number

Surname — Patient surname

First name — Patient first name

Date of birth — Patient date of birth (dd/mm/yyyy)

Postcode — Patient's home postcode

Sex — Patient sex

Age — Patient age

Admitting specialty:

1	General surgery	3	Orthopaedics	5	Faxiomaxillary
2	Neurosurgery	4	Plastic	6	Other

Admitting Dr — The doctor under whose care the patient is admitted. Additional consultants involved may also be listed.

Registrar — The surgical registrar involved in patient's workup and care. Additional registrars involved may also be listed.

Injury data

Injury date dd/mm/yyyy

Injury time 00:00 to 23:59. Enter the ambulance request time if exact injury time is unknown.

Postcode Postcode where injury occurred. If unknown, enter 9999.

Mechanism of injury

1	MVC driver	13	Fall ≥ 5 metres
2	MVC front passenger	14	Recreation
3	MVC back passenger	15	Burns
4	MBC rider	16	Other
5	MBC pillion	17	Not documented
6	Pedestrian	18	Dog bite
7	Pedal cyclist	19	Fall 1m to 5m
8	Personal assault	20	Fall from horse
9	Stabbing	21	Hanging
10	Gunshot	22	Limb thru Glass
11	Industrial	23	Cyclist (not v car)
12	Fall < 5 metres		

Place of injury

1	Street or highway	9	School or preschool
2	Home	10	Farm
3	Residential inst	11	Other
4	Industrial premises	12	Not documented
5	Facility inc railway	13	Not applicable
6	Hotel or club	14	Ladder
7	Recreational or unorganised sport	15	Work ladder
8	Organised sport		

Trauma type: Enter the type of trauma according to the patient's dominant injury

1	Blunt
2	Penetrating

Motor vehicle occupant restraint

1	None
2	Seatbelt lap/sash (most belts)
3	Seatbelt lap only
4	Child restraint
5	Not documented
6	Unknown
7	Not applicable

Safety equipment

Use this field for MVC, MBC, cyclists, construction worker safety harnesses, or other activities where it is usual to wear safety equipment.

1	None
2	Helmet
3	Airbag
4	Other
5	Not documented
6	Not applicable

Injury intent

0	Accidental
1	Self harm intended
2	Assault by another with intent to harm
3	Assault by partner
4	Child neglect/abuse
5	Undetermined
6	Legal intervention

Substance (drugs or alcohol)

1	Drug or alcohol documented
2	NIL documented
3	Undetermined
4	Drugs only
5	Alcohol only

Substance description: If applicable, enter a short description of the substance

Pre-hospital information

Yes	Ambulance / MRT
No	No pre-hospital care – go to 'Referring Hospital' data

Entrapment

1	Yes - enter time in minutes
2	No

Request time

At scene	Time the ambulance / MRT arrived on scene
Depart scene	Time the ambulance / MRT left the scene
Arrive hospital	Time of patient's arrival in ED

Ambulance level (level of training of most senior attending officer):

1	Probationer (not used)
2	Level 1-3
4	Level 4
5	Paramedics
6	Medical retrieval team - air
7	Medical retrieval team – by road
8	No form / not documented

Ambulance transport category (refer to the 'Pre-hospital care' chapter of this report for definitions):

1	Minor – UTS is nearest
2	Minor – MTS is nearest
3	Minor – bypass MTS to UTS
4	Serious – bypass UTS to MTS
5	Serious – MTS is nearest
6	Serious – MTS restricted service (rare)
7	Dying / threatened airway
8	Rural Protocol DP4
9	No form / not documented

Initial pre-hospital observations:

O_2 saturation ______ %

Pulse ______

Respiratory rate ______ (if patient is intubated prior to recording RR leave this field blank)

Blood pressure ______ / _______

Glasgow Coma Scale Eye __ Verbal __ Motor __

Pre-hospital CPR:

1	Yes
2	No

Airway intervention pre-hospital

1	Oxygen
2	Guedel or nasopharyngeal
3	Bag and mask
4	Endotracheal tube
5	Nasotracheal tube
6	N cricothyroidotomy
7	S cricothyroidotomy
8	Tracheostomy
9	No airway intervention
10	Not documented

Airway time: Time of airway intervention, applies to codes 4-8 only.

Pre-hospital fluid type:

1	Crystalloid
2	Colloid
3	Blood
4	Crystalloid and blood
5	Colloid and blood
6	Crystalloid and colloid
7	Crystalloid and colloid and blood
8	None
9	Not recorded

Pre-hospital fluid volume (mls)

The volume is the exact amount that has been administered by the paramedics or MRT prior to arrival in the ED.

If cannula is inserted and the only fluid administered is 10-20 ml saline flush, record 8 (None).

Pre-hospital drugs administered by ambulance officers or MRT:

1	N/A (inactive)
2	Nil
3	Morphine
4	Entenox
5	Maxalon
6	Other
7	Morphine and Entenox
8	Methoxyflurane
9	Midazolam

Intercostal catheter / chest drain pre-hosptial:

1	Yes
2	No
3	Bilat
4	Not documented
5	In situ

Referring hospital data

Transfer from referring hospital:

1	Yes – patient transferred from another hospital
2	No – not transferred. Go to ‘Medical Retrieval Team’

Referring hospital name:

1 Bankstown	4 Campbelltown
2 Bowral	5 Fairfield
3 Camden	6 Liverpool
7 Other – enter name of hospital in text box	

MRN at referring hospital (if known)

Arrival date and time	dd/mm/yyyy	hh:mm
Depart date and time	dd/mm/yyyy	hh:mm
Hotline call made:	Yes/No	Time hh:mm
Time elapsed to hotline call:	The registry calculates the time from arrival to Hotline call	

Initial observations at referring hospital:

Temperature	______
O_2 saturation	______ %
Pulse	______
Respiratory rate	______ (if patient is intubated prior to recording RR leave this field blank)
Blood pressure	______ / _______
Glasgow Coma Scale	Eye __ Verbal __ Motor __

CPR at referring hospital:

1	Yes
2	No

Airway intervention at referring hospital

1	Oxygen
2	Guedel or nasopharyngeal
3	Bag and mask
4	Endotracheal tube
5	Nasotracheal tube
6	N cricothyroidotomy
7	S cricothyroidotomy
8	Tracheostomy
9	No airway intervention
10	Not documented
11	Intubated prior

Airway time: Time of airway intervention. Applies to codes 4-8 only.

Fluid type at referring hospital

1	Crystalloid
2	Colloid
3	Blood
4	Crystalloid and blood
5	Colloid and blood
6	Crystalloid and colloid
7	Crystalloid and colloid and blood
8	None
9	Not recorded

Fluid volume at referring hospital (mls)

The volume is the exact amount that has been administered in the referring ED. Refers to resuscitative fluids only; do not include maintenance fluid (ie not fluid administered over greater than 4 hours).

Intercostal catheter / chest drain at referring hospital:

1	Yes
2	No
3	Bilateral
4	Not documented
5	In situ

Medical Retrieval Team

The Medical Retrieval Team is a team of doctors who are sent either to the primary scene of injury or at the referring hospital to treat and transfer seriously injured patients. They are part of the pre-hospital system of care and may use either helicopter or road transport.

1	Yes – MRT utilised for patient transport (primary retrieval or transfer)
2	No – MRT not used
3	Out – MRT used to transfer the patient out of hospital (eg. to paediatric MTS)

Request time	Time MRT contacted
Despatch time	MRT despatched from base
At scene	Time MRT arrived on scene or at referring hospital
Depart scene	Time MRT departed the scene
Arrive at hospital	Time of arrival at Liverpool Hospital

If times are not available ring N.R.M.A Careflight 9891 6144 or Westpac Lifesaver Helicopter Rescue Service 9311 3499

Emergency department

ED transport: Enter how the patient arrived at this hospital

1	Private
2	General ambulance
3	Paramedic ambulance
4	Helicopter MRT
5	Other
6	Not documented
7	Road retrieval MRT

Date of arrival	dd/mm/yyyy
Time of arrival	00:00 to 23:59

Trauma Team Activation (only applies to Liverpool Hospital):

1	Yes
2	No
3	Not applicable (TTA criteria not met)

Trauma team activation criteria:

If the trauma team was called, enter the criteria on which the call was made. If multiple criteria are met select the most life threatening.

Trauma team activation criteria may be based on history, vital signs or injuries.

History	1	MVC with ejection
	2	Pedal cyclist / MBC / pedestrian hit by vehicle > 30kmh
	3	Fall > 5 metres
	5	Inter-hospital trauma transfer meeting TTA criteria
Vital signs	6	Airway obstruction
	8	Age > 70 years with chest injury
	9	Pregnancy > 24 / 40 weeks with torso injury
	10	Systolic BP < 90mmHg
	11	Pulse > 130bpm
	12	Depressed LOC or FIT
	13	Respiratory rate <10/>30 per minute
	15	Deterioration in ED
Injuries	16	Injury ≥ 2 body regions
	17	Fracture > 2 long bones
	18	Spinal cord injury
	19	Limb amputation
	20	Penetrating injury head / neck / torso / proximal limb
	21	Burns: >15% BSA adults; >10% BSA children; to airway
	23	MVC with fatality in same vehicle
	24	Not documented

NB. Criteria 4, 7, 14 and 22 are no longer used and have been deactivated.

Initial observations in ED:

Temperature ______

O_2 saturation ______ %

Pulse ______

Respiratory rate ______ (if patient is intubated prior to recording RR leave this field blank)

Blood pressure ______ / _______

Glasgow Coma Scale Eye __ Verbal __ Motor __

CPR in ED

1	Yes
2	No

Airway intervention in ED

1	Oxygen
2	Guedel or nasopharyngeal
3	Bag and mask
4	Endotracheal tube
5	Nasotracheal tube
6	N cricothyroidotomy
7	S cricothyroidotomy
8	Tracheostomy
9	No airway intervention
10	Not documented
11	Intubated prior

Airway time: Time at which intubation was performed in the ED.

Fluid type in ED

1	Crystalloid
2	Colloid
3	Blood
4	Crystalloid and blood
5	Colloid and blood
6	Crystalloid and colloid
7	Crystalloid and colloid and blood
8	None
9	Not recorded

Fluid volume in ED (mls)

The volume is the exact amount that has been administered IN the Emergency Department. Refers to resuscitative phase of treatment therefore does not include maintenance fluids (e.g. 1 litre over MORE THAN 4 hours etc). Only includes fluids given in the first 4 hours, unless Trauma Team reactivated or patient's condition deteriorates whilst in Emergency Department.

Intercostal catheter / chest drain in ED:

1	Yes
2	No
3	Bilateral
4	Not documented
5	In situ

Head CT

1	Not done
2	Extradural haemorrhage (EDH)
3	Subdural haemorrhage (EDH)
4	Cerebral oedema
5	Subarachnoid haemorrhage (SAH)
6	Normal
7	NAD, subsequent CT abnormal (except EDH/SDH)
8	Intra-cerebral bleed
9	Other (includes #skull with no underlying injury)
10	Cerebral contusion
11	Not done in ED, subsequent EDH / SDH
12	Prior CT at other facility and EDH / SDH
13	Prior CT at other facility and abnormal CT
14	Not done in ED, subsequent CT NAD
15	Not done in ED, subsequent ED abnormal (except SDH / EDH)

If more than one abnormality is present select the one that is most severe or most urgently requires intervention.

Head CT time in — Use scribe notes (otherwise time printed on the first CT image)

Head CT time out — Use scribe notes (or add five minutes to time on the last CT image)

Diagnostic peritoneal lavage (DPL)

1	None
2	Positive
3	Negative
4	Delayed Pos
5	Delayed Neg

Laboratory results are definitive for positive or negative result (not the medical officer's interpretation of macroscopic inspection):

Element	***Positive result***	***Negative result***
Alkaline phosphatase	*> 3 u/L*	*< 3u/L*
Amylase	*>20 u/L*	*< 20 u/L*
Red blood cells	$> 10^{12}/L$	$< 10^{12}/L$
White blood cells	$> 10^{9}/L$	$< 10^{9}/L$

Abdominal CT

1	Not done
2	Positive
3	Negative
4	Delay positive
5	Delay negative

A positive finding is where an injury to an organ or the presence of free fluid in the abdomen can be detected on the CT scan. (Exception: Free fluid in the abdomen of a patient who has undergone a D.P.L. will not be regarded as a positive finding).

Abdominal CT contrast

1	None given
2	Oral
3	IV
4	Rectal
5	Oral and IV
6	Oral and rectal
7	IV and rectal
8	Not documented

Aortogram (or angiogram):

1	Not done
2	Positive
3	Negative
4	Delay positive
5	Delay negative

Aortogram is used to determine the presence of abnormality (leak or rupture) of the aorta. This may be suspected when there is a widened mediastinum visible on chest x-ray. A positive result is one where an abnormality is documented on the radiology report that requires intervention.

FAST or chest CT (only applies at Liverpool Hospital):

1	No FAST and no chest CT
2	FAST but no chest CT
3	Both FAST and chest CT done
4	No FAST but CT chest

ED disposition: The location the patient first went to after the ED

1	DOA (majors only)	12	ICU
2	Died in ED (majors only)	13	HDU
3	OT	14	Ward inappropriate
4	OT / ICU	15	Discharged from ward same day
5	OT / HDU	16	Transfer out later from ward to other hospital
6	Trauma ward	17	Transfer out later from ICU / HDU to other hospital
7	Ward	18	Died in OT
8	Transfer out to other hospital	19	Home from ED
9	Other (rarely used)	20	MTS Not Admit
10	OT - transfer out	21	Transferred to Liverpool not admitted there
11	OT - home same day	22	Home not admitted

Name of hospital: Applies if patient is transferred out to another hospital

Radio call from ambulance

0	N/A
1	Radio used
2	Not used

Time of call (if applicable):

Surgical registrar present on arrival of patient':

0	Not applicable / not required
1	Present
2	Delay
3	Fail to attend

The surgical registrar is an integral member of the trauma team.

Time of arrival of registrar: Enter time of arrival if applicable.

Hotline call for inter-hospital trauma transfer

0	Not applicable (default)
1	Hotline used correctly
2	Hotline used incorrectly
3	Fail to use Hotline

Performance indicators

Please refer to the 'Performance Indicators' chapter of this report for performance indicator definitions and criteria.

Operations

For each operation, enter the cavity code, operation code, and operation date and time, as detailed below.

Cavity

1 Craniotomy	Operations to the brain such as evacuation of EDH, SDH, or operation where the dura is opened by the surgeon. Excludes insertion of intracranial pressure monitor & elevation of depressed skull fractures (code these to "Other").
2 Thoracotomy	Thoracotomy is coded for operations, which involve entering the thoracic cavity and breaching the pleura.
3 Laparotomy	Operations that involve surgical incision of the abdomen and entry into the peritoneal cavity. Excludes DPL, laparoscopy and superficial exploration of the abdominal wall (code these to "Other").
4 Extremities	Operations to arms / legs where there is an opening of the cavity, eg. ORIF; fasciotomy for compartment syndrome.
5 Other	All other operations that do not enter cranial, thoracic, abdominal or limb cavities. Eg. Closed reduction of fracture, suturing lacerations, superficial exploration of stab wounds to chest or abdomen, repair of facial fractures.

Operation codes:

Code	Description	Code	Description
10	Intracranial neurosurgery	86	Mesh insertion
11	Spinal cord surgery	87	Laparoscopy
12	ICP monitoring	88	DPL
13	Intracranial surgery + ICP monitoring	89	Decompression
14	Decompressive craniectomy	90	Gastric surgery
20	Endocrine (thyroid/adrenal)	91	Small bowel surgery
30	Eye	92	Large bowel surgery
40	Ear	94	Oesophageal surgery
50	Face (excluding # mandible)	95	Biliary tree
51	Mandibular fixation	96	Pancreatic surgery
60	Thoracic	97	Renal and ureteric
61	Tracheostomy	98	Bladder and urethra
63	Cricothyroidotomy	100	Male genital
64	Thoroscopy	101	Female genital
65	ER Thoracotomy	102	TAC
66	ECMO	103	Relook Lap
67	Airway fibreoptic	104	Close TAC
70	Cardiac / great vessel in thoracic cavity	110	Skeleton trunk and spinal column (incl. pelvis)
71	CVS abdominal/pelvis	111	Skeleton upper limb
72	CVS neck	112	Skeleton lower limb
73	CVS upper limb	113	Muscle repair
74	CVS lower limb	114	Tendon repair
75	Major venous injury	115	Nerve repair
80	Splenorrhaphy	130	Skin repair
81	Splenectomy	131	Fasciotomy
83	Non therapeutic laparotomy	140	Other
84	Liver resection	150	Embolisation
85	Liver packing	151	Angiography not embolisation

Injury outcome

Days in ICU Total number of days spent in ICU or HDU

Discharge date dd/mm/yyyy (or date of transfer to rehabilitation, Brain Injury Unit etc.)

Survival outcome

1	Survive
2	Died

Status on discharge

1	Full recovery
2	Home help
3	Rehabilitation
4	Home help and rehabilitation
5	Died
6	Transfer to other hospital
7	Brain Injury Unit outpatients
8	Discharge against medical advice
9	Nursing home

Transfers out to other hospitals

Discharge date from subsequent hospital dd/mm/yyyy

Status on discharge from subsequent hospital

1	Full recovery
2	Home help
3	Rehabilitation
4	Home help and rehabilitation
5	Died
6	Transfer to other hospital
7	Brain Injury Unit outpatients clinic
8	Discharge against medical advice
9	Nursing home

Deaths

Place of death

1	DOA
2	ED
3	OT
4	ICU
5	HDU
6	Ward
7	Transfer
8	Other

Time of death:

Death classification

1	CNS (head and cord injuries)
2	Non-CNS (excluding #NOF)
3	#NOF death
4	Thoracic / abdominal bleeding

Outcome scores

List each injury and the corresponding AIS code in the section provided on the form.

The following figures are automatically calculated by the registry: ISS, TRTS, RTS, TRISS, ASCOT

Complications list and definitions

(A*dapted from UCSD Medical Centre Trauma Service Provider-Related and Disease-Related Complications Dictionary)*

Pre-hospital airway

1001 Aspiration

Inhalation of gastric contents or blood causing any element of pulmonary failure, which requires treatment. Rely on ICU diagnosis. Confirm with Trauma Fellow / Consultant.

1002 Oesophageal intubation

Any attempt at intubation, which resulted in placement of the endotracheal tube in the oesophagus; verified by physical examination, visualization or x-ray film.

1003 Extubation, unintentional

Inadvertent, accidental, unplanned removal of endotracheal tube or tracheostomy/ cricothyroidotomy tube, including tube placement discovered to be in the pharynx after the tube had been verified to be in the trachea.

1004 Main stem intubation

Any endotracheal intubation procedure resulting in leaving the placement of the tube in either the left or right main stem bronchus. Difficult to pick, usually results in collapsed lung or hypoventilation on initial ED x-ray

1005 Unable to Intubate

Inability to establish an airway via intubation either by nasal or oral routes.

1009 Other Airway

Pre-hospital fluids

1501 Inappropriate Fluid Management (except inability to start IV)

Obvious over hydration or failure to recognize the need for fluid administration. IV cannulation and fluid administration to patient with precordial penetration (gunshot/stabbing to heart). > 2000ml fluid without blood.

1502 Unable to Start an IV

Inability to establish a minimum of one intravenous line in the face of a clinical condition that mandates fluid resuscitation for re-establishing *hemodynamic* stability.

1599 Other

Pre-hospital miscellaneous

2003 Prehospital Delay

Prehospital scene time considered excessive or patient retained in transferring facility for inappropriate time frame relative to clinical presentation. > 20 mins at scene with no entrapment.

2004 No C-Collar (inappropriate)

2099 Other Prehospital

Hospital airway

2501 Oesophageal Intubation

Any attempt at endotracheal intubation which resulted in placing and leaving the endotracheal tube in the oesophagus; verified by physical examination, visualization or x-ray film

2502 Extubation, Unintentional

Inadvertent, accidental, unplanned removal of endotracheal tube or tracheostomy/cricothyroidotomy tube, including tube placement discovered to be in the pharynx after the tube had been verified to be in the trachea

2503 Main stem Intubation

Any endotracheal intubation procedure resulting in placing and leaving the tube in either the right or left main stem bronchus. Difficult to pick up - will code only when ICU documents this complication.

2599 Other Airway

Hospital pulmonary (includes pulmonary infections)

3001 Abscess (excludes empyema)

Parenchymal collection of purulent material, which is culture positive. It is not a positive wound swab.

3002 ARDS

Diagnosis with the following:

1. Tachypnea, air hunger
2. Hypoxemia (<60 mm Hg) without hypercarbia
3. Normal PCWP (<15 mmHg)
4. Diffuse infiltrate on chest x-ray film
5. (Qs/Qt > 25%)

3003 Aspiration/Pneumonia

Inhalation of gastric contents or blood causing any element of pulmonary failure, which requires treatment. This will be recorded in ICU notes.

3004 Atelectasis

Collapse of alveoli (which requires bronchoscopy?)

3005 Empyema

Pleural-based infection with a positive culture (Not a simple pneumonia)

3006 Fat Embolus

Clinical diagnosis manifested by change in PO2 and mental status and petechial signs and confirmed in physicians progress notes (in the presence of long bone fracture).

3007 Hemothorax - not included as a sequelae of traumatic event unless it is a retained pneumothorax

Iatrogenically caused collection of blood verified by chest x-ray or drainage of blood or retained hemothorax residual blood after chest tube placement. Requires chest tube blood drainage to allow diagnosis.

3008 Pneumonia

Fever, leucocytosis confirmed by x-ray study with infiltrate, positive cultures and treated with antibiotic therapy (not prophylactically or empirically).

3009 Pneumothorax (Barotrauma)

Resulting from or associated with positive pressure ventilatory therapy (ICU/theatre)

3010 Pneumothorax (Iatrogenic) -not included as a sequelae of traumatic event even if a late presentation/finding or delay in diagnosis

Resulting from treatment or interventions. Includes iatrogenic tension pneumothorax.

3011 Pneumothorax (Recurrent)

Either persistent reappearance of pneumothorax despite therapy or as a result of error in technique with discontinuance of the chest tube.

3012 Pneumothorax (Tension) - also included as part of a descriptor of traumatic injury diagnosis

Causing hypotension and hemodynamic instability (BP < 100, P > 120) with restoration of vital signs after intervention, or seen on chest x-ray film as causing mediastinal shift.

3013 Pulmonary Oedema

Documented by clinical or radiological signs and requires fluid restriction or medication.

3014 Pulmonary Embolus

Verified by positive V/Q scan, angiogram, or on post-mortem examination.

3015 Respiratory Failure/Distress

Non-traumatic cause of need to intubate or give prolonged ventilation support. Failure to wean for an extended time period or requiring re-intubation < 8 hours post-extubation. Also a pulmonary diagnosis that is not clearly attributable to other causes, including pneumonia, but which requires re-intubation.

3016 Upper Airway Obstruction

Mechanical upper airway (above larynx) obstruction that is clinically significant enough to require endotracheal intubation.

3017 Pleural Effusion

Sympathetic or late occurring pleural fluid collection (not blood) requiring drainage. (It requires a chest tube and fluid drainage to make this diagnosis)

3099 Other Pulmonary

Cardiovascular

3501 Arrhythmia

Cardiac arrhythmia requiring treatment (IV drugs/defibrillation) or consultation from cardiology service or includes new (not previously documented) arrhythmia. (Eg atrial fibrillation has the patient had this before?)

3502 Cardiac Arrest (unexpected)

Requiring CPR.

3503 Cardiogenic Shock

3504 CHF (iatrogenic)

Requiring treatment or consultation.

Due to myocardial failure requiring treatment with pharmacologic support.

3505 MI

Diagnosed by laboratory and/or ECG, or histologic changes present of post-mortem examination.

3506 Pericarditis

ECG changes and fever.

3507 Pericardial Effusion or Tamponade

Not part of the original injury; but sequelae occurring > 48 hours after admission.

3508 Shock

Sustained blood pressure < 100 mm Hg for greater than 15 minutes. Episode occurring after initial resuscitation, excluding cardiogenic shock. Or a drop of 40 mm Hg in a known hypertensive patient (e.g. in an 80 years old man whose normal BP 160/95, a BP of < 120 would indicate shock).

3599 Other Cardiovascular

Gastrointestinal

4001 Anastomotic Leak

Confirmed by x-ray film or re-operation (confirm with Dr Sugrue)

4002 Bowel Injury (iatrogenic)

Injury to the intestine including serosal tears not causing enteric spill (confirm with Dr Sugrue)

4003 Dehiscence/Evisceration

Fascial separation of surgical wound documented by progress notes or re-operation, with or without evisceration of thoraco-abdominal contents (confirm with Dr Sugrue).

4004 Enterotomy (iatrogenic)

Bowel injury with puncture of the bowel.

4005 Fistula (other than pancreatic fistula)

Any persistent fistula requiring treatment or prolonging hospital course (confirm with Dr Sugrue).

4006 Haemorrhage - Lower GI

Secondary haemorrhage from small bowel or colon causing decrease in hematocrit > 5% and requiring transfusion.

4007 Haemorrhage -Upper GI

Secondary haemorrhage from stomach or higher causing decrease in hematocrit > 5%, endoscopically confirmed and requiring transfusion. (This does not mean Acoffee grounds≅ stick to the criteria).

4008 Ileus

Prolonged duration, which lengthens hospital course and or prevents timely feeding. (Any patient who cannot be fed > 24 hours after surgery because of distended abdomen.

4009 Peritonitis

Intra peritoneal infection treated with surgical drainage with or without abscess formation.

4010 SBO (Small Bowel Obstruction)

Confirmed by x-ray film required treatment with surgery or nasogastric decompression.

4011 Ulcer - Duodenal/Gastric

Verified by endoscopic examination.

4099 Other GI

Hepatic / pancreatic / biliary / splenic

4501 **Acalculous Cholecystitis**

Inflammation of gallbladder confirmed by pathology at surgery or autopsy or clinical presentation confirmed by interventional radiologic drainage (confirm with Trauma Consultant).

4502 **Hepatitis**

Confirmed by persistent elevation of hepatic enzymes and bilirubin.

4503 **Liver Failure**

Progressive, unremitting elevation of enzymes and bilirubin associated with prolonged PT, PTT, decreasing albumin (confirm with Dr Sugrue).

4504 **Pancreatic Fistula**

Drainage with amylase > 50,000 without other enteric fistulae.

4505 **Pancreatitis**

Any unexpected pancreatitis Amylase > 100 IUL (confirm with Dr Sugrue).

4506 **Splenic Injury (iatrogenic)**

Iatrogenic

4599 **Other Hepatic/Biliary**

Includes biliary stasis, cholelithiasis. Any bilirubin > 30

Haematological

5001 **Coagulopathy (intra-operative)**

Bleeding associated with coagulation abnormalities, increased PT, PTT, decreased platelet count or decreased fibrinogen, with or without hypothermia.

5002 **Coagulopathy (other)**

Prolonged PT, PTT, or decreased platelet counts with clinical bleeding or preventing invasive procedures.

5003 **DIC**

Must meet two or more of the following criteria: Platelets < 100,000/ml, fibrinogen < 100mg/dL, schistocytes or helmet red cells form on blood smear (confirm with ICU notes)

5004 **Serum sodium**

5005 **Transfusion Complication**

Blood product infusion resulting in a transfusion reaction, infection, hepatitis, AIDS, etc., as confirmed by blood bank investigation. (Type A) transfusion reaction; type B infectious complication.

5009 **Other Hematological**

Infection (excludes pulmonary or orthopaedic infections)

5501 **Cellulitis/ Traumatic Injury**

Dermal site infection at trauma site or nonsurgical site includes IV sites, infected abrasions, and lacerations.

5502 **Fungal Sepsis**

Isolation of fungus from blood or treatment for systemic fungal infection (Candida - does not refer to athletes foot or perianal thrush)

5503 **Intra-abdominal Abscess**

Collection of purulent material in the abdominal cavity confirmed by tissue examination or CT scan

5504 **Line Infection**

Patient must have intravenous line and recognized pathogen from bloodstream, which is unrelated to pathogen at another site, with fever (T > 38.5) chills, or hypotension.

5505 **Necrotizing Fasciitis**

Confirmed by microscopic findings from tissue excised.

5507 **Septicaemia**

Positive blood culture. Excludes isolates that are felt to be contaminants.

5508 **Sinusitis**

Opacification on x-ray film wit positive purulent drainage.

5509 **Wound Infection**

Involving a clean surgical wound: drainage of purulent material from wound, requiring opening a closed wound, or erythema treated with antibiotics. Does not require a positive wound swab.

5510 Yeast Infection

Isolation of fungus from mouth, perineum, or skin treated with topical antifungal agents.

5599 Other Infection

Includes epididymitis, retroperitoneal infections. Do not report FUO or conjunctivitis.

Renal / genitourinary

6001 Renal failure

Includes diagnosis of ATN, acute renal failure, and pre-renal failure. Creatinine over 3.5, or BUMN   100, or requiring dialysis. Or, hyperkalemia or fluid overload requiring dialysis.

6002 Ureteral Injury

Includes only iatrogenic injury to the ureter.

6003 UTI, early

MSU > 20-pus cells/mm3 plus a positive colony count. Is also considered an Error in Technique.

> 100,000 colonies in clean urine culture and/or presumptive diagnosis that leads to treatment with antibiotics occurring within 3 days after catheter is placed. (Note: the catheter may have already been discontinued prior to the three days).

6004 UTI, late

>100,000 colonies in clean urine culture and/or presumptive diagnosis that leads to treatment with antibiotics occurring > 3 days after catheter placement. (Note: the catheter may have already been discontinued prior to the 3 days). A positive colony count is not adequate because it can be due to contamination.

6099 Other Renal/GU

Musculoskeletal / integumentary

6501 Compartment syndrome (can be diagnosis or complication)

Elevated muscle compartment pressures requiring fasciotomy for treatment. May be secondary to fracture, compression or venous obstruction.

6502 Decubitus, grade minor

Erythema not resolving within 30 minutes of pressure relief. Epidermis remains intact. Reversible with intervention.

6503 Decubitus, grade blister

Partial thickness loss of skin layers involving epidermis and possibly penetrating into but not through dermis. May present as blistering with erythema and/or induration; wound base moist and pink painful; free of necrotic tissue.

6504 Decubitus, grade open sore

Full thickness tissue loss extending through dermis to involve subcutaneous tissue. Presents as shallow crater unless covered by eschar. May include necrotic tissue, undermining, sinus tract formation, exudate, and/or infection. Wound base is usually not painful.

6505 Decubitus, grade deep

Deep tissue destruction, extending through subcutaneous tissue to fascia and may involve muscle layers, joints and/or bone. Presents as a deep crater.   May include necrotic tissue, sinus tract formation, exudate, and/or infection. Wound base is usually not painful.

6506 Loss of Reduction/Fixation

Loss of initial closed or open reduction (not anticipated) requiring subsequent re-manipulation.

6507 Non-union

Failure to heal < 3 months, despite normal therapy, requiring prolonged fixation or grafting.

6508 Osteomyelitis

Infection of bone based on laboratory values and/or x-ray films.

6509 Orthopaedic Wound Infection

Wound infection requiring antibiotics or drainage following open or closed orthopaedic procedure.

6599 Other

Neurological

7001 **Alcohol Withdrawal**

Fits, seizures, agitation, or delirium tremens requiring treatment.

7002 **Anoxic Encephalopathy**

A complication (not diagnosis) not attributable to original traumatic event. Diagnosis as noted by neurosurgeon, neurologist on progress notes or by medical examiner on autopsy.

7003 **Brain Death**

Unexpected event not attributable to initial pathological state. Patient fulfilling institution criteria and testing with appropriate documentation.

7004 **Diabetes Insipidus**

Excessive urinary output treated with vasopressin or DDAVP with appropriate response.

7005 **Meningitis**

Diagnosed by a positive culture or in the absence of a positive culture one of the following: >50% Polymorphonuclear cells on CSF cell count, minimum 50 cells counted; CSF sugar <15 mg%

7006 **Neurapraxia (iatrogenic)**

Motor dysfunction following procedure, unrelated to original injury.

7008 **Progression of Original Neurologic Insult**

Outcome worsened by unexpected sequelae of the original injury.

7009 **Seizure in Hospital**

Witnessed tonic- clonic activity.

7010 **SIADH**

Output of low volumes of concentrated urine in the face of serum hypotonicity

7011 **Stroke/CVA**

Secondary to original injury or treatment of original injury, which was unexpected.

7012 **Ventriculitis - post-surgical**

Diagnosed by positive culture or in the absence of a positive culture one of the following :>50% polymorphonuclear cells on CSF cell count, minimum 50 cells counted; CSF sugar <15 mg%

7099 **Other Neurologic**

Vascular

7501 **Anastomosis Haemorrhage**

Unexpected bleeding from a surgical anastomosis, which requires re-operation.

7502 **DVT (lower extremity)**

Documented occlusive condition, which requires anticoagulant therapy and/ or surgery or results in death or major ischemic injury.

7503 **DVT (upper extremity)**

Documented occlusive condition, which requires anticoagulant therapy and/ or surgery or results in death or major ischemic injury.

7504 **Embolus (Non-pulmonary)**

A documented visualization or high index of suspicion as documented by trauma surgeon or medical examiner.

7505 **Gangrene**

Dry gangrene tissue necrosis due to vascular insufficiency. (This is not moist gangrene or "gas gangrene" caused by species of Clostridia).

7506 **Graft Infection**

Unexpected infection, which causes loss of graft, requires antibiotic therapy, or requires surgical intervention.

7507 **Thrombosis**

Clot formation at a graft or vessel.

7599 **Other Vascular**

Psychological / Psychiatric

8001 **Psych**

A new condition identified as a result of the present injury or hospitalisation, which was, not present or identified prior to the injury and requires psychiatric/psychological evaluation or treatment.

Other complications

8501 Anaesthetic Complication

Any complication directly related to an anaesthetic agent or drugs used for anaesthesia therapy.

8502 Drugs

Any complication directly related to a drug used for therapy as confirmed by review. (Will only pick anaphylactic reaction that is one that requires adrenaline).

8503 Fluids

Any complication from fluid and electrolytes therapy confirmed by review

8505 Monitoring

Any complication directly relating to monitoring device. Examples: air embolism, line disconnection, alarm failure.

8508 Unexpected Postoperative Haemorrhage

Unexpected postoperative bleeding, which requires treatment with blood products or surgical **intervention.**

8599 Other

Provider error

9001 Delay in Disposition

Patient inappropriately spending greater than 2 hours in resuscitation space without definitive diagnostic or therapeutic plan.

9002 Delay in Trauma Team Activation

Failure to identify major trauma victim and activate trauma response.

9003 Delay to Operating Room

Greater than 2 hours to definitive surgical care. Greater than 6 hours to definitive surgical care for open fracture.

9004 Delay in MD Response

Failure to respond in a timely manner as defined by hospital protocol.

9005 Delay in Obtaining Consult

Failure to obtain consultation when alternative therapy would have been beneficial.

9006 Delay in Diagnosis

Injury-related diagnosis discovered after initial work-up completed and admission diagnosis is determined. (Do not code if the situation is coded in Error in Diagnosis).

9007 Error in Diagnosis

Although the injuries may have been worked up, injury was missed because of misinterpretation or inadequacy of physical examination or diagnostic procedure(s).

9008 Error in Judgement

Errors in medication administration, procedure interpretation or management strategy contrary to available information. This includes disease-specific iatrogenic complications, i.e., CHF from poor fluid management. GI bleed from inadequate prophylaxis.

9009 Error in Technique

Technical error related to procedure.

9011 Tertiary survey incomplete

9013 Delay suture laceration

Abdominal compartment syndrome

9103 ACS Primary

9104 ACS Secondary

ACS is defined as any IAP > 20 mmHg associated with progressive clinical organ dysfunction despite resuscitation, with improvement of physiological parameters following operative decompression. Clinical organ dysfunction is defined as urinary output less than 0.5/1 ml/kg/hr, or a Peak Airway Pressure (PAP) more or equal to 45 cm H_2O with pCO_2 > 50 torr or PaO_2/FiO_2 < 150, or CI < 3 L / min / m^2. Primary ACS was defined as ACS in the presence of abdominal injury and secondary ACS when no intra-peritoneal injuries were identified. Intra-abdominal hypertension is arbitrarily defined as any intra-abdominal pressure above 15 mmHg.

Spinal

9411 Missed C-spine injury

9413 Delay clearing C-spine

9415 Delay clearing T-L spine

MAJOR INJURY DATA COLLECTION FORM (PAGE 1)

DEMOGRAPHICS	CRSID		
Hospital	MRN	Surname	Given
M / F	DOB	Address	Postcode
Consultant Surgeon		Surgical Registrar	
Consultants Other specialties		Registrars Other Specialties	

INJURY	Date	Time	Postcode	Mechanism	Place	Blunt / penetrating

Restraint Nil, Lapsash, Lap, Child rest, NotDoc, Unknown, N/Ap	Safety Equipment Nil, Helmet, Airbag, Other, NotDoc, N/Ap
Intent Accident, Selfharm, Assault, By Partner, Child neglect, Undetermined, Legal intervention	Substance: (drugs or alcohol) Both drugs and alcohol, None, Undetermined, Drugs only, Alcohol only Specify:

PRE-HOSPITAL	Yes/No

Entrapment? Yes/No (if Yes how long?) ___	Request:	Despatch:	At Scene:	Depart:	At Hospital		
Ambulance Level	Transport Decision	Pulse	Resp	BP	Eye	Verbal	Motor
CPR	AIR	Time	MAST	Fluid type	Volume	Drugs	ICC

REFERRING HOSPITAL Yes/No	Name of Hospital	MRN				
Arrival Date	Time	Departure Date	Time	Hotline N/Ap - Correct - Incorrect Fail to Use	Time	
Temp	Pulse	Resp	BP	Eye	Verbal	Motor
CPR	AIR	Time	MAST	Fluid type	Volume	ICC

MEDICAL RETRIEVAL TEAM	Yes/ No/Out	Request:	Despatch:	At Scene:	Depart:	At Hospital

E.D. ADMISSION	Transport	Date	Time	Trauma Call	Criteria		
Temp	O2Sat	Pulse	Resp	BP	Eye	Verbal	Motor
CPR	AIR	Time	Fluid type	Volume	ICC		
Head CT	Time In	Time Out	DPL	Abdo CT	Contrast	Aortogram	FAST? ChestCT?

Disposal Name of Hospital (if transferred)	*Radio Used N/ap Y / N*	*Time __:__*
	Surg Reg N/ap Y / N	*Time __:__*
	Hotline ***(Liverpool) Received Y/N***	*Urban Y / N Time ___*

MAJOR INJURY DATA COLLECTION FORM (PAGE 2)

OPERATIONS PERFORMED Yes/No

1.	Cavity ________	Code ________	Date	Time
2.	Cavity ________	Code ________	Date	Time
3.	Cavity ________	Code ________	Date	Time
4.	Cavity ________	Code ________	Date	Time
5.	Cavity ________	Code ________	Date	Time
6.	Cavity ________	Code ________	Date	Time
7.	Cavity ________	Code ________	Date	Time
8.	Cavity ________	Code ________	Date	Time

DIAGNOSIS	**Injury**	**AIS Code**	**Highest AIS**
Head/Neck	________________	________	______
	________________	________	______
	________________	________	______
	________________	________	______
	________________	________	______
Face	________________	________	______
	________________	________	______
	________________	________	______
Chest	________________	________	______
	________________	________	______
	________________	________	______
Abdomen	________________	________	______
	________________	________	______
	________________	________	______
Extremities	________________	________	______
	________________	________	______
	________________	________	______
External	________________	________	______
	________________	________	______

Guess	ISS	TRTS	RTS	TRISS	ASCOT

MAJOR INJURY DATA COLLECTION FORM (PAGE 3)

PERFORMANCE INDICATORS

PRE-HOSPITAL		Bypass correct		GCS < 9 ETT	
Kept in SWSAHS		Scene < 20mins		IV cannula <500mls	
RESUSCITATIVE		Retrieval Team <30mins		<3 hrs Referring hospital	
Pathway		Exceed 2000 without blood		Explore penetrating trauma	
Pt in CT > 1hour		GCS <13 no CT		GCS <9 ETT	
DEFINITIVE CARE		Represent < 72hrs		Thrombo-embolic prophylaxis	
Missed fractures		Hypothermia		Fracture fixation <24hrs	
Compound fracture < 6hours		Non Therapeutic laparotomy		Injury to Craniotomy Time	
Arrival MTS to Craniotomy		Transferred from MTS		Joint dislocation > 1hr	
REVIEW		Arrest Haemorrhage for BP <90 Lap <45mins –Other <90mins		Injury to Laparotomy time	
Ischaemic limbs < 4hours		Unplanned OT		Unplanned ICU	
Document temp in OT		Hb > 85		All injuries diagnosed	

COMPLICATIONS

None ☐ Occurred ☐ *(enter code from list)*

Pre hospital airway	10	Neurological	70
Pre hospital	15	Vascular	75
Pre hospital miscellaneous	20	Psychiatric	80
Hospital Airway	25	Other (see list) MET NEWS Organ Donor	85
Hospital Pulmonary	30	Provider Error	90
Cardiovascular	35	ACS Cohort	91
Gastrointestinal	40	Referring Hospital Operations	92
Hepatic, Splenic, Biliary	45	c-spine	94
Haematologic	50	Pathway Ribs – Abdo – Pelvis – Femur - Head	95
Infection	55	Cat 7 True - Pseudo	96
Renal/Genito-urinary	60	Diagnostic item Blush – TOE – Factor 7 – ECMO	97
Musculo-skeletal	65		

INJURY OUTCOME

Days in ICU __ Discharge Date ________ Outcome ____ Status on discharge _______

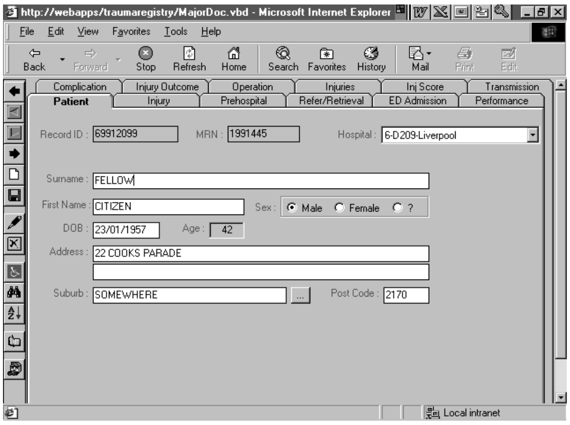
Discharge date from other hospital (if transferred) _______ Status at D/C other hospital _____

Death Details		
Place of Death *Time of Death*	***Classification*** *CNS* *Non CNS (exclude NOFs)* *#NOF* *Thoracic/abdominal bleeding without operation*	***Death Audit*** *Completed* *To be completed* *Not required* *Peer Review*

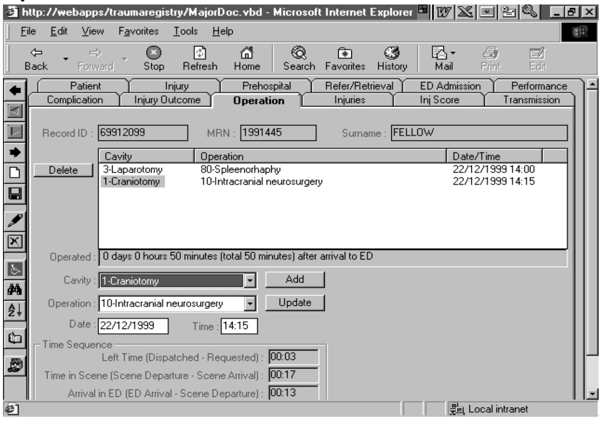
MINOR INJURY DATA COLLECTION FORM

MRN	**Surname**	**First name**
M / F	**DOB**	**AMO**
Specialty		**Mechanism**
Intent: *Accident Self-harm Assault Assault by partner* **(circle)** *Child abuse/neglect Undetermined Legal intervention*		**Place**
Status	**TTA Yes No NA**	**TTA Criteria**
Comments		
Diagnosis	**Admit date**	**Discharge date**
☐ *Referred from hospital name:* ☐ *Transferred to hospital name:*		**MRN**

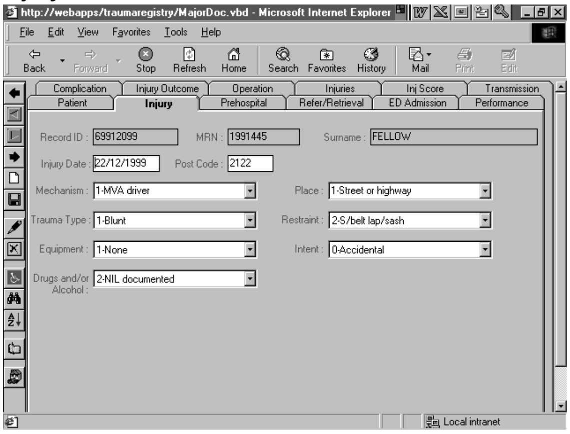
Patient Details



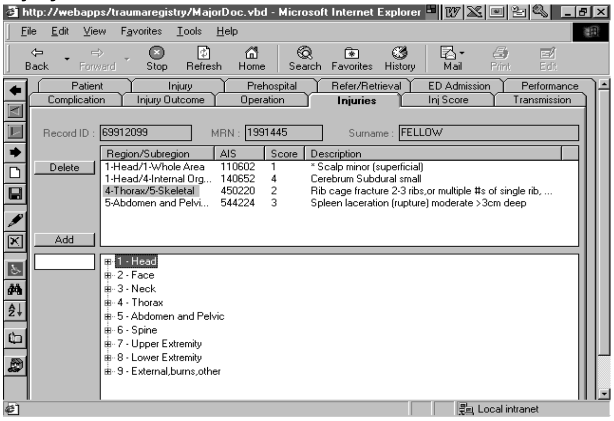
Operation Details



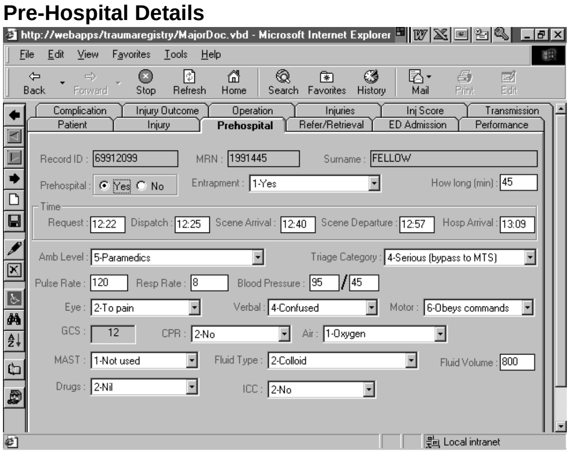
Injury Event



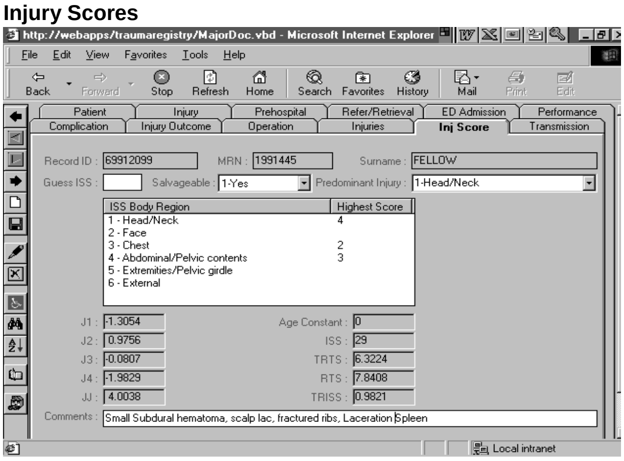
Injury Codes



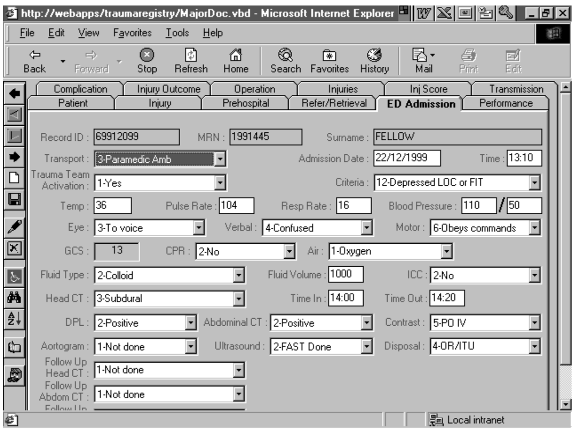
Pre-Hospital Details



Injury Scores



Emergency Department



This is a sample of the range of screens to provide a glimpse of the registry.

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Glossary of Abbreviations

AIS	Abbreviated Injury Scale
CNS	Central nervous system
CSAHS	Central Sydney Area Health Service. CSAHS is now part of Sydney South West Area Health Service.
DPL	Diagnostic peritoneal lavage
ED	Emergency Department
EDH	Extradural haemorrhage
EDIS	Emergency Department Information System
FAST	Focussed assessment with sonography in trauma
HDU	High Dependency Unit Patients are admitted to HDU when they require a nurse : patient ratio of 1: 2. Many require non-invasive ventilation.
ICU	Intensive Care Unit Patients are admitted to ICU when they require a nurse : patient ratio of 1:1, and/or require invasive ventilation.
ISS	Injury Severity Score
LGA	Local Government Area A term used to refer to areas controlled by each individual Local Government, and frequently used as a unit of analysis when reporting on hospital and other health-related data.
MBC	Motor bike crash
MRT	Medical Retrieval Team A team of two clinical personnel, one of whom is a doctor experienced in critical care, that performs inter-hospital critical care transfers. Some medical retrieval teams are trained in pre-hospital work including advanced clinical care and rescue. Advanced clinical care beyond normal ambulance protocols includes advanced airway management, sedation and analgesia including anaesthesia, intercostal catheters and blood transfusion (definition provided courtesy of NSW Medical Retrieval Unit). In NSW medical retrieval services are provided by NRMA Careflight and Westpac Lifesaver.
MRU	Medical Retrieval Unit The central coordinating body for medical retrieval services in NSW.
MTOS	Major Trauma Outcome Study
MTS	Major Trauma Service The major trauma service for SWSAHS is Liverpool Hospital.
MVC	Motor vehicle accident
NTL	Non-therapeutic laparotomy
#NOF	Fractured neck of femur
OT	Operating theatre
Pdeath	Probability of death
Ps	Probability of survival
RTS	Rural Trauma Service Bowral Hospital is the only rural trauma service in SWSAHS.
RTS	Revised Trauma Score
SAH	Subarachnoid haemorrhage
SBP	Systolic blood pressure
SDH	Subdural haemorrhage
SMR	Standardised Mortality Ratio
SSWAHS	Sydney South West Area Health Service SSWAHS officially began on January 1 2005, as a result of the amalgamation of CSAHS and SWSAHS.
SWSAHS	South Western Sydney Area Health Service. SWSAHS is now part of Sydney South West Area Health Service.
TRISS	Trauma Injury Severity Score
TL	Therapeutic laparotomy
TS	Trauma Score
UTS	Urban Trauma Service The urban trauma services in SWSAHS are Bankstown, Campbelltown, Fairfield and Camden Hospitals.

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Liverpool Hospital

Bankstown Hospital

Campbelltown Hospital

Camden Hospital

Fairfield Hospital

Bowral Hospital