





Evolution of trauma care and the trauma registry in the West Australian health system

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Trauma care is evolving throughout the world to meet the demand resulting from rapidly increasing rates of mortality and morbidity related to external injuries. The State Major Trauma Service was designated to Royal Perth Hospital in 2004 to provide comprehensive care for trauma patients in Western Australia (WA), which is the largest state by area in the country. The State Major Trauma Unit, which was established in 2008, functions as a level I center and admits over 1,000 major trauma patients per year, making it the second busiest trauma center in Australia. The importance of recording data related to trauma was identified by the trauma service in WA to inspire higher standards of patient care and injury prevention. In 1994, the service established a trauma registry, which has undergone significant changes over the last two decades. The current State Trauma Registry is linked to a statewide database called the Data Linkage System. The linked data are available for policy development, quality assurance, and research. This article discusses the evolution of the trauma service and the registry database in the WA health system. The State Trauma Registry has enormous potential to contribute to research and quality improvement studies along with its ability to link with other databases.

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INTRODUCTION

Trauma is defined as single or multiple injuries that are life-threatening or life-changing in terms of long-term outcomes and related disabilities. These injuries result from external forces such as motor vehicle crashes, interpersonal violence, falls, gunshot wounds, and industrial injuries [1]. Trauma centers are established in all mature health care systems to provide thorough evaluations and care to acute trauma patients. The American College of Surgeons (ACS) defined a ranking order for trauma

centers depending on the number of patients admitted annually and the availability of surgical and medical specialties, nursing, radiology, critical care, anesthetic services, and other resources. The ACS defined several levels of trauma care, such as level I (comprehensive services) and level III (limited services) [2,3].

Western Australia (WA) is the largest state in Australia and has a widely dispersed population, leading to significant challenges in delivering health services. It consists of three main metropolitan area health services and a country health service. The State Major Trauma Unit (SMTU) is located in Royal Perth Hospital, Perth,

WA, Australia. The SMTU functions as a level I trauma service, providing comprehensive care for major trauma across the state. About 6,000 patients are treated through the service annually, with access to all specialty services as described by the Royal Australasian College of Surgeons [4].

The State Major Trauma Service collects data for all trauma patients admitted to the hospital, as well as to other centers in the state, and maintains the State Trauma Registry (STR) database. Those who present to a health care service more than 7 days following a trauma event or stay in the health service for less than 24 hours are not included in the registry. The STR has undergone significant changes since its establishment 26 years ago. The aim of this review is to examine the trauma service in WA and the current trauma registry data collection system.

EVOLUTION OF THE TRAUMA SERVICE IN WA

Major trauma care was provided by the major hospitals in WA for over 100 years. Emergency departments increasingly played leading roles in managing trauma patients with surgical and other specialty support over the last 30 years. However, population growth, with the increased volume and complexity of major trauma and the availability of modern trauma management strategies, called for the consolidation of comprehensive trauma care. The need for a mature trauma system in WA was initially identified and designated by the WA Department of Health in 2004. The Trauma Working Group was formed and subsequently a plan was developed in 2008 to establish a WA Trauma Care System [5].

The SMTU is a 30-bed, specialized unit dedicated to the care of complex and multisystem trauma patients. The medical model of the unit consists of four trauma surgeons, five registrars, five resident medical officers, and two interns. The trauma unit manages all acute multisystem major trauma patients in the state and admits over 1,000 major trauma patients (Injury Severity Score > 12) per year, making it the second busiest trauma center in Australia. However, some trauma patients may be admitted to other health services within the state. Those patients in other facilities meeting the trauma team activation criteria (based on mechanism, physiology, and suspected injuries) are transferred to the STMU through a standardized major trauma interhospital transfer protocol. Once trauma patients are stabilized and acute injuries have been dealt with, patients are then referred to the most relevant specialty for longitudinal care. This transitional concept of the SMTU allows for the consolidation of complex, multitrauma patients into a single, dedicated area that facilitates

improved coordination among multiple specialties in the management of the acute phase of the patient journey. Dedicated high-acuity beds allow earlier step-down from the intensive care unit and a higher level of care for complex trauma patients than that available on a general ward. More recently, the SMTU became the first pilot ward for the Health in a Virtual Environment remote monitoring service, further enhancing the critical care capabilities of the unit. Elderly patients with complex comorbidities receive comprehensive geriatric assessment through the perioperative geriatric services to improve their outcomes. Coordination and active involvement of other surgical and medical specialties are encouraged for trauma patients in the SMTU.

THE STATE TRAUMA REGISTRY IN WA

The function and effectiveness of trauma care in WA are monitored through a trauma registry database, which was initially established in 1994 by Royal Perth Hospital. Later, other metropolitan health services started collecting data on trauma patients (Table 1).

The STR database commenced combining all trauma data into a single database in 2011. The STR coordinates data collection and evaluation of trauma demographics and hospital care for the purpose of monitoring the function and effectiveness of the WA trauma system. The main objective of the STR is to inspire higher standards of patient care and injury prevention. The registry monitors injuries, categorizes them, measures outcomes after injury, identifies system requirements, and reports and audits for quality improvement.

Almost all major trauma patients are transferred to the STMU according to the transfer protocol (stated above). Admission to STR is based on hospital admission, and only those whose length of stay is more than 24 hours in a registry hospital are entered to the registry. Those WA trauma patients who do not reach the Perth metropolitan area for admission to a registry hospital are also not captured (Table 1). Hospital Morbidity Data Collection is a registry that includes all hospitalized patients (Table 2). An automated data collection process of the Hospital Morbidity Data Collection minimum dataset was implemented in order to capture all WA trauma admissions throughout the state that meet the trauma registry criteria. This process started in January 2021, and all statewide trauma patients are recorded in the STR. Patients with major trauma, regardless of whether they are alive or deceased, who are identified by this process, will be manually captured using electronic information systems by the STR research nurses.

Table 1. Health services that have joined the Trauma Registry of Western Australia

Health service	Major trauma (ISS >15)	Minor trauma (ISS <16)
Royal Perth Hospital	From Aug 1994	From Aug 1994
Perth Children's Hospital ^{a)}	From Aug 1998	From Aug 1998
Fremantle Hospital	From Jan 1997 to Dec 2014	From Jan 2012 to Dec 2013
Joondalup Health Campus	From Jan 2010	From Jan 2010
Sir Charles Gairdner Hospital	From Jan 1997	From Jan 2012
Fiona Stanley Hospital	From Feb 2015	From Feb 2015
St John of God Midland Hospital	From Jan 2018	From Jan 2018

ISS, Injury Severity Score.

^{a)}Formally Princess Margaret Hospital of Children.

Table 2. Health registries linked to the Western Australia Data Linkage System

Registry name	Available since
Birth Registrations	1945
Cancer Registry	1982
Death Registrations	1969
Emergency Department Data Collection	2002
Electoral Roll	1988
Hospital Morbidity Data Collection	1970
Mental Health Information System	1966
Midwives Notification System	1980
Mortality Data: Coded fields	1969
Western Australian Notifiable Infectious Diseases Data	1988
Western Australian Register of Developmental Anomalies	1980
Home and Community Care	2004
Aged Care Assessment Program	2003
Western Australian Trauma Registry	1994

There are additional health-related and other government datasets.

A detailed dataset is collected on major trauma patients (Injury Severity Score > 12), from the time of trauma to discharge from hospital. A limited dataset is collected on minor trauma admissions (Injury Severity Score < 13). Previously, the trauma registries collected data individually in separate, although identical, Microsoft Access databases (Microsoft Corp., Redmond, WA, USA). Research nurses (Australian Nursing Federation level 2) and other officers collected trauma data, collaborated, and maintained the consistency and validity of the WA trauma registry [6]. The inter-registry staff were combined informally to ensure that data was consistently collected, in terms of data elements and interpretation, across all sites. In 2006, Royal Perth Hospital developed a web-based structured query language trauma registry database, which allows direct interface with hospital information systems (Patient Administration System, Emergency Depart-

ment Information System, Theatre Management System), making it possible to merge verified data such as demographics and surgical procedures. The new database provides augmented data quality via the use of improved validation rules and mandatory fields. In January 2011, the WA Department of Health and Health Information Network rolled out this database to the other WA hospital registries to facilitate the development of the WA STR database. The migration of legacy data has yet to occur, pending information technology resources; therefore, data for some registries are contained across two databases, as shown in Table 3.

The STR is a useful resource for research and quality improvement projects. STR data have been used to help guide national injury prevention policy by Public Health Association of Australia [7]. One study based on STR data found that the risk of death after major trauma was twofold higher in rural WA, but if patients survived transfer to the SMTU, the outcomes were equivalent to metropolitan areas. The trauma transfer policy was subsequently altered such that all major trauma patients are now transferred directly to the STMU [8]. Another study conducted recently, through collaboration with 31 trauma centers across Australia and New Zealand, described demographic and clinical variables predicting trauma mortality and length of stay. These variables are now used to assist in benchmarking the clinical outcomes of different trauma centers [9]. Another study found that there was a 6.1% risk of missing cervical spine injuries on plain radiographs, predominantly in older people. This resulted in the routine use of computed tomography cervical scans for all people over the age of 65 years with cervical spine injuries [10].

At the same time, the STR is routinely linked to the WA Data Linkage System (WADLS). The WADLS initially commenced as a collaboration between the Department of Health WA, University of WA, Curtin University, and Telethon Kids Institute in 1995 [11]. Later it was brought into the Department of Health WA,

Table 3. Trauma registry databases

Registry	Pre-January 2011	Post-January 2011
Royal Perth Hospital	New SQL database	New SQL database
Princess Margaret Hospital for Children	Access database ^{a)}	New SQL database (from Jan 2010)
Fremantle Hospital	Access database	New SQL database (until Dec 2014)
Joondalup Health Campus	New SQL database	New SQL database
Sir Charles Gairdner Hospital	Access database	New SQL database
Fiona Stanley Hospital	Not applicable	New SQL database
St John of God Midland Hospital	Not applicable	New SQL database

SQL, structured query language.

^{a)}Microsoft Access (Microsoft Corp., Redmond, WA, USA).

where it continues to operate. The WADLS connects information from multiple databases related to West Australians using personal identifying data, with the associated health or service data held separately. The linked data can be requested for policy development, quality assurance, and research [12]. More than 40 registries, including the STR, are linked via the WADLS. Major registries from the Department of Health are listed in Table 2, and additional health-related and other government datasets are managed by the service. By 2008, the WADLS had already supported more than 400 research studies, over 250 publications, and about 35 research degrees [13].

CONCLUSION

Major trauma care in WA is led by the State Major Trauma Service, which provides trauma care in the largest state in Australia. The State Major Trauma Service is a mature trauma service (ACS level I), delivering the best available trauma care, in collaboration with multiple health institutions across the state. The STR collects and combines trauma-related data, which are linked as part of the WADLS infrastructure to enable further analysis and storage. This review identified the potential of the trauma database and linkage services as sources of information that can be used to improve the outcomes of major trauma patients in WA.

NOTES

Ethical statements

Not applicable.

Conflicts of interest

The authors have no conflicts of interest to declare.

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Author contributions

Conceptualization: MTI; Data curation: MTI; Formal analysis: LF; Methodology: MB; Project administration: SR; Writing—original draft: MTI; Writing—review & editing: MB, SR, LF. All authors read and approved the final manuscript.

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