

# The New Zealand Major Trauma Registry: the foundation for a data-driven approach in a contemporary trauma system

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## ABSTRACT

**AIM:** To describe the development of the New Zealand Major Trauma Registry (NZ-MTR) and the initial experiences of its use.

**METHOD:** The background to the development of the NZ-MTR was reviewed and the processes undertaken to implement a single-instance of a web-based national registry described. A national minimum dataset was defined and utilised. Key structures to support the Registry such as a data governance group were established.

**RESULTS:** The NZ-MTR was successfully implemented and is the foundation for a new, data-driven model of quality improvement. In its first year of operation over 1,300 patients were entered into the Registry although coverage is not yet universal. Overall incidence is 40.8 major trauma cases/100,000 population. The incidence in the Māori population was 69/100,000 compared with 31/100,000 in the non-Māori population. Case fatality rate was 9%. Three age peaks were observed at 20–24 years, 50–59 years and above 85 years. Road traffic crashes accounted for 50% of all caseload. A significant proportion of major trauma patients (21%) were transferred to one or more hospitals before reaching a definitive care facility.

**CONCLUSION:** Despite the challenges working across multiple jurisdictions, initiation of a single-instance web-based registry has been achieved. The NZ-MTR enables New Zealand to have a national view of trauma treatment and outcomes for the first time. It will inform quality improvement and injury prevention initiatives and potentially decrease the burden of injury on all New Zealanders.

Abbreviations	
AIS	Abbreviated Injury Score
CT	Computerised Tomography
DHB	District Health Board
GCS	Glasgow Coma Scale
ICD	International Classification of Disease
ISS	Injury Severity Score
INR	International Normalised Ratio
NMDS	National Minimum Dataset for major trauma
NZ-MTR	New Zealand Major Trauma Registry
MTNCN	Major Trauma National Clinical Network

During her epic career, JK Rowling wrote “From this point forth, we shall be leaving the firm foundation of fact and journeying together through the murky marshes of memory into thickets of wildest guesswork”.<sup>1</sup> What JK Rowling did not know was that the trauma system in New Zealand has occupied that murky ground for some time. The time has come to distance ourselves from the magical realm of guesswork and enter a new era of data-driven trauma care provision.

Indeed there is good evidence to suggest that contemporary trauma systems, which are supported by accurate timely data, can reduce preventable levels of mortality, complications and lifelong disability among people who sustain major trauma.<sup>2-4</sup> Trauma registries are used extensively internationally to describe the patterns of trauma, demonstrate changes in patient and system outcomes, and provide data for research.<sup>5,6</sup> Another important function is to provide feedback to hospitals on trauma performance to support improvement in the quality of care and address issues of sub-optimal performance. Contemporaneous data provides useful information to support the effective management of trauma for local, regional and national trauma systems.

Historically in New Zealand and despite previous attempts,<sup>7-10</sup> there has been little investment in a national system of collecting trauma data, even though injury is one of the most significant contributors of health loss across all age groups, but particularly in the young.<sup>11</sup>

However, in 2012 the New Zealand Major Trauma National Clinical Network (the ‘Network’) was formed. The Network had three initial priorities: to establish a formal national structure, to implement a national registry and to develop consistent guidelines and policies. The Network is funded by the Accident Compensation Corporation (New Zealand’s no-fault accident insurer) and the Ministry of Health, and comprises senior clinical, management, funding and research stakeholders.

This paper describes the development of the NZ-MTR and initial experiences of its use.

## Method

The context in which the Network operates presents some unique challenges. New Zealand is a population of 4.6 million people, and while the majority (78%) live in the North Island, during the summer months the South Island population can expand significantly above its one million population. Universal health care is provided by 20 district health boards (DHBs) who have legislative autonomy to provide care across community and hospital services and are organised into four regions for selected shared services. There are six major trauma hospitals, including one which provides quaternary paediatric services, and two more which provide specialist burns and/or spinal cord injury services. There are two ambulance services and an extensive air ambulance network.

With the formation of the Network it was accepted that a major trauma registry was a key goal. The intent of the registry was to accurately describe the numbers of major trauma patients admitted to New Zealand hospitals, to measure system performance and enable research. Each of the initial meetings of the Network addressed the way in which this objective could be progressed. A key component of any registry is a concise, relevant and achievable dataset. Similarly, the form of the registry on which the data is to be collected and recorded and the cost of that solution are integral to having a functional registry. These issues were canvassed at length with the sponsors and among the Network to arrive at a solution which was feasible and would meet the requirements set out. Privacy and security of health-related data is another fundamental element of a registry and these issues were also considered by the Network in association with the Office of the Privacy Commission, a crown-funded independent entity. Finally, access to the data and appropriate use of its elements is very important. Options were explored by the Network and an effective framework established.

## National minimum dataset for major trauma

A national minimum dataset<sup>12</sup> (NMDS) for major trauma was developed using the background experience members of the

Network had in setting up the Bi-National Minimum Dataset in Australia over 10 years previously. New Zealand-specific requirements were also considered as well as what current and future health information technology solutions may capture. As a result the

**Table 1:** Summarised data points collected in the New Zealand Major Trauma Registry (NZ-MTR).

Type of information	Data point
Unique identifiers	National Health Index
	Incident number
	Definitive care hospital
Demographic	Age
	Sex
	Ethnicity
	Date of birth
Incident details	Date and time of injury
	Postcode of injury
	Cause of injury
	Intent of injury
	Activity at time of injury
	Place of injury
	Injury description (narrative)
	Safety devices used
Pre-hospital information	Date and time of first observations
	Vital signs (GCS <sup>‡</sup> , heart rate, systolic blood pressure, respiratory rate)
	Mode of transport from scene
Hospital information	Date and time of first observations
	Vital signs (GCS, heart rate, systolic blood pressure, respiratory rate)
	Vital sign qualifiers
	Inter-hospital mode of transport
	Blood alcohol levels, base excess, INR <sup>‡</sup>
	Date and time of procedures such as CT <sup>§</sup> , intubation, emergency operative procedures
Outcome	Coding for AIS <sup>‡</sup> and ISS <sup>‡</sup>
	Length of time intubated, in intensive care, in hospital
	Diagnosis made after 48 hours
	Discharge location
	Type of death

<sup>‡</sup>GCS Glasgow Comma Scale, <sup>‡</sup>INR International Normalised Ratio, <sup>§</sup>CT Computed Tomography, <sup>‡</sup>AIS Abbreviated Injury Score, <sup>‡</sup>ISS Injury Severity Score.

NMDS is closely aligned with the Bi-National Minimum Dataset used for the Australian Trauma Registry.<sup>13</sup> This was intentional to enable benchmarking of performance across a large collection and multiple jurisdictions. Of the 68 fields in the NMDS, 55 are a direct match with the Australian Bi-National NMDS. The New Zealand dataset contains items such as the National Health Index, ethnicity, paediatric weight and type of death, which the Australian dataset does not contain. Conversely, the Australian dataset contains elements such as pre-existing conditions, type of CT scan, blood transfusion and severe complications, which the New Zealand dataset does not contain. The non-matched items are either specific to the New Zealand context or were unlikely to be collected accurately. The data points are summarised in Table 1.

The definition of major trauma used by the Network is the Injury Severity Score (ISS)<sup>14</sup> of 13 or more using the 2008 revision of the 2005 edition of the Abbreviated Injury Scale (AIS).<sup>15</sup> Injury severity scoring is a unique coding system related to physical injury, used ubiquitously in trauma outcome research internationally over the last 40 years. The underlying AIS injury coding system is not a feature of any local information management system and the coding

not part of the training of health coding staff in the hospitals. For this reason the trauma registry is a unique repository of health quality improvement data.

ISS $\geq$ 13 correlates with one severe or critical injury or two injuries of which one is major (AIS $\geq$ 3) and one moderate injury (AIS $\geq$ 2). In keeping with this definition, the NZ-MTR includes patients with major trauma defined by ISS $\geq$ 13, and includes only those patients suffering physical injury as a result of energy transfer and not internal pathologic processes.

The inclusion and exclusion criteria are outlined in Table 2. While most patients admitted to ICU and many who have urgent torso surgery will have major trauma by anatomic (ISS) criteria, some will not. Criteria for admission to ICU will vary by institution, and priorities for urgent surgery will also depend on institutional factors. While these criteria may have value in defining a group of severely injured patients in a single institution, the same cannot be said for across multiple institutions. For consistency these criteria have not been included as criteria for the definition of major trauma.

Patients who have significant comorbidity and for whom a trivial injury is the final

**Table 2:** Inclusion and exclusion criteria of the major trauma National Minimum Dataset.

<p><b>INCLUSIONS</b></p> <p>All patients of any age admitted to hospital with either:</p> <ul style="list-style-type: none"> <li>• Injury Severity Score (ISS) <math>\geq</math>13, based on AIS<sup>a</sup> 2005, Update 2008<sup>14</sup></li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• Death following injury (including deaths in emergency department)</li> </ul>
<p>The following patients are excluded:</p> <p><b>EXCLUSIONS</b></p> <ul style="list-style-type: none"> <li>• Patients with delayed admissions more than seven days after injury</li> <li>• Poisoning or drug ingestion that do not cause injury</li> <li>• Foreign bodies that do not cause injury</li> <li>• Injuries secondary to medical procedures</li> <li>• Isolated neck of femur fracture</li> <li>• Pathology directly resulting in isolated injury</li> <li>• Elderly (<math>\geq</math>65 years of age) patients who die with superficial injury only (contusions, abrasions or lacerations) and/or have coexisting disease that precipitates injury or is precipitant to death (eg, stroke, renal failure, heart failure, malignancy).</li> <li>• Hangings</li> <li>• Drowning</li> </ul>

<sup>a</sup>AIS Abbreviated Injury Score.

common pathway to hospital admission and ultimate demise are not included in the registry. In these patients the management of the injury is largely unrelated to the outcome. The dilutional effect of including many of these patients on the registry would limit the ability to recognise trends and outcomes in patients with anatomically severe injury.

Conversely, if the injury is the cause of death, for example significant bleeding leading to haemorrhagic shock, and the comorbid patient would not have died if not for the injury (regardless of the severity of the injury) the patient is included in the registry.

### Technical solution

A variety of solutions was explored, including standalone software in each DHB and use of existing technology platforms with local modifications relevant to the differences in each DHB. These options had major limitations when it came to combining the data. Ultimately a single-instance web-based option based in the Midland Region was chosen, as this software was already operational in this health region and could be extended to a national reach with acceptable cost and complexity. The software used is a web-based version of Collector<sup>®</sup>, a proprietary trauma software product from Digital Innovations Inc. based in Maryland. Access to the NZ-MTR is via secure portal using the Connected Health infrastructure.<sup>16</sup>

A key feature of the Collector<sup>®</sup> system is the intuitive Tri-Code function which converts narrative descriptions for injuries into both ICD and AIS codes. Tri-Code uses artificial intelligence software that recognises text and assigns relevant codes where the text matches a valid description. Tri-Code has been found to have excellent agreement with correct coding of AIS severities (weighted kappa 0.83-0.98).<sup>17</sup> Automated coding also eliminates the variability associated with coding calculated by multiple coders as would be the situation in the New Zealand setting. The NZ-MTR utilises 2005 AIS coding (with 2008 updates).

### Data collection and assurance

Since 1 July 2015, all North Island hospitals have employed data collectors, however, there has been delay in the South Island

Region to appoint these positions due to financial constraints and other challenges. These issues have now been resolved and as of end June 2017 there are data collectors employed in all 22 acute hospitals. Data collectors have been trained in AIS coding and in the use of the NZ-MTR, and are typically registered nurses.

Each hospital uses an extract of acute admissions from the hospital patient administration system to filter for Accident Compensation Corporation eligible patients or patients admitted with 'trauma' diagnoses. An assessment of these patients is conducted to determine whether they have appropriate diagnoses and reach the threshold for inclusion in the registry. Data collection is both prospective (typically in the larger centres which have more resource) and retrospective (typically in smaller centres with part-time resource).

In-hospital deaths are identified in various ways such as mortality extracts from the hospital patient management systems to identify injured patients who have died, and direct notification to data collectors from emergency department and inpatients services.

Quality assurance processes are undertaken in each region every four months to audit for completeness, logic and accuracy. Corrections are sent back to the original data collector to amend. Comprehensive data quality reports are prepared for each region at the end of a cycle, which show the types of errors detected by each data point.

### Privacy framework

A comprehensive privacy framework<sup>18</sup> encompassing all aspects of the NZ-MTR, including the technical infrastructure, data collection and data use has been developed and reviewed by the Office of the Privacy Commission. There is information available for patients about the NZ-MTR and patients have the option to opt-off the registry.

### Administration and governance structures

The overall framework supporting the NZ-MTR is led by the Network, which has oversight of the National Minimum Dataset, the Privacy Framework and the underlying agreements. A data governance group is established to manage the use of NZ-MTR data and assess requests for data.

The day to day management of the NZ-MTR is contracted to Waikato DHB and operated by the Midland Trauma System on behalf of all other DHBs who fund it with contribution from the Accident Compensation Corporation for the data quality assurance and reporting functions.

No applications have yet been made by external parties to use the NZ-MTR data for research purposes, but when such applications are made they will be assessed by the NZ-MTR Governance Committee against agreed requirements and a decision made.

### Incentivising data collection

There are two incentives in place to support the collection and upload of data to the NZ-MTR. The first is the inclusion in the annual planning guidance set out by the Ministry of Health, which requires all DHBs to collect and input the NMDS on all major trauma patients. The second incentive comprises pro-rata regional funding for data collection, which is provided by the Accident Compensation Corporation. The incentive is used regionally for nurse and allied health continuing education in trauma.

## Results

Reporting on the NZ-MTR is relatively limited to date, as a result of the short time it has been operational. Monthly reports are provided for internal use to monitor entries to the registry and year to date information on mortality and injury severity scores.

The inaugural annual report for 2015–16<sup>19</sup> was published using data from all North Island DHBs, and excluded the South Island data because of gaps in collection. The findings of this report showed an overall incidence of 40.8 major trauma cases/100,000 population with variation between the regions ranging from 36–48/100,000. The incidence in the Māori population was 69/100,000 compared with 31/100,000 in the non-Māori population. Case fatality rate was a consistent 9% for each region. Three age peaks were observed at 20–24 years, 50–59 years and above 85 years. Road traffic crashes account for 50% of all caseload. A significant proportion of major trauma patients (21%) are transferred to one or more hospitals before reaching a definitive care facility.

**Table 3:** Summary of NZ-MTR results 2015–16.

Incidence of major trauma	40.8/100,000
Incidence of major trauma by ethnicity	Māori 69/100,000 Non-Māori 31/100,000
Case fatality rate	9%
Cause of injury	Road traffic 52% Falls 28% Other 12% Assault 8%
Age group	Three peaks observed: 20–24 years 50–59 years 85+ years

These findings are consistent with other jurisdictions internationally<sup>20,21</sup> and give us a good level of confidence that the veracity of the NZ-MTR data is within range of what we might expect. The information from this first report may help start to inform an effective approach to injury prevention and areas to improve quality of care.

## Discussion

Trauma registries are an essential element in trauma quality improvement and the literature is replete with historical examples of where data contained in a national or regional trauma registry has been the cornerstone to effective outcome improvement.<sup>22</sup> More recently the establishment of trauma registries in Victoria<sup>23</sup> and the UK<sup>24</sup> have been associated with significant quality improvement initiatives.

Based on experiences internationally, the benefits of the NZ-MTR are not expected to be realised for 5–10 years as data over time will enable longitudinal analysis and sufficient data to support statistical findings.<sup>25</sup> Notwithstanding this, the early analysis of data is hinting at its potential and each subsequent year of data will be beneficial in providing an overview of the trauma demographic and experience, and to provide an indication of our clinical performance regarding this group of patients.

The intent of the registry is to foster quality improvement. The initial focus will be on pre-hospital and hospital process

measures such as time to computed tomography scan and emergency surgical procedures because these can be measured. We expect to see a reduction to the percentage of patients transferred to one or more hospitals before reaching a definitive care hospital following the recent introduction of the out-of-hospital destination policies, which identify designated hospitals for major trauma. In time, the information from the NZ-MTR will help inform injury prevention and effective rehabilitation of trauma patients.

To keep the NZ-MTR contemporary, an ongoing review of the National Minimum Dataset is needed to ensure the appropriate balance between the number of data points, the feasibility of collection and recording, and their utility in providing information. Auto-population of specific data elements is being explored, such as using unique identifiers to pull data from pre-hospital and national collections into the NZ-MTR to reduce the burden of data collection and improve data reliability. Testing of feasibility and error rates will be needed to ensure continuation of accuracy and completeness of data. The option of including long-term outcomes for major trauma patients is also a possibility to provide a more comprehensive data collection.

While the principles embedded in the ISS have not changed since 1974, the baseline coding system, AIS, has been updated about every five years. Initially it only dealt with blunt injury but was upgraded in the 1980s to address penetrating mechanisms of injury. In the 1990s and 2000s improving diagnostic precision with CT scans in particular has allowed greater specificity in injury definition, which has been reflected in the coding. Finally, injuries which carried

a severe threat to life in the 1980s (AIS4–5) might no longer be so, and the AIS code has to be effectively downgraded. Consideration is needed to understand the implication of these types of changes to the AIS coding and what this means for the NZ-MTR. The Association for the Advancement of Automotive Medicine,<sup>15</sup> which publishes the AIS, has just finalised the 2015 revision of AIS. Whether or not, or at what point, the NZ-MTR should change over the AIS 2015 needs to be determined.

The sustainability of the data collection process is fragile in places. Many resources are on fixed-term contracts and some staff have taken reduced income in the hope their roles will develop. Mechanisms to support a more resilient system should include enabling regions to interrogate their own data through intuitive business intelligence tools, and fostering translational research in hospitals which demonstrate the impact of change.

## Conclusion

The NZ-MTR is the foundation for understanding the burden of major trauma in New Zealand. For the first time we have a national view of where major trauma happens, who it happens to, how well our health system manages it and the factors that contribute to death and rehabilitation of survivors. Over the next 5–10 years we will continue to build on this foundation to drive a mature, contemporary major trauma system.

The data contained in the NZ-MTR is expected to present possibilities to transform major trauma care in New Zealand and ensure our systems and expectations are consistent with best practice internationally.

**Competing interests:**

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