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Evaluation of road ambulance transports for trauma in NSW

Data linkage analysis from the Critical Care Acute Trauma and Emergency (CATE) Public Health Register 2019-20

April 2023

NSW GOVERNMENT

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Executive summary

Road ambulance transport of severely injured patients is a critical component of the NSW trauma system, ensuring patients receive the right care, at the right facility, at the right time. Evaluating this complex system requires multiple data sources to link pre-hospital transport information to hospital outcomes. This has been achieved for the first time in a major initiative from the NSW Institute of Trauma and Injury Management (ITIM), part of the Agency for Clinical Innovation (ACI), working in collaboration with NSW Ambulance. The work has allowed geospatial analyses of ambulance road transports for severe injuries, to be linked to clinical outcomes following hospitalisation.

The main findings of these analyses:

1. The NSW Ambulance Major Trauma (T1) Protocol was operating effectively to identify and transport severely injured patients, with an under-triage rate of 3% and an over-triage rate of 60%. Approximately one in four patients who were transported on this protocol sustained a severe injury.
2. Geospatial analyses demonstrated an increased population risk of severe injuries within the key regional areas such as the Hunter Region, Mid North Coast, Northern Rivers, Murrumbidgee, and parts of Western NSW.
3. More than 95% of all severely injured patients were transported within the time frames recommended by the Major Trauma (T1) Protocol.

This report summarises the main findings of this analysis. These findings are likely to improve both monitoring capabilities for NSW ITIM and the ACI more broadly, and identify key areas of improvement in pre-hospital transport of severely injured patients across the NSW trauma system.

Introduction

Severe injury remains one of the leading causes of morbidity and mortality in Australia.[1, 2] The pre-hospital triage, management, and transport of patients with severe injuries are critical components of the trauma system and are based on established ambulance triage and transport protocols.[3, 4] Ambulance trauma protocols are designed to identify and transport severely injured patients to the most appropriate hospital, in the shortest possible time.

Assessing how this system functions requires routinely collected data to be linked across relevant agencies. The NSW Critical Care Acute Trauma and Emergency (CATE) public health register was established in 2015, under the provisions of the *NSW Public Health Act (2010)*. CATE has enabled links between NSW ambulance, emergency department, and in-patient episodes of care.

A key driver for this evaluation was the need to understand established patterns in ambulance transport activity following the revisions made to the NSW Ambulance Major Trauma (T1) Protocol in 2018.[5] The ability to monitor pre-hospital trauma transport has major implications for the monitoring and evaluation of the NSW trauma system . Another important driver was to establish population-level risk profiles, and geospatial patterns that are associated with severe injury, to assist with planning and evaluating the NSW trauma system and other critical care referral networks.

Aims

The aims of this analysis were to:

- evaluate transport patterns and clinical outcomes associated with the NSW Ambulance Major Trauma (T1) Protocol
- describe epidemiology and geospatial distribution of patients with a severe injury transported by road ambulance across NSW.

Method

This was a data linkage and geospatial analysis using routinely collected NSW Health and NSW Ambulance datasets.

Setting

The NSW trauma system is an inclusive trauma system[6, 7] with more than 150 acute care hospitals supported by 20 designated trauma centres in a series of regional trauma referral networks. Inclusive trauma systems are characterised by more designated trauma centres and a higher proportion of acute care hospitals capable of managing severely injured patients. In NSW, there are seven adult major trauma centres (Level 1 or 2 equivalent), 10 regional trauma centres (level 2 or 3 equivalent), and three specialist paediatric trauma centres (Level I equivalent). Further detail about these trauma services is in Appendices 2 and 3.

Assumptions

In analysing routinely collected and linked health data, the following assumptions were made:

- Ambulance compliance in the documentation of scene and clinical characteristics and trauma protocols was consistent and unbiased throughout the analysis period.
- Patients who were discharged home from the emergency department (ED) did not have a severe injury.
- Patients who died within 30 days due to severe injury, died because of their injury or of complications arising from their injury.

Cohort definition

Cases for this analysis were identified in the NSW Ambulance data collection between January 2019 to December 2020 who:

- were transported by road to a public hospital emergency department in NSW; and
- had been assigned a Trauma (T) protocol within their NSW Ambulance record.

Ambulance transports involving aeromedical retrieval services and road transports to interstate facilities were excluded.

Outcome definition

Severe injury was defined as an emergency type admission, plus an injury severity score (ISS) of greater than eight (>8) based on in-patient diagnosis codes, or death due to injury within 30 days of the ambulance scene pick up date. An ISS>8 represented the lowest threshold for multiple or severe anatomical injuries, based on abbreviated injury scale coding which was deemed to be an appropriate threshold in the context of prehospital trauma triage. Pre-hospital assessment of injury severity is challenging, and ISS scoring is based on post-hoc injury diagnoses. It was recognised that previous evaluations utilised ISS >15 as the injury threshold, however this was felt to increase the risk of missing severe and or multi-system injury in a significant number of patients. In addition, the use of ISS > 8 as a threshold in the context of routinely collected datasets was found to correlate closely with major trauma volumes reported in NSW.[8]

Ambulance Trauma (T) protocols

Several transport protocols were available in the ambulance dataset. For this evaluation, only T protocols (protocols starting with the letter **T**) were analysed, with each patient having one or more transport protocols listed in their record.

The NSW Ambulance T1 protocol is one of the trauma protocols that directs paramedics to bypass non-trauma facilities where a patient is at risk of severe injury. In these situations, it directs paramedics to transport the patient to the highest-level trauma hospital within 60 minutes' drive in metropolitan areas, or within 90 minutes' drive in regional areas. The T1 protocol was structured around a mechanism, injuries, signs, and treatment (MIST) framework (see Appendix 1).

Data sources and linkage

Routinely collected datasets were obtained from the NSW Centre for Health Record Linkage (CHeReL) and linked at a patient level to generate a unique personal patient number (PPN). These datasets included the following:

- NSW Ambulance Data Collection, which routinely collects information on ambulance transports. Data variables used were age, sex, scene location, initial vital signs (Glasgow Coma Score, systolic blood pressure, pulse, and respiratory rate), mechanism of injury, transport protocols used, and transport times.
- Emergency Department Data Collection (EDDC), which routinely collects emergency department episode data from 170 emergency departments across NSW. Data variables used were facility identifiers, triage characteristics, and the mode of separation.
- Admitted Patient Data Collection (APDC), which routinely collects information on all in-patient separations across public hospitals in NSW. Data variables used were diagnoses, intensive care unit admissions, and the mode of separation.
- NSW Registry of Births, Deaths and Marriages (RBDM) was used to identify the date and cause of death based on the ICD10AM codes.

To generate a single period of care across ambulance, emergency, and in-patient episodes of care, episodes were linked probabilistically using the PPN, date, time, and facility identifiers. Where inter-hospital transfers were involved, the arrival at the first ED was linked to the APDC episode associated with the highest level of intensive care unit (ICU) by role delineation, as the final destination hospital.

Linking episodes of care

Linkage with an ambulance dataset occurred if ambulance arrival time was within a window of 1 to 8 hours of ED triage date and time indicated in the EDDC. Likewise, APDC data was linked to ED data if it was within a time window of 4 to 24 hours. To account for inter-hospital transfers, up to four consecutive APDC episodes were tracked across a period of care, with designated trauma hospitals (major trauma centre (MTC), regional trauma centre (RTC) and paediatric trauma centre (PTC)) flagged in this chain. Dates of death flagged by RBDM were used to identify deaths that occurred during or after hospital separation.

Data analysis

Ambulance scene pick-up latitude and longitude values were used for geospatial analyses. Incidence of severe injury was calculated based on the postcode of residence and unique PPN within a calendar year. Population values for 2019 and 2020 were obtained from the Australian Bureau of Statistics Estimated Residential population by local government area (LGA). The Australian Statistical Geography Standard was used to classify remoteness structure. With respect to T1 transports, under-triage was defined as the proportion of the cohort who had a severe injury outcome and were transported to a non-trauma facility. Over-triage was defined as the proportion of T1 transports who did not have a severe injury. Paediatric transport cases were defined by patients being less than 16 years of age.

Results

Cohort population and linkage process

There were 248,480 ambulance transport cases analysed, representing 204,000 unique patients. Between 2019 and 2020, 29% of patients had more than one period of care. A list of protocols with frequencies used is shown in Table 1. The most common T protocols were T19 (falls in the elderly) and T7 (limb injuries). The major trauma (T1) protocol was indicated in 4.4% of cases. Of the 248,480 ambulance transports, 185,143 cases were linked to an ED encounter episode, representing the analysis cohort.

Table 1: Ambulance transports (N = 312,677), patient count by protocols, 2019–2020, NSW*

Protocol	N (%)	Protocol	n (%)
T19 Falls in the Elderly	89,839 (28.7%)	T8 Penetrating Trauma	1,339 (0.4%)
T7 Limb Injuries & Fractures	83,126 (26.6%)	T22 Abdominal Trauma	1,114 (0.4%)
T4 Head Injuries	45,069 (14.4%)	T10 Traumatic Hypovolaemia	670 (0.2%)
T18 Wound Care	31,311 (10%)	T24 Behavioural Disturbance - Trauma	599 (0.2%)
T5 Spinal Injuries	15,872 (5.1%)	T14 Electric Shock	511 (0.2%)
T1 Pre-hospital Management of Major Trauma	11,548 (3.7%)	T21 Drowning	397 (0.1%)
T11 Facial & Neck Injuries	9,895 (3.2%)	T15 Crush Injuries & Trapped Patients	347 (0.1%)
T6 Chest Injuries	7,507 (2.4%)	T20 Traumatic Cardiac Arrest	346 (0.1%)
T12 Burns	3,360 (1.1%)	T23 Trauma in Pregnancy	311 (0.1%)
T9 Pelvic Injuries	3,184 (1%)	T3 Aeromedical Team Primary Response	186 (0.1%)
T1P Pre-hospital Management of Major Trauma	2,337 (0.7%)	T25 Inhalation Injuries	142 (0%)
T13 Eye Injuries	1,964 (0.6%)	T17 Deteriorating Trauma Patient	87 (0%)
T16 Limb Realignment and/or Difficult Extrication	1,567 (0.5%)	T26 High Pressure Injuries	49 (0%)

** More than one protocol may be indicated for each transport episode.*

Figures 1 show the linkage process of cases, with around 75% of cases of non-linkage due to patient discharge directly from the scene without being transported to hospital. Only 2.5% of road transports to an NSW public hospital ED could not be linked to an ED episode. Figure 3 shows the mechanisms of injury for the analysis cohort, which was derived from ambulance “case given as field” variable in the ambulance eMR. The most common mechanisms were falls, mechanical forces and “other”, which comprised non-trauma mechanisms.

Figure 1: Data inclusions and exclusions

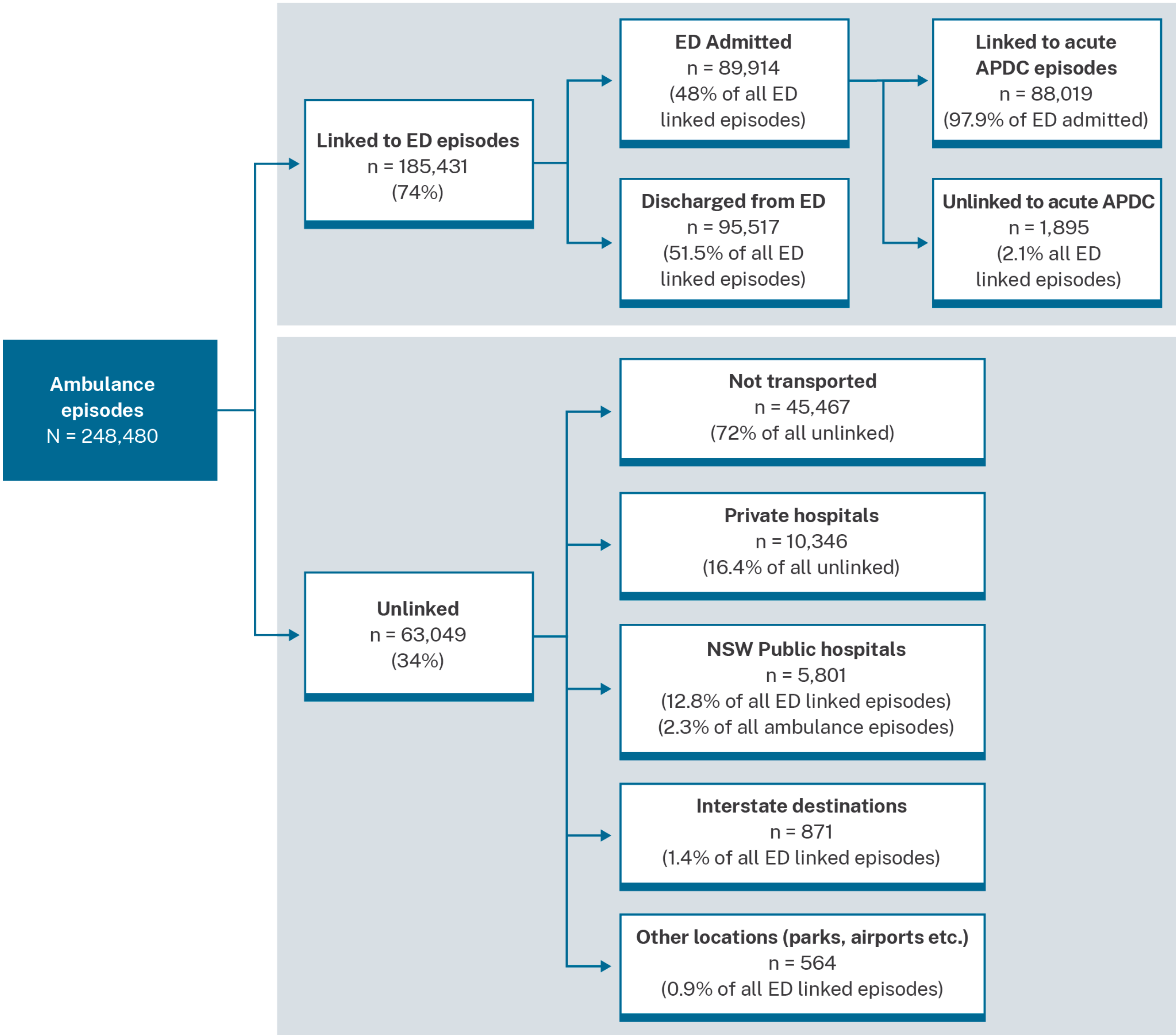
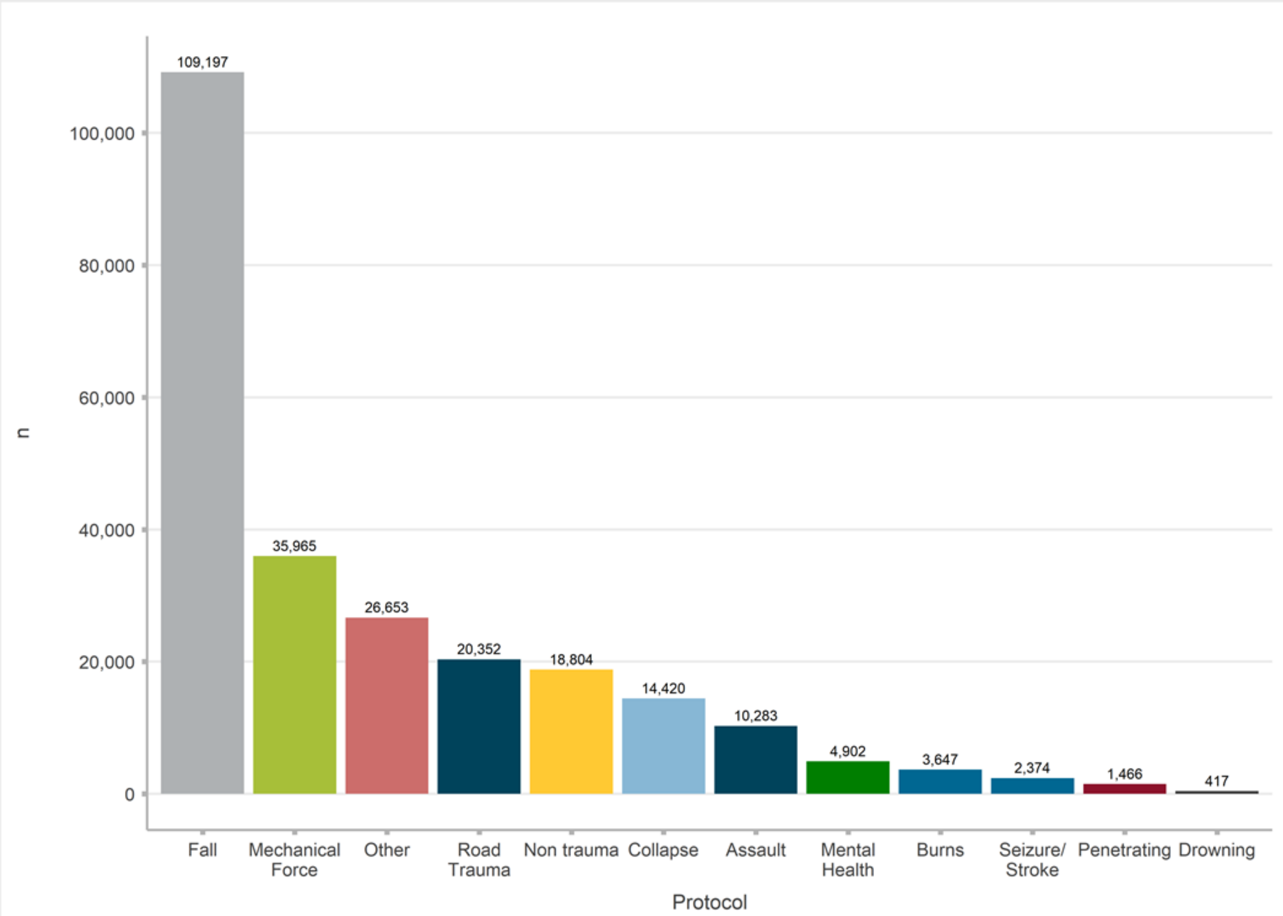


Figure 2: Number of cases by mechanism of injury, ambulance data, all T protocol road transports, NSW, 2019–2020



Overview of linkage

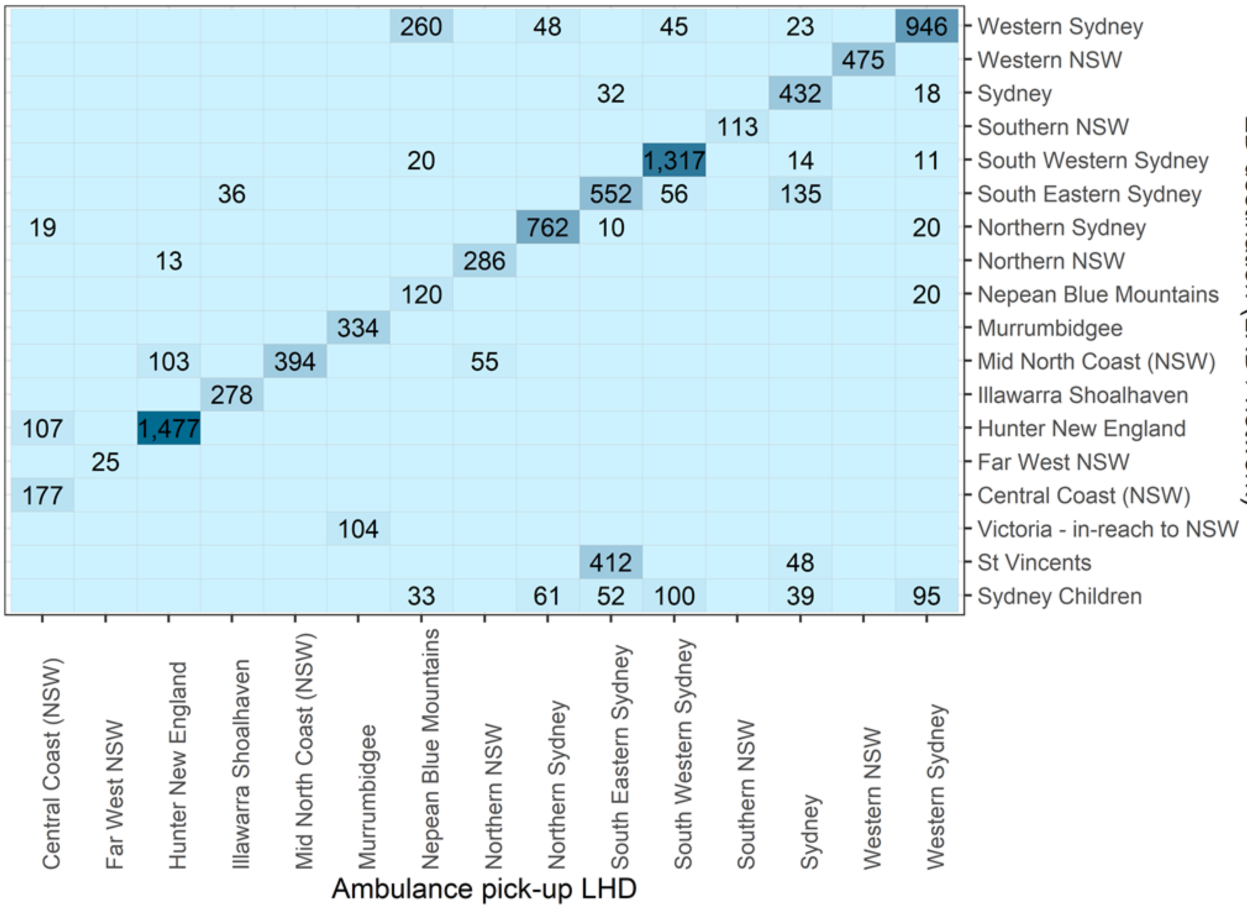
T1 protocol: flows within and between local health districts

To quantify T1 transport flows according to local health district (LHD) boundaries, transport matrices were constructed as shown in Figures 3 and 4. These were based on ambulance scene pick up locations within LHD boundaries and destination ED within the LHD. The diagonal represents road transports that remain within an LHD. Most transports crossing LHD boundaries were associated with proximity to the nearest trauma service or paediatric transports to Sydney Children's Hospitals Network (The Children's Hospital at Westmead and Sydney Children's Hospital).

Pickup LHD to destination LHD / network

Figure 3 shows the ambulance pick up LHD location and the receiving emergency department LHD according to the transport matrix for T1 protocol cases 2019-2020. Note the diagonal pattern reflecting the bulk of patients are transported within the same LHD as their pickup point. Numbers between 0 to 9 are shown as "*".

Figure 3: Ambulance T1 transport flows, pickup LHD to destination LHD, NSW, 2019–2020



Pickup LHD to destination LHD: paediatrics

Figure 4 shows the ambulance pick up LHD location and the receiving emergency department LHD according to the transport matrix for paediatric T1 protocol cases 2019-2020. Note, the diagonal and bottom horizontal line reflecting direct transport to a PTC within the Sydney basin and adjacent surrounds. A similar pattern is found in Hunter New England (n=159) where John Hunter Children's hospital is located. Numbers between 1 to 9 are shown as "*".

Figure 4: Ambulance T1 transport flows, pickup LHD to destination LHD, people aged <16 years, 2019–2020

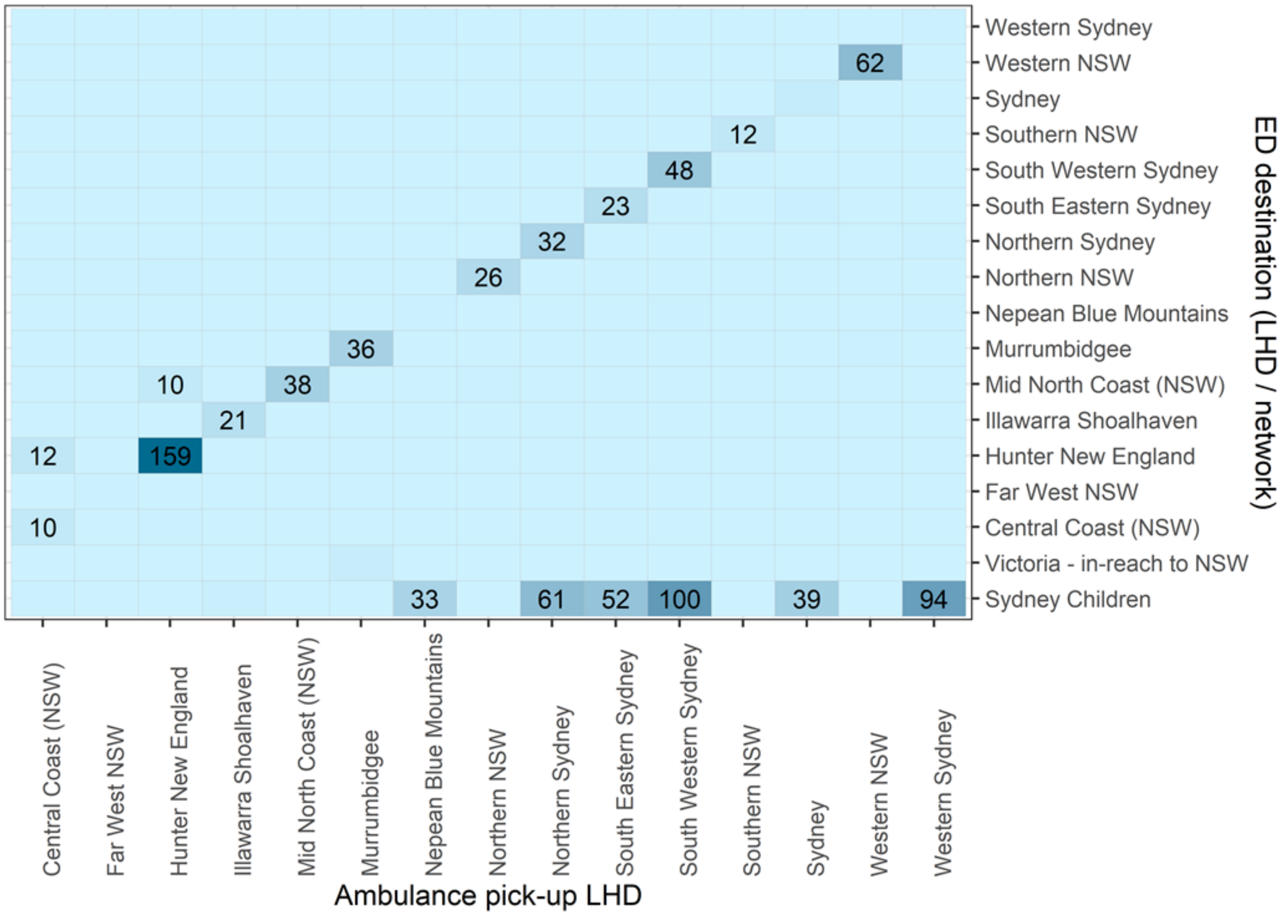


Table 2 shows the number and percentage of patients admitted to the ED who were transferred under a T1 protocol. Note, hospitals with n < 10 records are not recorded. The most common mechanism of injury associated with T1 transports were road trauma incidents followed by fall and mechanical forces.

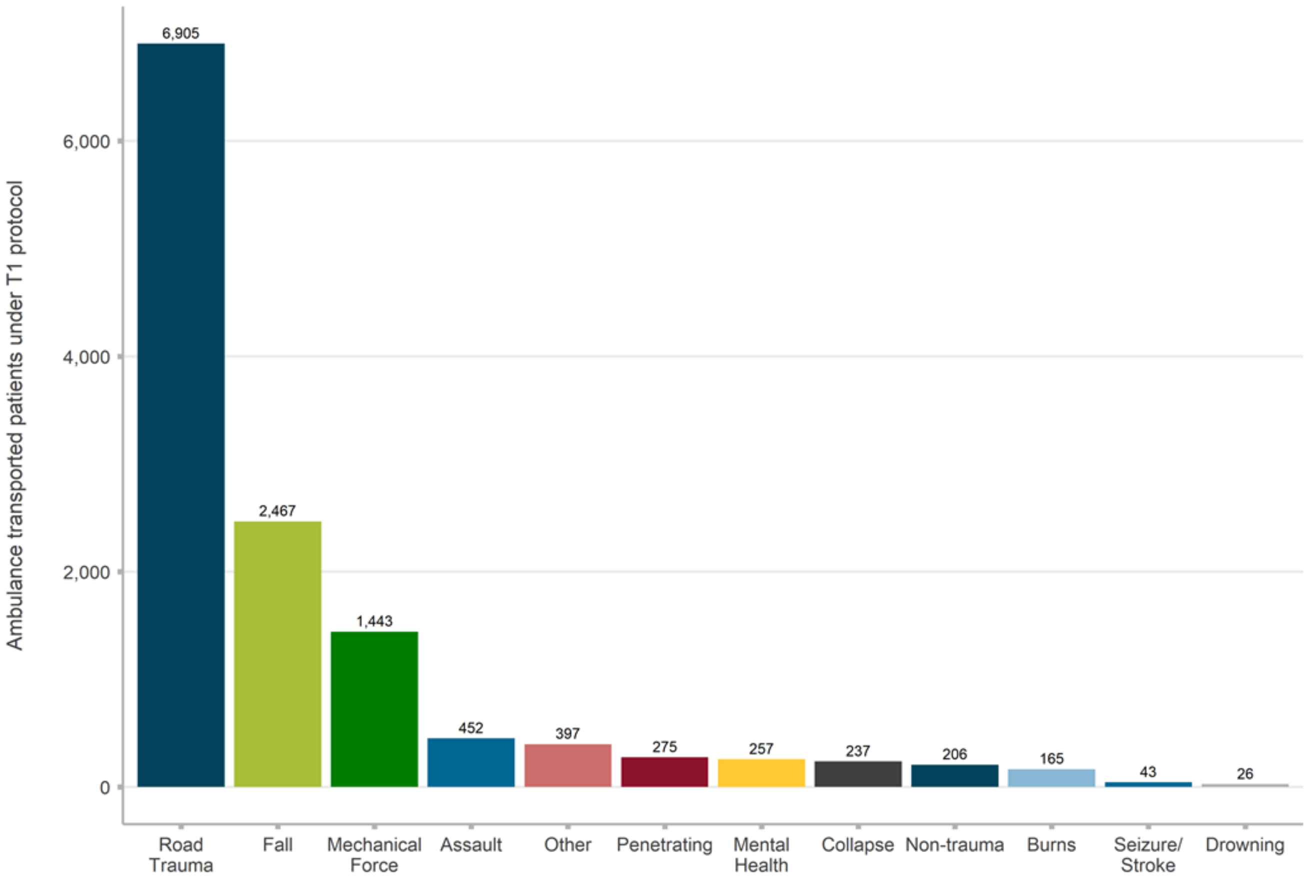
Table 2: Number of T1 protocol hospital admissions

ED facility	n (%)	ED facility	n (%)
Liverpool Hospital	1,320 (13.7%)	Griffith Base Hospital	55 (0.6%)
Westmead Hospital	1,310 (13.6%)	South East Regional Hospital	55 (0.6%)
John Hunter Hospital	1,218 (12.6%)	The Tweed Hospital	48 (0.5%)
Royal North Shore Hospital	807 (8.4%)	Manning Base Hospital	30 (0.3%)
St George Hospital	761 (7.9%)	Bankstown / Lidcombe Hospital	25 (0.3%)
Royal Prince Alfred Hospital	474 (4.9%)	Broken Hill Base Hospital	25 (0.3%)
St Vincent's Health Sydney	473 (4.9%)	Concord Hospital	22 (0.2%)
Port Macquarie Base Hospital	301 (3.1%)	Moree District Hospital	21 (0.2%)
The Children's Hospital at Westmead	278 (2.9%)	Campbelltown Hospital	20 (0.2%)
Coffs Harbour Base Hospital	266 (2.8%)	Goulburn Base Hospital	20 (0.2%)
Wagga Wagga Base Hospital	243 (2.5%)	Mudgee District Hospital	18 (0.2%)
Wollongong Hospital	239 (2.5%)	Blacktown Hospital	17 (0.2%)
Lismore Base Hospital	232 (2.4%)	Queanbeyan Health Service	16 (0.2%)
Orange Health Service	232 (2.4%)	Prince of Wales Hospital	14 (0.1%)
Tamworth Base Hospital	198 (2.1%)	Fairfield Hospital	13 (0.1%)
Gosford Hospital	177 (1.8%)	Moruya District Hospital	13 (0.1%)
Dubbo Base Hospital	163 (1.7%)	Narrabri District Hospital	13 (0.1%)
Nepean Hospital	138 (1.4%)	Nyngan Multi-Purpose Service	12 (0.1%)
Sydney Children's Hospital	115 (1.2%)	Sutherland Hospital	12 (0.1%)
Albury Base Hospital	108 (1.1%)	Condobolin Health Service	11 (0.1%)
Shoalhaven and District Memorial Hospital	56 (0.6%)	Muswellbrook District Hospital	11 (0.1%)
Armidale and New England Hospital	55 (0.6%)	Hornsby and Ku-Ring-Gai Hospital	10 (0.1%)

Mechanism of injury (MOI)

Figure 5 demonstrates the ambulance-recorded mechanism of injury (MOI) for T1 protocols. Road trauma and falls are the leading two injury types.

Figure 5: Ambulance-recorded mechanism of injury, T1 transfers, NSW, 2019–2020

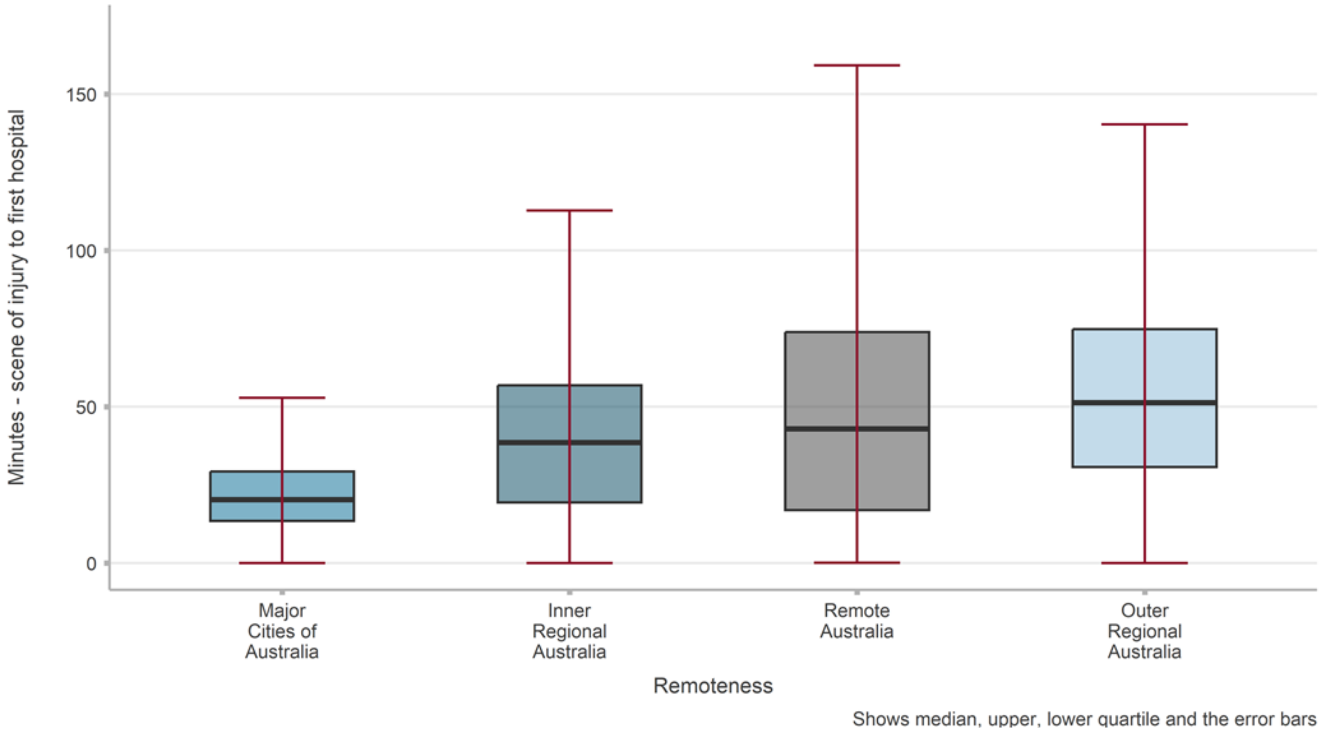


Remoteness

Figure 6 shows the median ambulance road transport time (minutes) from scene to ED. Note, remote and very remote Australia have been categorised together as remote Australia due to smaller numbers in these categories to ED admission.

- 97% of cases were transported to hospital within specified timeframes according the T1 protocol (60 minutes of scene departure time in metropolitan areas and 90 minutes in rural and regional locations).
- Compliance was 98% in metropolitan areas, 96% in inner regional and 81% in outer regional or remote locations.

Figure 6: Median ambulance road transport time (minutes) for T1 transports by ABS remoteness category NSW 2019–2020.

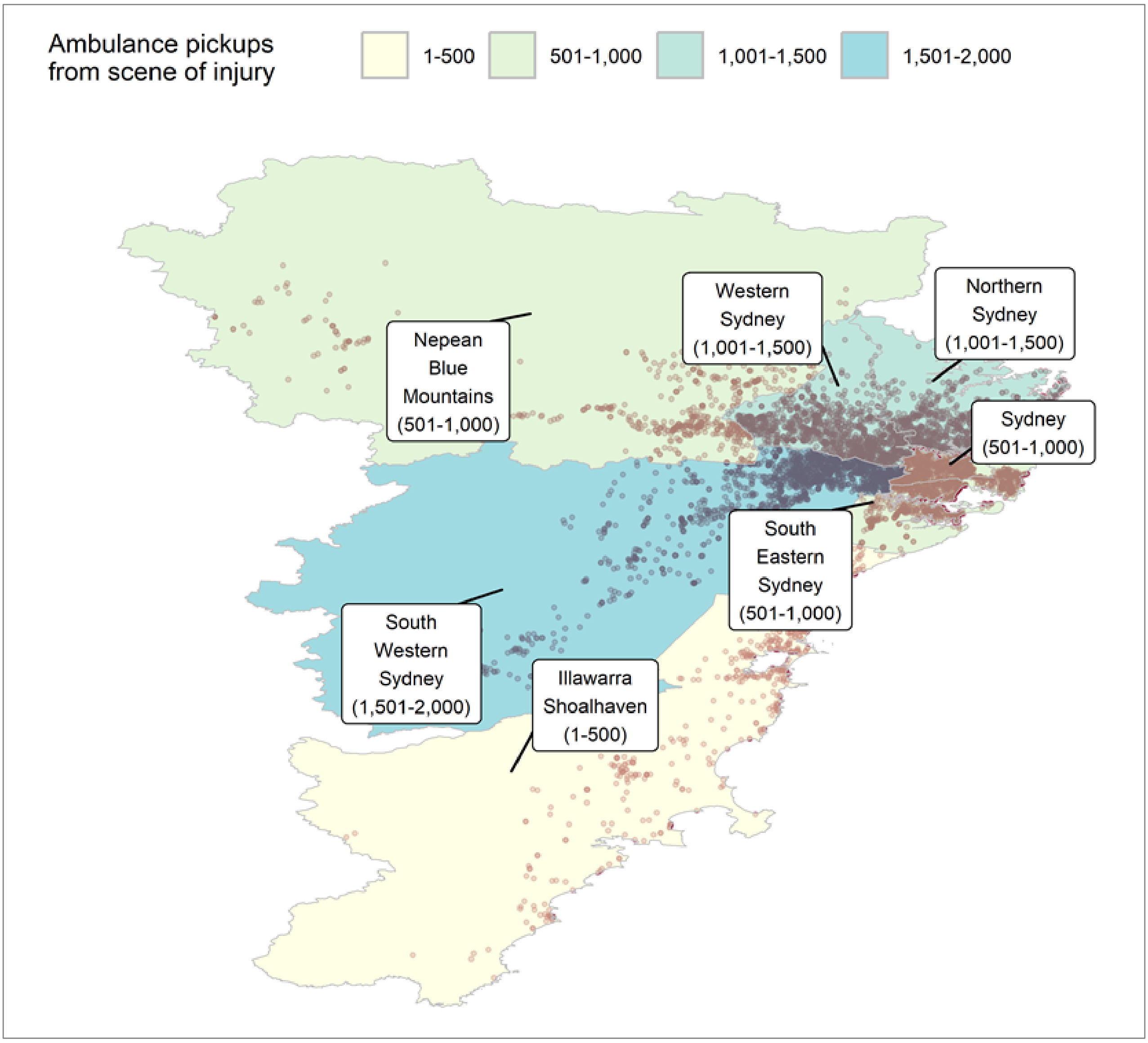


Geospatial analysis of T1 transports

Metropolitan LHDs

Figure 7 shows the distribution of ambulance pickups for T1 transports, by LHD within Sydney metropolitan area. Note, each dot on the map represents the approximate location of the actual injury.

Figure 7: Distribution of ambulance pickups for T1 transports, by metropolitan NSW LHD, 2019–2020



Rural distribution of ambulance pickups

Figure 8 shows the distribution of ambulance pickups by LHD outside Sydney metropolitan area.

Note, the dots on the map represent the approximate location of the actual injury.

Figure 8: Distribution of ambulance pickup locations for T1 transports, by regional NSW LHD, 2019–2020

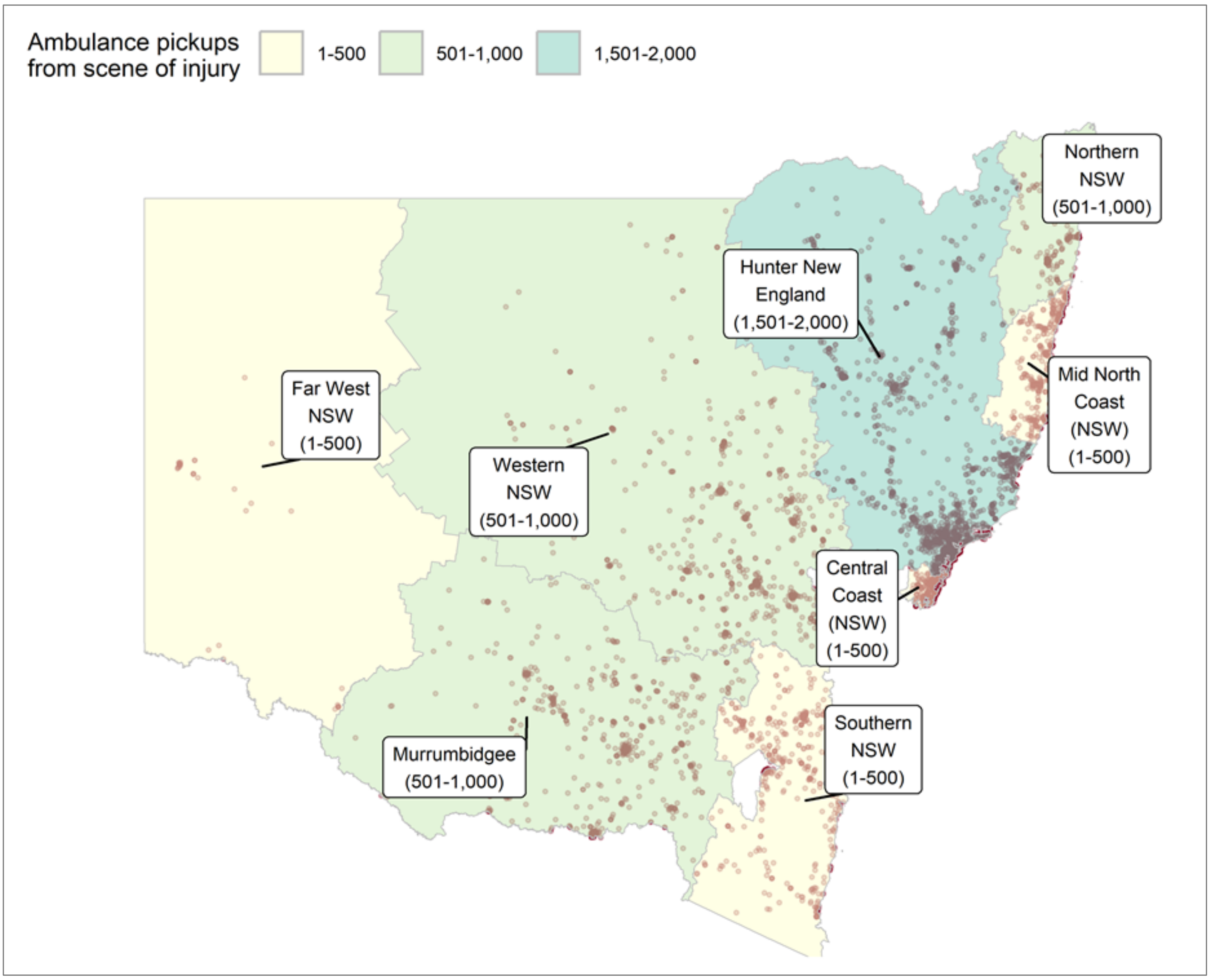
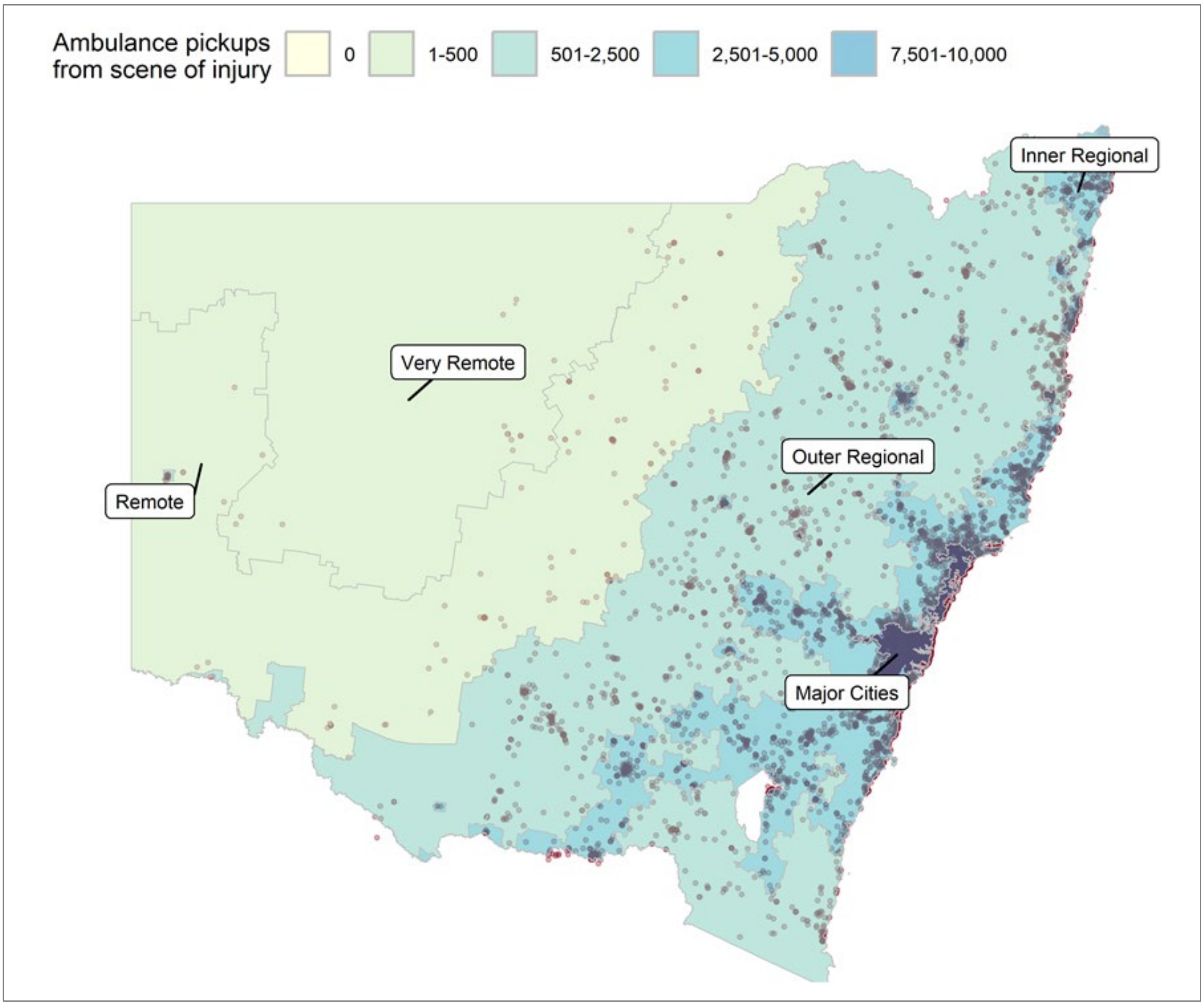


Figure 9 shows ambulance pickup locations by ABS remoteness structure. Note, the dots on the map represent the approximate location of the actual injury.

Figure 9: Ambulance pickup locations using ABS remoteness structure



Epidemiology and geospatial distribution of severe injury

Figures 10 and 11 demonstrate the incidence of severe injury per 10,000 population based on residential local government area (2020) recorded in the EDDC. The analysis was conducted to establish baseline population risk of severe injury and describe any geospatial patterns or gradients seen.

Geospatial analyses demonstrated an increased population risk of severe injuries centred around key regional areas, such as the Hunter Region, Mid North Coast, Northern Rivers, Murrumbidgee, and parts of Western NSW.

Ambulance pick-up locations (denoted by dots on geospatial maps) corresponded to main highway routes in NSW. In metropolitan areas, population risk was concentrated in areas with older populations, associated predominantly with falls. There was also moderate risk associated with outer metropolitan LGAs such as Hawkesbury, Wollondilly and Hornsby.

Figure 10: Incidence of severe injury for Metro and greater Sydney region

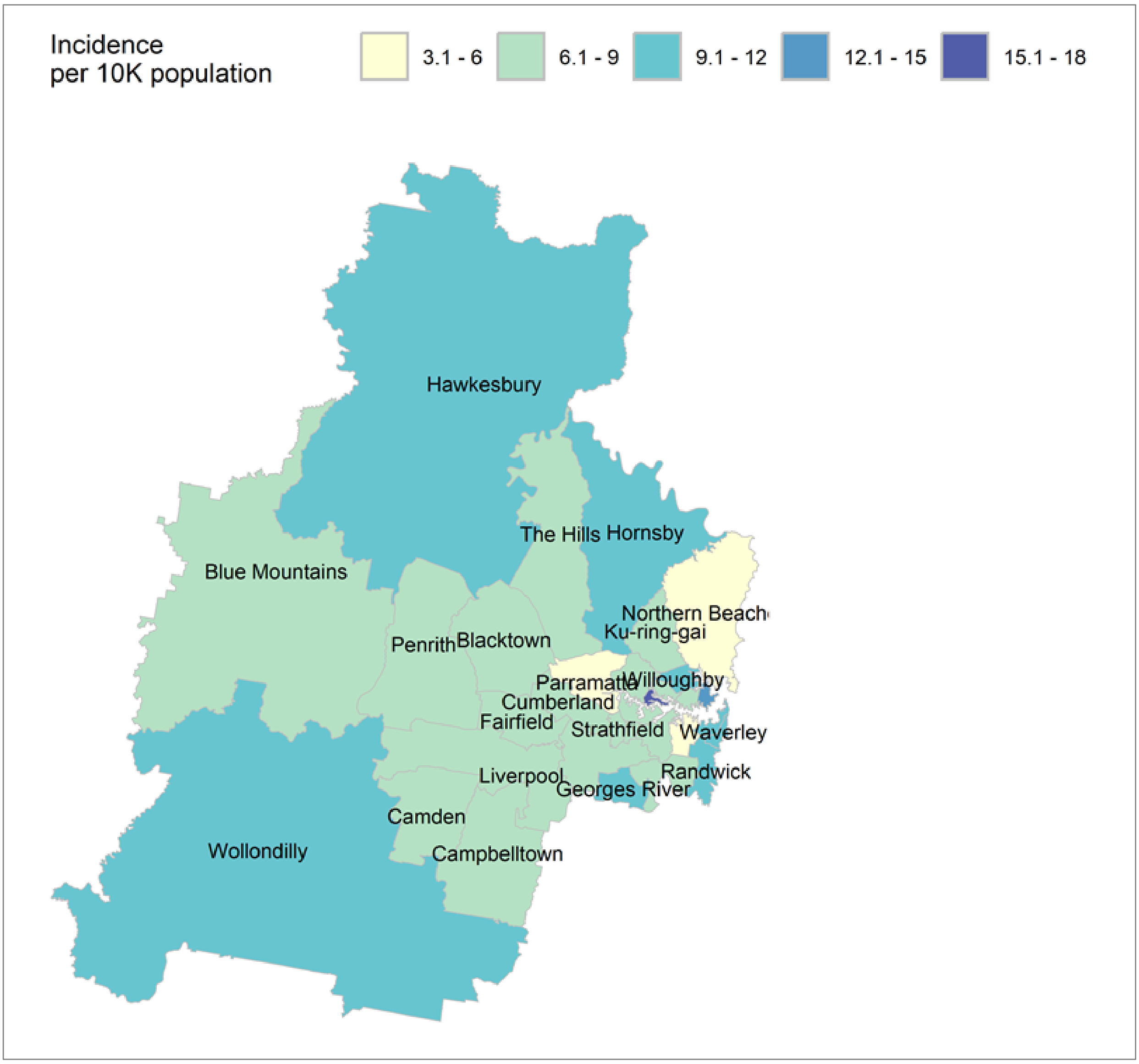
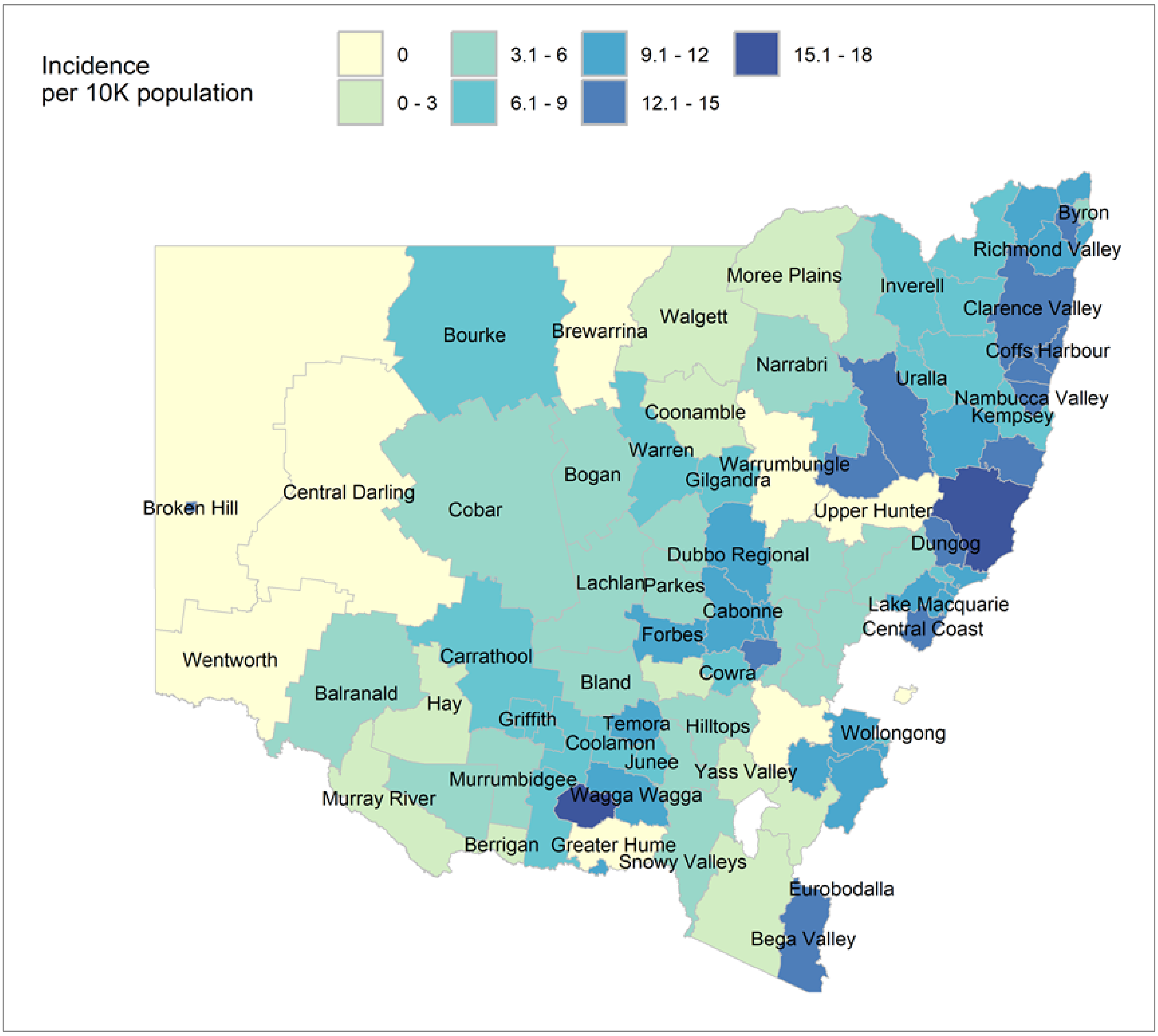


Figure 11: Incidence of severe injury rural NSW



Clinical outcomes following T1 transports

A severe injury outcome was associated with 20% of T1 transports (Figure 12). This increased to 27% when only designated trauma facilities were analysed. The most injured body regions were limbs, external (e.g. wounds) and head injuries.

The over-triage rate associated with the T1 protocol was 63%, and the under-triage rate was 3%. In ED, 98% of cases were triaged categories 1, 2 or 3 (Table 3).

Of patients transported on the T1 protocol, 25% were discharged from the ED. In a logistic regression model of T1 cases, over-triage was associated with younger age groups (OR 3.2 95%CI 1.9, 5.2) and those with normal initial vital signs (OR 2.3 95%CI 2.0, 2.5). Inner regional areas were associated with a slightly increased risk of over-triage (OR 1.1 95%CI 1.0, 1.3).

Figure 12. Injury severity score (ISS) distribution associated with T1 ambulance transports, NSW, 2019–2020

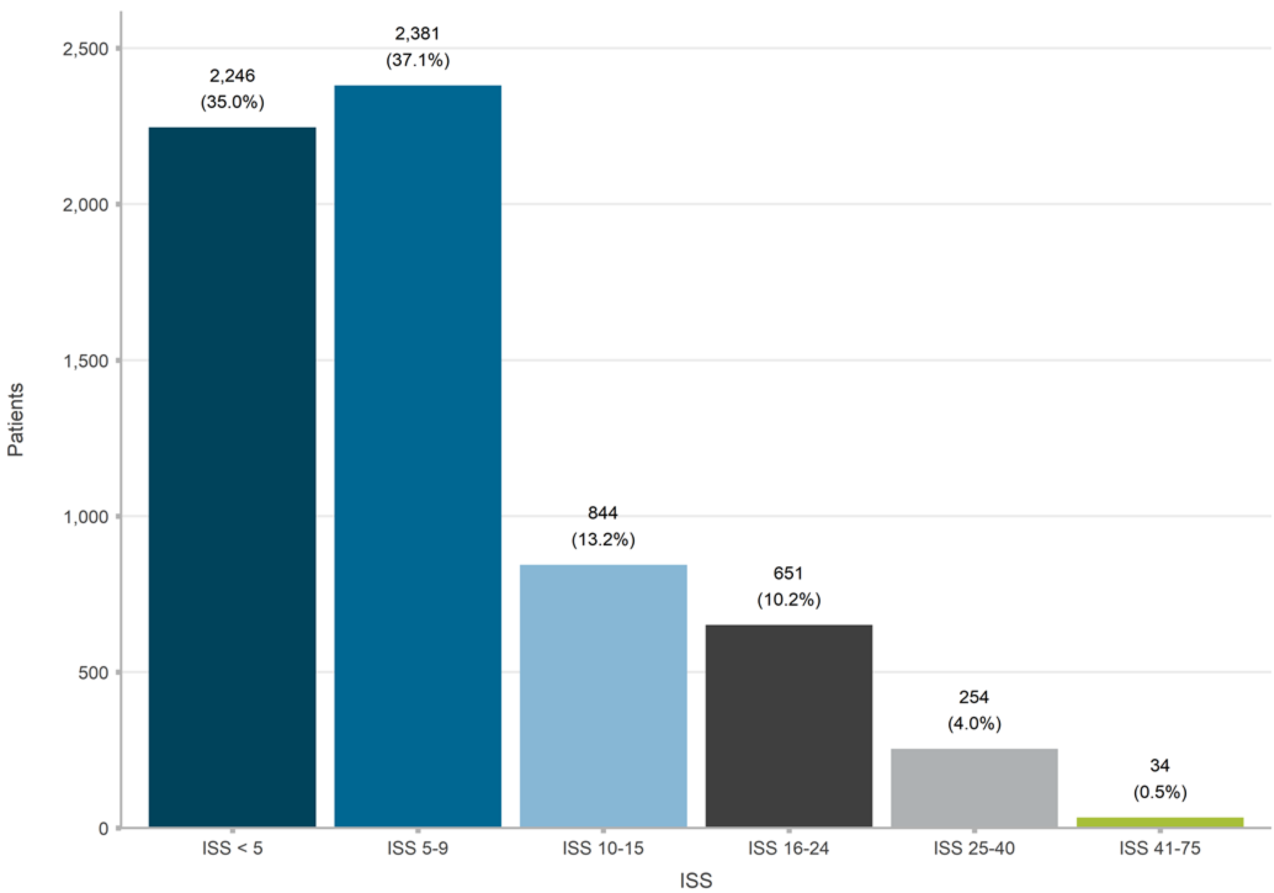
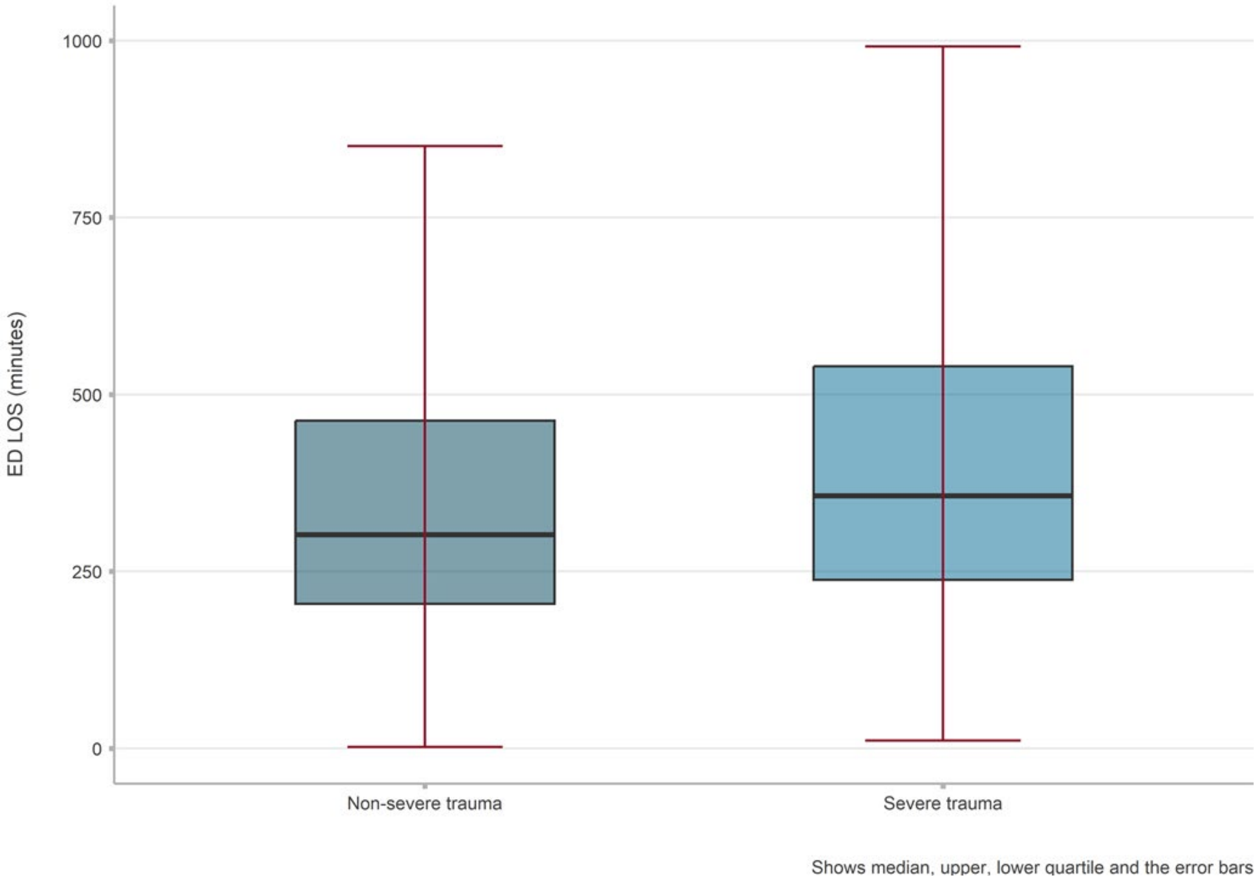


Table 3: ED triage categories following T1 ambulance transport, NSW, 2019–2020

ED triage category	N = 9,939	%
Resuscitation (1)	2,235	22.5%
Emergency (2)	5,627	56.6%
Urgent (3)	1,839	18.5%
Semi-urgent (4)	234	2.4%
Non-urgent (5)	4	0.0%

The comparative ED length of stay for severe (yes) and non-severe (no) trauma is shown in Figure 13.

Figure 13: Comparative ED length of stay (LOS) for severe and non-severe patients



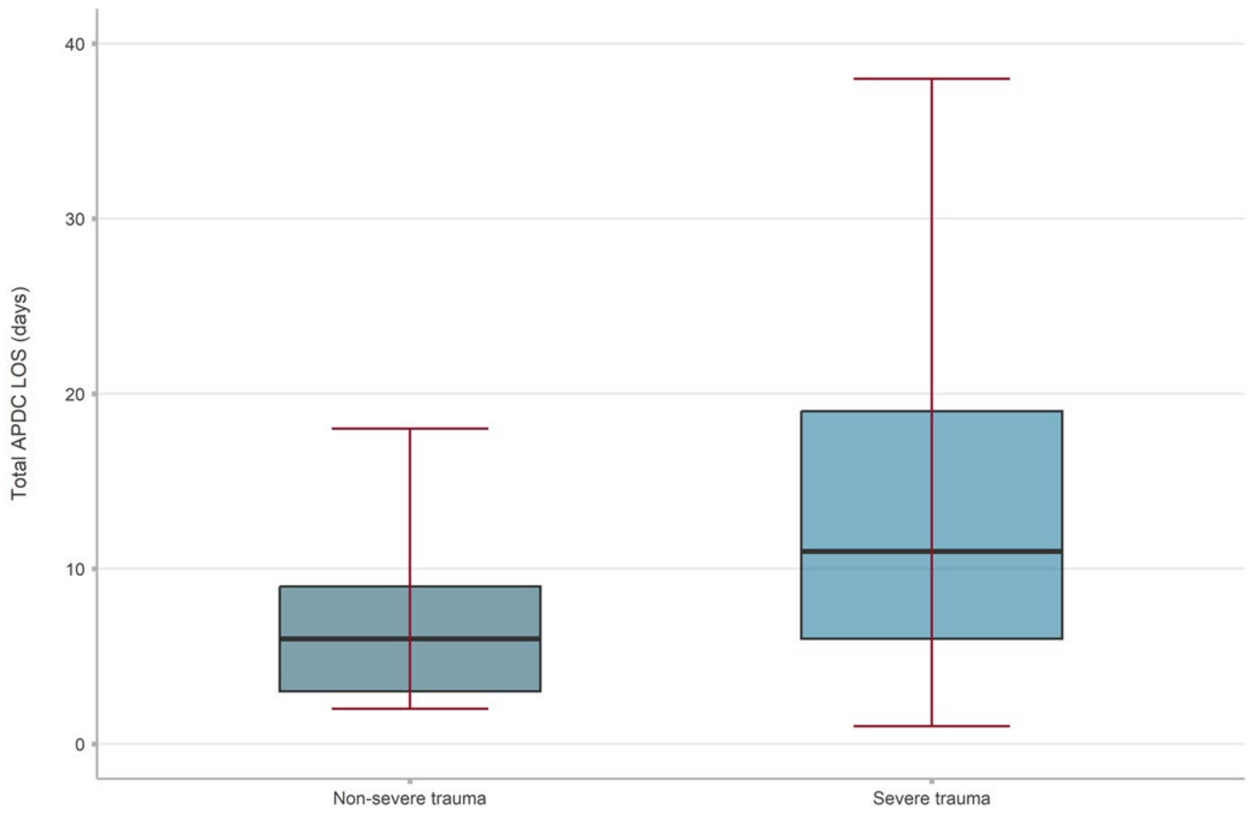
After ED admission, the majority (56%) of patients progressed to a non-critical care ward compared with 9.2% who were admitted to a critical care ward. Of the total, 24% of cases were discharged after completing treatment (Table 4).

Table 4: Patient next location after ED admission

Mode of separation	N = 9,938
Admitted to ward / inpatient unit, not a critical care ward	5,522 (56%)
Departed: Treatment completed	2,371 (24%)
Admitted: To critical care ward (including HDU/CCU/NICU)	915 (9.2%)
Departed: Transferred to another hospital without first being admitted to hospital transferred from	436 (4.4%)
Admitted: Via operating suite	410 (4.1%)
Departed: Left at own risk	195 (2.0%)
Died in ED	32 (0.3%)
Departed: for other clinical service location	25 (0.3%)
Departed: Did not wait	14 (0.1%)
Unknown	18 (0.2%)

APDC length of stay

Figure 14: APDC length of stay following T1 protocols for severe and non-severe cases



Shows median, upper, lower quartile and the error bars

Injury by body region

Table 5 demonstrates the different body regions impacted stratified by severe and non-severe injury classification.

Table 5: Body regions injured for severe and non-severe injuries

AIS body region	Severe injury (No) n = 6,760	Severe injury (Yes) n = 7,878
Head and neck	1,172 (17%)	1,330 (17%)
Chest	613 (9.1%)	1,259 (16%)
Abdominal and pelvic content	307 (4.5%)	992 (13%)
Extremities and pelvic girdle	1,621 (24%)	1,619 (21%)
Face	966 (14%)	1,124 (14%)
External	2,081 (31%)	1,554 (20%)

Discussion and further directions

This is the first statewide evaluation of geospatial patterns and clinical outcomes associated with road ambulance transports for severely injured patients in NSW. It used routinely collected data available within NSW Health and NSW Ambulance.

Previous evaluations of the NSW trauma system have relied on linkages with the NSW Trauma Registry, which relied on manually collected data from designated trauma facilities only. This contrasted with the current analysis, which linked data across all public hospitals in NSW, with important implications in the context of a large regionalised and inclusive trauma systems. This capability enabled a broader evaluation of ambulance transports, including the performance of the major trauma T1 protocol as well as geospatial analyses based on scene locations and transport times.

The present analysis demonstrates the following:

- The T1 protocol has good predictive value, with 27% of T1 arrivals to designated trauma centres having a severe injury outcome.(9) This compares favourably with previously published single centre reports of T1 performance.
- The under-triage rate of around 3% falls within accepted international standards from the American College of Surgeons Committee on Trauma guidelines for pre-hospital trauma triage.(10)
- The over-triage rate of 63% is higher than the accepted standards, suggesting this could be an area for future investigation. Over-triage results in patients being transported to designated trauma centres when they could have been managed adequately in other facilities.

The findings of this report have several implications. Firstly, a system-wide analysis of pre-hospital trauma protocols has not been previously reported in Australia. Most international studies have evaluated pre-hospital trauma triage using trauma registries. This has the limitation of analysing selected data from a limited number of facilities.

Importantly, data from non-trauma facilities has been included in this report, allowing a more comprehensive and unbiased appraisal of under-triage. This report established a useful baseline to evaluate any future changes to the protocol and for other jurisdictions to compare.

The findings were benchmarked against agreed international standards, suggesting that the current Major Trauma (T1) Protocol was operating effectively in triaging and transporting severely injured patients across NSW.

More than 95% of patients were being transported within the agreed timeframe (60 minutes road transport time for metropolitan areas and 90 minutes road transport time for rural and regional areas) specified in the protocol.

The analysis showed that linkage between ambulance and hospital data was feasible, with linkage rates of more than 95%. This has important implications for the design and discovery phases of the planned trauma electronic clinical quality registry build as part of NSW Trauma Outcomes Registry and Quality Evaluation (NSW TORQUE). It is anticipated that most pre-hospital and hospital data points will be fed directly from electronic health records and routine data collections.

Opportunities to improve over-triage rates

Potential solutions described in the literature to improve the over-triage rates for the T1 protocol, include the use of tiered protocols.[11] Under these protocols, patients who meet isolated or limited criteria are deemed "lower risk" for severe injury and transported to the nearest local hospital for initial evaluation, compared to bypassing the local hospital and going direct to the designated trauma centres which are often further away. This would be particularly relevant in cases with isolated limb trauma.

Other solutions include the use of machine learning to understand whether a combination of factors can increase or decrease the risk of serious injury. For instance, various combinations of trauma protocols initiated by paramedic crews could flag the risk for serious injury through automated real-time algorithms.

Limitations

Several limitations in this analysis were acknowledged:

- Cases involving transport by medical retrieval services were excluded. Such cases would be at higher risk of severe injury and have different transport pattens. Sensitivity analyses could be performed to address this, but the impact on overall results was likely to be minimal given the relatively small numbers of retrieval transports.
- Interstate transports were outside the scope of this analysis as routinely collected datasets did not include interstate hospitals.
- Cases classified as T1P were not differentiated from T1 cohort, and this may have affected the specificity of the protocol.
- The T1 protocol by ambulance crews may have been used to assess patients rather than initiate a transport bypass protocol. However, ED triage outcomes and geospatial patterns suggest that the vast majority of T1 cases were documented appropriately.

Summary

This data linkage analysis of ambulance road transports for trauma patients demonstrates that the Major Trauma (T1) Protocol was operating effectively in identifying and transporting patients with severe injury across NSW. Further work is currently underway to further understand over-triage and under-triage associated with the T1 protocol. The data linkage analysis has major implications, not just for future evaluation of trauma systems but for other acute and critical care systems that operate across LHD boundaries.

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Appendices 1. Major Trauma (T1) Protocol (sample)

PROTOCOL: T1 PRE-HOSPITAL MANAGEMENT OF MAJOR TRAUMA

Trauma Triage Tool – Major Trauma Criteria (MIST)

MECHANISM OF INJURY (MOI) – Triage by MOI alone has limited accuracy, however the "force of mechanism" still needs to be factored into clinical decision making for appreciation of potential underlying injuries.

MOI + *high risk groups = much stronger indicator for major trauma

***High risk groups include:**

- Patients < 16 or ≥ 65 years
- Significant co-morbidities
- NESB / Difficult to assess
- Obstetric patients > 20 weeks gestation
- Patients on anticoagulants, antiplatelet medications or with clotting disorders

In the pre-hospital environment a major trauma patient is defined as a patient that meets **ANY** of the criteria of the Trauma Triage Tool.

Trauma Triage Tool:

M— MECHANISM

Blunt

Transport Incident	Other Incidents
-Death in same vehicle -Intrusion into occupant compartment > 30cm -Steering wheel deformity -Patient side impact -Cyclist/motorcyclist (fall or collision) -Vehicle vs pedestrian -Ejection from vehicle (partial or complete) -Entrapment with compression	-Agricultural machinery or equipment/quadbike -Livestock (e.g. horse/cattle) -Crush Injury (excluding fingers/toes) -Falls > 3m or paediatrics twice the child's height -Falls off ladder > 1m -High voltage injury -Any rapid deceleration incident -Focal blunt trauma to head or torso (eg. implement/assault/bike handlebars) -Hanging

I— INJURIES

Penetrating - <u>All</u> penetrating injury (excluding isolated injury to hands or feet) e.g. blast/shooting/stabbing/impalement

Head: Head Injury with LOC or amnesic to events with **ANY** of the following: • 2 or more vomits • Seizure • Patient on anticoagulants, antiplatelet medication or Hx clotting disorder • Open, depressed skull # or signs of base of skull # (periorbital ecchymosis, CSF leak) **The primary cause of a patient's ↓ LOC is due to the traumatic injury until proven otherwise.** **Alcohol consumption/drug use as the primary cause should only be considered once ALL OTHER CAUSES of ↓ LOC have been ruled out.** **Face:** Injury with potential airway risk, severe haemorrhage **Neck:** Swelling, severe bruising, hoarseness or stridor **Chest:** Suspicion of multiple rib #'s, severe pain, restraint abrasion/contusion, evidence of blunt impact	**Abdomen:** Severe pain, rigidity, distension, swelling, restraint abrasion/contusion, evidence of blunt impact. **Pelvis:** Pain, **including severe lower back pain,** (Does MOI suggest a potential #), deformity, significant abrasion/contusion. **Limbs:** 2 or more proximal long bone #'s, degloving injury, ischaemia, amputation proximal to digits **Spinal/Back:** Visible deformity, priapism, severe pain **Burns:** Dermal or full thickness burns **Adults > 20%, Children > 10%,** or burns involving face, hands, feet, genitalia, perineum, anus and major joints or inhalation injury with cutaneous burns. All circumferential burns or burns in a patient with significant comorbidities or pregnant women in the 2nd/3rd trimester **Note:** For burns patients in the Sydney Metro area without multi-system trauma (i.e. no additional T1 criteria other than burns) refer to Protocol T12 Burns Patient Transportation Cascade.

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PROTOCOL: T1 PRE-HOSPITAL MANAGEMENT OF MAJOR TRAUMA

Trauma Triage Tool – Major Trauma Criteria (MIST) continued

S— SIGNS AND SYMPTOMS

Airway: Potential injury / at risk, hoarseness, stridor
Breathing: RR < 10 or > 29, SpO_2 < 90% on air, cyanosis or respiratory difficulty, chest wall crepitus, subcutaneous emphysema
Circulation: HR > 120
SBP < 100 at any time or severe haemorrhage or suspected severe haemorrhage
Disability: GCS ≤ 13 or combined motor sensory deficit or any worsening trend in ABCD

Paediatrics:
Physiological changes are late indicators of serious injury in a child whom may lose 30% blood volume prior to ANY changes in vital signs. The following is a guide:

	1st year	1-5 yrs	6-12 yrs
HR	> 160	> 140	> 120
SBP	< 60	< 70	< 80
RR	> 60	> 35	> 30

T— TRANSPORT

If a patient meets Major Trauma Criteria paramedics are **authorised** to transport up to 60 minutes Metropolitan/90 minutes Regional from scene in order to reach the appropriate destination (see transport destination algorithm for suitable destinations- this includes cross border)

MANDATORY NOTIFICATION by Paramedics via the Control Centre to the Aeromedical Control Centre (ACC) is required for direction on a suitable destination for patients unable to be transported directly to the appropriate destination indicated in the transport destination algorithm. Once a destination hospital has been determined in conjunction with the ACC Retrieval Consultant, Paramedics are to comply with the agreed destination. **Do not delay transport to hospital waiting for higher clinical skill level/Aeromedical team – rendezvous en route.**

Considerations for patients ≥ 65 years:
- May have different physiological responses to trauma resulting in:
  - Vital signs that do not fit within the parameters listed above
  - Vital signs that don't reflect the severity of the injuries due to medications, hypertension Hx and co-morbidities
- Low impact mechanisms (e.g. ground level falls, low speed MVAs) may result in severe injury

Transport destinations

Major Trauma Service (Adult)		
John Hunter	Liverpool	Royal North Shore
Royal Prince Alfred	St George	St Vincent's
Westmead	The Canberra (ACT)	#Gold Coast University (QLD)
Major Trauma Service (Paediatric)		
Sydney Children's (POW)	Children's Hospital Westmead	John Hunter Children's

Where established local cross-border agreements exist.

Regional Trauma Services		
^Albury	Gosford	Nepean
Wollongong	Coffs Harbour	Lismore
Orange	Port Macquarie	Tamworth
Tweed Heads	Wagga Wagga	

^Where established local cross-border agreements exist.

Trauma Staging Hospitals			
Armidale	Broken Hill	Dubbo	Griffith
Manning	Shoalhaven	South East Regional (Bega)	

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PROTOCOL: T1 PRE-HOSPITAL MANAGEMENT OF MAJOR TRAUMA

Treatment:

Patient Care – A2

↓

T1 Assessment:

Assess the scene and provide reports and requests to the Control Centre:

- Initial situation report using **ETHANE**
  - **E**xact location
  - **T**ype of incident
  - **H**azards
  - **A**ccess to location
  - **N**umber of casualties
  - **E**mergency services, required or present
- Provide Control Centre with SMART Tag™ patient triage colour when completion of a full MIST might be delayed

RED Priority 1	YELLOW Priority 2	GREEN Priority 3	BLACK Deceased

- Provide a **FULL MIST** report
  - **M**echanism of injury
  - **I**njuries
  - **S**igns and symptoms
  - **T**reatment/transport
- Request for additional resources as required (higher clinical skill level/Aeromedical team etc)

↓

Minimise time on scene where possible.

Remember: Patients with penetrating trauma and/or blunt trauma who are exsanguinating require early pre hospital notification from scene to the receiving hospital, extremely short scene times and treatment en-route because surgical intervention and major blood transfusion is often needed to control the bleeding and stabilize the patient

↓

Treat per specific protocol/s

↓

Trauma Code 3 notification to the receiving hospital

↓

⚠ Urgent Transport – Refer to specific transport destination algorithm

Regularly repeat and document ABCD physical examinations and physiological observations in order to identify trends, clinical deterioration and/or response to treatment

Documentation Requirements - The correct documentation of Protocol 'T1' on a patient's clinical record, is essential to enable pre-hospital and in-hospital data linkage to track patient outcomes.

- **Patients who are positive to T1 Trauma criteria – Record T1P as the chief protocol**
- Patients assessed and are negative to T1 Trauma criteria – **Record T1** on the clinical record

Refer to Reference R39—Pre-Hospital Management of Major Trauma Principles for further information

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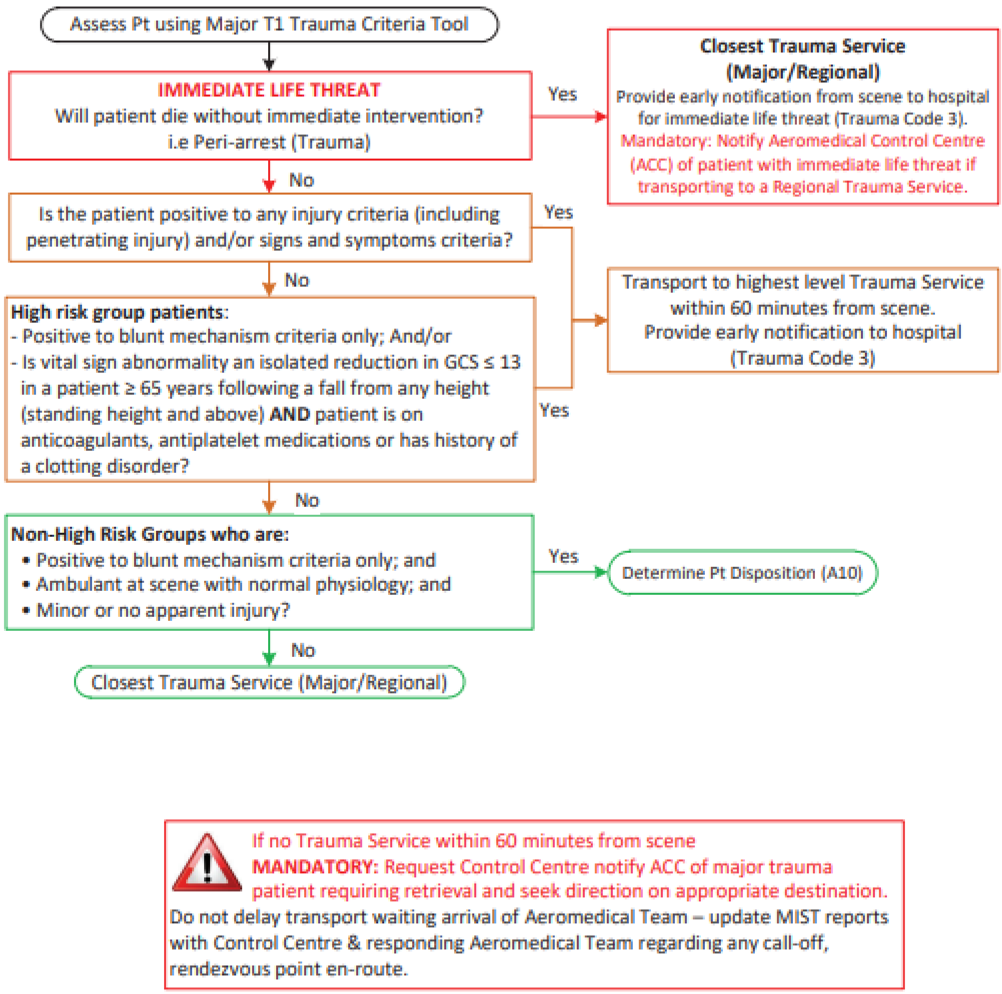
PROTOCOL: T1 PREHOSPITAL MANAGEMENT OF MAJOR TRAUMA

Major Trauma: Adult — Metropolitan Transport Algorithm



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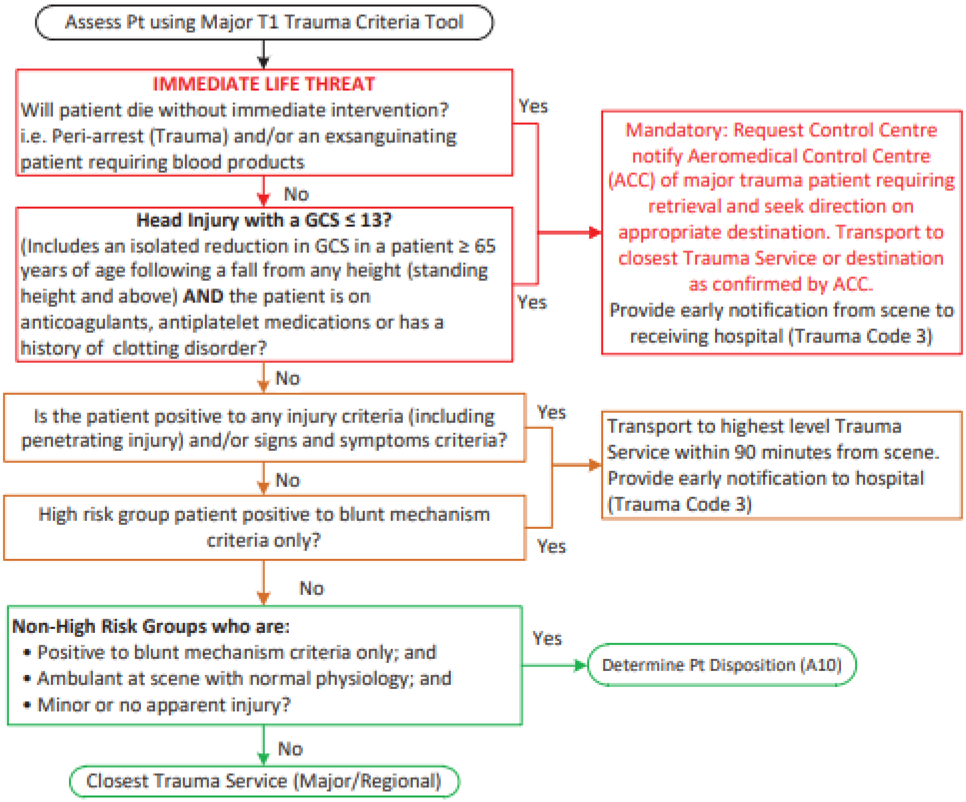

PROTOCOL: T1 PRE-HOSPITAL MANAGEMENT OF MAJOR TRAUMA

Major Trauma: Adult - Regional Transport Algorithm

If no Trauma Service within 90 minutes from scene
MANDATORY: Request Control Centre notify ACC of major trauma patient requiring retrieval and seek direction on appropriate destination.
Do not delay transport waiting arrival of Aeromedical Team – update MIST reports with Control Centre & responding Aeromedical Team regarding any call-off, rendezvous point en-route.

Hospital Destination Cascade

1. Trauma Service within 90 minutes from scene, if not then;
2. Trauma Staging Hospital within 90 minutes from scene, if not then;
3. Local Hospital

If unable to transport to a Trauma Service, request Control Centre notify ACC of major trauma patient and seek direcion on appropriate destination.

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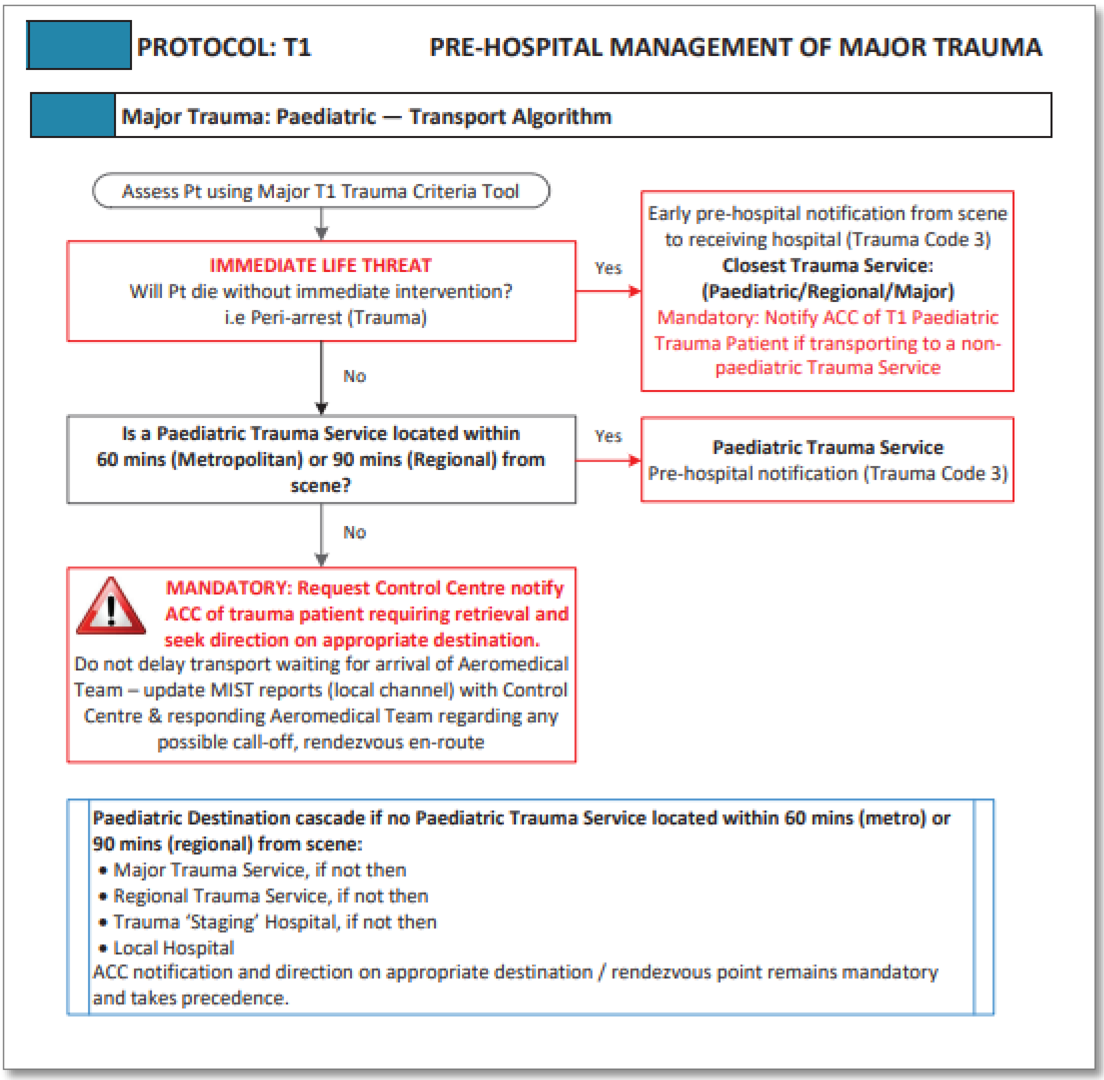
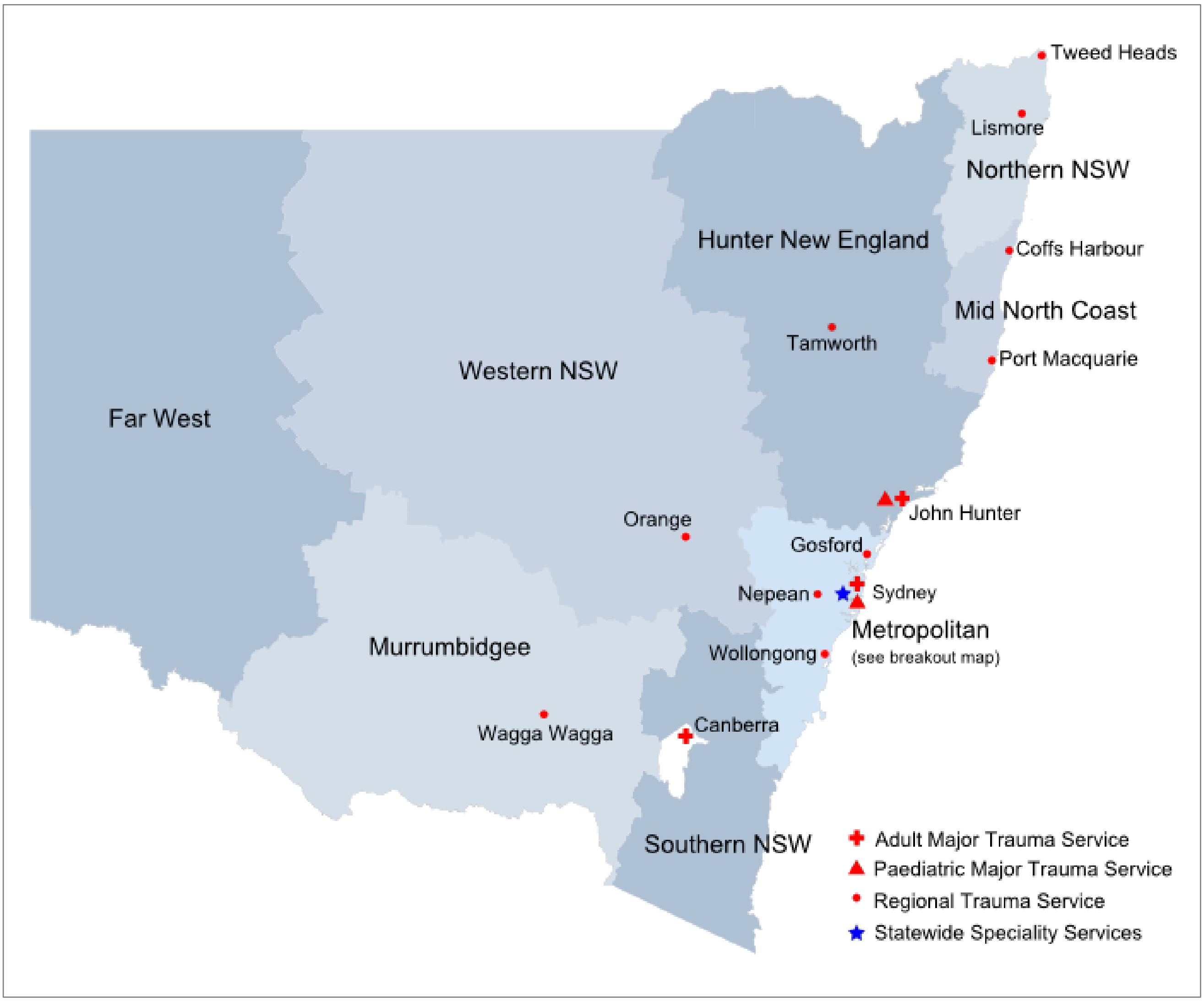
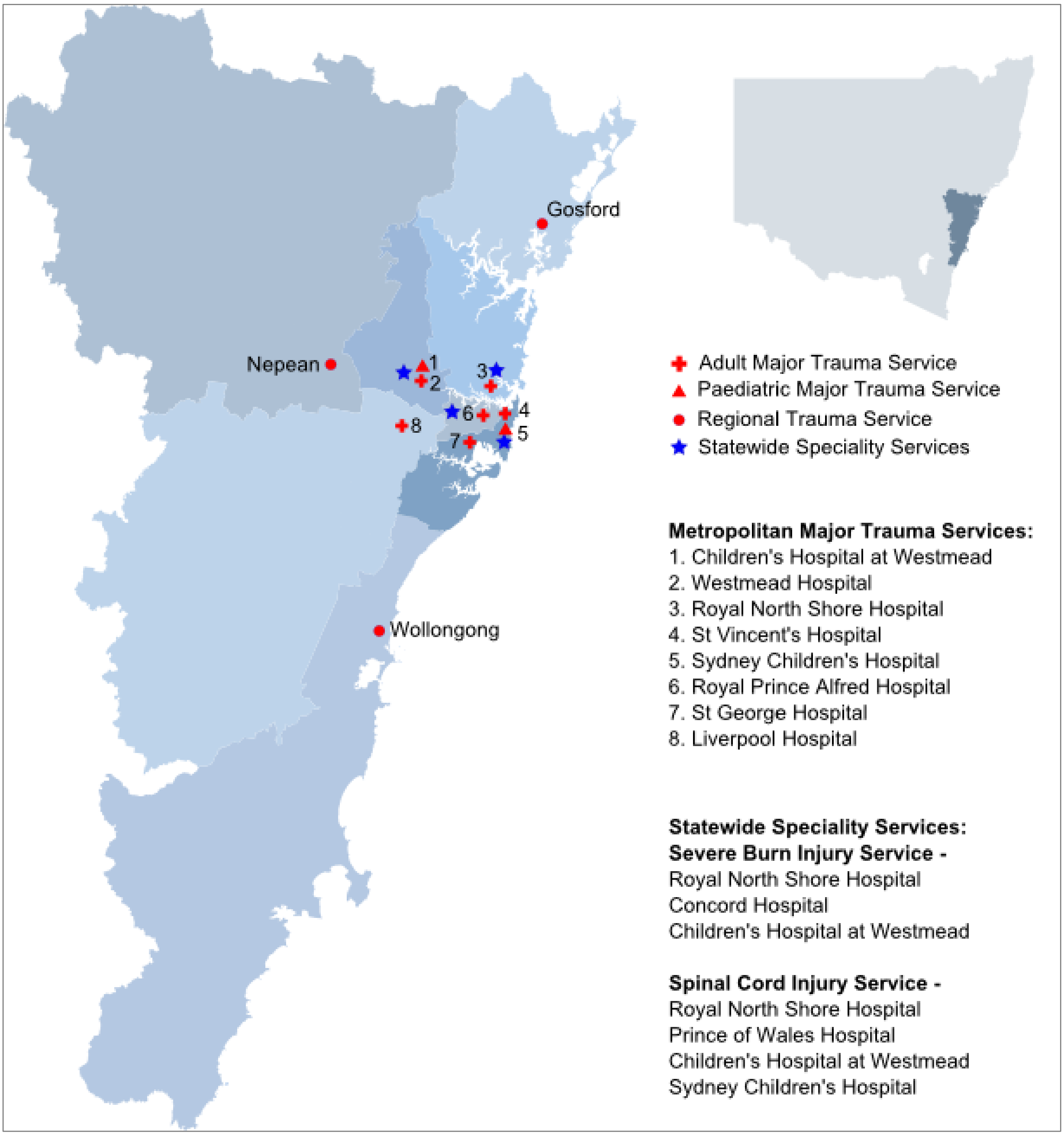

PROTOCOL: T1
PRE-HOSPITAL MANAGEMENT OF MAJOR TRAUMA
Major Trauma: Paediatric — Transport Algorithm
Assess Pt using Major T1 Trauma Criteria Tool
IMMEDIATE LIFE THREAT
Will Pt die without immediate intervention?
i.e Peri-arrest (Trauma)
Yes
Early pre-hospital notification from scene to receiving hospital (Trauma Code 3)
Closest Trauma Service:
(Paediatric/Regional/Major)
Mandatory: Notify ACC of T1 Paediatric Trauma Patient if transporting to a non-paediatric Trauma Service
No
Is a Paediatric Trauma Service located within 60 mins (Metropolitan) or 90 mins (Regional) from scene?
Yes
Paediatric Trauma Service
Pre-hospital notification (Trauma Code 3)
No
MANDATORY: Request Control Centre notify ACC of trauma patient requiring retrieval and seek direction on appropriate destination.
Do not delay transport waiting for arrival of Aeromedical Team – update MIST reports (local channel) with Control Centre & responding Aeromedical Team regarding any possible call-off, rendezvous en-route
Paediatric Destination cascade if no Paediatric Trauma Service located within 60 mins (metro) or 90 mins (regional) from scene:
• Major Trauma Service, if not then
• Regional Trauma Service, if not then
• Trauma 'Staging' Hospital, if not then
• Local Hospital
ACC notification and direction on appropriate destination / rendezvous point remains mandatory and takes precedence.

Appendices 2. NSW regional trauma centres



Appendices 3. NSW metropolitan trauma centres



Glossary

APDC	Admitted Patient Data Collection
ACI	Agency for Clinical Innovation
CATE	Critical Care Acute Trauma and Emergency. Refers to the public health register established in 2015 under the *NSW Public Health Act (2010)*
CHeReL	Centre for Health Record Linkage
eCQR	electronic Clinical Quality Registry
ED	Emergency department
ITIM	Institute of Trauma and Injury Management
ICD10-AM	International Statistical Classification of Diseases and Related Health Problems Tenth Revision, Australian Modification
ISS	Injury severity score
Collector	Name used for the NSW Trauma Registry
PPN	Personal patient number
RBDM	Registry of Births, Deaths and Marriages
TORQUE	Trauma Outcomes and Quality Evaluation
T1 protocol	A major trauma protocol used by NSW Ambulance to activate and guide clinical and operational management of patient(s) experiencing acute major trauma episode.

Acknowledgements

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