BETTER PRACTICE GUIDELINES

INTER-HOSPITAL TRAUMA TRANSFERS

In South West Sydney Area Health Service

An initiative of the

Injury Advisory Committee

Important note:

This document is produced as a guide to enhance the implementation of best practice principles. It should serve as a supplement to the clinicians' judgement in each individual case.

The guidelines contained within this document are based upon a combination of the best available evidence at the time of writing and the expert opinion of a multi-disciplinary panel.

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Foreword

This document has been developed to provide evidence based recommendations about the management of inter-hospital trauma transfers in the South Western Sydney Area Health Service (SWSAHS). It encompasses recommendations based upon published literature coupled with expert local experience. Electronic databases and the Internet were searched for English language material produced between 1980 and 2001. This document will, in time, be updated to incorporate new evidence as it becomes available.

In addition to the provision of best practice guidelines the Injury Advisory Committee will make expert recommendations in relation to a process of evaluation of each recommendation using performance indicators. Future editions of this document, after comprehensive evaluation of the effect of guideline implementation on clinical practice, will propose an appropriate threshold for each performance indicator which will indicate the frequency of achieving the performance indicator that would indicate best practice.

The guidelines use a four point rating system to identify the evidence base for key decision points. The rating system is recommended by the National Health and Medical Research Council (NHMRC)[1].

I	*Evidence Obtained From A Systematic Review Of All Relevant Randomised Control Trials*
II	*Evidence Obtained From At Least One Properly Designed RCT*
III-1	*Evidence Obtained From Well-Designed Pseudo-Randomised Controlled Trials (Alternate Allocation Or Some Other Method)*
III-2	*Evidence Obtained From Comparative Studies With Concurrent Controls & Allocation Not Randomised (Cohort Studies), Case-Control Studies, Or Interrupted Time Series With A Control Group*
III-3	*Evidence Obtained From Comparative Studies With Historical Control, Two Or More Single-Arm Studies, Or Interrupted Time Series Without A Parallel Control Group*
IV	*Evidence Obtained From Case Series, Either Post-Test Or Pre-Test And Post-Test*[1]

Level I and II publications represent the gold standard of evidence. However, such evidence is not available in many of the topic areas pertinent to this review. The Injury Advisory Committee, therefore, decided that it was appropriate to base its recommendations upon the available levels of evidence as they represent the best evidence available at this time. Where there is insufficient evidence upon which to base recommendations, the expert opinion of key stakeholders in the multi-disciplinary field of inter-hospital trauma transfer has been sought and consensus achieved as to the best practice principles.

This document provides clinicians within the South Western Sydney Area Health Service (SWSAHS) with evidence based information about the process of inter-hospital trauma transfer and is aimed at optimising the transfer process. It does not attempt to simply extrapolate information from international guidelines which may be designed to meet the needs of health systems that bear little similarity to our region[2,3,4,5,6,7,8]. Where possible existing local guidelines have been incorporated to ensure continuity and acceptance into practice[10, 11].

The project team involved in the preparation of this document is the Injury Advisory Committee of the SWSAHS. This Committee is comprised of injury experts from a range of specialties including trauma, emergency, general practitioners, allied health and prehospital care providers. It reports directly to the Clinical Council of the SWSAHS. The Injury Advisory Committee is grateful to all those who have contributed their time and expert opinion to the development of this publication.

Michael Sugrue
Chair, Injury Advisory Committee
South Western Sydney Area Health Service
June 2001

Summary of Guidelines

The following points represent a summary of the guidelines presented within this document. Each recommendation should be carefully considered in terms of the specific patient presentation and local circumstances. To better understand the context of each of these guidelines, the reader should refer to the appropriate section of the document.

- All patients meeting Protocol 4 prehospital triage criteria must be transferred directly to a major trauma service (MTS) from the scene.

- Patients meeting the criteria for inter-hospital trauma transfer outlined in Table 2. must be transferred to a MTS as a trauma transfer.

- Where specific occasions arise, when the resources at the urban or rural hospital are overwhelmed, the trauma patient should also be transferred to the MTS to ensure an adequate standard of care.

- Hospitals receiving dying trauma (Category 7) patients must have;
    a) The ability to receive prehospital notification directly to the Emergency Department of the impending patient arrival.
    b) Hospital Trauma Team response with activation criteria and group paging mechanism.
    c) The ability to perform basic airway maneouvers in the Emergency Department ranging from intubation to cricothyroidotomy.
    d) The ability to arrest external blood loss as required.
    e) The ability to perform thoracotomy and control of major vessel bleeding with proximal control within 5-10 minutes of patient arrival.
    f) The ability to provide 24 hour theatre staff and facilities, and have a surgical specialist on call.
    g) The ability to provide immediate chest and pelvic radiology 24 hours a day.

- The impending arrival of all Category 7 patients should be advised by the Ambulance Service to the Emergency Department of the receiving hospital. In addition, Ambulance control must notify the medical retrieval unit (MRU), who in turn will notify the MTS and the retrieval team.

- Patients with spinal column injury with or without neurological deficit, injured in SWSAHS should be transferred directly to the MTS.

- Transfer to a specialised spinal injury unit will be at the discretion of the Consultant Neurosurgeon and, if necessary, should occur as soon as practical, preferably within 12 – 24 hours of injury.

- Patients meeting the following criteria should be transferred to a specialised burns unit either directly or as soon as practical within 4-6 hours of injury;
    a) Full thickness burns > 5% BSA in any age group
    b) Partial thickness burns involving > 20% BSA in adults
    c) Partial thickness burns involving > 5% BSA in patients < 10 years or > 50 years.
    d) Inhalation injury
    e) Partial or full thickness burns involving the face, hands, feet, genitalia, perineum or skin over major joints
    f) Electrical burns, including lightning strike
    g) Significant chemical burns
    h) Lesser burns with complicating pre-existing disease or concomitant trauma that could complicate management, prolong recovery or adversely affect mortality
    i) Burn injury with special social requirements (e.g. suspected child abuse) or long term rehabilitation

- The doctor at the urban or rural hospital should notify the MTS of the arrival of a patient meeting the trauma transfer criteria. This notification should be via the Trauma Hotline as soon as possible, but preferably within 20 minutes of patient arrival.

- A dedicated “Hotline” number should always be used to allow staff from referring hospitals to communicate directly with a member of the trauma team at the trauma service for all patients who potentially require High Dependency or Intensive Care admission.

- Trauma transfers should be carried out in a manner which transports the patient to a location where definitive management can be instituted as soon as practical. The following times are recommended for the Retrieval Team in SWSAHS; Response time ≤ 10 minutes, Scene time ≤ 30 minutes, Transport time ≤ 30 minutes

- Prior to transfer the patients airway, breathing and circulation should be stabilised. All significant haemorrhage must be controlled prior to transfer.

- A haemodynamically unstable patient with known intra-abdominal injury should have the bleeding controlled prior to transfer.

- The Intensive Care Registrar from the MTS or medical doctor from the retrieval team should advise the referring hospital regarding patient management and preparation for transfer using the established processes. In SWSAHS the N.E.W.S. system is to be utilised.

- Attempts should be made to thoroughly assess the patient prior to transfer to determine the full extent of their injuries. All patients identified as requiring inter-hospital trauma transfer should be seen by the Consultant Surgeon or Surgical Registrar prior to leaving the primary hospital.

- The MTS will provide a minimum of one formal multidisciplinary trauma education session in each urban / rural hospital every six months.

- All new registrars and senior registrars at the MTS who accept the care of trauma patients must have attended a trauma education and orientation program within one week of commencing their term.

- All patients requiring invasive procedures prior to or during transfer, particularly airway management, must be transferred using a medical retrieval team.

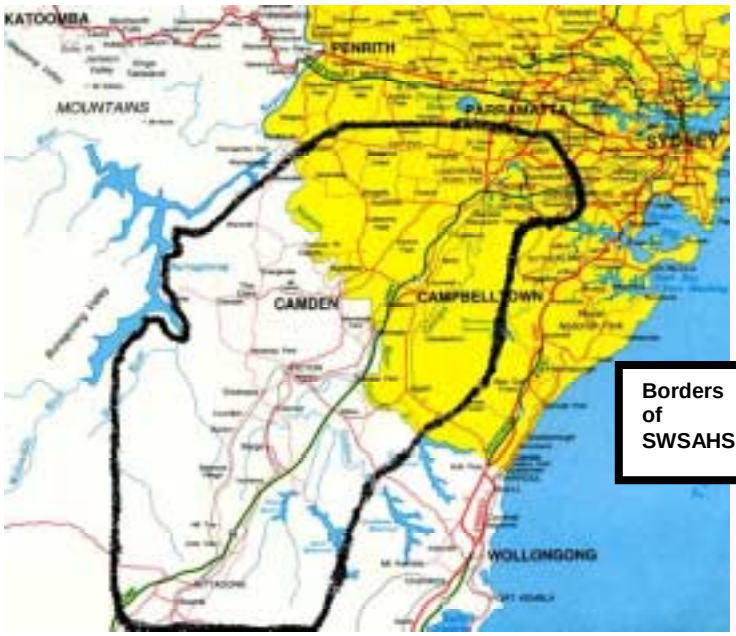
Current Status of Inter-hospital Trauma Transfer in SWSAHS

Adapted from a review by Dr Patrick Schoettker, Honorary Trauma Fellow, and Nadia Nocera, Regional Trauma Co-Ordinator, Liverpool Hospital, 2001.

Accumulative international evidence has suggested that it is possible to reduce the mortality and morbidity associated with trauma by the provision of effective medical care through a regionalized trauma system[12,13,14,15,16]. In trauma patients, the rapid transportation of patients to institutions offering definitive care is recognised as a critical component of optimal trauma care[14,17,18,19,20,21,22]. Most studies have suggested that the early and timely transfer of severely injured patients to a MTS are associated with better survival[23,24,25,26,27,28,29,30,31].

Previous studies conducted in the United States and Australia have shown that trauma patients, on the average, spent between 2 hours and 45 minutes[18] and 3 hours[32] in local emergency departments before transfer to a MTS. This time interval has been deemed to be too long[18,33], and could pose significant risk of mortality for these patients[19]. In New South Wales, a state-wide guideline for prehospital care providers has been developed in order to reduce the time taken for transport to definitive care by bypassing the nearest hospital and taking trauma patients directly to the MTS[34]. The effectiveness of different modes of transportation for trauma patients has not been well documented in this country.

Geography of SWSAHS



South Western Sydney is a region of 6512 km^2 with a population of 720,000. The region has 5 urban and 1 rural hospitals[35]. Liverpool Hospital is the designated MTS for the region; it has 520 beds, including 22 Intensive Care Unit beds. Specialist services include neurosurgery and cardiothoracic surgery.

The Existing System

Since 1995, the Hospital has operated a dedicated direct access phone number through which referring staff can immediately access a trauma team member, usually the Intensive Care Registrar[36]. In addition to providing advice regarding the need and logistics of retrieval the ICU Registrar is also able to advise on patient management issues.

Inter-hospital trauma transfers are normally undertaken by either ambulance officers, paramedics or a medical retrieval team using a helicopter or a road ambulance, or via private vehicles. The crew of the medical retrieval team consists of a physician, a paramedic and pilot / driver. The physician is either a specialist or an advanced trainee in anaesthesia, emergency or intensive care medicine.

Data on inter-hospital trauma transfers is kept at Liverpool Hospital[37], Medical Retrieval team and the Ambulance Service of New South Wales. Trauma patients admitted to Liverpool Hospital are entered onto a regional computerised trauma registry by a group of trained trauma nurses[37].

Between January 1995 - December 1999, 9225 trauma patients were admitted to Liverpool Hospital; of these, 384 (4.2%) patients arrived via inter-hospital trauma transfer. Transfers were conducted in 219 cases (57.0%) by ambulance officers, in 70 cases (18.2%) by paramedics, in 68 cases (17.8%) by medical retrieval team and 27 cases (7.0%) by private transport.

The mean Injury Severity Score (ISS) for the entire group was 13.0 ± 9.1; and 122 (32%) of the transferred patients had an ISS ≥16. Patients transported by the medical retrieval team had the highest ISS (20.5 ± 12.6), which was significantly greater than those transported by ambulance (ISS = 10.5 ± 6.8, $p<0.05$), paramedic (ISS = 14.4 ± 8.3, $p<0.05$) or private transport (ISS = 11.7 ± 7.1, $p<0.05$) (Table 1).

Table 1. ***Demographic Characteristics & Mechanisms Of Injury By Mode Of Transport***

	Ambulance	Paramedic	Medical retrieval	Private transport
Number of patients	219	70	68	27
Males	166 (75.8)	51 (72.9)	52 (76.5)	19 (70.4)
Age	40.6 ± 20.9	37.6 ± 21.7	35.5 ± 18.9	33.2 ± 20.4
Mechanisms of injury				
Road trauma	68 (31.1)	28 (40.0)	23 (33.8)	5 (18.5)
Interpersonal violence	45 (20.5)	20 (28.6)	17 (25.0)	3 (11.1)
Falls	72 (32.9)	17 (24.3)	19 (27.9)	10 (37.1)
Others	34 (15.5)	5 (7.1)	9 (13.3)	9 (33.3)
Severity scores				
ISS	10.5 ± 6.8	14.4 ± 8.3	20.5 ± 12.6**	11.7 ± 7.1
RTS	7.8 ± 0.5	7.3 ± 1.4	5.3 ± 1.9**	7.8 ± 0.2
GCS	14.4 ± 1.6	13.2 ± 3.8	10.0 ± 4.8**	14.5 ± 1.2

Percents in parentheses are shown.
** Significant difference between Medical Retrieval and Paramedic, and between Medical Retrieval and General Ambulance ($p<0.05$, t test).

The time intervals used for analysis are shown in Figure 1. The mean time to MTS for the entire sample was 387 ± 253 minutes (Figure 2). Ambulance transport was associated with the longest time compared to medical retrieval team and paramedic; however, there was no significant difference between paramedic and medical retrieval team. Patients transported by ambulance spent a mean of 330 ± 247 minutes at the referring hospital; this was significantly longer than that recorded in patients transported by paramedics (mean: 254 mins. ± 247; $p< 0.001$) or by the medical retrieval team (mean: 251 mins. ± 213; $p < 0.001$). There was no significant difference in the referring hospital scene time between paramedics and medical retrieval team. The medical retrieval team was involved in 68 patient transfers. The mean time to MTS was 316 ± 169 minutes. The mean time to call the retrieval team was 190 ± 243 minutes, accounting for 60% of the time to major trauma centre (figure 3).

Patients with ISS > 16 had a mean time to MTS of 334 ± 236 minutes, compared to those with ISS < 9 who had a mean time to MTS of 409 ± 275 minutes (Figure 4). There was, however, a small increase in time to MTS for patients whose ISS was between 16-24 in comparison with patients whose ISS was between 10-15.

Figure 1. Time intervals used for analysis

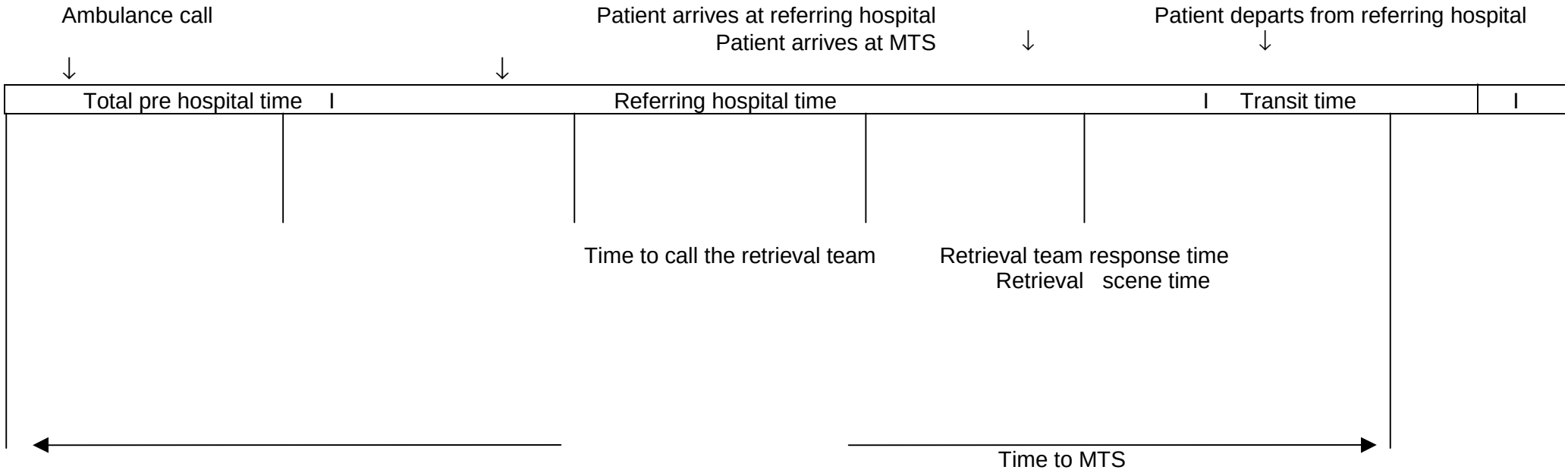


Table 2. ***Length Of Time In Each Phase Of Inter-Hospital Transfer***

	Total population	Ambulance	Paramedic	Medical retrieval	Private
Total prehospital	32 ± 16	30 ± 14	33 ± 17	33 ± 21	n.a
Referring hospital scene	305 ± 256	330 ± 247	254 ± 247	251 ± 213	397 ± 406
Transit time	37 ± 23	37 ± 20	38 ± 31	32 ± 13	49 ± 36
Time to MTS	387 ± 253	448 ± 274	338 ± 234	316 ± 169	n.a

Figure 2. ***Time Intervals To MTS For Patients Transported By Medical Retrieval***
(% Of Total Time To MTS).

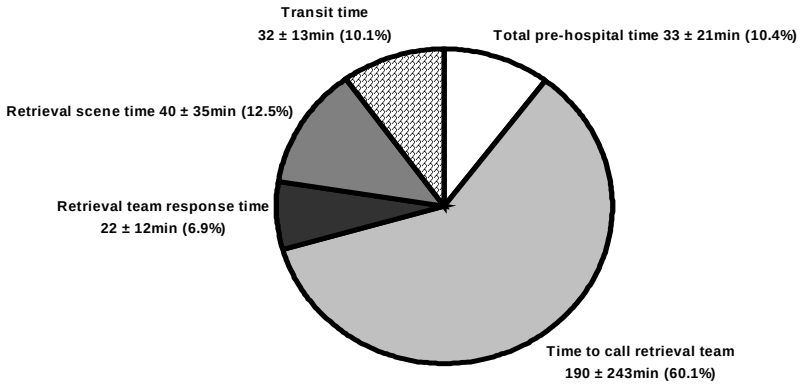
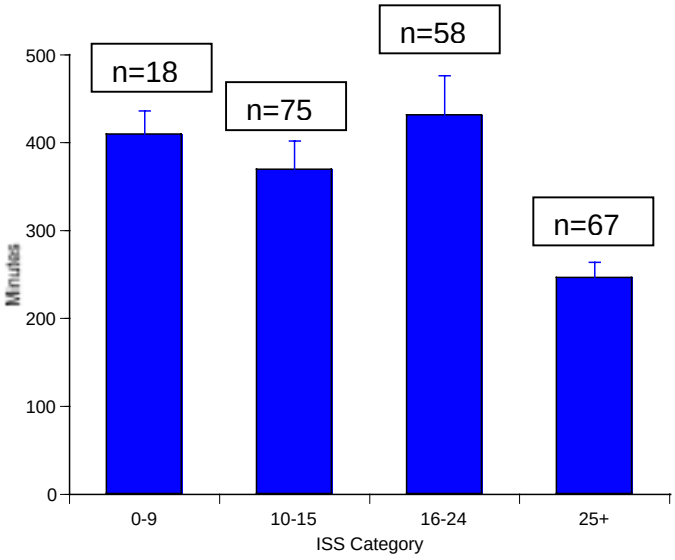


Figure 3. ***Relationship Between Time To MTS And Injury Severity Score***



Implications

This discussion provides a comprehensive overview of the issues surrounding times to inter-hospital trauma transfers in a single Area Health Service. It indicates that the time to definitive care for trauma patients was unacceptably long. The potential consequences of this delay are widely recognised[14,17,21,22,23,26,31,35,38], although the precise significance of delays to long term outcomes remains an area requiring further in-depth investigation. Previous work on trauma death outcomes in SWSAHS has, however, identified that delayed inter-hospital trauma transfer has been a contributor to potentially avoidable deaths[39]. Based upon these findings the development of better practice guidelines for inter-hospital trauma transfer was identified as a priority.

The development of the best practice guidelines for the management of inter-hospital trauma transfer described within this document aims to streamline the transfer process through clear delineation of best practice and to maximise the outcomes for trauma patients by reducing the time to definitive care.

Part 1:
Identification Of Patients Needing Trauma Transfer

PREHOSPITAL TRIAGE / CATEGORY 4 PATIENTS

Question: Which patients should be triaged to the MTS ?

The concept of bypassing the nearest hospital to transport the trauma patient to the MTS was introduced by the N.S.W. Ambulance Service in 1992 as Protocol 4 (See Table 1)[34]. It stems from the principles of reducing the time between injury and the institution of definitive treatment[14,17,22,23,31,35,38,41], and the improvements in outcomes demonstrated by facilities with increasing volumes of trauma patients[24,26,34,40,42,43]. It has been shown in the literature that the utilisation of prehospital trauma triage criteria are potentially good indicators of a major trauma victim[44,45,46].

The South Western Sydney (SWS) Regional Trauma Registry reports that failed bypass occurred in 3.9% of trauma cases admitted to hospitals in SWSAHS between 1995-9[37]. During this time, 43 patients were transferred to Liverpool Hospital following the failure of prehospital triage Protocol 4 (Table 1). This accounted for almost 20% of all inter-hospital transfers which were undertaken during this period. Therefore, improvements in prehospital triage would most certainly significantly reduce the subsequent number of inter-hospital trauma transfers[41,46,47].

GUIDELINE

All patients meeting Protocol 4 prehospital triage criteria[34] must be transferred directly to a MTS from the scene.

PERFORMANCE INDICATORS

- Trauma patients are correctly triaged by ambulance officers under Protocol 4 guidelines.
- All inter-hospital transfers are monitored to establish the continuing effectiveness of prehospital triage and a formal report is made by the Regional Trauma Coordinator at each meeting of the South Western Sydney Area Health Service.

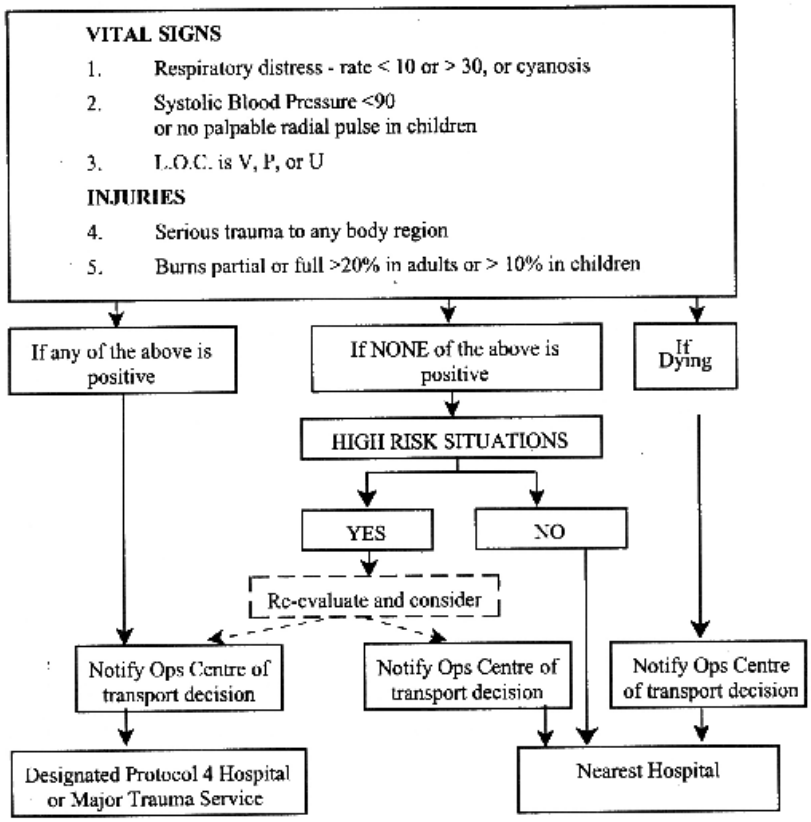
SCIENTIFIC FOUNDATION

FINDING	REFERENCE	LEVEL OF EVIDENCE
Severely injured patients should be transported to major trauma services direct from the scene without treatment or attempts at stabilisation at other facilities.	48	III-2
No specific group of injuries could be identified that had a more specific benefit of direct transport to a major trauma service.	31	III-3
Patients with major trauma taken directly to a major trauma service had shorter hospital / ICU stays and lower mortality than those seen at other hospitals & transferred. 62% of deaths who were transferred had PS < 0.5, as opposed to only 22% of deaths in those directly admitted.	31	III-3

The magnitude of the distance flown had no significant effect on subsequent death or survival (aircraft configured like an ICU).	49	III-3
Survival rates decreased with increasing injury severity. There was no difference in survival between patients transferred in & those admitted directly to the tertiary hospital.	50	IV
The majority of patients meeting prehospital trauma criteria were transported to major trauma services. Compliance with triage protocols to deliver major trauma patients to designated major trauma services varied with different criteria. Patients only meeting physiology criteria were much less likely to be transported to major trauma services.	51	IV
Patient survival following inter-hospital transfer was no different to those who were admitted directly to a major trauma service	51	IV

TABLE 3.

PREHOSPITAL TRIAGE OF TRAUMA
FOR RURAL AND METROPOLITAN NSW **PROTOCOL 4**



1. If an ambulance officer considers a critically ill patient will not survive the time to transport to a Major Trauma Service (Metropolitan) or Designated Protocol 4 Hospital (rural), where this is not the closest, the patient should be taken to the nearest hospital en-route for urgent resuscitation.
2. Some patients with serious injuries may be in difficult circumstances eg difficult access, time delay over 30 minutes, trapped at the scene, over 30 minutes after loading to Major Trauma Service or Designated Protocol 4 Hospital, or circumstances which the scene officer determines at their discretion warrant assistance. In these situations notify Operations Centre that difficult conditions apply and be advised regarding the need for ALS/Paramedic and/or a primary medical response team.
3. If the patient is apparently not seriously injured but has been involved in a mechanism of injury which is high risk, the officer should re-evaluate the situation and decide at his discretion whether to take the patient to a Major Trauma Service/Designated Protocol 4 Hospital or the nearest hospital if the Major Trauma Service/Designated Protocol 4 Hospital is not the closest.

Approved By: Dr Tony O'Connell
Chairman, Medical Advisory Committee

Dr Barbara-Ann Adelstein
Medical Director

PREHOSPITAL TRIAGE OF TRAUMA FOR RURAL AND METROPOLITAN NSW **PROTOCOL 4**

DEFINITION OF SERIOUS INJURY

1. Penetrating injury of:-
   - ❶ Head.
   - ❷ Neck.
   - ❸ Chest.
   - ❹ Abdomen.
   - ❺ Perineum.
   - ❻ Back.
2. Head:-
   - ❶ 1 or 2 dilated pupils.
   - ❷ Open head injury.
   - ❸ Severe facial injury.
3. Chest:-
   - ❶ Subcutaneous emphysema.
   - ❷ Major flail segment.
4. Abdomen:-
   - ❶ Distension.
   - ❷ Rigidity.
5. Spinal:-
   - ❶ Weakness.
   - ❷ Sensory loss.
6. Limb:-
   - ❶ Vascular injury with ischaemia of limb.
   - ❷ Amputation.
   - ❸ Crush injury of limb or trunk.
   - ❹ Bilateral femur fractures.

HIGH RISK SITUATIONS

1. Vehicular crash > 60km/hour.
2. Major deformation of vehicle.
3. Fatal injury in same vehicle.
4. Fall from height > 5 metres.
5. Patient ejected from vehicle.
6. Child cyclist / child pedestrian hit by vehicle > 30km/hour.
7. Injuries to multiple body regions.

This protocol was written in conjunction with the NSW Department of Health

CRITERIA FOR TRANSFERRING TRAUMA PATIENTS

Question: Which patients should be transferred to the MTS from urban / rural hospitals?

With improved regionalisation of trauma care and under the NSW Trauma Plan[35] it has been the aim to allocate the right patient to the right hospital as soon as possible. Whilst the use of Protocol 4[34] in the prehospital environment has reduced the number of severe trauma patients presenting at urban and rural Emergency Departments this is only one part of the process of rapidly transporting trauma patients to locations for definitive treatment [37,35]. Criteria for triage have related to specific injury patterns, injury severity score, co-morbid factors and the resources available at the local urban or rural hospital. There are few studies relating specifically to the triage criteria for identification of trauma patients requiring transfer to a MTS. All current publications are level III and IV evidence.

GUIDELINES

Patients meeting the criteria for inter-hospital trauma transfer outlined in Table 2. (below) must be immediately transferred to a MTS as a trauma transfer.

Where specific occasions arise, when the resources at the urban or rural hospital are overwhelmed, the trauma patient should also be transferred to the MTS to ensure an adequate standard of care.

PERFORMANCE INDICATORS

- All patients transferred to the MTS should meet the criteria outlined in Table 2. All trauma admissions to urban or rural hospitals meeting this criteria must be transferred to the MTS as soon as practical.

- When adequate resources are unavailable at the urban or rural hospital patients are transferred to the MTS.

- Patients with minor head injuries and limb fractures should be treated at the urban or rural hospital where resources allow.

SCIENTIFIC FOUNDATION

FINDING	REFERENCE	LEVEL OF EVIDENCE
Overtriage most often occurs as a result of suspicions of more severe injury that cannot be ruled out at the referral hospital.	32	III-2
Currently, methods of triage are sub-optimal with 49% of inter-hospital transfers being inappropriate	17	IV
19% of all trauma discharges from a major trauma centre should have received treatment at a trauma centre. Of these 66% actually were sent to a trauma centre. Of those who did not require treatment at a trauma centre, 62% were actually treated at a trauma centre.	47	IV
Inappropriate transfer of less seriously injured patients was potentially reduced by providing a mechanism of obtaining advice regarding optimal management of these patients by trauma experts.	52	IV
≥ 3 rib fractures indicates the need for inter-hospital transfer in 90% of cases	54	IV
Patient selection was, on the whole, adequate to select appropriate patients for referral (selection criteria not specified).	55	IV
28% of head injured patients returned to the referral hospital after a CT scan.	56	IV
Inter-hospital transport may be unnecessary in some cases where injuries are relatively minor but inadequately assessed. 4/21 had minor head injuries, 2 had no significant head injury – ¼ died.	57	IV
The high eventual mortality in some patient groups means that accurate prediction of outcome is desirable to avoid inappropriate transfers.	58	IV
Although 89/102 severely injured patients transferred were thought by the review team to have been unsalvageable, clinical evaluation alone cannot predict chance of survival.	59	IV
Many patients who were transferred with head-injuries were found, following complete examination, not to have injuries that required neurosurgical treatment. Therefore, transfers were of limited value.	59	IV
Retrospective data analysis revealed significant difficulties in establishing for whom the transport service was essential and for whom it was of no benefit or merely helpful.	59	IV

TABLE 4. CRITERIA FOR CONSIDERATION OF TRAUMA TRANSFER (Adapted from: [53])

CENTRAL NERVOUS SYSTEM

- *Head injury* - *Penetrating injury / open fracture (± Cerebrospinal fluid leak)*
  - *Depressed skull fracture*
  - *Glasgow Coma Scale (GCS) <14 or GCS deterioration*
  - *Lateralizing signs*
- *Spinal cord injury* - *Spinal cord injury or major vertebral injury*

CHEST

- *Major chest wall injury or pulmonary contusion*
- *Wide mediastinum or other signs suggesting great vessel injury*
- *Cardiac injury*
- *Patients who may require prolonged mechanical ventilation*
- *Multiple fractured ribs / flail chest*

PELVIS / ABDOMEN

- *Unstable pelvic ring disruption*
- *Open pelvic injury*
- *Solid organ injury*
- *Pelvic fracture & shock / evidence of hemorrhage*

MAJOR EXTREMITY INJURY

- *Open long-bone fractures*
- *Fracture / dislocation with loss of pulses*
- *Extremity ischaemia*

MULTIPLE-SYSTEM INJURY

- *Burns with associated injuries*
- *Multiple long-bone fractures*
- *Head + face, chest, abdominal, or pelvic injury*
- *Injury to > two body regions*

COMORBID FACTORS

- *Age >55 years*
- *Children <5 years of age*
- *Insulin-dependent diabetes*
- *Morbid obesity*
- *Pregnancy*
- *Immunosuppression*
- *Pre-existing cardiac or respiratory disease*

SECONDARY DETERIORATION (LATE SEQUELAE)

- *Mechanical ventilation required*
- *Sepsis*
- *Single or multiple organ system failure (deterioration in central nervous, cardiac, pulmonary, hepatic, renal, or coagulation systems)*
- *Major tissue necrosis*

PREHOSPITAL MANAGEMENT OF THE DYING PATIENT (CATEGORY 7)

Questions: For which patients is it not safe to bypass the rural / urban hospital ?
What are the minimum standards for hospitals which receive Category 7 patients ?

From 1992 all Sydney Metropolitan Ambulance Officers, in accordance with the NSW Trauma Plan, began implementing the Trauma Triage system whereby any patient sustaining serious injury would be taken to an appropriate hospital to expedite the provision of definitive treatment[34,35]. Patients are triaged into various categories (1-7) following the initial assessment. Category 7 comprises of patients who are considered to be dying and deemed unlikely to survive the duration of the journey to the MTS – they are, subsequently, transported to the nearest hospital.

A retrospective review of hospital records, ambulance case sheets and the SWS Regional Trauma Registry[37] of Category 7 patients was used to identify objective criteria indicating significant risk of death. These criteria were determined to be the presence of one or more of the following:

- *Systolic blood pressure <90 mmHg*
- *Respiratory rate <10 or >30 / min*
- *Pulse <50 or >140 / min*
- *Sucking chest wound*
- *Documented tension pneumothorax*
- *Documented airway obstruction*
- *Exsanguination from external source which could not be controlled.*

Each case was reviewed to see if it was considered whether the patient could be classified as dying according to the above criteria.

Between September 1994 and October 1997 28 patients were classified as Category 7 - 79% males; mean age 33 years (±17.8). Eight (29%) were penetrating trauma and 20 (71%) blunt trauma. The mechanism of injury was road injury (32%), falls (11%), interpersonal violence (39%), and other (18%). Thirteen patients (46%) were deemed on retrospective medical review not to have been dying and, thus, not truly Category 7 patients. Of these patients 12 were subsequently transferred to a MTS and 1 went to ICU. The mean Injury Severity Score (ISS) of the group was 31.3 (±23.6). The mean ISS for the patients deemed Category 7 by both ambulance officers and the medical review was 38.3 (±24.3), and the mean ISS for the patients deemed Category 7 by ambulance officers only was 23.1 (±20.6).

Of the 15 patients considered to be true Category 7, 4 patients had no vital signs and were clinically dead on arrival at the hospital, 3 died later in the Emergency Department, 1 died in the Operating suite, 1 underwent surgical intervention and was admitted to the ward, 1 was admitted to the ICU, and 5 were subsequently transferred to a MTS. Of the five transferred to a MTS, 1 underwent surgical intervention and was admitted to ICU and 4 were direct admissions to ICU. The mean transfer time to the MTS was 200mins (3.33hrs), range 110-458mins (1.8-7.6hrs).

In its current format, Category 7 has led to incorrect classification in 47% of patients. It gave rise to secondary inter-hospital transfer in 60% of patients. In addition, the delivery of Category 7 patients to smaller urban or rural hospitals posed a great challenge to the expertise and resources of the in house staff at these facilities. The definition and utilisation of Category 7 in prehospital triage needs to be urgently re-evaluated to optimise the effectiveness of its outcomes.

GUIDELINES

Hospitals receiving dying trauma (Category 7) patients must have;

a) The ability to receive prehospital notification directly to the Emergency Department of the impending patient arrival.
b) Hospital Trauma Team response with activation criteria and group paging mechanism.
c) The ability to perform basic airway maneouvers in the Emergency Department ranging from intubation to cricothyroidotomy.
d) The ability to arrest external blood loss as required.
e) The ability to perform thoracotomy and control of major vessel bleeding with proximal control within 5-10 minutes of patient arrival.
f) The ability to provide 24 hour theatre staff / facilities and have a surgical specialist on call.
g) The ability to provide immediate chest and pelvic radiology 24 hours a day.

The impending arrival of all Category 7 patients should be advised by the Ambulance service to the Emergency Department of the receiving hospital. In addition Ambulance control must notify the MRU, who in turn will notify the MTS and the retrieval team.

Notification of arrival of a Category 7 patient to an urban hospital should lead to an automatic dispatch of a medical retrieval team.

PERFORMANCE INDICATORS

- The Ambulance Service of NSW will notify the Emergency Department of the receiving hospital and the MRU of all Category 7 patients prior to their arrival.
- The MRU will notify the MTS of all Category 7 patients being transported to referring hospitals in the region.
- All hospitals to which Category 7 patients are transported have available resources that meet the above criteria.
- A medical retrieval team will automatically be dispatched after notification that a Category 7 patient is being transported to an urban / rural hospital.

MANAGEMENT OF PATIENTS WITH SUSPECTED OR PROVEN SPINAL INJURY

Question: Should patients with suspected spinal injury be transported to the MTS ?

All patients who have a high index of suspicion of spinal injury should have a hard collar applied and remain immobilised until the presence or absence of spinal injury can be determined. Trauma patients presenting with the following findings on clinical examination should be considered with a high index of suspicion for the presence of spinal injury;

- Vital signs - bradycardia, hypotension
- Respiratory Pattern – diaphragmatic in high cord injury
- Neurological examination – flaccid paralysis in limbs, sensory level to pain, reduced anal tone, altered sweat level / pattern, plantar response, priapism, elevated shoulders in cervical injury, urinary retention[60].

GUIDELINE

Patients with spinal column injury with or without neurological deficit injured in SWSAHS should be transferred directly to the MTS. Transfer to a specialised spinal injury unit will be at the discretion of the Consultant Neurosurgeon.

PERFORMANCE INDICATOR

- Patients with spinal injuries with and without neurological deficit will be transferred to the MTS in SWSAHS.

SCIENTIFIC FOUNDATION References: 60, 61

MANAGEMENT OF PATIENTS WITH BURN INJURY

Question: Should patients with burns be transferred to the MTS or a Burn Unit ?

The unique problems and long term nature of the treatment of severely burnt patients frequently requires early intervention from specialised staff and dedicated burns units[62,63] All patients being transferred to a Burns Unit should have a clearly documented fluid balance chart and a copy of the NSW Burns Transfer Information chart completed and with the patient[63].

GUIDELINE

Patients meeting the following criteria should be transferred to a specialised burns unit either directly or as soon as practical within 4-6 hours of injury;

a) Full thickness burns > 5% BSA in any age group
b) Partial thickness burns involving > 20% BSA in adults
c) Partial thickness burns involving > 5% BSA in patients < 10 years or > 50 years.
d) Inhalation injury
e) Partial or full thickness burns involving the face, hands, feet, genitalia, perineum or skin over major joints
f) Electrical burns, including lightning strike
g) Significant chemical burns
h) Lesser burns with complicating pre-existing disease or concomitant trauma that could complicate management, prolong recovery or adversely affect mortality
i) Burn injury with special social requirements (e.g. suspected child abuse) or long term rehabilitation

PERFORMANCE INDICATOR

- Patients meeting the above criteria are transferred directly to a specialised Burns Unit as soon as practicable, preferably within 6 hours of injury.

SCIENTIFIC FOUNDATION References: 9, 53, 60, 63, 64, 65

Part 2:

The Transfer Process

Delays are common in the course of inter-hospital trauma transfer for a variety of reasons including;

- the failure to initially recognise that the trauma patient requires transfer to a MTS[66,67]
- communication difficulties between the referring hospital, the transport / retrieval service and the MTS[68,69]
- administrative issues[67]
- inadequate patient preparation prior to the arrival of the transport / retrieval team[70,71,62]

Some studies have demonstrated significant reductions in transfer times as a result of the institution of administrative policies or triage guidelines that have simplified and streamlined the decision making process[73,74]. This section of the document aims to assist in streamlining the process of trauma transfer and reducing the time to definitive care, thus potentially improving the standard of patient care and patient outcome.

COMMUNICATION WITH THE MTS

Question: When and how should the referring doctor contact the MTS ?

Once it is established that a patient potentially requires inter-hospital transfer it is essential that this assessment is promptly communicated to both the MTS and the transport / retrieval service. The SWS Regional Trauma Registry 1995/1999 report[37] and a review of the current status of inter-hospital trauma transfer in the SWSAHS[69] indicates that there is currently a significant delay in transferring trauma patients within the region. These findings have been supported in other studies, with delays reportedly occurring in between 20-33% of transfers[17,67]. It would appear that up to 60% of the time delay relating to inter-hospital trauma transfer is related to the time taken to notify the retrieval team, accounting for in excess of three hours in some cases[69].

The establishment of a dedicated telephone “Hotline” has been found to facilitate communication and increase staff satisfaction with the transfer process[15,36,55,75]. Published evaluation of our Trauma Hotline between September 1997 and February 1999 indicated that there were 161 trauma hotline calls[36]. 47% of calls directly activated an inter-hospital trauma transfer, 17% were consultations not resulting in transfer, 22% were retrieval services communication via the hotline, 9% were repeated calls on trauma transfer and 5% were other unrelated calls. We have identified that a single call is required by the referring doctor in 67%, and 75% of referring doctors were exceptionally satisfied with the hotline system.

Establishing communication with the MTS / retrieval service not only serves to initiate the retrieval process but also facilitates contact with trauma experts that can provide practical advice in terms of patient management and suitability for transfer[15,36, 63,75].

GUIDELINES

The medical officer at the urban or rural hospital should notify the MTS of the arrival of a patient meeting trauma transfer criteria. This notification should be via the Trauma Hotline as soon as possible, but preferably within 20 minutes of patient arrival.

A dedicated "Hotline" number should always be used to allow staff from referring hospitals to communicate directly with a member of the trauma team at the trauma service for all patients who potentially require High Dependency or Intensive Care admission.

PERFORMANCE INDICATORS

- Activation of the trauma hotline occurs within 20 minutes of the arrival of the trauma patient at the urban or rural hospital.

- The trauma hotline (9828 3666) is used to arrange the transfer of all trauma patients requiring intensive care / high dependency admission.

SCIENTIFIC FOUNDATION

FINDING	REFERENCE	LEVEL OF EVIDENCE
RECOGNITION OF NEED FOR TRANSFER		
There is a general trend towards the more timely transport of patients with lower survival probabilities.	33	III-3
Community hospitals are able to expedite the transfers of pediatric trauma patients and so should be able to reduce the time taken for adult transfers.	73	IV
Injured children were referred to trauma centres more quickly than those aged > 16 years. Patients with more significant injuries (as evidenced by trauma scores, ISS etc) were not transported sooner than those with less severe injuries.	76	IV
FREQUENCY OF DELAYS		
Delay was involved in 20% of transfers (33% of appropriate transfers)	17	IV
4/93 hospitals reported that there were almost always delays, 18/93 reported delays as being common & 71/93 rarely experienced delays in transfer.	67	IV
The median interval in ED prior to transfer was 1 hour 43 minutes (IQR – 1 hour 11 mins. – 2 hours 40 mins.).	77	IV
There is often a lengthy period between the arrival of a trauma patient at a rural ED and notification of the trauma centre. There is no objective reason as to why these delays occur.	76	IV
CAUSES OF DELAYS		
Most avoidable delay in the transfer process occurs at the referral hospital level.	66	IV
Harmful avoidable delays occurred as a result of either failure to institute appropriate treatment for extra-cranial injuries or from a failure to realise that transfer was necessary.	66	IV
Delays in inter-hospital transfer occur for a variety of reasons including administrative, transport / equipment related and due to the patient's condition.	67	IV
The mean time to definitive care for retrieval team transfers was 297 minutes. The majority of this delay was observed in contacting the team by the referral hospital. The mean time to call the retrieval team was 194 minutes.	69	IV

EFFECTS OF DELAYS		
Patients with major trauma taken directly to a trauma centre had shorter hospital and ICU stays and lower mortality than those seen at other hospitals and subsequently referred. Although there is no significant difference in overall mortality in patients who survived > 48 hours it is possible that potentially salvageable patients died before they could be transferred. 62% of deaths in the transferred group had PS < 0.5, as opposed to only 22% of deaths in the direct admission group. No specific group of injuries could be identified that had a more specific benefit of direct transport to a trauma centre.	31	III-3
The effect of delay in obtaining definitive treatment at a tertiary centre upon survival in patients with blunt trauma is uncertain, but not shown in this study to be statistically significant.	33	III-3
The patients transported from the scene compared to those referred from other hospitals were similar in terms of demographics, injury severity, hospital LOS, & crude mortality. The scene transfers were marginally younger and had a lower PS. There was a significant difference in time to definitive care (34.2 mins. vs 196.2 mins., p<0.001), overall complication rate (39.1% vs 57.6%, p=0.009) and potentially preventable deaths (PS > 0.5, 11.6% vs 44%, p=0.02) in favor of the direct transfer group.	38	III-2
Severely injured patients should be transported to tertiary trauma centres direct from the scene without treatment or attempts at stabilisation at other facilities.	48	III-2
Survival rates decreased with increasing injury severity. There was no difference in survival between patients transferred in and those admitted directly to the tertiary hospital.	50	IV
Patient survival following inter-hospital transfer was no different to those who were admitted directly to a trauma centre	51	IV
INTER-HOSPITAL COMMUNICATION		
As a result of the low numbers of trauma cases encountered at some hospitals there is a difficulty in educating staff regarding appropriate stabilisation and transport criteria. To overcome this the authors propose to introduce a trauma hotline to facilitate contact with trauma specialists.	55	IV
Good communication with the receiving hospital can facilitate the mobilisation of teams to reduce delays in treatment post-transfer.	66	IV
Inter-hospital communication must be improved.	68	IV
The mean time to definitive care for retrieval team transfers was 297 minutes. The majority of this delay was observed in contacting the team by the referral hospital. The mean time to call the retrieval team was 194 minutes.	69	IV
The presence of a roster system designating the receiving institution significantly streamlines the transfer process.	73	IV
The presence of a roster system designating the receiving institution significantly streamlines the transfer process.	73	IV
Implementation of the American College of Surgeons criteria has the early beneficial effect of increasing transfers of seriously head injured patients and improving survival in the most seriously injured group. This improvement is most probably related to streamlining and expediting the transfer process.	74	III-3
Teleradiology is an effective means of communicating with the accepting neurosurgical team, although it requires the availability of a scanner and qualified staff at the referral hospital.	78	III-2
Improvements in the standard of care as compared to previous studies have been the result of continuing medical education, including Advanced trauma life support courses, & establishment of clear lines of communication between referral centres and the neurosurgical department.	79	IV
Developing clinical and administrative partnerships between level II and level I EDs altered transfer patterns between the two hospitals	80	IV

MODE OF TRANSPORTATION

Question: How does the trauma patient get transported to the MTS ?

Whilst helicopter transportation has been demonstrated to be far quicker than road transport[81], the higher costs of air travel are reportedly outweighed by the significant time savings in this mode of transport[51,82]. The benefit of air transport is reportedly related to the severity of the injury and demonstrated by some studies only in patients with a probability of survival of < 90%[59,81] or when injured in rural or remote areas[82,83,84]. Other authors reported no significant differences in survival with helicopter transport[85,86,87]. Therefore, despite the apparent benefits of helicopter transportation, the types of patients whom it would benefit are still to be determined[88].

Ultimately, the geographical location of the patient, the perceived acuity of their condition, the ability of the referral hospital to provide satisfactory management of life-threatening injuries and the resources of the local retrieval system all impact upon the mode of transport utilised in each case. The mode of transport will need to be chosen on a case by case basis, working on a time frame to definitive care.

GUIDELINE

Trauma transfers should be carried out in a manner which transports the patient to a location where definitive management can be instituted as soon as practical. The following times are recommended for the Retrieval team in SWSAHS;

- Response time ≤ 10 minutes
- Scene time ≤ 30 minutes
- Transport time ≤ 30 minutes

PERFORMANCE INDICATORS

- The time interval between time of calling the retrieval team to time of departure of the retrieval team from their base (*response time*) is ≤ 10 minutes.

- The time of arrival of the medical retrieval team at the referring hospital to the time of leaving the referring hospital (*scene time*) is ≤ 30 minutes.

- The interval between leaving the referring hospital to arriving at the MTS (*transport time*) is ≤ 30 minutes.

SCIENTIFIC FOUNDATION

FINDING	REFERENCE	LEVEL OF EVIDENCE
SUPPORTING HELICOPTER USE		
Major trauma patients are better transported by air when evaluated by TRISS. The benefit of air transport was directly related to the severity of the injury and demonstrated only in patients with a probability of survival of <90%.	81	III-2
Air transport decreased transport time by 51 min. (equivalent distances were traveled).	81	III-2
Mortality analysis of patients with ISS ≥ 25 and penetrating trauma showed a marked, but not statistically significant, decrease in mortality associated with air transport. The air transported patients in this sub-group had a mortality of 28.1% whilst the ground transported patients had a mortality of 45%. The relative mortality risk was 1.6 (95% confidence interval 0.77-3.34)(p=0.244). The study had a power of only 22% to detect a difference at this magnitude.	89	III-2
There was a strong statistical correlation between the intensity of medial services required, TISS scores and appropriate use of helicopter transport.	90	IV
The higher costs of air travel were outweighed by the significant time savings in this	51	IV

mode of transport.		
Severely injured patients need to be transported expeditiously to experienced trauma care facilities. Air transportation makes this possible.	59	IV
AGAINST HELICOPTER USE		
There was no improvement in outcomes in patients who were transported by helicopter, as compared to those transported by ground.	85	III-2
There is no survival advantage in helicopter transportation of patients in an urban area with a sophisticated prehospital system.	86	III-2
Analysis of the cost per mile of fixed-wing versus helicopter transport indicates that the true helicopter costs were 400% higher than the true costs of fixed wing aircraft & associated road ambulances. There is no statistical difference in patient outcomes using fixed or rotary wing aircraft.	87	III-2

PATIENT PREPARATION

Question: How can the trauma patient be best prepared for transfer to reduce delays when the retrieval team arrive ?

Thorough preparation of the trauma patient is essential prior to inter-hospital transfer to minimise the occurrence of complications secondary to missed or inadequately treated injury[91]. Whilst the transfer of patients may delay other surgical priorities, failure to investigate and treat significant injuries prior to transfer significantly increases the patients' morbidity and mortality[57,92,93,94]. The practice of hurriedly transferring unstable patients to MTSs continues, when urban hospitals have the ability to provide basic treatment for life-threatening injuries[94]. The most commonly reported inadequacies in patient preparation are inadequate volume resuscitation, airway stabilisation and ventilation[17,56,57,92,93].

Some patients (Category 7) will have been transported to an urban or rural hospital as they are thought to have been too ill to survive the initial journey to the MTS[35]. Additionally, patients with injuries not initially thought to have been severe enough to warrant immediate transport to a MTS may become more unstable and require emergency intervention. Prior to transport it is advisable for all trauma patients to be assessed by the Surgeon on call to optimise their stability during transfer and evaluate the need for immediate surgical intervention.

Inadequate patient preparation also serves to extend ground and, subsequently, transport times as retrieval teams are required to perform procedures to enhance patient stability[70,72]. In one study it was reported that 64% of trauma patients required interventions by the retrieval team prior to transfer[72]. The need for minor interventions increased ground time by 21% to 37.8 minutes and when major interventions were required ground time increased by 84% to 57.4 mins. ($p<0.01$)[72].

It is important to acknowledge, however, that the process of investigation, stabilisation and preparation for transfer are all limited by the available resources and practitioner experience at the urban / rural hospital and the need to expeditiously transport the patient to a location where definitive management can be achieved. Therefore, careful evaluation of priorities needs to occur to assess the best practice in each case. The implementation of the N.E.W.S. checklist can assist in streamlining the preparation of the trauma patient for safe transfer[95].

GUIDELINES

Prior to transfer the patients' airway, breathing and circulation should be stabilised. All significant haemorrhage must be controlled. A haemodynamically unstable patient with known intra-abdominal injury should have the bleeding controlled prior to transfer.

The Intensive Care Registrar from the MTS or medical doctor from the retrieval team should advise the referring hospital regarding patient management and preparation for transfer using the established processes. In SWSAHS the N.E.W.S. system is to be utilised.

Attempts should be made to thoroughly assess the patient prior to transfer to determine the full extent of their injuries. All patients identified as requiring interhospital trauma transfer should be seen by the Consultant Surgeon or Surgical Registrar prior to leaving the primary hospital.

PERFORMANCE INDICATORS

- Upon the arrival of the retrieval team patients will have been prepared for transfer as per the advice of the MTS / retrieval service and using the N.E.W.S. system.

- Transferred patients will have all life-threatening injuries identified and controlled prior to transfer.

- Transferred inter-hospital trauma patients should all have been reviewed by the surgical on call specialist or registrar at the urban or rural hospital.

SCIENTIFIC FOUNDATION

FINDING	REFERENCE	LEVEL OF EVIDENCE
AVERAGE TIMES FOR RETRIEVAL TEAM		
Ambulance transport was associated with the longest time (mean 330 mins) compared to paramedic (mean 254 mins; p< 0.001) and medical retrieval (mean 251 mins; p <0.001). There was no significant difference between paramedic and medical retrieval.	69	IV
The average time spent at the referral hospital was 1 hour 40 minutes (range 30 mins. – 4 hours 15 mins.)	71	IV
FAILURE TO STABILISE PATIENT PRIOR TO TRANSFER		
Transfer of patients may delay other surgical priorities.	57	IV
Thorough preparation of the critically ill patient is essential prior to inter-hospital transfer.	91	IV
Failure to investigate and treat significant injuries prior to transfer increases the morbidity and mortality rates of trauma patients.	94	IV
The practice of hurriedly transferring unstable patients to trauma centres continues when "community" hospitals have the ability to treat extracranial injuries.	94	IV
MISSED INJURIES / INADEQUATE MANAGEMENT		
29% of patients had inadequately diagnosed / managed injuries on arrival	56	IV
Inadequate assessment of patients prior to transport leads to missed injuries and inadequate management.	57	IV
Failure to investigate and treat significant injuries prior to transfer increases the morbidity and mortality rates of trauma patients.	94	IV

EDUCATION / TRAINING IN REFERAL HOSPITALS

Question: How can we ensure optimum standards of care from referral hospitals ?

The evidence suggests that a strong association exists between MTS volume and patient outcomes[24,26,34,40,42,43].There are significant improvements in mortality and length of stay when the MTS volume exceeds 650 cases per year, especially in patients at high risk of adverse outcomes[26]. This assertion has, however, not been fully supported in terms of specific practitioners' caseloads and outcomes[42,96]. Whilst the implementation of the trauma bypass system[34] has had the beneficial effect of transporting severely injured patients to definitive treatment sooner, it has subsequently reduced the volume of trauma cases seen in urban and rural Emergency Departments. It is difficult, therefore, to maintain standards of education, training and competency in advanced procedures within the urban and rural environments[55]. The area of education / training is particularly poignant as it is the urban and rural Emergency Departments that are going to encounter either those patients who are too sick to bypass to the MTS or those who have severe injuries that were initially missed in prehospital triage[40].

In addition to providing advice in specific cases, the MTS has a responsibility to provide opportunities for continuing education to develop and maintain the skills of those practicing in urban or rural areas. The development of these better practice guidelines serves to complement regular trauma education and evaluation programs. The provision of such education is especially challenging, however, considering the frequency of medical rotation through the specialty areas involved in trauma care.

GUIDELINES

The MTS will provide a minimum of one formal multidisciplinary trauma education session in each urban / rural hospital every six months.

All new registrars and senior registrars at the MTS who accept the care of trauma patients must have attended a trauma education and orientation program within one week of commencing their term.

PERFORMANCE INDICATORS

- The MTS will provide a minimum of one education session for urban and rural hospitals every six months.

- All ICU, surgical and emergency registrars must undergo an education and orientation program clarifying their role in trauma care before commencing duty at their respective hospitals.

SCIENTIFIC FOUNDATION

FINDING	REFERENCE	LEVEL OF EVIDENCE
Increased per-Surgeon experience in the treatment of severe trauma (ISS ≥ 13 or AIS ≥ 3 head injury) is associated with improved outcomes.	42	III-2
A strong association exists between trauma centre volume and outcomes. There is significant improvements in mortality and LOS when volume exceeds 650 cases per year. These benefits are only evident in patients at high risk of adverse outcomes.	26	IV

COMPOSITION OF THE RETRIEVAL TEAM

Question: Who is responsible for transporting trauma patients between hospitals ?

The high acuity of many trauma transfer patients requires medical staff with adequate training in anaesthetics / intensive care (inotropic support, airway management & mechanical ventilation) who can undertake advanced procedures both prior to and during transportation[58,91]. Whilst nurses and paramedics have been reported in the literature to be able to undertake a range of advanced procedures[88,97,98], Baxt & Moody[23] demonstrated that they had a significantly lower success rate and ability to strictly follow protocols / procedures when compared to teams that included medical practitioners. The selection of patients suitable for transfer using paramedic, as opposed to a medical retrieval crew, therefore, needs to be undertaken carefully following clearly established triage practices. Given the relative shortage of paramedics in the distant sectors of SWSAHS, most complex retrievals in this region will require the utilisation of the medical retrieval team.

International literature reports a significant incidence of adverse events or inadequate standards of care occurring during the process of interhospital transport[56, 57, 68,71, 79, 85, 92,93,99], with some suggestion that the occurrence of adverse incidents is correlated with poorer patient outcomes[78]. Only one study reported that the majority of transfers were safely carried out[55]. In their Australian study, Deane, Gaundry, Woods, Read & McNeil[17] also reported finding significant deficits in clinical management. Whilst the international experience may not truly reflect the Australian conditions the current paucity of local literature precludes further analysis at this time.

There is generally a lack of experienced staff based at urban and rural hospitals to accompany the trauma patient during interhospital transfer[100]. Staff accompanying patients during transport need to undergo additional education and regular training to ensure currency in procedures and situations that they may encounter during the transport process[100]. Even where a clinician with such skills is available locally, it is often not reasonable to deplete the urban or rural hospital of this individual for the duration of the transfer. Therefore, a central retrieval team is a practical option for the interhospital transfer of trauma patients and should be integrated within a MTS. Such a system provides the combination of experienced and trained staff to facilitate optimal transfer practice and ensure a high standard of care[101].

GUIDELINE

All patients requiring invasive procedures prior to or during transport, particularly airway management, must be transferred using a medical retrieval team.

PERFORMANCE INDICATOR

- All patients requiring airway management or advanced procedures were transported to the MTS using a medical retrieval service.

SCIENTIFIC FOUNDATION

FINDING	REFERENCE	LEVEL OF EVIDENCE
ACUITY OF PATIENTS BEING TRANSFERRED		
The high acuity of patients requires medical staff with adequate training in intensive care (inotropic support, airway management & ventilation).	58	IV
13% of patients required at least one major procedure prior to transport (n=40). 8% required in-transport major procedures (n=25).	70	IV
Experienced staff are vital in terms of inter-hospital transfer in terms of the expertise of treatment strategies and monitoring ability.	91	IV
TRANSFERS WERE UNDERTAKEN SAFELY		
The majority of trauma transfers were safely carried out.	55	IV
ADVERSE EVENTS DURING TRANSFER		
Significant deficits in clinical management were encountered during transfer	17	IV
8% of patients transported by the primary aeromedical team had adverse events occur during transport, whilst only 5 patients transported by road suffered adverse events.	85	III-2
Head injured patients who sustained secondary insults during transfer generally had a poorer outcome after six months.	78	III-2
The number of adverse incidents was directly correlated to the education & training of the transport team. More experienced teams produced significant reductions in the number of adverse events during transport.	102	III-2
Inadequate preparation of patients (e.g. securing airway) and monitoring during transport have been identified as significant occurrences, although there effect on patient outcomes was not determined. 11 patients were transferred without an ETT. 6 of these had no monitoring despite the fact that 5 were in a coma prior to transfer. 3 of these patients had no medical escort & 7 had inadequate IV access.	56	IV
3 / 204 patients suffered adverse events during transfer related to the transport process itself.	71	IV
68/150 (45%) patients transferred to a neurosurgical unit had either a single untoward incident or inadequately treated extracranial injury on arrival. Major deficits involved untreated hypotension & poor airway management.	93	IV
32 patients had adverse incidents before reaching the neurosurgical unit. 20/82 (24%) patients with multiple injuries had them poorly managed. Major deficits involved untreated hypotension & poor airway management.	92	IV
Whilst no significant injuries were missed the protection or exclusion of injuries fell well below Advanced trauma life support guidelines.	79	IV
25 patients encountered problems during transfer, this does not well reflect the picture obtained from vital signs at the trauma centre and may reflect inadequate monitoring. The incidence of problems was not related to the grade of accompanying doctor. Transfer problems included; cardiovascular instability – 10, inadequate sedation / agitation – 5, airway / breathing difficulties – 4, equipment malfunction – 4.	79	IV
9/21 cases were insufficiently assessed, there were 7 major missed injuries (Unstable C5/6 # / quadriplegia, Le Fort II facial #, liver laceration, Open book pelvis #, external rotation pelvic ring injury, vertical shear unstable pelvis #, complete brachial plexus lesion with 1st rib # & haemothorax). IV fluids were delivered by a single line in 11 cases, 2 lines in 2 patients and was absent in 8 patients. 4 developed hypovolaemic shock during transfer. 5 cases were inadequately resuscitated.	57	IV
Major departures in accepted standards of care were evident in 80% of patients transferred. Transporting staff had inadequate training for the care that was required by the patient.	68	IV

STAFF USED TO TRANSFER PATIENTS		
Of the 239 patients treated by the Nurse / paramedic crew there were 4 instances where they could not place an IVC, 6 failed tracheal intubations, 2 instances of unrecognised oesophageal intubation and 3 instances of failure to insert a needle or tube thoracostomy. Of the 305 patients treated by the Dr / Nurse crew there was 1 failed intubation and 1 failure to insert a needle or tube thoracostomy. (Prehospital transport) Of the 19 patients who died in the nurse / paramedic group there were 9 instances where protocol was not followed or where procedures were unsuccessful (2 – insufficient IV fluid, 1 - oesophageal intubation, 1 - inability to intubate, 1 – failure to intubate when clinically indicated, 2 – failing to administer Mannitol when indicated, 4 – not placing a needle or tube thoracostomy when indicated). Of the 11 patients who died in the nurse / Dr crew group there were no instances when protocol was not followed or procedures unsuccessfully performed. The difference in predicted and actual mortality between the paramedic / nurse crew and the nurse / Dr crew was statistically significant ($p<0.05$).	23	III-1
In 33% of transfers the Dr escort was a Senior House Officer with < 6 months experience in anaesthetics.	79	IV
There is no significant difference in patient morbidity / mortality or transportation duration between crews of 2 dual-licenced RN / paramedics or 1dual licenced RN / paramedic and 1 licenced paramedic.	97	IV
Flight nurses are capable of performing advanced life support procedures similar to those performed by flight Drs.	98	IV
There is a lack of experienced staff to accompany the patient on transfer. Additional education needs to be provided for / undertaken by staff accompanying patients during transport.	100	IV
A central retrieval team is a practical option for the interhospital transfer of trauma patients and should be integrated within a trauma centre. Such a system provides a combination of experienced and trained staff to facilitate optimal transfer practice.	101	IV

Appendix A.
Terms of Reference of the Injury Advisory Committee

AIMS:

1. To prevent and reduce the incidence of injury in the people of South Western Sydney

2. To improve treatment, rehabilitation and outcome in injury victims in South West Sydney.

PURPOSE:

The Injury Advisory Committee has been established to provide South Western Area Health Service with advice regarding the means by which injury can be prevented and the impact of injury on the people of South West Sydney can be minimised when it occurs and where appropriate, to initiate and co-ordinate action based upon this advice.

TERMS OF REFERENCE:

1. To identify the key issues in injury that need to be addressed in South Western Sydney Area Health Service.
2. To advise and act upon South Western Sydney Area Health Service wide population strategies for injury prevention.
3. To advise on provision of information to patients, carers and other stakeholders regarding service availability.
4. To advise and act upon strategies to develop injury services to meet the needs of South Western Sydney residents.
5. To advise and act upon strategies to achieve increased equity of access for all injured persons in South Western Sydney.
6. To advise and act upon strategies to improve continuity of care and ensure appropriate planning, management and co-ordination of services, including working and consulting with other advisory groups on issues of mutual concern. Create a corporate culture that will foster the provision of a co-ordinated injury service.
7. To identify and promote current evidence based best practice in injury and to provide the highest quality standards and advice and act upon strategies to ensure uptake of this practice.
8. To advise and develop appropriate performance indicators for injury**.**
9. To develop a comprehensive injury profile for South Western Sydney.
10. To advise strategies on research priorities in injury.
11. To identify opportunities and advise on strategies to promote South Western Sydney Area Health Service Injury Services to other Health Service Areas.

MEMBERSHIP:

Membership will be multidisciplinary and drawn from sectors across the South Western Sydney Area Health Service so as to provide an appropriate balance of expertise and sector representation, and will include community representation.

REPORTING AND MECHANISM:

Advice and six monthly reporting of progress with health outcome indicators is given through a member of the Area Executive to the Health Priorities and Outcomes Committee and will be reported annually to QOC. Minutes to have specific action and time frame.

Membership of the Injury Advisory Committee

Ms Kathy Bowie	**NUM Emergency Nursing**	**Bowral Hospital**
Ms Erica Caldwell	**Trauma Data Manager**	**Liverpool Hospital**
Dr David Conforti	**Director of Rehabilitation**	**Liverpool Hospital**
Ms Anne-Louise Gray	**Senior Project Officer Area Services**	**Liverpool Hospital**
Dr David Hugelmeyer	**Director, Emergency**	**Campbelltown Hospital**
Ms Jenny Jacka	**Service Co-Ordinator Physiotherapy**	**Bankstown Hospital**
Ms Lisa Kremmer	**Nursing Unit Manager**	**Campbelltown Hospital**
Mr Rick Kruit	**Resources Manager**	**Ambulance Service Of NSW**
Dr Charles Pain	**Area Director of Medical & Clinical Services**	**Liverpool Hospital**
Dr Michael Sugrue	**Director, Trauma Services**	**Liverpool Hospital**
Ms Daena Wilson	**Service Co-Ordinator Occupational Therapy**	**Bankstown Hospital**
Ms Mandy Williams	**Director Health Promotion**	**Liverpool Hospital**
Mr Jeff Woods	**Operations Manager**	**Ambulance Service Of NSW**
Dr Peter Wyllie	**Staff Specialist Emergency Department**	**Liverpool Hospital**
	Director Emergency Department	**Fairfield Hospital**

Appendix B.

List of Submissions Received

1. *Ms Erica Caldwell* – Trauma Data Manager, Liverpool Trauma Department
2. *Dr John Crozier* – Vascular Surgeon, Liverpool Hospital
3. *Dr Keith Edwards* – Emergency Physician Liverpool and Fairfield Hospitals
4. *Dr Arthas Flabouris* – ICU Staff Specialist Liverpool Hospital / CareFlight
5. *Dr Alan Garner* – Emergency Physician, Nepean Hospital****
6. *Dr Kerry Goulston* MD, FRACP - ***
7. *Dr Sue Ieraci* – S.W.S.A.H.S. Area Advisor in Emergency Medicine
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