SECTION 6

DEFINITIVE CARE

SECTION 6

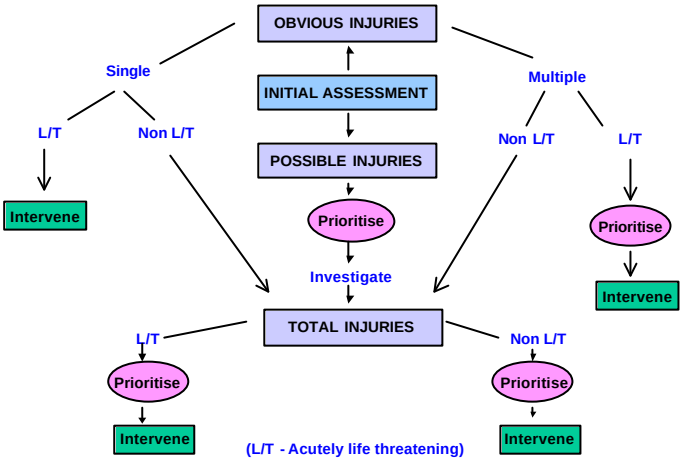
DEFINITIVE CARE (continued)

INTRODUCTION

Trauma patients require minimisation of:
1. Hypoxia
2. General hypoperfusion
3. Regional hypoperfusion (extremity / organ ischaemia)
4. Internal leakage of secretions.

These adverse events determine the occurrence and magnitude of:
1. MOF (SIRS, MODS)
2. Sepsis
3. Secondary brain injury
4. Death.

Understanding the cellular events is central to determining the priorities and strategies in both the “first hour” (initial assessment) and in the “second hour” (early definitive care). This “second hour” requires very strong surgical direction and coordination.



SECTION 6

The above figure attempts to highlight some of the complexity of decision making in trauma care. The algorithm begins with “initial assessment”. Major decisions are required at each point highlighted by the words “prioritise” or “intervene”.

HOW TO MAKE DECISIONS BASED ON LIMITED INFORMATION

Decision making in trauma care is largely determined, at the clinical level, by:

Pattern recognition
Protocols
Probabilities

The probabilities include the:

- Probability of a particular injury being present.
- Probability of an adverse outcome occurring from that injury.
- Probabilities within a range of severities for each possible adverse outcome.

Despite the many variables which have an impact on our clinical decisions, the foundations for those decisions need to be supported by:

- Evidence.
- Protocols.
- Education.
- Supervised Experience.
- Clinical Review.

Evidence helps us construct or calculate the **PROBABILITIES**.

Good **PROTOCOLS** express both the evidence and the experience of experts.

Education should, wherever possible, be based on sound evidence and will often be expressed through **PROTOCOLS**.

Supervised experience and **clinical review** lead to **PATTERN RECOGNITION** which can become a most powerful positive influence on decision making.

The passage and consumption of TIME is of great significance. A patient's early outcome is usually determined by the **physiological** consequences of injuries rather than the **anatomic** disruption of the injury itself.

Thinking of the patient in terms of physiological risk may help us to set better priorities and effect more rapid treatment.

REMEMBER: A good trauma care system minimises time from injury to definitive care!

GOALS IN THE SECOND HOUR

The goals in the "second hour" can be summarised in the following list which is ranked from highest to lowest priority:

- Prevent early death.
- Minimise late MOF (MODS).
- Minimise late sepsis.
- Minimise long term disability.
- Minimise short term disability / complications.
- Minimise length of stay.

This requires a mental focus on cellular pathophysiology as indicated above.

To treat the patient, treat the cells!
Check blood gases and lactate.

PRIORITIES IN THE SECOND HOUR

If the above goals and the ranking of those goals are generally agreed, they can be expressed as a set of practical priorities as follows (ranked from highest to lowest priorities):

- Airway maintenance.
- Breathing – optimising oxygenation and ventilation.
- Perfusion – general.
- Raised ICP.
- Perfusion – regional.
- Contamination / sepsis.
- Crushed, contused, ischaemic wounds.
- Fracture stabilisation.

None of the above items are unimportant and a number may co-exist within the same region of injury.

Airway
In most situations, this will be corrected in the "first hour". Airway risks in the "second hour" relate to:
(a) Problems with an unprotected airway (glottic oedema, aspiration of blood and vomitus).
(b) Displacement or occlusion of artificial airways.

Breathing
On most occasions, this has also been corrected in the "first hour". It particularly becomes an issue in the "second hour" when:
(a) There is a massive air leak, which may require a thoracotomy.
(b) There is an increasing requirement for respiratory support (e.g. major flail with pulmonary contusion).

Perfusion - general
This is usually a problem of inadequate blood volume and relates to active bleeding. There are five principal areas of bleeding, all of which should have been identified in the "first hour":
1. External. While temporary control may have been achieved during "initial assessment", definitive control may be a significant issue to be addressed among the priorities in "definitive care".
2. Chest – significant continuing bleeding may require thoracotomy.
3. Abdomen.
4. Pelvis.
5. Long bones - these should have at least been splinted in the "first hour".

In the situation of massive bleeding, and when it is not possible to perform simultaneous surgery in multiple body regions, it will most often be appropriate for massive intrathoracic bleeding to take priority over major intra-abdominal bleeding and for both of these to take priority over pelvic bleeding.

In the Australian situation, general hypoperfusion (shock) as a consequence of primary cardiac dysfunction is unusual. Pericardial tamponade is infrequent where penetrating trauma rates are low.

Significant myocardial contusion is rare and does not correlate with the vast majority of sternal fractures which predominantly occur in the older members of the community. Myocardial infarction needs to be considered as a possible cause of the injury event or as a possible consequence of shock.

Raised ICP

Only after thoroughly attending to the issues of airway, breathing and general perfusion, should we be directing attention to intracranial strategies. The three principal strategies available to us in the "second hour" are:

1. CT scan.
2. Intracranial pressure monitoring.
3. Craniotomy.

Neurosurgical involvement and input is critical toward prioritising head injury interventions.

Perfusion - Regional

Regional ischaemia most commonly relates to the upper and lower extremities. Early diagnosis and confirmation of ischaemia should have been achieved within the "first hour". Benefits from traction and splintage should also have been achieved within the "first hour".

The issues for the "second hour" relate to:

- early restoration of blood flow
- early fasciotomy.

Particular emphasis needs to be given to restoring regional perfusion in order to minimise late MOF.

Regional ischaemia should be corrected inside six hours from the time to injury - that means a plan must be in place within the first hour!

Contamination / Sepsis
Knowledge of bacterial proliferation rates in wounds, combined with increasing understanding of the release and adverse effects of toxic inflammatory mediators, support the following.

Control of contamination should be achieved within 3 - 4 hours from the time of injury!

Debridement of major wounds should occur within 6 hours from the time of injury!

Surgeons wishing to minimise the chance of late multiple organ failure and late sepsis need to be "**watching the clock"** while they proceed with appropriate interventions to control bleeding, restore general and local perfusion, control contamination, and debride major wounds.

REMEMBER: The clock started ticking at the time of injury!

Crushed, contused, ischaemic wounds
The principles are much the same as those discussed in relation to the previous two priorities.

Fracture Stabilisation
While this may appear low down the list of urgent priorities, it is often a mistake to simply regard this as an anatomic exercise. Displaced and unstabilised fractures may have significant early adverse physiological features especially relating to continuing bleeding, regional ischaemia, and continuing soft tissue laceration and contusion.

Nature Of Decisions

Decisions are bases on chances, not certainties!

The above statement relates to therapeutic interventions in trauma care. It is an aspect of significant difference between decision making in trauma care and decision making in much of the rest of medical practice. This is the nature of triage – a statistical exercise to maximise the numbers of good outcomes. As more clinical data are accumulated with the passage of time, the performance of repeated clinical evaluations, and the performance of investigations, the relative contributions of probabilities and certainties to the making of clinical decisions change. However, the surgeon and the management team are often far advanced down the definitive care pathway before a situation can be reached where there is a high level of certainty about a patient's overall status and total list of injuries.

Making decisions is more important than making diagnoses!

Signals are an important feature of the differentiation of trauma management from some other aspects of the practice of medicine. Examples of this probability-based paradigm are as follows:

1. A widened mediastinum denotes a ruptured thoracic aorta.
2. Blood at the urethral meatus denotes a ruptured urethra.
3. Gross haematuria in the presence of a fractured pelvis denotes bladder rupture.
4. A central retroperitoneal haematoma denotes major vascular injury.
5. Differential pulse pressures between two limbs denotes a vascular injury.
6. Localised peritoneal signs denotes a bowel injury.

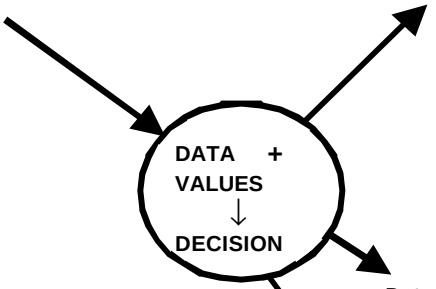
Each statement of this nature has a sequence of mathematical probabilities attached to it. Our current difficulty is that we do not have reliable indications of the magnitude of most of these probabilities. Hence, our decisions can lie along a spectrum – at one end is a type of "clinical judgement" which is little better than an idiosyncratic response; at the other end are versions of protocols which are promoted as inflexible dogmas. Our difficulty, and particularly so in Australia, is that for "clinical judgement" to be the expression of a well developed fabric of "pattern recognition" requires many years of experience. The process can probably be advanced by concentrated periods of exposure to experts in the context of high volume case management or case scenario discussion; it can also be greatly assisted by robust clinical review with peers. This is the context which best justifies a weekly trauma audit meeting.

Pattern of errors in trauma care

Not only do we need to know patterns of disease, we need to know patterns of errors in care delivery.

The ability to recognise patterns of injury as well as patterns of error can lead towards better decision-making.

CRITICAL DECISION NODES



Examples
Treat or not
Investigate or operate
Investigation options
Operation options
Operate or not
Reconstruct or not

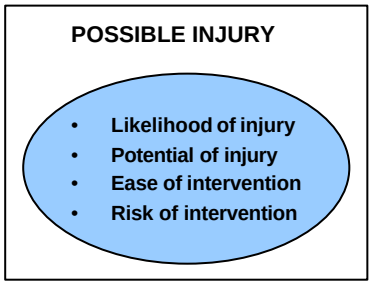
Data
Knowledge
Experience
Protocols
Patient
Resources

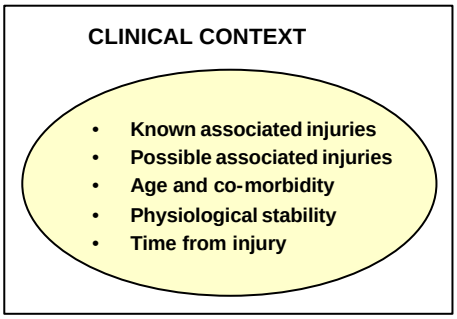
Our discussion has already indicated many points in trauma patient management where a decision needs to be made and a choice of decisions is available. The use of the term "**critical decision nodes**" is helpful to our thinking and to our leadership of trauma teams in "the second hour". They often involve competing priorities of possible or probable injuries in different body regions. It may be that more than one potential decision pathway will lead to a satisfactory outcome but the choice of the pathway, the strategic direction, and the assessment of progress requires great clinical maturity and a firm commitment to understanding the clinical priorities across multiple surgical and non-surgical disciplines. The above figure lists some general examples of the pivotal questions at some of these critical decision nodes. Also indicated above are some of the categories of data which will influence the selection of the pathway from among the available choices.

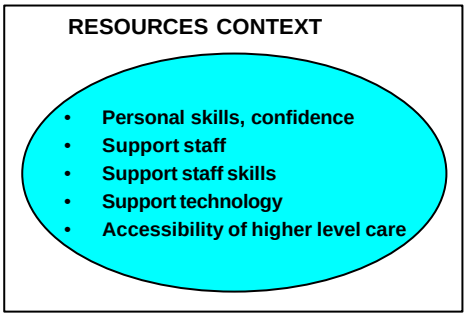
Because of the number of variables involved, the sharp differences between available options, and the lack of probability data, these critical decision nodes often cannot be codified with sufficient clarity to enable the construction of clear guidelines or protocols.

COMBINING THE CLINICAL VARIABLES

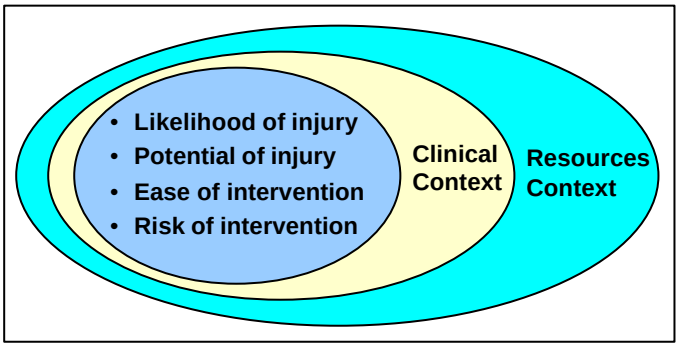
Let us reconsider the variables which we may need to address for any one particular injury, in an effort to answer the most generic question "what should be done?"







The complexity of the decision making can then be represented as follows:



In reality, there are **multiple** potential injuries being evaluated within the same clinical context and resources context. When multiple interventions are required, a new level of complexity enters the decision making.

LEADERSHIP

When decisions need to be made regarding multi-specialty interventions, the decisions need to be agreed among a number of "leaders", or a style of leadership needs to have been previously agreed where one designated surgical leader orchestrates the multi-specialty performance. The added complexity can readily expose a poorly organised surgical trauma care system, differing perceptions of relative risks of different injuries, and differing personalities and ego strengths.

It is the recognition of these levels of complexity which particularly justify senior clinical leadership (with **pattern recognition** skills), attempts to pass on the **pattern recognition** in education programs, the need for sophisticated research with extensive trauma registry data (and controlled trials where possible) to further elucidate the **probabilities**, and the importance of appropriate **protocols.**

Pattern Recognition
Probabilities
Protocols!

The levels through which our thinking needs to escalate while making these trauma care decisions can be further summarised in the following diagram:

PERSONALITIES AND VALUES

Strategic errors may be independent of particular injuries, the clinical context or the resources context. They may relate to the surgeon within a personal, professional and ethical context.

1. **Patient Value**

   Examples:

- Children - fear of the intellectual consequences of brain injury can perversely elevate the importance of a head CT scan above that of adequate oxygen delivery to peripheral cells.
- Pregnant - concern about the unborn child can focus attention away from the immediate high priority needs of the mother.
- Intoxicated - allocation, in the clinician's mind, of a label of

"intoxicated" to a patient, and allocation of a sense of value or priority to that label can perversely prevent attention to the issue of oxygen delivery to stressed cells.

- Elderly - particularly in the presence of multiple younger patients, inappropriately low ranking of priority can be given to this subgroup of patients who are less able to tolerate cellular insult than their younger counterparts.

2. Medical Specialist Availability

Examples:

- A specialist who is "here now" may inappropriately elevate the priority of an intervention requiring his/her presence.
- A specialist who is "elsewhere" may inappropriately devalue the priority of an intervention which requires his/her physical presence.
- Unsupervised trainees may be inappropriately invited to exercise their own clinical judgement, uninformed by a mature kit of pattern recognition skills which is normally acquired over years of practice.
- A team may have no leader.

3. Distorted Personal Judgement

Examples:

- Deciding to do the "easy" thing rather than the most appropriate thing.
- Taking on an inappropriate technical "challenge" rather than a more appropriate but less challenging temporising measure.
- Undervaluation of regional ischaemia as a systemic threat.

4. Ego Issues

These issues derive from a frame of reference which often reflects self, "favourite" data, and external stresses. Within what needs to be a team approach, ego differences can express themselves as interpersonal rivalries, the spirit of a gambler, the defence of personal values and judgement which are contradicted by data, inappropriate "convictions". Perhaps worst among these problems, particularly when teamwork is required, is erratic performance and erratic decisions which can sometimes be the manifestation of clinical practice insecurities which have been difficult to appropriately address.

CONCLUSION

As you approach **CRITICAL DECISION NODES** in the management of trauma patients, you may be assisted by remembering these summarising principles:

- **The patient is his/her cells!**
- **Healthy living cells are the goal!**
- **"Listen to the cells" as time passes!**
- **Decisions are based on probabilities!**
- **Protocols protect from inexperience!**
- **Leadership protects from perverse decisions!**
- **Resources recalibrate the priorities!**

DOCUMENTATION OF DEFINITIVE CARE

Documentation is an extremely important issue for all caregivers involved with trauma patients. This includes Trauma Team Leader, surgical registrar, nurses, radiologist and subspecialty consultants. Clinical findings in trauma patients are a dynamic entity. Throughout the course of care of any given patient, caregivers change and it is vital that all be able to examine the patient's record to determine previous clinical findings. This issue is of primary importance for good clinical care but is also very important from the medicolegal perspective.

TESTS

All radiological and laboratory findings must be determined and documented in progress notes. You are responsible for total patient care and for all tests that have been done. Results and sound decision-making based on them is your responsibility from the perspective of good patient care. With regard to radiology, you are required to review results with an experienced radiologist and subsequently record the results in the patient notes with the time reviewed and the name of the radiologist with whom the images were reviewed.

INTERVENTIONS

Equally important is the documentation of any procedures or interventions carried out by you on the patient. A procedure note in the patient's progress notes should document all interventions such as chest tube insertion, DPL (with a follow-up note specifying cell counts and chemistry), suturing of lacerations, central line insertion, etc. Any findings with these interventions (e.g. large haemothorax, grossly positive DPL) must also be documented. Complications arising from any procedure are to be included in the procedure note.

DAILY CARE AND FOLLOW-UP

Patients must be seen and examined on a daily basis. Notes should be written by the team caring for the patient detailing findings as well as an assessment and plan for that day.

REMEMBER – Ordering the test is one thing, but it is the result that the patient needs!

PRIORITISATION OF PROCEDURES AND INVESTIGATIONS

The acute management of critically ill trauma patients requires critical judgement and decision making to ensure optimal outcomes. An error in prioritisation or judgement may result in the death of a patient. The great tragedy is that it is easy to say that critically ill patients would have died irrespective of the treatment.

We know from peer review analysis of trauma deaths at Liverpool Hospital and other major trauma services, that:

1. **failure to control bleeding, and**
2. **delay to the operating theatre**

are the most important errors contributing to avoidable deaths.

There are a number of key points to prioritisation:

1. Recognition of a critically ill patient.
2. Recognition of patterns of disease and probabilities.
3. Fundamental to the thought process is the need to stop the bleeding. This takes precedence over resuscitation.
4. Obviously Airway and Breathing must be sorted before proceeding to Circulation. Ideally in a trauma situation, this should be done simultaneously with the Airway Doctor intubating, the Surgical Registrar and/or another member placing bilateral chest tubes or unilateral chest tubes as appropriate, then proceeding to identification of a cavity responsible for the major bleed.

History is Critical

Pre-hospital characteristics would predict patients at risk for exsanguination. They include:

1. Unrelenting hypotension, systolic BP < 60.
2. Unable to mount compensatory tachycardia.
3. Truncal penetrating trauma.
4. Non-reactive pupils.
5. Weak pulse.
6. Compromised or absent spontaneous ventilation.

Having identified a patient with life threatening haemorrhage, some conflicts can occur in the following classical scenarios:

- Major haemothorax, distending abdomen.
- Obvious intracranial injury versus intra-abdominal injury.
- Limb exsanguination versus intra-abdominal or chest injury.

Fortunately, the double jeopardy of thoraco-abdominal or limb injuries requiring surgical intervention is unusual. It is important to have objective evidence of bleeding. This requires either a chest x-ray showing massive haemothorax or a chest tube with more than one litre of blood drained. Remember that chest tubes, even when put in quickly, do not give an immediate indication of a massive haemothorax (surprising but true), and time is not on your side to sit there and wait to see how much is coming out of the chest tube. **In a moribund patient, frank blood from a chest tube requires a thoracotomy.**

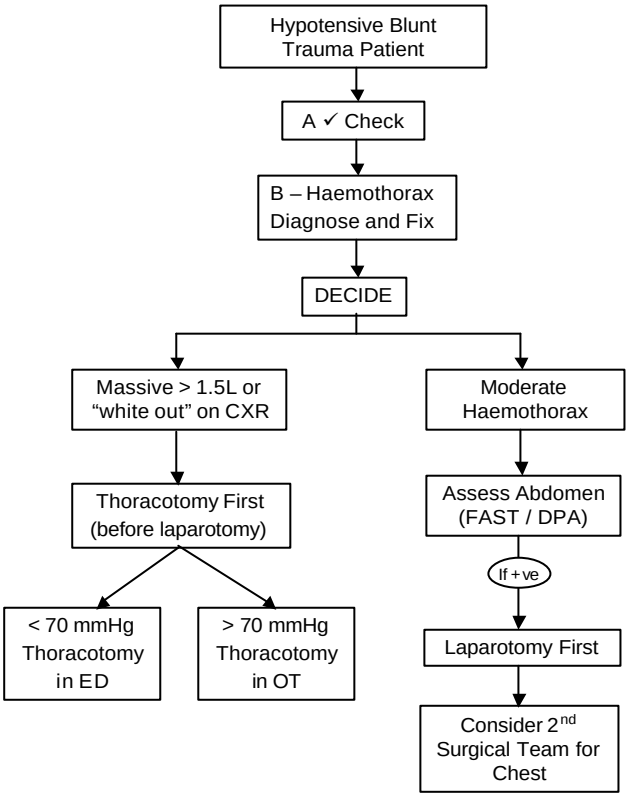
MORIBUND PATIENT

- **Frank blood from ICC = immediate ED thoracotomy**
- **Blood ++ from ICC but BP > 70 = immediate thoracotomy in Operating Theatre**

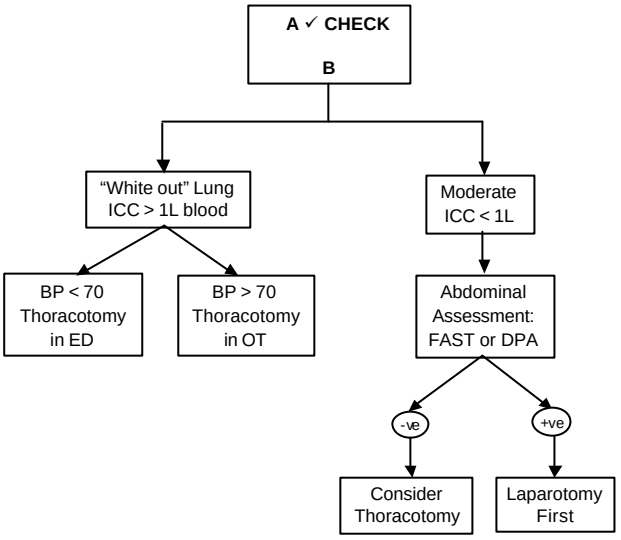
- If the systolic BP is 70 or more, thoracotomy should be done in the operating room.
- If the systolic BP is less than 70, thoracotomy should be done in the emergency department. When should thoracotomy be done?? There and then!

Following are 2 algorithms for prioritisation in blunt and penetrating injury:

PRIORITISATION IN AN UNSTABLE BLUNT INJURY



PRIORITISATION IN A HYPOTENSIVE TRUNCAL PENETRATING INJURY



SECTION 6

In all cases of severe head injury, remember to stop the bleeding first, rather than dealing with the subdural or the extradural. Remember bleeding is usually in the abdomen or chest. It is important to remember that "C" always comes before "D". The concept of doing a CT scan to see if the patient is salvageable from the head point of view, is inappropriate. These decisions are often extremely difficult to make.

WHY CONSENT IS NECESSARY?

Guidelines to consent reflect the common law right of all legally competent people aged 16 years or over to make their own informed decisions about medical treatment. No procedure or treatment should be undertaken without the full consent of the patient unless the patient is unable to give consent and treatment is urgently required. Failure to procure informed consent could result in litigation against the practitioner for assault and battery.[1,2,3,4]

OBTAINING CONSENT

The treating medical officer is responsible for providing information and advice, and for obtaining consent of the patient[3,4]. Registrars and resident medical officers (RMOs) may be delegated the task of informing a patient and obtaining consent.

Nursing or administrative staff cannot obtain consent for a proposed operation, procedure or treatment and cannot be delegated the task of informing a patient about the material risks involved.

FOUR REQUIREMENTS FOR A 'VALID' CONSENT [3,4]

The criteria listed below must be met whether obtaining a written or oral consent.

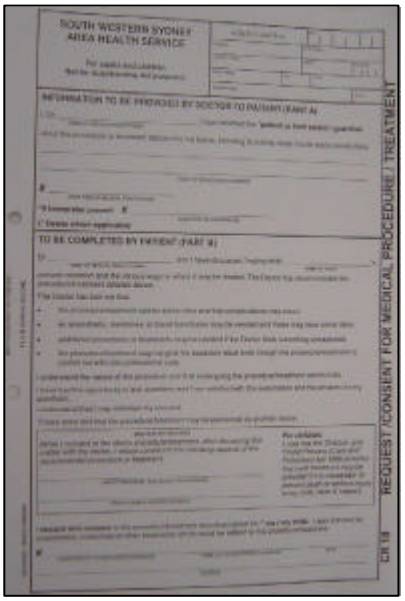
1. The patient must be capable of giving consent – i.e. they must be able to understand the implications of having treatment. This excludes:
   a) children under the age of 14 years,
   b) some people affected with mental illness, dementia, brain damage or intellectual disability; and
   c) some people temporarily or permanently impaired by drugs or alcohol.

2. The consent must be given freely, with no coercion from hospital staff, medical practitioners or family.
3. The consent must be specific.
4. The patient must be informed in broad terms of the proposed procedure, operation or treatment.

USING INTERPRETERS TO CONSENT

Interpreters should be used for any non-English speaking patient in order to ensure a valid consent is obtained. The interpreter must also sign the consent form.[3,5]

Relatives must NOT be utilised as interpreters[5], bilingual staff members should not be used to interpret at professional levels (i.e. with consent for procedure, treatment or operation). Utilising anyone other than accredited and recognised Health Care Interpreters may invalidate the obtained consent.[6]



WRITTEN CONSENT

Consent may be given either orally or in writing, or may be implied from a person's conduct (i.e. putting out his / her arm for cannulation).

Legally, consent does not need to be documented.[4] It is both NSW Health Department and Liverpool Hospital policy to obtain written consent for invasive procedures .[3,5]

WHEN CONSENT IS NOT REQUIRED

Consent is not required in the following circumstances (these apply to both adults and children):

a) where immediate treatment is necessary to save a person's life; or
b) to prevent serious injury to a person's health; or
c) to prevent the patient from suffering or continuing to suffer significant pain or distress [3].

WHO MAY CONSENT TO TREATMENT

- In a patient under the age of 14 years, the consent of a parent or legal guardian in required.
- A person aged 16 years and over is able to provide their own consent.
- A child aged 14 or 15 years of age should have parental or guardian consent (unless the child objects), provided the patient adequately understands and appreciates the nature and consequences of the operation, procedure or treatment. [1,6]
- For patients aged 14 to 16 years, it is advisable to obtain parental or guardian consent, however, if the views conflict, the child's views should take precedence and the Medical Administrator should be contacted. [5]
- Where a patient is unable to give consent, a "person responsible" may do so on the patient's behalf. A "person responsible" includes: (in hierarchial order - keep moving down the list until the first suitable variable is fulfilled):
  1. **Spouse or de facto** where a close relationship continues;
  2. **Carer** where the carer provides unpaid domestic support on a regular basis, or organises same;
  3. **Close personal friend or close relative** where there is a personal interest in the patient's welfare on an unpaid basis.

NB - Where there exists a guardian appointed by the Guardianship Board who has been granted consenting capability for medical procedures for the patient, this person becomes the "person responsible" overruling all others.[1,3,7]

If nobody fits the "person responsible" role, the Guardianship Board can consent to major medical treatment and Medical Administration should be contacted. This, however, does not apply when emergency treatment is necessary.

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