

Department of
Intensive Care Medicine
Nepean Hospital

Medical Officer's Manual
2014

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Department of Intensive Care Medicine Nepean Hospital

The Intensive Care Unit:

- Is a mixed medical and surgical Unit divided into 2 sections
- Receives direct referrals from all the hospitals in the Nepean Blue Mountains Local Health District (Nepean, Blue Mountains District Anzac Memorial Hospital, Lithgow Hospital, Hawkesbury Hospital and small centres in Oberon, Portland and Rylstone). ICU is a statewide service, and we make a particular effort to accept patients from Goulburn, Dubbo and Bathurst Base Hospitals because we already have a relationship with them.
- Has 20 available beds – 15 ventilated beds and 5 non-ventilated beds
- Operates as a “closed unit”. That is, while input from all medical teams is encouraged, all changes in management must be co-ordinated through the Intensive Care Registrar/Senior Registrar/Specialist.

Other Services provided by ICU personnel

- Medical Emergency Team
- Cardiovascular Ultrasound Laboratory
- Central Line service
- Plasma exchange
- ICU Liaison Service

Senior Staff in the ICU:

Nursing

Nurse Unit Manager –
NUM 1's – Clinical Nurse Unit Managers

Medical Specialists

Director - Professor Tony McLean
Louise Cole – RMO Supervisor
Ian Seppelt
Stuart Lane - Supervisor of Registrar Training
Marek Nalos
Arvind Rajamani
Nhi Nguyen- Roster Manager
Don Stewart and Ray Parkin (Echo Lab only)
Sam Orde (starting in 2014)

INTENSIVE CARE UNIT SENIOR REGISTRAR

RESPONSIBLE TO: INTENSIVE CARE SPECIALIST ON DUTY

GENERAL DESCRIPTION:

The Senior Registrar is responsible for the day-to-day management of all patients in the ICU. He/she is not yet a specialist and will be supervised to a level considered appropriate on an individual basis. The level of supervision complies with CICM requirements.

EDUCATIONAL AIMS:

To widen experience and maturity in the management of critically ill patients with a diverse spectrum of disorders.

To develop a consultant's approach to direct patient care, liaise with specialist colleagues, and develop understanding of the organization of the Intensive Care Unit.

To develop an interest in teaching and teaching skills, especially as applied to medical students, post-basic nursing graduates and junior medical staff.

To develop an appreciation of the importance of good management practice and Quality Improvement in the ICU and get involved in such activities.

To develop an appreciation for the importance and application of data base management in the ICU.

DUTIES & RESPONSIBILITIES:

To attend ICU ward rounds and contribute to discussions of patient care.

Participate in clinical duties as arranged by the Intensive Care Specialists.

Participate in the after hours roster as designated by the Intensive Care Specialists. Whenever the Senior Registrar is rostered as the first on call, the Duty Specialist will supervise the Senior Registrar.

Participate in training programmes as appropriate to the future career path of the Senior Registrar.

Attend and actively participate in unit continuing education meetings.

Provide advice and assistance to the ICU Registrars.

Prepare the cases for review at the monthly Morbidity and Mortality meeting

To possess a responsible attitude and commitment to the teaching and supervision of junior medical staff in the unit.

Assist with the resuscitation and management of unstable patients within the ICU and hospital.

Contribute towards administrative duties in the unit including assisting the Director of Intensive Care in rostering medical staff.

Undertake research into aspects of Critical Care Medicine as directed.

FEEDBACK & ASSESSMENT

The Supervisor of Training of ICU Senior Registrars is Dr Stuart Lane.

The ICU Senior Registrar and the Supervisor of Training will complete in-training Assessments at six-month intervals, as per the CICM Training Guidelines.

INTENSIVE CARE UNIT REGISTRAR

RESPONSIBLE TO: INTENSIVE CARE UNIT SPECIALIST ON DUTY

HOURS: Rotating roster of shifts

GENERAL DESCRIPTION:

The ICU Registrar is responsible for the day-to-day management of all patients in the Intensive Care Unit (ICU), providing 24-hour medical cover.

EDUCATIONAL AIMS:

- Development of clinical skills in Intensive Care appropriate to level of training and prior experience.

CLINICAL DUTIES SPECIFIC TO ICU REGISTRAR POSITION:

Take primary responsibility for the clinical duties applicable to patients in ICU.

Assess all patients referred for Intensive Care Admission as per the ICU Admission Policy. Liaise with Unit Manager (NUM 1) or Team Leader and the ICU Senior Registrar / ICU Specialist before accepting or rejecting patients. Document requests for in-house Patient Review/Admission and inter-hospital transfers and the outcome.

Review all ward requests for admission to the ICU prior to acceptance.

Along with the ICU specialist, communicate with relatives of patients regarding management plans and significant changes in patient condition.

Communicate with ward team Specialist or Registrar regarding significant changes in patient's condition. The ICU Registrar may enlist the help of the ICU RMO, but overall responsibility remains with the ICU Registrar.

Communicate with ward team Registrar when a patient discharge from the ICU is anticipated. There must be an **agreed management plan** that is clearly documented in the patient progress notes. The ICU Registrar may enlist the help of the ICU RMO, but ideally this should be a "Registrar to Registrar" communication.

After hours discharges are to be treated with special care, and the Medical or Surgical Registrar on ward duty must be contacted when discharge occurs.

Ensure that all transports for procedures outside the ICU are conducted according to the CICM recommendations for the transport of the critically ill (see below). In general, the ICU Registrar will conduct transports for CT. Transport arrangements for MRI, interventional radiology and other prolonged investigations will be discussed with the ICU Specialist on Duty.

Ensure that all procedures are performed safely and in accordance with our protocols, and documented clearly in the patient notes.

Supervise the clinical duties of the ICU RMO.

Be involved in the training of the ICU RMO in performing procedures such as arterial and venous cannulation and insertion of intercostal catheters.

Be the Team Leader of Medical Emergency Team (see below).

Attend all trauma calls and assist (if required) for Code Crimson patients

Ensure that the ward team Specialist is aware of the outcome of MET calls on their patients. This task may be delegated to the Medical or Surgical Registrar out of hours, or the ward team Registrar during hours, but it must be clear who will contact the Specialist. Ultimately it is the responsibility of the ICU Registrar.

FEEDBACK & ASSESSMENT

The Supervisor of Training of ICU Registrars is Dr Stuart Lane.

The ICU Registrar and the Supervisor of Training will complete in-Training Assessments at six-month intervals, as per the CICM training guidelines.

DAILY CLINICAL DUTIES SHARED BETWEEN REGISTRAR & RESIDENT:

All staff are expected to be familiar with all patients in both sections of the ICU. [There are some duties that the Registrar and Resident have in common:](#)

Ensure that there is a Medical Officer present within the Intensive Care Unit at all times.

Notify NUM 1 and other ICU Resident/Registrar if leaving the Unit, even if only for a short period of time. Any prolonged (more than 15 minutes) absences from the Unit during the day must be cleared with the ICU Senior Registrar or ICU Specialist.

Present patients at daily handovers and ward rounds and the patient care meeting each Thursday morning.

Communicate frequently with other members of the ICU medical team. General ICU management is a team effort and involves “network” communication (please see the section on “How We Work”).

Review patients with acute changes in condition and manage as appropriate. Discuss issues with more senior staff if any doubt exists as to the best plan of management. ***In crisis situations,*** communicate directly with the Duty Specialist.

Attend promptly to take a hand-over from any staff escorting a patient into the ICU

Documentation:

- Review and edit the computer based ICU Ward Round database each shift. During the day, patient plans are reviewed and usually validated at the 1100 X-Ray/Clinical meeting.
- Include a date and time with all hand-written entries in the notes, and print your name with any signature.
- Type medical progress notes every shift for all patients, i.e. at least twice a day, and more frequently if unstable.
- Prescribe all ventilation settings, drugs administered by infusion, and fluids in Intensys (the electronic ICU record)- orders must be documented before our nursing staff can commence treatment. All subsequent changes and additions must also be entered. *(Include any goals for each infusion e.g. for noradrenaline- titrate to a MAP xx, for midazolam- titrate to comfort and specify the desired RASS).*
- Prescribe generic medications (avoid trade names) on the generic drug chart.
- Enter renal replacement therapy and plasma exchange orders in Intensys.
- ***Ward teams are not permitted to change any medication orders without confirmation from the ICU medical staff.*** Requests for treatment changes (e.g. removal of drains) must be documented in the patient notes (preferably by those who want the changes!)

- Ensure nursing staff are aware of patient management plans and that the plans are carried out. Notify nursing staff of any changes as soon as they are documented, because verbal orders alone are neither sufficient nor legal.

Arrange investigations and consultations.

Document and review results of investigations and consultations. Notify the appropriate staff of the results. Ensure recommendations made by consulting teams are acted upon and implemented after discussion with senior ICU staff.

Complete ICU Discharge Summaries in Intensys if the patient is going to a ward in Nepean, or in Powerchart if the patient is going home/to another hospital. Have the Senior Registrar or specialist check the summary before printing it out for the patient's written medical record.

Ensure adequate documentation of all deaths in the ICU, including date, time and criteria used. Ensure ward team Specialist (after hours) or ward Registrar (within hours) is notified of the death of the patient.

Document all recognised incidents that actually or potentially lead to patient morbidity in the IMS computer program or the Morbidity and Mortality (M & M) Book. This includes complications of procedures, which should be documented in both the patient's record and in the M & M Book/IMS system. **Notify the Duty Specialist of all such incidents.** Documentation should include any action that was taken.

Contribute to the Intensive Care teaching sessions, as attendees and presenters. This includes the Thursday Clinical Meeting at 0900 and Tuesday teaching at 0730. All medical staff on duty if possible should attend the Thursday 1430 meeting (Journal Club, Ward meeting, Morbidity & Mortality meeting and research meeting take place in turn).

Attendance at non-ICU hospital clinical meetings or primary exam tutorials is encouraged, provided that senior medical colleagues are notified on the day and provided that at least one medical officer remains in the ICU.

Be familiar with entry criteria for research projects and inform senior ICU staff or our research co-ordinators when potential candidates are identified.

Aid in collection and collation of data as required.

Participate as requested in Quality Assurance activities.

Night Shift:

- **2000-2030 Handover.** This should be followed by a more detailed round to be sure that every patient is stable, and that you understand the rationale for all therapy. Approximately 2200: telephone round with specialist to discuss any issues as required
- **Overnight:**
 1. E-Order all CXR and routine blood tests.
 2. Check all outstanding test results for each patient, especially microbiology. These are often not available until late in the day, and may not get checked by day staff.
 3. Re-write any expired medication charts
 4. Ensure that the routine blood tests are all taken and sent off before 0600. The nurses will often do this for you, but they are really doing you a favour and it is still the registrar/resident's responsibility to make sure all bloods are done
 5. From 0700, check the blood results so that you can highlight major changes on handover.

INTENSIVE CARE UNIT RESIDENT

RESPONSIBLE TO: INTENSIVE CARE UNIT SPECIALIST ON DUTY

HOURS: Rotating roster of 12.5 hourly shifts

GENERAL DESCRIPTION:

The ICU Resident assists the ICU Registrar in the day-to-day management of all patients in the ICU, providing 24-hour junior medical staff cover.

EDUCATIONAL AIMS:

Develop a good practical knowledge of common critical illnesses, as well as confidence in the management of these patients, including the appropriate procedural skills.

Be able to recognise life threatening illness or acute physiological change and respond appropriately in terms of early management of airway, breathing and circulation.

Be able to work as part of a multi-disciplinary team.

- Understand the limits of their capability and know when to involve senior staff

CLINICAL DUTIES SPECIFIC TO ICU RESIDENT POSITION:

Take primary responsibility for the clinical duties applicable to any patients they are allocated (see the above section on Daily Clinical Duties Shared Between Registrar and Resident).

INTENSIVE CARE LIAISON CNC – Hailey Carpen

The ICU Liaison CNC acts as a link between ICU and the wards and supports the team of ICU Liaison nurses. ICU responsibilities include providing clinical support to nursing and medical staff, coordinating the central venous access service, and following up patients who have been discharged from ICU. In particular, the Liaison CNC is a resource person for tracheostomy care within the hospital.

The Liaison CNC also provides teaching and supervision for the insertion of Central Lines, PICC lines and arterial lines for JMO.

ROLE OF THE NURSE UNIT MANAGER (NUM III)

The NUM III has overall responsibility for the management of the ICU in conjunction with Professor McLean. Any nursing issues must be brought to their attention. If you have any concerns regarding equipment, budgeting, staffing, conflict resolution, bed management etc, please see him/her.

ROLE OF THE CLINICAL NURSE UNIT MANAGER (NUM I) – ICU

Jenny Yeo, Giselle Garrick, Carmel Zucak, Darren Peel, Karen Willis, Becky Bentham

The NUM 1 is responsible for the daily running of the unit. In particular, all bed allocation and staffing issues must be referred to the NUM 1 on duty ***especially before accepting patients.***

When a NUM 1 is not on duty, then responsibility for day-to-day management passes to the Team Leader.

The NUM 1 (or Team Leader) must know where you are at all times (when you are doing clinical work!).

ICU MANAGEMENT COMMITTEE

The ICU has a management committee that oversees all management decisions within the ICU. The management committee meets every second Wednesday at 12.00am and all staff should bring ANY concerns to the attention of the management committee. The management committee is made up of all Staff Specialists, Senior Registrars, NUM III, NUM I, Data Manager, Clinical Nurse Educator ICU, Clinical Nurse Consultant for Critical Care (area wide), and the ICU Liaison CNC.

ICU RESEARCH CNC – Leonie Weisbrodt- and the RESEARCH COORDINATORS

Nepean ICU has a team of nurses who coordinate and carry out much of the ICU research, starting with screening likely patients for entry into clinical trials. There are multiple trials happening at any one time and the research co-ordinators should be contacted if you think a patient might be suitable for inclusion in any study. Please also contact the research co-ordinator on duty if you have any queries about management of a patient who is in a clinical study

ICU Admission Policy

1. Patients admitted to the Intensive Care Unit should be those patients likely to benefit from intensive care, including:
 - Critically ill unstable patients in need of intensive treatment and monitoring that cannot be provided outside the ICU.
 - Patients requiring intensive monitoring and possible immediate intervention
 - Unstable patients who require intensive treatment to relieve acute illness (some of these patients have therapeutic limits, such as no intubation or CPR).
2. The Intensive Care Registrar must assess all patients referred for Intensive Care admission. This assessment may take the form of a telephone consultation with a senior member of the team referring the patient, but usually should include a physical assessment of the patient. Liaise with Unit Manager (NUM 1) or Team Leader and the Senior Registrar/ Specialist before accepting patients.
3. When an outside Specialist requests a bed, this must be discussed with the Specialist on for Intensive Care. No admission requested by another Specialist should be refused without discussion with the Intensive Care Specialist.
4. Ward requests for admission to ICU/HDU **must be reviewed** prior to acceptance.

TRAUMA ADMISSIONS

All serious trauma patients requiring an Intensive Care Admission will be accepted from the NBMLHD hospitals. In the event of a bed **not** being available, the patient will be accepted for immediate treatment, and some other arrangement made after the presentation. The Emergency Physician on duty (ext 42766) accepts the transfer of the trauma patient, and then notifies ICU. **All trauma admissions transferred within 24 hours of the injury must be assessed in the Emergency Department prior to transfer to the Intensive Care Unit.**

All residents and registrars should be aware of the current protocols for *spinal imaging* and the *management of head injuries* included in this manual.

NEUROSURGICAL PATIENTS

The following neurosurgical patients are routinely admitted to ICU/HDU:

- All intracranial surgery for 24 hours post-op
- All major spinal cases involving thoracotomy or intra-abdominal approaches for 24 hours post-op
- All Grade subarachnoid haemorrhages preoperatively
- All subarachnoid haemorrhages post operatively for at least 72 hours
- All head injuries that are at significant risk of deterioration e.g. patients with new contusions or thin extracerebral collections requiring observations < 4 hourly

CRITICAL CARE INTER-HOSPITAL TRANSFERS (excluding trauma)

The Nepean Hospital Intensive Care is the automatic referral ICU for Hawkesbury, Blue Mountains, Lithgow, Rylestone, Portland and Oberon. **Any patient from NBMLDH who requires an immediate life-saving procedure is accepted into the Nepean ICU even if an ICU bed is not immediately available.** Beds will be organized later, sometimes in another hospital.

If no bed is available for receiving a patient from these hospitals, the Intensive Care Specialist on call must be contacted.

If a critically ill patient requires transfer to Nepean Hospital:

- Referring hospital clinician rings 47344519. This phone is carried by the NUM in charge. They are then able to transfer the call to the ICU Senior Registrar or Consultant on call. Advice and transfer arrangements will be determined depending on the clinical status and location of the patient.
- The Medical Retrieval Unit based at Westmead campus will transport most patients that require medical supervision during transfer. The referring hospital usually will ring the MRU

Please Note:

1. Nepean ICU is the “default” ICU for all NBMLHD patients if there are no ICU beds available elsewhere in NSW ie we must accept our default patients.
2. Patients coming from wards or ED in other hospitals are transferred direct to our ICU, once the decision has been made to accept their care. If we do not accept them, then they might be transferred from another ED to our ED, but only after discussion with the ED specialist on duty at Nepean. **Ward patients from other hospitals cannot be transferred to Nepean ED.**
3. All trauma patients within 24 hours of injury must be assessed in the ED first, and should have any imaging done before they come to the ICU

What to say when you are called about a sick patient

The ICU often receives calls from other areas in the hospital or from other hospitals requesting advice or requesting a transfer to your ICU.

PLEASE ALWAYS BE HELPFUL. The ICU staff have equipment and expertise that should be shared freely.

Regarding the Patient

- Identify the major problem, and take a quick history of the illness
- Assess the severity of the problem
- Ask about level of consciousness
- Ask about the state of the airway (obstructed, or patent, or intubated)
- Ask about breathing (respiratory rate, oxygenation, signs of respiratory distress)
- Ask about the circulation (heart rate, BP, rhythm, peripheral perfusion and urine output)
- Ask about relevant past history
- Ask about the current treatment
- Ask what vascular access and monitoring is being used

Be aware that:

- The person whom you are advising will usually have less equipment and expertise than are available in the ICU (for intubation, central line insertion, sophisticated ventilators)
- Your advice should be directed toward stabilizing the patient in the simplest way until you can review that patient on the ward, or transfer can be arranged (see section on Trauma and Critical Care Inter-hospital Transfers)
- Simple requests (such as an intern asking you to look at a blood gas) may be an indirect way of requesting help
- Other registrars should be involved in the care of patients- if you are helping out with a problem, the appropriate (medical, surgical, obstetric, emergency) registrar should also be involved

You will need to:

- Support the current management on the ward, OR indicate you will assess the patient on the ward for potential admission, OR advise urgent transfer to the ICU
- If the problem is urgent and/or you are unable to evaluate a ward patient within a reasonable time, ask the ICU Senior Registrar or ICU Specialist for help
- Monitor patient progress and provide encouragement by repeat telephone calls
- If the patient is transferred to our ICU, provide feedback to the referring institution and staff regarding the patient's progress

For ED referrals:

- **As soon as you have seen the patient, you need to make a decision as to whether the patient needs ICU/HDU or can go to the ward.** Please don't say you will review the patient later, because this leaves ED in limbo, and they are under pressure to move patients along within 4 hours of arrival at ED. Document the decision immediately after seeing the patient in the patient's medical record in ED (discuss with the Specialist or Senior Registrar first).

Trauma Call Policy

Activation of a "Trauma Call"

The "Trauma Call" will be activated on either notification of impending arrival or the arrival of injured patients, meeting criteria outlined below. The people to be notified by the trauma call are:

1. Surgical Registrar (page 17063)
2. ICU Registrar (page 17015)
3. Anaesthetic Registrar (page 17071)
4. Radiographer (page 17156)
5. After Hours Director of Nursing (page 17111)
6. Operating Theatres Supervisor (page 17647)
7. Blood Bank (extension 42182)
8. ED Wardsman (page 14740, page 14846 and page 14529)
9. Emergency Physician on-call (notified by ED Clinical NUM)

Activation Criteria:

The call will be **activated by** one of the following (call 5555, and say "Trauma Call"):

1. Emergency Physician or Registrar between 0800-2400 or,
2. The ED RMO/SRMO between 2400-0800 or,
3. The ED Clinical Nurse Unit Manager between 2400-0800 (the Emergency Physician on-call should be notified of any difficulties)

Criteria for activation include:

Criterion	Examples
1. Airway or respiratory Compromise	<ul style="list-style-type: none">• Unconscious patient• Agitated patient with respiratory distress• RR < 8, RR > 30, SaO₂ < 90%
2. Circulatory Compromise	<ul style="list-style-type: none">• Pulse rate > 120/min• Systolic BP < 90mmHg on arrival• Large external blood loss
3. Neurologic Abnormality	<ul style="list-style-type: none">• GCS ≤ 12, pupil abnormalities, lateral limb weakness• Evidence of spinal cord injury
4. Specific Injuries (this list is not exhaustive)	<ul style="list-style-type: none">• Injury to ≥ 2 body regions• Isolated chest injury with respiratory distress• Isolated head injury with GCS ≤ 8• Acute abdomen following trauma• Pelvic fracture with shock• Penetrating torso injury
5. Multiple casualties	≥ 3 depending upon suspected injury severity

Where there are **multiple (≥ 3) severely injured patients** presenting to the Emergency Department, the **Clinical NUM in the ED** will arrange for switchboard to **notify the on-call General Surgeon and Anaesthetist and ICU specialist** of the situation. Further information will be supplied to them as soon as possible during the assessment of the patients, to allow for planning of further care of the patients.

Activation of the system may occur in other circumstances, at the discretion of the Emergency Department medical staff and nursing team leader (e.g. paediatric patients, pregnant patients, times of limited senior medical staffing).

Expected Responses:

Responder	Expected Response	Details
Surgical Registrar	Come to ED immediately	If in OT, contact ED immediately to ascertain details
ICU Registrar	Come to ED immediately	Ascertain details regarding need for ICU/HDU bed
Anaesthetic Registrar	Contact ED immediately, extension 42766	Ascertain details Notify OT staff of possible case Come to ED ASAP as required (e.g. multiple casualties, render assistance)
Radiographer	Come to ED immediately	Bring plates CXR, pelvic x-ray, and lateral cervical spine x-ray Stay in ED as required
After Hours ADON	Contact ED Clinical NUM immediately, on extension 42771	Ascertain details Assist in ED as required (e.g. Care of relatives, mobilising staff in multiple casualty situations, arranging ward beds for patients)
OT Supervisor	Contact ED Clinical NUM (ext 42771) within 15 minutes of call	Ascertain likelihood of OT cases and timing
Blood Bank	Not required to contact ED	Be aware of likelihood of urgent processing Contact ED when blood products are available
ED Wardsman	Come to ED immediately	Assist as directed by ED medical and nursing staff

If any responder is going to be delayed, they must notify the ED Clinical NUM (ext 42771) immediately.

Monitoring of the System:

The system will be tested weekly by switchboard to ensure all pagers are working.

Code Crimson

This means a patient with life-threatening haemorrhage is being rushed to theatre from ED or the wards. The ICU registrar can activate Code Crimson by calling the Switchboard on 5555 and requesting 'Code Crimson Activation'. Once the code has been activated, only a consultant surgeon can cancel it. Even if a surgeon is not immediately available, it is usually best to await the surgeon's arrival in the operating theatre.

Confidentiality

Confidentiality of patient information must be maintained at all times. Do not discuss patients in public areas, and ***deposit all unwanted patient lists in a secure waste bin.***

Medical Emergency Team

All inpatient observations within Nepean Hospital are documented on the Between the Flags track and trigger charts. Each chart is colour coded to indicate when a patient's observations meet calling criteria and the response required. Nepean Hospital has a 3-tier approach in responding to medical emergencies:

Urgent Medical Review: for observations falling within the yellow zone. The call goes to the admitting team JMO who has 30 minutes to respond and 60 minutes to have a plan of management in place.

Pre Arrest Criteria for Escalation (PACE): if observations fall within the red calling zone but the patient's condition is not immediately life threatening, then a PACE call is initiated. This call goes to the admitting team registrar who has 10 minutes to respond and 30 minutes to have a documented plan of care.

Medical Emergency Team (MET): if observations fall within the red calling zone and the patient's condition is immediately life threatening then a MET is called. The MET responds immediately and consists of the ICU Registrar (team leader), ICU Nurse, Medical Registrar, Medical Intern and a wardsperson. If a child is involved, the Paediatric Registrar is also called, and the Obstetric Registrar is also called to any emergencies within the Delivery Suite or post-natal ward. If the admitting team member fails to respond (ie. either urgent medical review or PACE), or the patient's condition continues to deteriorate then the call must be escalated to the next level of response. If the MET call has been going for 30 minutes and there is no management in place, the MET team leader (ICU Registrar) must call the Intensivist on call for advice.

The MET is there to support all staff treating potentially critically ill patients. If the hospital staff are worried about any of their patients or a team fails to respond, they are encouraged to ring 5555 and initiate a MET call. All ICU staff are expected to be supportive of the ward staff no matter how trivial the call may seem.

The ICU Registrar is the MET team leader. When arriving at the MET call site, he/she should:

- Start any resuscitation (arrange IV fluids, oxygen supplements, defibrillation, tracheostomy change, endotracheal intubation, administration of glucose, frusemide, naloxone, and so on = taking care of ABCs).
- Arrange transfer of the patient to ICU if it is appropriate. Any inpatient (ie any patient admitted to the hospital including Day Surgery & ED patients) should be transferred to the most appropriate inpatient area for their needs.
- Arrange transfer to ED for any non-inpatient who is the subject of a MET call (e.g. hospital staff, outpatients, visitors). Only triage and life saving treatment should take place before the patient is taken to ED. Please notify the ED NUM on ext 42771 if at all possible prior to arrival in the ED.
- Allow a dignified death for those patients whose business it is to die
- Tell the ward medical team about the change in patient status and advise what should happen to the patient. Ideally, the ward team would be contacted during a MET call in-hours and should attend the call.
- If the patient can safely stay in the ward, the ICU Registrar should formally hand care of the patient over to the Medical Registrar, document hand-over of care in the notes and then return to ICU.
- The ICU Registrar should encourage the ward team to organize a resuscitation directive for appropriate patients if it has not already been done (e.g. not for CPR if the patient has a terminal illness).

- The ICU Registrar is responsible for notifying the attending specialist of a MET call involving one of his or her patients (or delegates that responsibility to the Medical Registrar).

Less than a quarter of MET call patients will require ICU. The majority of patients who are subject to a MET call remain on the ward.

The ICU Registrar is responsible for the subsequent care of any patient he/she has accepted into ICU, even if the patient is not physically in ICU.

MET Equipment

It is the responsibility of all team members to ensure that the necessary equipment is taken to the call. There is a MET trolley located just inside the door to ICU 2 that holds the defibrillator and a MET bag. This can be taken to any MET within the hospital buildings. If the call is to one of the distant buildings or the location cannot be reached by footpath (ie not across the car parks) then the packs and defibrillator will need to be carried by the team. If the call is to a location outside of one of the hospital wards, please ensure that the blue oxygen bag is also taken. Extra paediatric equipment is located in a black pack on the trolley.

How we work

With thanks to John Cartmill and Erromed for the phrasing in this section

Modern intensive care medicine is too hard for any individual to do alone. Just as a multi-celled organism can do more than a single celled one so a team can do more than an individual ... Just so long as it's a team and not just a bunch of individuals in the same place. The concept of the team in Intensive Care is not touchy feely, it is a vitally important way to keep patients safe.

Good ICU medicine requires effective communication!

Communication should be:

- Specific
- Positive
- Directed
- Acknowledged
- (And if possible explained)

Example: *"Peter" (directed) "please bring the arrest cart to Bed 5" (specific) "it looks like we might need it" (explained). Peter says "bringing the arrest cart to Bed 5" (acknowledged).* In an ideal world a request will be explained as well, there is not always time.

There are two techniques of communication that are particularly helpful for ICU work:

▪ **Challenge response**

The only that you can be sure that you have been heard is if the other person repeats what you have said. Similarly the only way you can be sure that you have heard another person correctly is if you repeat the communication back to them. The official "military" name for this very formal method of communication is "challenge – response". It is highly stylised and not at all "easy going". On those occasions where accurate communication is necessary (*such as hand-over*) do not be embarrassed to use challenge-response. Situations where challenge response can be particularly effective include stressful situations and "noisy" situations where a great deal is happening at the one time.

• **Graded assertion**

Sometimes you will have information that is vital to patient safety that other members of the team may not be aware of. Be prepared to use graded assertion to get your point across.

1. Start with an *"I" message*: *"I haven't seen today's electrolytes yet"*
2. Move on to a *"suggestion"*: *"She could be low in magnesium"*
3. If your suggestion is still not being listened to or taken seriously, move onto a *"question"*: *"I am sure that there is an explanation but could you please explain why we are ignoring the metabolic causes of status epilepticus"*
4. If there is still no response use *"emergency language"*: *"You must listen"*

Of course you may feel that a particular situation does not warrant sticking your neck out to this extent. However, there is no shortage of examples in which patients suffered for want of graded assertion.

These techniques apply as much to patients and their family as they do to members of staff.

A background level of respect for good manners, eye contact, positive body language, the studied avoidance of eye rolling, derogatory comments or the use of sarcasm is assumed. You are working with an intelligent, well-intentioned and motivated group of people, so please speak with them like that.

The traditional model of a leader is “someone who tells everyone else what to do”. In a team setting, a leader is someone who can effectively bring all the physical and emotional resources, knowledge bases and experience available in the team to bear on a problem. Interpersonal skills are **vital** because a team is interpersonal.

It might be helpful to think of an individual as a single celled protozoan capable of eating, moving, reproducing and so on, on a fairly limited scale. Using this model a team is a multi-celled organism able to take advantage of all of its specialised parts. What enables this multi cellular organism?
...Communication between the cells.

How to admit a patient to ICU

- Be there to take any hand-over from the medical retrieval team, theatre or emergency staff. Listen actively!

- Do a primary survey:

1. Is the **airway patent and secure**? ET tubes should be tied approximately 24cm at the lips for men, and 21cm for women
2. Is the **breathing adequate**? What is the **oxygen** saturation? If the saturation is <90%, put the patient on 100% oxygen until the ABG is done. Check the respiratory rate, chest expansion (should be equal and sufficient on both sides), and breath sounds. *Check ABG and BSL early!*
3. Is the **circulation adequate**? Check the peripheral perfusion, heart rate and BP, check the venous access. Assess the state of hydration
4. What is the **level of consciousness**?

Any problems identified on the primary survey should be treated appropriately before starting a full physical examination (with oxygen, IV access, IV fluids). Obviously if a patient is admitted for the treatment of pneumonia, for example, they will not have a normal respiratory examination. The purpose of the primary survey is to secure the airway, and identify respiratory, circulatory or neurological decompensation that requires urgent support

- Do a full physical examination
- Prescribe treatment on Intensys: ventilation settings, sedation/analgesia, drugs by infusion, and fluids.
- **Re-write the ward drug chart** using only the drugs that apply to the current ICU admission. **Generic names for drugs please!**
- Prescribe ranitidine for acid prophylaxis and prophylactic DVT anti-coagulation as appropriate (If the patient is already taking a proton pump inhibitor, they continue on IV or enteral pantoprazole instead of ranitidine for the acid prophylaxis)
- Outline the treatment plan to the bedside nurse
- Request/do the procedures e.g. arterial line, CVP line, nasogastric tube, bladder catheter
- Organize the basic investigations: FBC, clotting screen, EUC, LFT, Mg, Ca, PO₄, BSL, septic work-up, CXR (to check the tube positions and after line placement)
- Prescribe enteral feeding (unless there is a very good reason not to start)
- Notify the ICU Specialist and discuss the management plan. Notify the admitting ward Specialist if this has not been done already (especially for patients who have been retrieved from another hospital)
- Review patient's old notes, current notes, operation sheets, pathology reports and radiology reports and prepare an initial problem list.
- Enter the patient in Intensys, including the section for clinical issues and the initial management plan.

- Check if the patient can be recruited for any ICU clinical trials (look at the inclusion and exclusion criteria)
- Tell the family about the suspected diagnosis, and what is planned. Ask them about the patients' level of physical and psychosocial function at home

Full Patient Assessment

Document important events from previous shift if not documented already

Think about the following aspects. Not all of these will be relevant for every patient, but this list covers most useful things to document. Try to include the relevant positive and negative examination findings for the specific disease processes that a patient has. Comment on the degree of organ support that is required, or interpret changes to the results of investigations rather than just repeating information already found on the Powerchart or Intensys nursing observations e.g. creatinine is rising, 500micromol/L today (*repeating the result*) rising creatinine most likely due to hypovolaemia (*higher order interpretation*).

CNS:

Level of consciousness, sedation required, whether delirium is present

Focal exam findings followed by any changes since admission

Respiratory:

Airway & respiratory support (ETT, PEEP, Ventilation mode & settings); a summary of the degree of support and how this is changing

Sputum quantity & quality

ABG

Exam findings in sufficient detail that staff working future shifts can work out if things are changing

CVS:

Target MAP, vasoactive drugs in use (inotropes, nitrates etc.)

Exam findings related to intravascular filling, peripheral perfusion

Abdomen:

Enteral feed in use & tolerance

How long since bowels last worked

Drains/Stomas: condition and output

LFT, Coagulation tests

Exam findings

Renal:

Urine output, EUC, clinical assessment of hydration

Sepsis:

Temperature profile, WCC, sentinel culture & specific culture results

Are the clinical and biochemical signs of sepsis resolving or persisting?

Lines:

Sites, duration

Document your physical examination of the patient at least once per shift

Feel free to ask the consultant or senior registrar for information found on examination if they forget to tell you.

How to use Clinical Issues section in Intensys

This is a list that documents the important clinical problems that each patient has in the ICU. It always includes the “reason” why the patient came to the ICU, and any chronic condition that influences the ICU management in any way. It is updated to include major complications as they occur.

A “problem” for the purposes of this list is any clinical feature or aspect of a patient that needs to be considered when making management decisions. Thus, a problem may be a disease process, a clinical symptom or sign if the diagnosis is unknown, or a severely abnormal investigation that potentially influences all management decisions.

A ‘diagnosis’ may be adequate to label the problem, but usually does not contain enough information to allow for management decisions to be made. For example: the problem “Insulin dependant diabetes” identifies the disease process but more information is required for clinical decision-making.

Additional information is added to the problem list in the form of one or more “descriptors”. For example:

Problem: Insulin dependant diabetes

Descriptor 1: High Insulin requirements, 120U insulin a day

Descriptor 2: Recurrent hypoglycaemia

Descriptor 3: Severe diabetic retinopathy

Whenever a new patient is admitted, the resident/registrar will need to enter the initial problems into Intensys. Whatever is recorded there at the time the discharge summary is done, will automatically populate that component in the discharge summary.

How to transport a ventilated patient to CT and elsewhere

These are joint nursing and medical responsibilities- talk to each other about the preparation for transport!!

1. Confirm procedure is booked and specific time has been arranged (usually 1400 hours for CT on weekdays).
2. Arrange extra sedation as required.
3. Ensure adequate amount of infusion fluid is available for the duration of the procedure (take delays into account).
4. Set up transport monitor at the bottom of the bed (ensure battery is charged, take the electrical lead with you). Set alarm limits on the transport monitor and connect the patient.
5. Take an O₂ cylinder with suction attachment (ensure O₂ cylinder is full and suction tubing is available).
6. Test Laerdal bag is functioning and place on the bed. Get a red MET/ transport backpack and check that all the seals are intact in the packs. This bag may be carried or placed on the bed (if the seals are broken, assume that the contents are incomplete and the bag needs to be re-checked).
7. Attach the transport ventilator to the bedrail and plug into the wall power and oxygen outlets. Switch it on and adjust the settings in accordance with the patient's requirements. Attach the patient to the transport ventilator at least 15 minutes prior to setting off. Attach the ventilator oxygen supply line to a full oxygen cylinder shortly before leaving.
NB The transport ventilator should be used on all transports unless the patient is very PEEP dependant (≥ 15) or has a high FiO₂ requirement (≥ 0.6). If the patient is likely to de-recruit with even brief loss of PEEP, clamp the ETT before disengaging bedside ventilator, turn the travel ventilator on, and only unclamp ETT after travel ventilator circuit is connected.
8. If towing the Evita XL, check ventilator O₂ and air cylinder are full and turn on (check battery is fully charged). On arrival of the CT wardsperson hook up tow bar to the ventilator and bed.
9. Disconnect any IV lines that are not required during the transport. Transfer remaining IV bags and pumps to the bed IV pole
10. Tape any arterial line transducers to the patient's arm
11. ICU medical officer and RN complete the "Intra-hospital Transport" checklist together (print out a copy from website).
12. The wardsperson, ICU Registrar, and the ICU RN transport the patient to CT. Ensure no lines / tubing is pulled especially the ETT and ventilator tubing.
13. Lift the patient onto the CT table using PAT slide or Jordan frame. Hand-ventilation during transfer is sometimes necessary.
14. Transfer the IV pumps and fluids to the IV pole in X-Ray. Arrange lines and tubes so to allow for easy movement of the CT table (prevent any pulling). Arrange monitor so it can be viewed from behind the X-ray screen.
15. Hook up the ventilator to the O₂ and electricity. Plug in the transport monitor.
16. Observe and monitor patient throughout the CT. Liaise with CT staff and attend to any patient requirements as needed.
17. Return patient to the ICU bed and prepare equipment for return trip.
18. Return patient to the ICU and reconnect to ICU equipment.
19. Organise for gas bottles to be changed if required.
20. Restock any equipment used from the MET/transport backpack.
21. Document transport in the notes.

Critically ill patients are unstable or potentially unstable, any movement outside the ICU is life threatening. (See ANZCA Intra-hospital Transport of Critically Ill Patients [PS39 2000])

Intra-hospital Transport Check List

Date and Time of Transport

Patient Label

Destination

☐ CT

☐ MRI

☐ Cardiac Catheter lab

☐ Operating theatre

Other _____

Check List

Travel ventilator checked and functioning ☐

Chest moving post-attachment to the travel ventilator ☐

Laerdal bag tested and present on bed ☐

Oxygen cylinders full for ventilator and suction ☐

Ventilator and monitor alarms set ☐

Suction available and checked ☐

IV Access available and secure ☐

IV lines simplified as far as possible ☐
Disconnect unnecessary lines

Spare Infusion bags if likely to be necessary ☐

Anaesthetic drugs available if required ☐

Transport Pack ☐

CT scans/X-Rays/ patient's medical record ☐

Signatures _____(RN)

_____(Medical Officer)

What to do if your patient is hypotensive

Hypotension is defined as a systolic blood pressure < 90 mmHg, or mean arterial pressure < 60 mmHg, or BP reduced by $\geq 30\%$ from the usual values for that patient. Hypotension in the ICU is often multi-factorial: a patient with severe sepsis will have hypotension secondary to relative hypovolaemia (leaky capillaries), extreme vasodilatation, and depressed myocardial contractility.

Like all acute situations in the ICU, **diagnosis** and **supportive treatment** of hypotension should proceed simultaneously.

1. What is the *cause* of the hypotension? This will determine the **definitive management**.

Consider:

- **Hypovolaemia** (the commonest cause of hypotension)
- Sepsis
- Cardiac causes e.g. arrhythmias, tamponade, acute infarction, cardiac failure (patients with acute heart failure are normovolaemic or relatively hypovolaemic, and patients with chronic heart failure are hypervolaemic)
- Tension pneumothorax
- Anaphylaxis
- Excessive use of anti-hypertensive agents (the presence of β -blockers or vasodilators such as ACE inhibitors will prevent the normal sympathetic reflex response to hypovolaemia or cardiac dysfunction, and thus blood pressure will fall early when the cardiovascular system is stressed).

2. Give repeated intravenous fluid challenges with rapid aliquots of 200-500 ml of fluid until the intravascular volume is restored (normal saline or Plasmalyte). Simple assessments should be used initially to monitor the effect of a fluid bolus (peripheral perfusion, heart rate, urine output). If these rapidly improve, consider giving another bolus of fluid. If minimal improvement occurs, the volume may be close to correction. Fine-tuning of volume resuscitation may then require measurements such as CVP, or cardiac output, or arterial pH. These measurements are only useful if they are consistent with other simple assessments. For example: CVP in the presence of hypovolaemia can be low, normal or high. After a fluid bolus, it may increase, decrease, or remain the same. The repeated measurement of the CVP after fluid boluses gives a 'trend' that is more useful than a single absolute measurement. If the CVP is consistently rising, this suggests that more fluid is not required.

3. Correct any reversible cardiac cause e.g. restore sinus rhythm, drain tamponade

4. Consider inotropic/vasopressor support **ONLY** if intravascular volume has been restored, and definitive management of the cause of hypotension is underway. This should be discussed with the ICU Specialist or Senior Registrar.

What to do if your patient is oliguric

Oliguria is defined as a urine output less than 0.5ml/kg/hr for 2 hours or more. Think about possible causes before giving any treatment. Oliguria may partly be a physiological postoperative response in the context of high circulating levels of ADH and aldosterone, or the use of NSAID. Consider:

- Hypovolaemia (the commonest cause of true oliguria)
- Hypotension
- **A blocked catheter** (this is the most common cause of reduced urine volumes!)
- Nephrotoxic drugs (particularly NSAID, ACE inhibitors, aminoglycosides)
- Sepsis
- Myoglobin (in association with rhabdomyolysis)
- Intrinsic kidney disease (e.g. nephritis secondary to antibiotics, glomerulonephritis)
- Obstruction (e.g. ureteric stones, intra-abdominal masses, intra-abdominal pressure greater than 20 mmHg)

1. Flush the catheter to assess its patency. Replace the catheter if there is any doubt about obstruction

2. If hypovolaemia is the likely problem, give a fluid bolus, and consider an increase in the rate of fluid infusion. Think about possible causes of hypovolaemia

3. If hypotension is the problem, correct any hypovolaemia. Then restore the patient's blood pressure to 'normal' levels (at least a mean arterial pressure of 75 mmHg!) with vasopressors (talk to the ICU Specialist first)

4. If the oliguria is persistent despite restoration of intravascular volume and a "normal" blood pressure, stop any nephrotoxic drugs and check gentamicin levels

5. Check the urinary sodium only if diuretics have not been given (e.g. a urinary sodium of <20 mmol suggests a pre-renal cause for oliguria which should be correctable. A urinary sodium >40 is consistent with diuretic use or acute renal failure)

6. Send a CSU for analysis of sediment and to exclude infection. Consider a renal ultrasound to exclude obstruction (particularly if anuric)

7. Give frusemide only if the patient is clinically hypervolaemic. Oliguria is not generally due to a shortage of frusemide. If refractory oliguria is present, restrict fluids to the replacement of ongoing losses

CLEARANCE OF THE SPINE

Using the Spinal Clearance Algorithm, this may be performed by:

- ED Consultant/Registrar/MMO (level 2 or 3)
- Orthopaedic Consultant/Registrar
- Neurosurgical Consultant/Registrar
- ICU Consultant/Registrar

Clearance of the spine in trauma patients

In most cases, efforts to clear the spine ("exclude bony injury") will have already commenced while the patient is in ED. Junior medical staff should take handover from the ED staff and find out how far the patient has progressed along the algorithm. They should then continue to use the algorithm to guide further investigations of the spine until the conclusion is reached.

When there is uncertainty about the presence of bony injury, the patient should continue to be log rolled with in-line stabilization of the neck.

1. If a patient fulfils the NEXUS criteria the spine is cleared clinically
2. If clinical clearance not possible, an awake non-intubated patient gets a 3 view cervical series ± 2 view thoracolumbar series, with CT supplementation for any area not adequately seen. Any patient with an injury to 2 or more anatomical regions must have the thoracolumbar imaging
3. The unconscious or intubated patient needs a complete cervical CT at the time of the first head CT, as well as AP and lateral films of thoracic and lumbar spine within 24 hours of the injury. If these are **reported normal** (by radiologist, neurosurgeon or intensivist) then collars are removed and spinal precautions ceased
4. Any radiological abnormalities, neurological abnormalities or midline pain must be further investigated as appropriate
5. Stiff neck collars must be removed as soon as possible (preferably within 4 hours) and changed to either sandbags or a Philadelphia collar if the neck cannot be cleared. There is high morbidity including missed injuries if this is not done

Clinical Assessment of Spine:	
1. Posterior Midline spinal tenderness	
2. Altered level of consciousness	
3. Neurological deficit	
4. Evidence of intoxication	
5. Painful distracting injuries	
If no to all, imaging not indicated – Remove immobilisation.	
If yes to any, maintain spinal immobilisation and perform plain x-rays with CT supplementation as indicated.	
Radiological Assessment:	
XR C-spine No/Yes - Result:	
XR T-spine No/Yes – Result:	
XR L-spine No/Yes – Result:	
CT Scan C-Spine No/Yes – Result:	
CT Scan T/L-Spine No/Yes – Result:	
If no fracture/subluxation detected, perform functional assessment. <ul style="list-style-type: none"> - If functional assessment is normal remove spinal immobilisation. - If functional assessment not normal, maintain spinal immobilisation and consult regarding further assessment/management 	
SPINE CLEARED by:	Date/Time:
Further consultation:	
- Neurosurgical or Orthopaedic Team notified <input type="checkbox"/> Date/Time:	
CLEARANCE BY CONSULTING TEAM:	
<ul style="list-style-type: none"> - Further imaging required-- No/Yes Details: - Immobilisation removed – No/Yes Details: - Follow up plan: 	
Name:	Date/Time:

Documentation of spinal clearance

ALGORITHM FOR CLEARING THE ENTIRE SPINE IN THE INJURED PATIENT

Selected plain spinal radiography *is indicated* for trauma patients (over the age of 8 years)

unless they exhibit all of the following criteria:

- No posterior midline spinal tenderness, and
- No altered level of alertness, and
- No focal neurological deficit, and
- No evidence of intoxication, and
- No painful distracting injuries

NO to all

X-ray not indicated
Remove Collar & mobilise
Cease spinal precautions
Treatment as indicated

YES to Any

3 View C-spine XR

XR's reviewed by senior clinician or radiologist/radiology registrar

Normal, adequate Spinal X-rays

Abnormal Spinal X-rays

Inadequate views

Clinical Functional Assessment*

Maintain immobilisation ***

Further imaging in consultation with radiology

Normal

Abnormal or untestable

Abnormal or untestable

Normal

Consultation**
? CT ?MRI
?dynamic fluoroscopy

Clinical Functional Assessment*

Remove Collar & mobilise
Treatment as indicated

Abnormal

Treatment as indicated

Normal

Remove Collar
Treatment as indicated

* **Clinical Functional Assessment**

Remove collar and assess:

1. Active painless bilateral rotation of neck to 45°
2. The patient can lift their head off bed ± flex spine without significant midline neck/spine pain
3. Patient able to sit upright without marked pain in thoracolumbar region

****Consultation**

Neurosurgical, Orthopaedic, ICU, ED consultation as indicated

*****NB.** If the patient is going to require cervical immobilisation for more than **4 hours**, their semi-rigid collar (eg Stiff Neck) should be replaced with a **Philadelphia collar**, spinal board should be removed & regular pressure area care commenced

MANAGEMENT OF SEVERE HEAD INJURIES IN ADULTS

These guidelines summarize modern “best practice” and are consistent with the Brain Trauma Foundation guidelines of 2003. Many of these basic principles apply to the care of **all** ventilated neurosurgical patients in ICU.

Any deviation from these guidelines must be discussed with the ICU specialist first and documented. Always inform the neurosurgeons of significant changes in a patient’s condition.

Basic Resuscitation and ICU Management

1. ATLS (EMST) Primary Survey with due attention to **Airway, Breathing, Circulation, Disability and Exposure** – the first important thing in a head injury is a clear and unobstructed airway!
2. Rapid sequence induction and intubation (generally using thiopentone, suxamethonium +/- fentanyl). Sedation as appropriate (fentanyl, midazolam, propofol). A neuromuscular blocker can be used while completing all CT scans.
3. **Ventilation:** patients should be kept **normocarbic** with PaCO_2 36 – 40 mmHg. This generally corresponds to $\text{P}_{\text{ET}}\text{CO}_2$ 31 – 35 mmHg. **All ventilated head injury patients must have continuous capnography.** They must be kept well oxygenated with $\text{PaO}_2 > 90$ mmHg and $\text{SpO}_2 > 95\%$ [a single episode of hypoxaemia worsens prognosis]
4. Early CT brain (non contrast) guides subsequent therapy.
5. **Cerebral perfusion:** all patients should have arterial and central venous lines inserted as soon as practical. After volume resuscitation to euvolaemia, noradrenaline is used to maintain a MAP of 80 mmHg. [A single episode of hypotension also dramatically worsens prognosis]. Once an ICP monitor has been placed, fluid and noradrenaline are used to maintain a Cerebral Perfusion Pressure (MAP – ICP) of **60 mmHg**. ICP and arterial transducers should both be zeroed to the level of the external auditory meatus.
6. **ICP monitoring** is used in all severe head injuries. An external ventricular drain (=EVD) is preferable, as this allows the therapeutic option of CSF drainage. A parenchymal catheter (Codman) is used if ventriculostomy is not feasible. Sometimes a combined Codman-EVD is used. Intracranial pressures are measured with a zero point at the external auditory meatus.
7. All ventilated patients must have an oro- or nasogastric tube. Anterior base of skull fracture must be excluded before a nasal tube is placed. Enteral feeding is commenced as soon as any urgent surgery has been completed.
8. **Positioning:** all patients are nursed 30° head up unless their BP is unstable, or they need large doses of noradrenaline, or they have unstable spinal or pelvic injuries. This both maximizes venous drainage and minimizes ventilator-associated pneumonia. Avoid obstructing jugular venous drainage – **use** brown tape or ETAD device to secure endotracheal tubes rather than white tape around the neck. Remove cervical collars and use sandbags instead, after admission to ICU.
9. **Spinal clearance:** All spinal radiology (cervical, thoracic and lumbar) should be completed within 24 hours of injury. A full CT neck must be requested at the same time as the first brain CT. Hard collars must be removed within four hours and either changed to a Philadelphia collar or preferably sandbags, if the spine cannot be cleared. Beware collar compressing neck and

elevating ICP. If the lateral C/spine X-ray **and** CT neck are **reported normal** then all collars can be removed (see protocol). Dynamic imaging is not required.

10. Fluid management: isotonic crystalloid (generally 0.9% saline unless there is significant hyperchloraemia) to maintain serum sodium 140 – 149 mmol/l and clinical euvolaemia.

11. Temperature management: patients should be kept **normothermic** (37° C) with appropriate use of warming or cooling, and paracetamol.

12. Stress ulcer prophylaxis: ranitidine 50mg IV tds unless already taking another agent.

13. Anticonvulsants: only patients who have had a seizure should be routinely loaded with phenytoin 15 mg/kg IV and prescribed phenytoin 150 mg IV b.d. for 7 days. Anticonvulsants must otherwise be discussed with the neurosurgeon.

14. DVT prophylaxis: Sequential calf compressors should be used routinely. After discussion with neurosurgeon, add heparin 5000 U sc b.d. 48-72 hours post-injury or drainage of haematomas.

15. Maintain BSL in the range 8-10 mmol/l with an insulin infusion if necessary [Severe hyperglycaemia worsens outcome].

16. Pressure relief mattresses may be used as soon as the spine is cleared radiologically.

What if the ICP goes up?

When the above principles have been applied, and the ventilated patient still has an episode of raised ICP (generally > 20 mmHg for more than 5-10 minutes), then the options for active management of raised ICP are listed in escalating order:

1. **Deepen sedation:** recheck basics including ventilation (CO₂ and oxygenation) and monitoring system (including ICP waveform). There should be sufficient sedation to make the patient unresponsive to external stimuli.
2. **Neuromuscular blockade:** bolus 10mg cisatracurium. If ICP comes down, then deepen the sedation. The aim of paralysis is cessation of patient coughing or moving in response to stimuli = to reduce train-of-four to two twitches. Do regular neuromuscular monitoring if the patient is paralysed.
3. **Drain CSF** from an intra-ventricular drain for 5 minutes with the drain set at 5cm above the auditory meatus (unless draining continuously at 5cm). Then monitor for 10 minutes **NB: ICP must be measured with drain closed.** Repeat as necessary
4. **Osmotherapy** should only be used to buy time, and after specialist consultation. It is **contraindicated if serum osmolality > 315 mosm/kg**. Use 3% hypertonic saline (100 – 200 ml boluses) or mannitol 20% (100ml). Expect a greater diuretic effect with mannitol.
5. Manual hyperventilation should only be used to buy time in a life threatening emergency, and is not routinely used for elevated ICP.

The ICU Specialist and the neurosurgeon should be notified when the ICP rises for the first time, or when the ICP does not respond to drainage of CSF and boluses of sedation **before the use of hypertonic saline, mannitol or frusemide.**

If ICP remains > 20 mmHg for 15 minutes despite the above treatment:

1. Recheck the monitoring system. Does the ICP monitor show a normal waveform?
2. Notify neurosurgeon and intensivist

Second line treatment for persistent intracranial hypertension:

1. If a bolus of 250 mg fentanyl lowers the ICP, then more sedation is required.
2. Optimize fluids. If fluid balance > 2000 ml positive consider frusemide IV. If serum Na < 150 mmol/L, give 3% hypertonic saline bolus 100ml.
3. Open EVD to continuous drainage (normally set at 5 cm)
4. Mild hypothermia: cool to between 36.5 and 37.0 °C, but don't allow temperature to fall below 36.0
6. Neuromuscular blockade: Bolus as above then, if required, infuse neat cisatracurium at 0.05 – 0.15 mg/kg/hr. **Neuromuscular monitoring** (maintain Train Of Four 1/4 at the ulnar nerve) **is mandatory when a relaxant infusion is used.**
7. Thiopentone 2 mg/kg boluses. If necessary move on to an infusion 100 mg/hr, and increase to achieve burst suppression on EEG. **Bedside EEG monitoring is mandatory if a thiopentone infusion is used** [BIS is an acceptable substitute if you ignore the number and look at the waveform from the frontal EEG]. Back off to the minimum effective dose when burst suppression has been achieved for 20 minutes, cease infusion when ICP controlled for 24 hours.
8. By this point you **must** have a pressure-relieving mattress on the bed!
8. Consider late decompressive craniectomy in selected cases.

NB: The BP goals will be different for the patient with an unclipped aneurysm or vasospasm following aneurysm surgery. Vasopressors may be required, but only if euvolaemia has been achieved. ***The BP goals should be documented. Discuss the use of vasopressors with the ICU consultant before you start them.***

The MAP best correlates with organ perfusion, and the systolic blood pressure best corresponds with the risk of bleeding. The systolic BP should be monitored with a non-invasive cuff, and decisions about management made from the non-invasive value, because the intravascular waveform will often over read the systolic value.

1. Brain Trauma Foundation. American Association of Neurological Surgeons. Congress of Neurological Surgeons. Guidelines for the management of severe traumatic brain injury [Erratum appears in J Neurotrauma 2008; 25: 276-8] *J Neurotrauma*, 2007, 24 Suppl 1:S1-106.
2. Cooper DJ et al. Decompressive Craniectomy in Diffuse Traumatic Brain Injury. *N Engl J Med* 2011; 364: 1493-502 (the DECRA trial)

What to do if a patient complains of pain

1. Ask the patient to describe the pain. A full pain history should include:

- Site
- Severity (can be “measured” by asking the patient to give a score from 0-10 where ‘0 equals no pain and ‘10 equals the worst pain imaginable’)
- Timing (e.g. onset, duration)
- Nature (e.g. sharp, dull, colicky)
- Radiation
- Relieving and exacerbating factors
- Associated symptoms
- Effect on sleep, moving, deep breathing and coughing
- Previous pain experiences, personal beliefs and expectations

NB: There are many behavioural, psychological and social factors that influence a patient’s response to, and report of, pain. Anxiety and depression will reduce the ability to cope with pain. There is usually a poor correlation between the patient’s assessment of pain and the nursing or medical assessment of the pain the patient is experiencing. **In general, pain is what the patient says it is!** If a patient is unable to give a self-report of pain, then functional assessment will be less biased than staff observation of behaviour and/or vital signs. The ability to take deep breaths, cough, ambulate and cooperate with physiotherapy will give some indication of the effectiveness of analgesic therapy. **Thus, pain should be assessed at rest and during activity.**

It is also useful to characterize the pain as *nociceptive* or *neuropathic*. Nociceptive pain results from the stimulation of nociceptors by tissue damage or inflammation, and is the most common type of acute pain seen in the Intensive Care Unit. Neuropathic pain results from disease or injury to the peripheral or central nervous system, and may be seen following post-thoracotomy, post-amputation, traumatic injury of nerve plexi, third-degree burns, and neuropathies (eg Guillain-Barre). A description of neuropathic pain might include ‘shooting’, ‘burning’, ‘tingling’, ‘crawling’, ‘raw’ and ‘sensitive’, and the pain will often be associated with sensory loss or distortion. The distinction can be important, because neuropathic pain is relatively resistant to opioids.

2. Consider the likely cause of pain. Think about the original cause for patient admission. Think about possible complications (e.g. infection, leaking anastomosis, bleeding) particularly with unexpectedly high levels of pain in the postoperative phase. NB: Effective analgesia does NOT interfere with the ability to diagnose surgical conditions before or after surgery.

3. Prescribe analgesics -or- alter the current prescriptions to increase the amount of analgesia provided.

4. Re-assess the patient frequently, and change prescriptions as required. Allow sufficient time for drug levels to peak or reach steady state first. (E.g. IV bolus morphine reaches a peak effect at 15 minutes, but the final steady state concentration of morphine given by infusion is not attained until five drug half-lives have passed. If analgesia is inadequate, then a bolus of drug needs to be given before increasing the infusion rate).

5. If you need advice, please ASK a senior colleague at anytime! *Unrelieved pain is as important as any organ dysfunction.* Contact the ICU Duty Specialist, or the Anaesthetic Registrar on duty for the Pain Service (page 17071) or Dr Suyin Tan or Dr Oliver Shaw (Staff Specialists for the Acute Pain Service at Nepean).

We cannot specify what to do in every situation, but there are some general principles that will help you decide the amount and type of analgesia that is likely to be helpful:

- Aggressive and possibly pre-emptive treatment of acute pain will reduce myocardial oxygen consumption, respiratory complications (atelectasis and sputum retention), the neuroendocrine

stress response, muscle spasm and immobility, patient anxiety, and the subsequent incidence of chronic pain

- Multi-modal analgesia (ie the combined use of different classes of analgesics) produces better analgesia with lower doses and fewer side-effects than single agent analgesia
- Patient-controlled analgesia (PCA) in a mentally competent patient provides better pain relief and patient satisfaction and respiratory performance than staff-controlled analgesia (this *particularly* applies to the IV administration of opioids)
- A combination of opioids and local anaesthetic produces the best analgesia via the epidural route
- The use of long-acting oral opioids is appropriate for trauma-associated persistent nociception, which may continue into the rehabilitation phase
- Supervision of PCA by an Acute Pain Service reduces the incidence of side-effects and complications

Multi-modal analgesia should include:

1. **Paracetamol**- regular dosing should be used (maximum 4g/24 hours- reduce in the elderly). Use an IV formulation if the oral route is not available.
2. **Non-steroidal analgesics** (not suitable for patients with acute or incipient renal failure, after CABG, patients with acute bleeds or coagulopathies, and usually not for elderly patients). Examples are parecoxib (40mg as a stat dose lasts for 24 hours) and indomethacin (100mg rectally b.d. or 25-50mg tds orally). NSAID are more effective for musculoskeletal pain and renal colic than opioids.
3. **Tramadol** has noradrenergic and serotonergic effects that are beneficial even if combined with opioids (tramadol dose 50-100mg IV/orally 6hrly). Tramadol use is contra-indicated in patients taking a SSRI and is relatively contra-indicated in the elderly, or those with severe renal and hepatic dysfunction.
4. **Opioids**- There can be up to a tenfold inter-patient variation in the amount of opioid required to obtain the therapeutic effect with minimal side-effect. It is necessary to individualise and titrate doses. **Age is the initial guide for dosage (NOT body weight)**, and dosing intervals depend on the route of administration, monitoring of pain and sedation scores. Example: age < 70 years: use 1-4mg morphine IV boluses, age > 70 years: use 0.5-2mg morphine IV boluses. The intravenous route in general ICU patients is usually more reliable than oral or subcutaneous routes. In opioid naïve patients aged between 20 and 70 years, the average first 24-hour maintenance PCA morphine requirements after major surgery = 100 – age (in mg). A decrease in respiratory rate is a late and unreliable marker of respiratory depression; a sedation score is a more sensitive indicator of overdose. Morphine and fentanyl are the preferred intravenous opiates. Pethidine can have more side-effects with lesser analgesia, and thus should be reserved for epidural use where it is particularly beneficial.
5. Antidepressants (such as amitriptyline) and anticonvulsants (such as gabapentin or pregabalin) are effective in the treatment of traumatic or postsurgical neuropathic pain.

Good references for the management of pain are:

- Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine “Acute pain management: scientific evidence” 3rd Edition 2010 (available from ANZCA)
- Acute Pain Management A practical guide: 2nd Edition; Pamela E. Macintyre & L. Brian Ready, Harcourt Publishers Ltd 2001 ISBN 0-7020-2581-X

Prescription for PCA (Patient-Controlled Analgesia)

- PCA is suitable for patients following major surgery and those with marked 'incident' pain (e.g. fractured ribs, painful dressings). Contraindications include untrained nursing and medical staff, patient refusal, patient inability to comprehend the technique, extremes of age, and physical inability to push the button. A past or current addiction to opioids is *not* a contraindication.
- Use the PCA form and comply with the standing orders on the chart.
- Document it on the nursing flow chart as "Fentanyl (or whatever) PCA infusion" including the infusion volume, type of fluid and total drug.
- PCA is a good way to maintain patient comfort, but an inefficient way to gain initial comfort. A loading dose of opioid is required using manual titration of intermittent doses at intervals of 5 minutes (e.g. < 70 yrs: use 1-4mg morphine boluses; age > 70 yrs: use 0.5-2mg morphine boluses). Once the patient is comfortable, then the PCA can be commenced.
- *Incremental bolus doses:*
 1. Morphine 1 mg (1mg/ml solution)
 2. Fentanyl 20µg (20µg/ml solution)
 3. Start with half these amounts for patients > 70 yrs
 4. Double the dose if analgesia is inadequate and the patient is getting > 3 doses per hour. Ideally, a patient should be comfortable with 3 or less boluses per hour.
- *Lockout period: 5 minutes*
- *Background infusion:*
 1. 0 mg/hr before the patient's opioid requirements are known
 2. Use background infusion in selected patients only, and rate should not exceed the size of the bolus dose. These patients might include opioid-dependent patients, those with severe pain at night, and those needing PCA for long periods.
- *PCA in the opioid-dependent patient:*
 1. These patients may require much larger doses of opioid and a background infusion
 2. Calculate an appropriate background infusion based on 75-100% of their normal daily requirement (calculate equi-analgesic doses for 24 hours using a ratio of 3:1 for conversion from oral to IV morphine, and a ratio of 2:1 for methadone to IV morphine).
 3. Bolus dose is the same as the infusion dose in mg/hr e.g. 4mg/hr = 4mg bolus
- *If analgesia is inadequate:*
 1. Consider a post surgical or post injury complication
 2. If receiving ≤ 2 boluses/hr, re-educate the patient re PCA mechanism. Patients often need repeated reassurance and encouragement to use a PCA
 3. If receiving ≥ 3 boluses/hr, increase the size of the bolus dose
- *If over-sedation is a problem:*
 1. Sedation score ≥ 4 (=very drowsy or unresponsive), and respiratory rate > 8/min: reduce (e.g. half) bolus dose
 2. Sedation score ≥ 4, and respiratory rate < 8/min: give naloxone 100µg IV stat and cease PCA. *Repeat naloxone 3 minutely prn to a total of 400µg.*
 3. Sedation score = 5 (unresponsive) regardless of respiratory rate: give naloxone 100µg IV stat and cease PCA. *Repeat naloxone 3 minutely prn to a total of 400µg.*
 4. Don't forget that naloxone has a shorter elimination half-life than morphine or fentanyl, and re-narcotization can occur as naloxone levels wane.

Always notify the Acute Pain Service if a patient is discharged to the ward with a PCA (*particularly* if it was commenced in ICU!). Either page the CNC for Pain Management (Maria on 17267) during office hours, or the Anaesthetic Registrar on for pain service (pager 17071), or fill in a PCA form headed "Nepean Hospital Acute Pain Service" and leave that form in the white folder in Recovery.

Intubation of ICU patients

The Intensive Care Unit is not an operating room. Intensive care patients are different for the following reasons:

- Intubation is generally at least “semi-urgent”, and frequently under less than ideal conditions
- Patients have little or no respiratory or haemodynamic reserve, compared with elective patients. There is no time to stuff around.
- Patients are rarely ‘fasted’ – even if not eating, gastric stasis is common
- Difficult anatomy and difficult intubation is at least ten times more frequent in ICU patients than in the operating theatre

Generally registrars should have gained basic airway skills under controlled elective circumstances in the operating room before being expected to intubate a patient in ICU. **Do not** assume that things are going to go as they do in theatre.

Before doing anything you can’t reverse think about the following:

1. **Technique.**

Sick very obtunded patients can sometimes be intubated with no drugs except perhaps a spray of lignocaine to the cords.

If upper airway reflexes are present then drugs should generally be used. Thiopentone and suxamethonium (with cricoid pressure) is the standard rapid sequence technique for intubation. **Remember sedative or induction drugs should only be given in a fraction of the dose you would use for a healthy patient. The same dose of muscle relaxant is used.**

Beware the contraindications to suxamethonium: hyperkalaemia (from any cause), acute renal failure and tetanus. ‘Sick’ bedbound patients develop a relative myoneuropathy after a few weeks and suxamethonium can potentially cause a significant rise in K^+ in these patients. In these situations consider the use of non-depolarising relaxants eg rocuronium (1mg/kg). With the latter paralysis will persist, and this may turn into a life-threatening situation if intubation is unsuccessful. There is no single right answer for a dilemma like this, and the advantages and disadvantages of each technique need to be considered on a patient-by-patient basis.

2. In trauma there IS a right answer, and a definitive trauma rapid sequence intubation sequence is specified in the procedural competencies.

NOW DO THE FOLLOWING

3. **Examine the patient’s airway using the American Society of Anesthesiology algorithm**, looking for predictors of difficult intubation.
4. **Check your equipment.** Before embarking on an intubation check: two working laryngoscopes, suction on and immediately to hand, drugs including emergency drugs available, appropriate tube checked, ventilator available and checked, alternative means of ventilation available and checked (Laerdal bag or Mapleson D circuit). Capnograph must be turned on. Check your difficult intubation equipment – as a minimum a nylon bougie and laryngeal mask airway must be available.
5. **Think about what you would do in a ‘can’t intubate, can’t ventilate’ situation.** That algorithm has to be totally automatic as you won’t be able to go from first principles in a crisis.
6. **Have multiple assistants available and instructed.** An emergency intubation is a great test of crew resource management.

7. **Have an IV line running with a pump set** in case you need to give fluid rapidly for hypotension. If the patient is sick, have some metaraminol or ephedrine drawn up ready to use.
8. **Confirm the tube position** by capnography immediately after intubation.

What to do if you can't intubate?

If you can mask ventilate: have your one best attempt at intubation and then stop. If you still can't intubate with optimal positioning and optimal equipment then repeated attempts wouldn't help and can just turn a controlled situation into a catastrophically uncontrolled situation. Stop trying to intubate, mask ventilate and call for help (ICU specialist, anaesthetic registrar, consultant anaesthetist, or all three depending on circumstances).

If you can't mask ventilate: again, **one best attempt** to intubate then stop trying. Call for help. Insert a laryngeal mask airway (LMA), which in most cases provides at least a partial airway and allows oxygenation while you wait for help to arrive. If the LMA fails and the patient remains apnoeic you are committed to providing an emergency surgical airway. Hopefully you have already done this once on an animal during your EMST course.

Emergency surgical airway is a CRICOTHYROTOMY, not a tracheostomy. Make a 1cm transverse cut over the cricothyroid membrane, push a pair of dilators or large forceps in to the airway and insert a cuffed 6.0 mm tracheostomy tube (or failing that a 6.0 cuffed ETT). Confirm placement with capnography.

Ventilator emergencies - What to do if the patient desaturates?

You will be frequently asked to assess a ventilated patient who suddenly desaturates. Most commonly it will be due to sputum plugs causing an acute V/Q mismatch, especially after a change of position. Before making that conclusion, however, you need to:

1. Switch to 100% oxygen while you are sorting things out

2. Then consider what the cause of the problem could be:

- **Is the ventilator functioning?** Is the circuit disconnected? If in doubt, bypass ventilator problems by manually ventilating the patient with a self-inflating bag. If the patient is PEEP dependent (eg ARDS), don't take them off the ventilator.
- **Check tube position.** Is the tube in the airway? Check the capnography, and ensure that CO₂ is coming out.
- **Try to pass a suction catheter down the tube.** Is the tube blocked with secretions or kinked or obstructed by the patient?
- **Check chest expansion and air entry on both sides of the chest.** Are they symmetrical? Are they the same as earlier in your shift? If not: consider an endobronchial tube (has the tube worked its way in?) a pneumothorax or major acute collapse of part of the lung. If in doubt, get an urgent CXR.
- **Is patient-ventilator dysynchrony a problem?** If the patient is "fighting the ventilator" a bolus of sedation might be appropriate. Neuromuscular blockade is almost always the wrong thing in this situation.
- Get a blood gas. Remember this is not therapeutic and should not come in front of points 1 – 4.
- **Think about recruitment manoeuvres**, either with a self-inflating bag or a short (30 second) application of high PEEP using the ventilator.

If the problem does not rapidly resolve, discuss this with the Duty Specialist or Senior Registrar NOW.

What about a patient “fighting the ventilator”?

‘Fighting the ventilator’ applies to a distressed patient trying to breathe in or out against a machine that is trying to do the opposite. More generally, if your patient is agitated and difficult to ventilate do the following:

1. **Suction the patient.** Check the tube and equipment – the patient may be struggling because his endotracheal tube is obstructed
2. **Check the ventilator settings.** Are the machine settings appropriate? Are the alarm limits appropriate? Many ventilators will instantly dump a breath if the high pressure limit is reached, e.g. during a cough. If high pressures (above 30 cm H₂O) are an issue you may be better served by a pressure limited rather than volume limited mode of ventilation (discuss this with the Specialist if you are unsure)
3. **Give a sensible bolus of sedation.** Try not to get into a vicious cycle of over-sedation for agitation when the actual problem is elsewhere. There are some patients, especially young muscular men, who don’t tolerate a ‘slow awakening on a tube’ and just need to be extubated. If you need to sedate someone just to keep them intubated then rethink whether they actually need a tube!
4. **Again, there is ALMOST no place for neuromuscular blockade here** – generally you just hide a problem rather than fixing it and it can be life threatening if the patient is struggling because of an airway problem.

If you can’t rapidly fix the problem, discuss it with the Duty Specialist or Senior Registrar.

What about tracheostomy problems?

Tracheostomies are used frequently in Intensive Care but have their own risks and problems. The vast majority are performed in ICU using a percutaneous dilatational technique.

1. Don't even think about touching a 'fresh' tracheostomy (less than a week old). If you take it out the track will close and you will **NOT** be able to get it back in. If you push a tube in blindly you are most likely to cannulate the anterior mediastinum.
2. If a fresh tracheostomy "falls" out or something awful happens to it, put an occlusive dressing (or someone's thumb) over the hole and re-establish the airway from above with oral intubation. Push the ETT down until any air leak stops – the cuff is then at or just below the stoma. The tracheostomy can then be **electively** re-established when senior staff are available.
3. If there is bleeding from a tracheostomy, notify the Duty Specialist. Minor bleeding is usually controlled with pressure or Caltestat. Occasionally an anterior jugular vein will require ligation or diathermy. A catastrophic (and usually lethal) late complication of low tracheostomy is the development of a tracheo-innominate fistula with torrential haemorrhage. The only thing that can be done is put your finger in the stoma and try to compress the artery against the back of the sternum, while running to the operating theatre for surgical control. This shouldn't happen with proper placement of the tracheostomy between first and second tracheal rings.

MANAGEMENT OF THE DIFFICULT AIRWAY (paraphrased from the ASA website www.asahq.org)

These Practice Guidelines 2002 up-date the 1993 publication of ASA's Guidelines for Management of the Difficult Airway.

A difficult airway is defined as the '*clinical situation in which a conventionally trained anaesthetist experiences difficulty with face mask ventilation of the upper airway, difficulty with tracheal intubation, or both*'.

The purpose of these Guidelines is to make the management of difficult airways easier, and to reduce the likelihood of an adverse outcome. Adverse outcomes include (but are not limited to): death, brain injury, cardiac arrest, unnecessary tracheostomy, airway trauma and damage to teeth.

Before attempting ANY intubation you need to go through the following:

Evaluation of the Airway

1. **Take an airway history before any attempt at airway management** to detect medical, surgical, and anaesthetic factors that may indicate the presence of a difficult airway. Examine previous anaesthetic records
2. **Physically examine the airway before any attempt at airway management** to detect physical characteristics that may indicate the presence of a difficult airway. Multiple airway features should be assessed systematically, because no single feature is a reliable indicator of difficulty. (*Table 1*)

The importance of oxygenation

1. **Traditional pre-oxygenation (3 or more minutes of tidal volume ventilation) is more effective than fast-track pre-oxygenation** (i.e., four maximal breathes in 30 seconds) in delaying arterial desaturation during subsequent apnea.
2. **Continue to deliver supplemental oxygen throughout the process of difficult airway management, and monitor oxygen saturations continuously.** You could use nasal cannulae, facemask, LMA, insufflation, or jet ventilation during intubation attempts; and oxygen by facemask, blow-by, or nasal cannulae after extubation of the trachea.

Strategy for Intubation of the Difficult Airway

Having identified that intubation might be difficult, you need to:

1. **Assess the likelihood and anticipated clinical impact of four basic problems that may occur alone or in combination:**
 - a. Difficult ventilation
 - b. Difficult intubation
 - c. Difficulty with patient cooperation
 - d. Difficult surgical airway
2. **Consider the relative merits and feasibility of three basic management choices:**
 - a. Awake intubation *versus* intubation after induction of general anesthesia
 - b. Use of non-invasive techniques for the initial approach to intubation *versus* the use of invasive techniques (i.e. tracheostomy or cricothyrotomy)
 - c. Preservation of spontaneous ventilation during intubation attempts *versus* ablation of spontaneous ventilation during intubation attempts
3. **Identify your preferred approach to:**
 - a. Awake intubation.
 - b. The patient who can be adequately ventilated but is difficult to intubate.
 - c. The life-threatening situation in which the patient cannot be ventilated or intubated.
4. **Identify alternative approaches to be used if your preferred approach fails or is not feasible:**
 - a. Table 2 displays options for difficult airway management.
 - b. Airway management in the uncooperative or pediatric patient may require an approach (e.g., *intubation* attempts after induction of general anesthesia) that is not the first choice (e.g., awake intubation).
5. **Use end tidal CO₂ to confirm tracheal intubation.**

Strategy for Extubation of the Difficult Airway

If a patient was difficult to intubate, you must have a plan for extubation. You should:

1. Consider the relative merits of awake extubation *versus* extubation before the return of consciousness. Generally, an awake extubation is preferred in ICU.
2. Evaluate the general clinical factors that affect ventilation after the patient has been extubated (such as poor cough leading to sputum retention).
3. Formulate a re-intubation plan should the patient not be able to maintain adequate ventilation after extubation. This must be done BEFORE the extubation.
4. Consider the short-term use of a device that can serve as a guide for re-intubation. This is inserted through the lumen of the tracheal tube and into the trachea before the tracheal tube is removed. The device may be rigid to facilitate intubation and/or hollow to facilitate ventilation.

Follow-Up Care

The nature of any airway difficulty should be documented in the patient medical records. You must document:

1. What airway difficulties were encountered. Distinguish between difficulties encountered in face-mask or LMA ventilation and difficulties encountered in tracheal intubation.
2. What airway management techniques were used. Indicate the extent to which each of the techniques served a beneficial or detrimental role in management of the difficult airway.

The patient (or responsible person) must be told about the airway difficulty that was encountered and given a letter for future reference. The documentation should include: the presence of a difficult airway, the apparent reasons for difficulty, how the intubation was accomplished, and the implications for future care. As well as the letter you must: notify the patient's ward team and local doctor, consider a Medic-Alert bracelet, and flag the medical notes.

The patient must be followed up for complications such as: oedema, bleeding, tracheal and esophageal perforation, pneumothorax, and aspiration

Description of the Difficult Airway

1. Difficult Face Mask Ventilation.

It is *not* possible for the anaesthetist to provide adequate face mask ventilation due to one or more of the following problems: inadequate mask seal, excessive gas leak, excessive resistance to the ingress or egress of gas. Signs of inadequate face mask ventilation include (but are not limited to): *absent or inadequate chest movement, absent or inadequate breath sounds, auscultatory signs of severe obstruction, cyanosis, gastric air entry or dilatation, decreasing or inadequate SpO₂, absent or inadequate exhaled CO₂, absent or inadequate spirometric measures of exhaled gas flow, and hemodynamic changes associated with hypoxemia or hypercarbia (e.g. hypertension, tachycardia, arrhythmia).*

2. Difficult Laryngoscopy.

It is *not* possible to see any portion of the vocal cords after multiple attempts at conventional laryngoscopy.

3. Difficult Tracheal Intubation.

Tracheal intubation requires multiple attempts, in the presence or absence of tracheal pathology.

4. Failed Intubation.

Placement of the tracheal tube fails after multiple intubation attempts.

Table 1: Components of the Preoperative Airway Physical Examination

This table displays some findings of the airway physical examination that may suggest the presence of a difficult intubation. The table is not intended as a mandatory or exhaustive list of the components of an airway examination. The order of presentation in this table follows the "line of sight" that occurs during conventional oral laryngoscopy.

Airway Examination Component	Non-Reassuring Findings
1. Length of upper incisors	Relatively long
2. Relationship of maxillary and mandibular incisors during normal jaw closure	Prominent "overbite" (maxillary incisors anterior to mandibular incisors)
3. Relationship of maxillary and mandibular	Patient cannot bring

incisors during voluntary protrusion of mandible	mandibular incisors anterior to (in front of) maxillary incisors
4. Interincisor distance	Less than 3 centimeters
5. Visibility of uvula	Not visible when tongue is protruded with patient in sitting position (e.g. Mallampati class greater than II)
6. Shape of palate	Highly arched or very narrow
7. Compliance of mandibular space	Stiff, indurated, occupied by mass, or non-resilient
8. Thyromental distance	Less than 3 ordinary finger-breadths
9. Length of neck	Short
10. Thickness of neck	Thick
11. Range of motion of head and neck	Patient cannot touch tip of chin to chest, or cannot extend neck

Table 2: Techniques for Difficult Airway Management

IMPORTANT: This table displays commonly cited techniques. It is not a comprehensive list. The order of presentation is alphabetical and does not imply preference for a given technique or sequence of use. Combinations of techniques may be employed. The techniques chosen by the clinician in a particular case will depend upon specific needs, preferences, skills, and clinical constraints.

I. Techniques for difficult intubation

Alternative laryngoscope blades
Awake intubation
Blind intubation (oral or nasal)
Fibreoptic intubation
Intubating stylet/tube changer
Intubating laryngeal mask airway
Light wand
Retrograde intubation
Invasive airway access

II. Techniques for difficult ventilation

Oesophageal-tracheal combitube
Intratracheal jet stylet
Laryngeal mask airway
Oral and nasopharyngeal airways
Rigid ventilating bronchoscope
Invasive airway access
Transtracheal jet ventilation
Two-person mask ventilation

Difficult Airway Algorithm (on the next page): Footnotes

- Other options include (but are not limited to): surgery utilizing face mask or LMA anaesthesia, local anaesthesia infiltration or regional nerve blockade. Pursuit of these options usually implies that mask ventilation will not be problematic. Therefore, these options may be of limited value if this step in the algorithm has been reached via the Emergency Pathway.
- Invasive airway access includes surgical or percutaneous tracheostomy or cricothyrotomy.
- Alternative non-invasive approaches to difficult intubation include (but are not limited to): use of different laryngoscope blades, LMA as an intubation conduit (with or without fibreoptic guidance), fibreoptic intubation, intubating stylet or tube changer, light wand, retrograde intubation, and blind oral or nasal intubation.

BiPAP & Non-invasive Ventilation in Acute Respiratory Failure

Desired Outcome

1. Adequate non-invasive ventilatory support for hypercapnic respiratory failure (thereby avoiding endotracheal intubation with all its complications). NB: Non-invasive ventilation will not usually normalize CO₂ levels.
2. Symptomatic relief of dyspnoea
3. Improvement of cardiac function in the presence of ischaemia and/or left ventricular afterload sensitivity

Prescriptions for IPAP/EPAP settings must be written on the flow chart.

Indications and Contra Indications

Pressure support ventilation is used for hypercapnic respiratory failure secondary to respiratory muscle failure, high inspiratory workloads, or reduced alveolar ventilation.

Definite indications for BiPAP include:

1. ***Exacerbations of COAD associated with hypercapnia***
2. ***Cardiogenic pulmonary oedema associated with hypercapnia and/or unresponsive to CPAP alone***
3. ***Respiratory distress and pulmonary infiltrates in immunosuppressed patients***
4. ***Acute-on-chronic hypercapnic respiratory failure due to chest wall deformity or neuromuscular disease***
5. ***Decompensated obstructive sleep apnea with hypercapnia***

Currently there is insufficient data to support the routine use of BiPAP or any other form of non-invasive ventilation in other forms of acute lung injury, including post-operative or post-traumatic acute respiratory failure. In selected patients with hypoxaemic respiratory failure without hypercarbia (including community-acquired pneumonia) BiPAP may be useful, but the evidence suggests that invasive ventilation leads to a better outcome for this group overall. Intubation should be undertaken **early** if the BiPAP is unsuccessful. BiPAP may also be used as an aid to weaning from ventilatory support post-endotracheal extubation to avoid re-intubation, but only if the original indication for the mechanical ventilation is listed above as a definite indication for BiPAP. Those patients with other forms of acute lung injury (post-operative, post-traumatic or pneumonic respiratory failure) who fail a trial of endotracheal extubation should simply be re-intubated if mechanical ventilation is required again.

Definite contra-indications include:

1. ***A reduced level of consciousness which results in an unprotected airway (GCS < 10)***
2. ***Neurotrauma associated with raised intracranial pressure or fractured base of skull***
3. ***Recent upper gastrointestinal surgery***
4. ***Burns or trauma affecting the face***
5. ***Bowel obstruction and/or vomiting***
6. ***Severe confusion/agitation***
7. ***Patient failure to clear respiratory secretions***

BiPAP should not be used as a substitute for endotracheal intubation and invasive ventilation when the latter is clearly more appropriate (e.g. post-arrest, major haemodynamic instability requiring inotropes, uncontrolled arrhythmias, moribund asthmatics, fixed obstruction of the upper airway, life-threatening hypoxaemia).

NB Any pneumothoraces should be drained before commencing non-invasive ventilation!

Knowledge of arterial blood gases is essential before deciding whether BiPAP should be applied, because most of the benefit of non-invasive ventilation has been demonstrated in patients with a respiratory acidosis ($\text{pH} < 7.35$). The patient should first be established on appropriate oxygen therapy and the ABG interpreted in light of the FiO_2 , because ABG often improve rapidly with maximum medical treatment and appropriate supplementary oxygen.

There are 3 ways BiPAP may be used:

- As a holding measure to assist ventilation in patients at an earlier stage than that at which invasive ventilation would be considered
- As a trial with a view to intubation if the BiPAP fails
- As a ceiling of treatment in patients who are not candidates for intubation

The decision about intubation if BiPAP fails should be made early for each patient after due consultation with senior medical staff and the patient and family, and DOCUMENTED in the notes.

Factors associated with success in non-invasive ventilation:

- High PaCO_2 with low A-a oxygen gradient
- pH 7.20-7.35
- Stabilisation of pH , PaCO_2 , and improvement in respiratory rate after 1 hour of treatment
- Good level of consciousness with good airway reflexes

Factors associated with failure in non-invasive ventilation:

- High APACHE score
- Pneumonia
- Copious respiratory secretions
- Edentulous state
- Poor nutritional state
- Confusion or impaired consciousness

Monitoring

The first 1- 6 hours of BiPAP is labour intensive and will ideally have one-to-one nursing. However, nurse allocation is at the discretion of the Clinical NUM or Team Leader.

Regular clinical assessments should be made and include:

- Chest wall movement (should be obvious and simultaneous with IPAP phase)
- Co-ordination of patient respiratory effort with the ventilator
- Accessory muscle use
- Patient comfort and conscious state
- Pressure areas on the skin beneath the mask

Successful treatment usually implies visible improvement in chest wall movement. If this does not occur, causes should be sought (such as inappropriate IPAP, patient intolerance, leaks around the mask or the open mouth).

Physiological assessment includes:

- Hourly heart rate
- Hourly respiratory rate
- Continuous or hourly oxygen saturation (in general should be $> 90\%$)
- Frequent ABG (at baseline, 1 hour, 4 hours and varying intervals thereafter)

Common reasons for BiPAP failure include:

- Excessive air leak due to poorly fitting mask
- Patient intolerance of mask
- Intermittent upper airway obstruction that is not overcome by the IPAP/EPAP settings

- Patient-ventilator dysynchrony e.g. brief rapid inspirations won't give the machine time to cycle into expiration, so that the patient's expiratory effort begins while the machine is still delivering inspiratory gas. This may also be due to large air leak
- Inadequate patient inspiratory effort fails to trigger IPAP e.g. following large tidal volumes associated with large IPAP values
- Poor EPAP/IPAP selection e.g. the lower the EPAP, the more re-breathing occurs vs. the greater the EPAP, the greater the level of patient discomfort

Likely problems and how to deal with them

Problem	Response
PaCO ₂ remains elevated	<p><i>Is the patient on too much oxygen?</i> Aim for SpO₂ 90-92%.</p> <p><i>Is the air leak excessive?</i> Check mask fit and examine circuit for leaks.</p> <p><i>Is re-breathing occurring?</i> Check the patency of the expiratory port and consider an increase in EPAP to flush out more expired gas. The expiratory port should be as close to the mask as possible.</p> <p><i>Is patient-ventilator dysynchrony a problem?</i> Observe the chest wall movement and consider the factors above.</p> <p><i>Is the minute ventilation inadequate?</i> Observe chest expansion and the measured tidal volume. Consider an increase in IPAP.</p> <p>If the PaCO₂ fails to improve despite BiPAP for 2-4 hours, invasive ventilation should be considered. Intubation should occur earlier if the patient clinically deteriorates with respiratory distress.</p> <p>Consider complications such as aspiration, pneumothorax</p>
PaCO ₂ improves but PaO ₂ remains low	Increase FiO ₂ . Consider an increase in EPAP
Excessive air leak	A small leak is acceptable as long as it does not blow towards the eyes. If the leak is large, check mask fit and adjust as required. Insert any false teeth. Check for circuit leaks. Consider a reduction in pressure if the mask fits well and tidal volumes are adequate. If tidal volumes are inadequate, and the mask fits well, then poor lung/chest compliance may be the problem.
Hypotension in pre-load sensitive subjects	Ensure adequate intravascular volume before applying positive pressure
Decreasing level of consciousness	Check ABG for hypercarbia. BiPAP may no longer be appropriate.
Increasing confusion/agitation	Check ABG for hypercarbia. BiPAP may no longer be appropriate. If agitation is not due to the respiratory state and ABG are improving (e.g. agitation due to claustrophobia), then a SMALL amount of sedation may be appropriate (e.g. morphine 2mg IV)

Resources

BiPAP Vision Ventilator with appropriate tubing, bacterial filter, power cord and source
A range of oronasal masks (or the full facial mask) with the appropriate strapping
An exhalation port (either in the tubing or on the mask)

Steps

Before the application of BiPAP:

Procedure	Rationale
Check ABG	Baseline PaO ₂ and PaCO ₂ required for comparison
Check CXR	Exclude pneumothorax
Baseline observations (HR, RR, BP, SaO ₂)	BiPAP may not be appropriate if haemodynamically unstable
Check level of consciousness	BiPAP is not appropriate if airway is unprotected

To apply BiPAP (these instructions do *not* replace a thorough knowledge of the manual):

Procedure	Rationale
Check that all the above equipment is present at the bedside and assemble the circuit (manual page 16-2)	Ease of assembly
Choose the mask of best fit for this patient	There is no such thing as a <i>comfortable</i> mask; it is only <i>tolerable</i> . Don't compensate for a poorly fitting oronasal mask by pulling the strapping too tight (allow enough space for two fingers beneath the head straps). An oronasal mask or full facial mask is preferable to a nasal mask at least initially in acute respiratory failure, because most dyspnoeic patients are mouth breathers
Turn the machine on Connect the oxygen to wall outlet	This is always helpful
Check the patency of the exhalation port visually and using the machine port test (Manual page 3-14)	The pressurized gas causes a continuous flow of gas through the exhalation port which flushes exhaled gas from the circuit
Press the monitoring key to begin operation	The system will revert to the most recent settings
Choose the mode: CPAP or S/T or PAV/T (manual pages 8-1 to 10-1)	CPAP is generally appropriate when hypoxaemia is the sole problem, or cardiogenic pulmonary oedema is the diagnosis. S/T or PAV/T modes are appropriate when the patient has a respiratory acidosis and/or hypercarbia in addition to hypoxaemia.
Set the desired CPAP pressure - or - set the desired IPAP and EPAP settings (senior medical help is required to set PAV/T settings) and then set alarms	If the pressures are not specified by the medical team, then default initial settings are CPAP = 5, IPAP = 12 and EPAP = 5cmH ₂ O. The difference between the IPAP and EPAP settings is the pressure support
Set the backup rate to 4 breaths of 1 second timed inspiration	The minimum rate that can be set on the BiPAP is 4. If the patient's own respiratory drive and respiratory rate are inadequate, then endotracheal intubation and mechanical ventilation with a set rate should be

	considered
Set the inspired oxygen	Unless otherwise specified, sufficient to keep SpO ₂ above 90%
Adjust the CPAP, IPAP and EPAP pressures according to patient progress	See the manual or the above risk/response table for an introduction to troubleshooting patient performance. Unless otherwise specified, increase pressures by increments of 2cmH ₂ O.

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Insertion of Central Venous Catheters

Staff specialists, ICU Liaison CNC and Senior Registrars can insert lines.

Junior medical staff can insert lines after a period of supervision.

Nursing staff are responsible for the care and removal of the lines.

ICU Central Line Service

The ICU provides a Central Line Insertion Service to the wards. This service will be provided Monday to Friday and is coordinated by the CNC ICU Liaison. As part of your rotation you will be expected to insert central lines under supervision.

JMO must complete the online training for CVC insertion

(<http://www.cec.health.nsw.gov.au/resources/cli-online-training>) and print out the certificate for proof that they are ready to begin the practical training before attempting to insert lines. Give the certificate to the ICU Liaison CNC.

Inexperienced staff should have a minimum of 3 fully supervised insertions in each site (internal jugular, subclavian, femoral), before they insert lines at those sites unsupervised.

Following the insertion of a central line an insertion record must be completed. This allows us to keep a record of lines inserted. If the data entry staff can read your name on the insertion record, we can provide you with a record of the lines you inserted whilst in ICU. If your name is not clear on this record, your line insertion cannot be recorded. The insertion records are attached to the CVC insertion kits. They are in triplicate. The first 2 pages are returned to the patient notes, and the 3rd copy is put in the CLAB folder.

When filling out the CLAB form, please

- Write in black pen
- Use block letters and legible writing in free text fields
- ***Ensure your name is legible***
- One letter / square
- Colour in circles where indicated

Indications for Central Venous Catheterisation and the preferred insertion sites include:

Indications	Site 1*	Site 2**
Total parenteral nutrition	SC	IJ
Acute haemodiafiltration / plasma exchange	F	IJ
Emergency transvenous pacemaker	RIJ	LIJ or SC
Pulmonary artery catheterization	RIJ	LSC
Hypovolaemia with inability to perform peripheral venous catheterisation- use a 8 FG sheath (The peripheral route with ≥ 16 g cannulae is preferred for fluid resuscitation)	SC	IJ
General purpose venous access for vasopressor drugs and irritant medications	SC	IJ
Monitoring central venous pressure	SC	IJ
General purpose venous access when peripheral access impossible	SC	IJ

SC=subclavian, IJ=internal jugular, F=femoral, EJ=external jugular, L=left, R=right

*Site 1 indicates the preferred site of CVC insertion for that particular indication.

**Site 2 indicates a second option if the first site is unsuitable for a particular patient. For each insertion of a CVC, the clinician must think about the risk-benefit ratio for that route in that particular patient.

Factors to consider include pre-existing catheters, anatomical deformity, relative risk of bleeding and pneumothorax. **If there is uncertainty, discuss it with the Duty Specialist.**

- The subclavian is often the preferred site because it is associated with the lowest risk of colonisation and infection. It is the most suitable for long-term access (apart from PICC).
- If the patient has a coagulopathy, the femoral or external jugular veins are the preferred first site, and the internal jugulars are the 2nd choice. The subclavian site cannot be compressed directly, and has a higher risk of bleeding associated with coagulopathy.
- Relative contraindications for subclavian insertion include bilateral pulmonary pathology, high-pressure mechanical ventilation, and altered local anatomy (because of the higher risk of pneumothorax).
- If one attempt at subclavian insertion has been unsuccessful, an attempt on the opposite subclavian is relatively contraindicated because of the risk of bilateral pneumothorax
- If a unilateral pulmonary disease or intercostal tube is present, SC and IJ insertion should be done on the same side as the affected lung or the intercostal tube.
- Femoral venous lines should not be inserted through the inguinal fold-they should be inserted via a puncture site 2-3cm below the inguinal fold.

- Femoral lines are unsuitable for ambulatory or confused patients.
- Femoral lines have a greater risk of infection and thrombosis, and must be removed/changed at 6 days. They are NOT the preferred site for anything except renal replacement therapy.
- Avoid putting lines close to contaminated areas (e.g. burns, infected tracheostomy site)
- **Inexperienced operators are only allowed 3 passes for the vein at a particular site before requesting help**
- Choose an appropriate CVC – consider catheter type, number of lumens, and duration of therapy.
 - Use antiseptic coated catheters for short-term lines (approximately one week). Use antibiotic impregnated lines for long-term lines (more than one week).
 - The minimum necessary number of lumens, connectors and ports should be used.
 - TPN requires a dedicated lumen
- **A nurse or other appropriate assistant should be available to assist during the insertion to ensure asepsis and use of appropriate technique (refer to *CVC Insertion Checklist*).**

The evidence suggests that Central Line Associated Bacteraemias (CLAB) can be reduced during insertion of a CVC by:

- Strict adherence to hand hygiene protocols
- Maximal barrier precautions
- Chlorhexidine skin antisepsis
- Optimal catheter site selection, with subclavian vein as the preferred site for non tunnelled catheters
- Daily review of line necessity, with prompt removal of unnecessary lines (Pronovost et al 2006)

The sterile set up should be prepared immediately prior to the procedure.

All staff performing CVC insertions must wear full theatre personal protective equipment (PPE) that includes protective eyewear, operating theatre cap, sterile gown, sterile gloves and mask. The combined mask with visor is recommended to protect against splash injuries.

CVC Insertion kits are available which contain most of the equipment required for line insertion.

A few additional items are required

- Chlorhexidine
- Dressing
- **Suture**
- Bungs
- Normal Saline ampules x 3
- Lignocaine 1% x 2
- Ultrasound probe cover (as appropriate)

If CVC insertion kits are not available this is a list of the equipment that is required:

- Sterile gown, sterile gloves, theatre hat and mask with face shield
- General tray (contains forceps, scissors, suture forceps, plastic dishes for saline and lignocaine)
- Gauze squares
- Large fenestrated drape (or multiple smaller drapes)

- Local anaesthetic (lignocaine)
- Needle/syringes for saline and local anaesthetic
- Central Line Insertion Checklist
- Suture material
- Ampoules of 0.9% sodium chloride solution (to flush the line)
- Ampoules of full strength heparin (to soak dual lumen catheters before insertion)
- An interlink cap for each lumen
- Green 2% chlorhexidine + alcohol swabs
- Transparent occlusive dressing
- Ultrasound machine
- Ultrasound probe cover

This guideline for the insertion of a CVC is evidence-based. Please make an effort to follow it!

Procedure

- If possible, explain to the patient or family member the procedure and explain the need for a CVC. Check patient allergies.
- Set up the trolley according to the list above, organise the ultrasound machine
- Perform a pre-scan to assess the vein for patency
- Monitor pulse oximeter and ECG. Apply oxygen if required
- Position the patient according to the planned insertion site and tuck in some blueys
- Clip hair on skin (do not shave!) at least 10 cm diameter from planned entry point
- Don cap and mask/visor. Operator's long hair should be tied back
- Surgical hand and forearm scrub with antiseptic containing soap solution (such as chlorhexidine) for 2 minutes
- Don sterile gown and gloves using no-touch technique
- **Skin preparation:** Cleanse the skin liberally with gauze swabs using alcohol-based chlorhexidine (the green swabs that dry to 2% chlorhexidine), three passes using a new swab each time, spiral outwards, complete each spiral within the boundaries of the previous spiral. Allow complete drying time before needle insertion (at least a minute). Do not wipe or blot the solution
- Drape extensively to cover the patient's body and all surfaces between insertion point and the sterile trolley. Only sterilized skin should be visible
- Drape the ultrasound probe with the sterile probe cover
- Prime the catheter lumens with saline. Cap those lumens not involved in the passage of the wire
- Apply the sterile cover to the ultrasound probe and identify the vein
- Raise a skin bleb with 1% Lignocaine, and then infiltrate deeply with a 23G needle following the path of intended cannulation

- The catheter is inserted by the modified Seldinger technique. Use the J-tipped end of the guide-wire and only insert the wire 15-20 cm, there should be little resistance. Beware the loose end of the wire touching a non-sterile surface!
- If the vein is not encountered, do not change needle direction midcourse; retract the needle tip to a subcutaneous position and redirect it under ultrasound guidance. Insertion attempts are limited to 3 for inexperienced clinicians (those with < 50 CVC insertions experience)
- The average insertion depth for a SC line should be 13-15 cm on the right and 15 cm on the left
- ALL lumens must be aspirated to ensure that blood flows freely through each lumen. Flush with saline under pressure to clear the lumens. Check that the line is not in the artery by taking a blood gas or measuring the pressure
- Suture the line securely (this means that the line must be secured at two sites with *at least 3 sutures*- at the insertion site and at the plastic clamp or hub)
- Apply the dressing so that the centre of the dressing lies over the insertion site. Do **not** use antibiotic or antiseptic creams
- Discard all sharps, other waste and linen in the appropriate containers; wipe the re-usable equipment free of blood and leave it in the CSSD box
- Arrange and view a CXR post-insertion for SC and IJ lines prior to use (X-Rays are not required for femoral lines or if the Sherlock system has been used for PICC)
- Wash your hands again post-insertion with alcohol-based waterless hand cleanser or soap solution

Documentation

- Enter the procedure into intensys. Document any Complications recognized during insertion, including arterial puncture
-
- Complete the CVC insertion record. Place the first 2 copies in the patient notes and the third copy in the CLAB folder.
- For ward patients complete the green sticker and place in the patients notes.
- CXR result .Ensure CVC tip lies in the lower SVC for SC and IJ lines (at the level of the carina) and is parallel rather than perpendicular to the vessel wall.

Catheters are left in place as long as clinically indicated.

- Review the need for them on a daily basis, and remove them when they are no longer required.
- Replace them where possible with peripheral venous cannulae, because the **incidence of serious infection is greater in central than peripheral lines.**

Central lines are not routinely changed weekly or on any other schedule, with the exception of femoral lines. Femoral lines have an increased risk of associated thrombosis and infection.

The insertion site should be examined daily for redness, swelling, pain, suture integrity and catheter position. Central lines are only replaced for clinical indications:

- Infected skin site with frank pus or cellulitis
- Unidentified source of systemic sepsis and a line greater than 4 days old (a line may be the source of infection even if there is no reaction at the insertion site e.g. coagulase negative staphylococcus)
- Previous insertion of a line under less aseptic conditions outside the ICU (e.g. during resuscitation attempts). Remove the line ASAP and replace at a different site. Review the need to change lines from other hospitals as soon as a patient arrives in Nepean ICU, and check the security of the suturing.
- **All femoral catheters which are 6 days old**
- Pulmonary artery catheters (and sheath) are ideally removed after 72 hours

Guide-wire exchanges are generally discouraged and must be discussed with the ICU

consultant. One exception is a mechanical problem in a very new catheter (leaks or kinks) and difficult anatomy of a patient.

Trouble-shooting

Risk	Precaution
Bleeding	Check the clotting screen on the day of insertion. CVC insertion should be postponed (or done by experienced clinicians) if the platelet count is < 50,000 or the INR is > 1.5.
Arterial puncture	Stop procedure and compress the site for 10 minutes by the clock
Air embolism	Patient should be lying head down 15-20° during SC or IJ insertion. Keep the needle hub and catheter lumens as close to patient skin as possible. After insertion, Luer locks or Interlinks at all connections will help prevent line disconnection
Arrhythmias	Don't insert wire more than 20 cm or line more than 15 cm This would also ensure that you don't leave the wire inside the patient!
Break in sterile technique	Re-gown if required. Replace any contaminated equipment before continuing with the procedure
Pneumothorax	If patient is at high risk of pneumothorax because of lung hyper-

	expansion, the IJ site is preferable. Check CXR post-insertion (SC or IJ)
Malposition	Check CXR post-insertion (SC and IJ only). Catheter tip should lie in the lower SVC
Thoracic duct damage	Avoid the LIJ or LSC site if possible
Extravasation	Lumen patency and function should be checked before commencing an infusion. Blood should be freely aspirated from all lumens at initial insertion. Loss of blood return should raise the possibility of CVC dislodgement. The site should be checked for swelling when a saline flush is given. Continue intermittent observation of the site during any infusion
Catheter-induced thrombosis	Limit insertion attempts to 3 for inexperienced clinicians Tip of SC or IJ CVC should lie in the lower superior vena cava Any femoral CVC must be removed after 6 days regardless of the clinical situation, and must not be sent to the ward
Lumen occlusion	If precipitation of incompatible medication is observed in the giving set, giving set and fluids should be discarded. Intermittent occlusion often implies thrombus at the catheter tip
Atrial/ventricular perforation (rare) or infection	CVC tip should lie above the pericardial reflections at the level of the carina, because there is a small risk of perforating the right atrium if the tip lies below the pericardial reflection
Venous erosion or perforation	Ensure CVC tip is parallel rather than perpendicular to vessel wall (especially for LIJ lines)
Unintended arterial cannulation	Leave the line in place and consult the Duty Specialist or Senior Registrar. If you are unsure, either transduce the line pressure or take a sample of blood for blood gases

Insertion of a Peripherally Inserted Central Catheter (PICC)

Vein selection

Cubital fossa veins are most commonly used for PICC insertion. They have highly variable anatomy, so look at the patient's veins with a tourniquet and ultrasound before choosing the most suitable vein. If possible, choose the side of the non-dominant hand. The basilic vein (on the medial side at the elbow) is usually the first choice because it is the largest, and the catheter will feed most easily into the auxiliary, subclavian, and innominate veins. It also has a greater blood flow reducing the risk of thrombus formation. The second choice is the median cubital vein and the third is the cephalic (on the lateral side at the elbow). PICC in the cephalic vein have the greatest incidence of thrombosis, and the patients with a cephalic PICC should be on drug DVT prophylaxis.

PICC Selection

PICC are available as single and double lumens. Check the indication for the PICC before choosing a single or double lumen PICC. A double lumen PICC must be used for TPN and chemotherapy. If a patient is requiring inotropic support and has multiple other infusions, then a PICC is not usually appropriate and a central line should be inserted. For the patient requiring intravenous access for antibiotics a single lumen is adequate. Below is a description of the most common PICC inserted at Nepean Hospital.

Power PICC SOLO

The Power PICC SOLO catheter is a PICC with a few special functions. This catheter can be used for usual indications but can also be used for contrast power injections at up to 5mls/sec, which means a patient does not need an additional cannula for contrast injection. It also has a valve mechanism that allows fluids to flow in or out but it remains closed when not in use. This means it does not require the use of heparinised saline to lock the catheter

Bard Power injectable PICC's with Sherlock 3 CG Tip Confirmation system

An extension of the Power PICC Solo is the Sherlock 3CG* Tip Confirmation System (TCS). It is indicated for guidance and positioning of the PICC. Malpositions are common with blind PICC insertion so this allows constant monitoring of the PICC tip during insertion. The Sherlock 3CG* TCS provides real-time PICC tip location information by using passive magnet tracking and the patient's cardiac electrical activity (ECG). When relying on the patient's ECG signal, the Sherlock 3CG* TCS is indicated for use as an alternative method to chest x-ray and fluoroscopy for PICC tip placement confirmation in adult patients. (See Insertion of a Peripherally Inserted Central Catheter

(PICC) utilising the Sherlock 3CG technology for more information). At present a post insertion chest X-ray is still required.

PICC Measurement

The superior vena cava is located between the second and third intercostal space. With the patient supine and with the arm in a 90 degree angle (place arm on a bedside table)

- Locate the site of venepuncture
- Measure from the puncture site to the suprasternal notch
- Then measure down to the third intercostal space, you are at your goal. The Power PICC is then trimmed to the correct length.
- PICC tips should lie in the lower superior vena cava. If the PICC has headed up the neck, it has to be re-inserted

Equipment required (As per CVC Insertion)

Procedure for non Sherlock PICC insertion

- Explain the procedure to the patient. Check if patient has any allergies. Obtain consent.
- Gather equipment and open onto sterile field.
- Position the patient. Apply hat mask and goggles. Apply tourniquet and perform a prescan to identify a suitable vein.
- Wash hands for 2 minutes and don sterile gear.
- Prepare the skin.
- Locate and cannulate the vein. Remove the needle and observe for pulsatile flow. Pulsatile flow usually indicates arterial puncture.
- Insert tip of guide wire through the cannula and advance to required depth.
- Hold guide wire in place and remove cannula. **Maintain a firm grip on the guide wire at all times**
- Thread tapered dilator/peel away sheath assembly over guide wire. Grasping near skin, advance catheter with a slight twisting motion to a depth sufficient to enter the vessel
- Holding the sheath in place, remove the guide wire and inner dilator.
- Grasp the distal end of the PICC and start to feed catheter into the vein. At this point ask the patient to turn their head towards you with their chin placed on their shoulder, to reduce the risk of PICC entering the Jugular vein. Advance to pre-measured length. Ensure blood can be aspirated from the catheter and proceed to flush with 10mls of normal saline. Withdraw the peel away sheath until it is free from the venepuncture site. Grasp the tabs of the peel away sheath and pull apart until the sheath splits down the entire length.

- Remove the stylet and flush again
- Attach cannula cap.
- Secure with a Statlock as below

Securing the PICC using a Statlock

Cleanse the skin with the supplied skin prep. Allow to dry.

Spread wings of the flexible catheter clamp and position on catheter (ensure proper placement over Statlock posts).

Snap rectangular rigid fastener onto flexible catheter clamp

As a unit, snap catheter assembly onto Statlock posts and secure each side.

Remove paper backing from one half of the Statlock anchoring pad and press onto dry prepared skin.

Repeat the process for the other side.

Apply sterile occlusive transparent dressing and document line insertion in the patient notes. Fill out the CVC Insertion Record. Confirm placement with a chest Xray.

Insertion of PICC using Sherlock 3CG tip technology.

Refer to separate policy (Insertion of a Peripherally Inserted Central Catheter (PICC) utilising the Sherlock 3CG technology) as it is a bit lengthy to include in this manual.

What to do if your patient is an organ donor, or a potential organ donor

Some patients who die in the ICU will become organ donors. The 2 pathways via which organ donation may occur are donation following brain death (DBD) or donation following cardiac death (DCD). Further reading about these pathways can be found in the ANZICS guidelines for death and organ donation accessed via www.anzics.com.au/death-and-organ-donation or via the Nepean ICU website.

IDENTIFICATION OF POTENTIAL ORGAN DONORS:

Identification of potential organ donors remains the responsibility of all ICU staff. Preliminary identification is done by using the GIVE criteria (GCS <6, patient is Intubated and being Ventilated and End of life care is imminent). Once a patient has been identified, they need to be medically assessed for suitability to donate. The ICU consultant or the donor coordinator does this.

REQUEST FOR ORGAN DONATION:

The request for organ donation is done at senior level and only after discussion with the consultant. Once a verbal consent has been obtained, or if the family would like more detailed information, the ICU consultant/social worker involved will introduce the donor coordinator to the family.

CONSENT/WORKUP:

The donor coordinator will obtain formal consent from the family and commence the workup process for donation. Some initial tests can speed the process if already organised:

1. A formal blood group
2. Recent EUC, LFT, CMP, FBC, coagulation screen, amylase, lipase, CK, troponin and a formally reported x-ray.
3. A post brain death Echocardiogram (not required for a DCD pathway)
4. A recent ECG – reported.
5. Tissue typing bloods (boxes and instructions kept in ICU 1)

The donor coordinator will liaise with the ICU medical staff regarding further tests that may be required.

CERTIFYING DEATH:

The Human Tissue Act of 1983 outlines the two means by which death can be certified. In the case of brain death, the irreversible loss of all blood flow to the brain is determined in one of two ways:

1. Clinical testing. For bedside clinical testing to occur, there are a number of preconditions that must be filled. Two sets of tests must be carried out, one by a designated specialist, the second by a doctor who has worked for at least five out of the last eight years. Time of death is recorded as the completion of the second set of tests.
2. 3-4 vessel cerebral angiogram or radionuclide imaging. If any of the pre-conditions required to perform clinical tests cannot be met, then one of these scans needs to be performed to demonstrate no intracranial blood flow. The images and report need to be reviewed by a designated specialist and the second doctor, who will determine that the patient is brain dead. The time of death is recorded as the time that the second doctor views the scan.

In a DCD pathway, death is confirmed by the irreversible cessation of all blood flow. Withdrawal of cardio-respiratory support occurs at a pre-arranged time in consultation with the surgeons, patient's family and OT. The senior registrar or consultant should be present when withdrawal occurs. The patient continues to be monitored via an arterial line. Once output has ceased on the arterial line for 2 minutes, the doctor examines the patient and declares death. The patient is then transferred to OT for organ retrieval surgery. If, at 90 minutes after withdrawal, the patient has not died, then organ procurement is abandoned and end of life care continues as per usual.

PROCUREMENT:

Visiting surgeons perform organ retrieval in Nepean OT. Time for OT will be negotiated by the donor coordinator and will be done in consultation with the OT, surgeons and family. Management of the patient needs to continue until the patient leaves the ICU and is transferred to OT.

CONTACT:

The Nepean donor coordinator can be contacted on 0447 084 407 during business hours for referrals, questions or advice. The on-call donor coordinator can be contacted after hours via switch.

Medical management of the organ donor, or potential organ donor

The situation is time critical, as it is not possible to stabilise a brain dead patient indefinitely. Cardiovascular failure usually occurs within 72 hours after brain death. At the time that critical brain-stem ischaemia occurs, vagal stimulation (decrease in heart rate, BP, and cardiac output) is followed by additional sympathetic stimulation (the “Cushing’s response” of hypertension and bradycardia). When the lower medulla fails, there is unopposed sympathetic stimulation (hypertension and tachycardia) that may precipitate ventricular failure and pulmonary oedema. The final change is a profound reduction in sympathetic tone and circulating catecholamines (resulting in bradyarrhythmias and severe hypotension). Pituitary dysfunction may be seen (eg diabetes insipidus).

The aims of medical management are directed towards maintenance of organ perfusion and reduction of physiological problems caused by brain death. In patients who are likely to progress to brain death, pre-empting the haemodynamic changes that are likely to occur is important. In practice these goals are:

1. **Maintain body temperature between 36-37.5°C** with active cooling or heating devices. Brain death cannot be confirmed unless the central body temperature is >35°C.
2. **Maintain euvolaemia: target CVP 6-12mmHg.** Volume loading is still the first line of treatment for hypotension, because occult hypovolaemia is usually a consequence of treatment for raised ICP. If hypotension persists despite adequate volume loading, then the problem of vasodilatation need exogenous catecholamines and the choice of agent usually depends on local practice (noradrenaline at Nepean Hospital).
3. **Correct acidosis: target pH 7.40-7.45.** Aim for a normal PaCO₂ first, then use bicarbonate as required.
4. **Correct hypoxaemia: target PaO₂ > 80mmHg, SaO₂ > 95%.** Continue chest physiotherapy, suctioning and bronchodilators as required. Avoid high PEEP if the lungs are suitable for donation (use 5cm).
5. **Adjust noradrenaline to keep MAP ≥ 60mmHg: target dose is less than 0.2µg/kg/min.** High doses of adrenaline or noradrenaline will tend to result in rejection of the heart or liver for donation.
6. **Organize an echocardiogram** to rule out structural abnormalities (such as LVH, valvular disease)

7. **Diabetes insipidus** is common, but only treat it with DDAVP if the urine output is >200ml/hr for more than 2 hours. Replace the urine output with 5% dextrose, and give 0.1-0.5µg DDAVP IV 8-12 hourly. Only aim for urine output approximately 100ml/hr.
8. **Hyperglycaemia** should be treated with the usual insulin infusion to maintain BSL 4-8mmol/l.

If the result of the first 5 measures includes a MAP < 60mmHg, CVP > 12mmHg, noradrenaline dose > 0.2µg/kg/min, OR echocardiogram shows LVEF < 45% or major LV wall motion abnormality, then hormonal resuscitation is required.

Hormonal resuscitation:

9. Start vasopressin at 2.4 Units/hr
10. Methylprednisolone: 15 mg/kg IV bolus
11. T3: 4µg IV bolus + infusion at 4µg/hr
12. Insulin: 1 unit/hr titrate to a BSL 4.0-8.0mmol/l

Ongoing haemodynamic management includes adjustment of fluids and the noradrenaline infusion rate at 15-minute intervals to minimise the use of noradrenaline, **AND** to meet these targets:

- MAP > 60mmHg,
- CVP 6-12mmHg, and
- Noradrenaline < 0.2µg/kg/min.

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Infection Control and effective hand washing

- All patients admitted to the Intensive Care Unit are screened for multi-resistant organisms on admission and every subsequent Tuesday and Thursday (nose, throat and perianal swabs). Occasionally VRE audits are conducted using rectal swabs.
- **Hand washing by hospital staff is the single most important measure that reduces transmission of organisms from one patient to another.** Unfortunately, Nepean Hospital audits in 2007 have shown that medical staff only wash their hands 20-30% of times when hand washing is appropriate. **All staff entering or leaving ICU must wash their hands with soap & water or apply hand gel, whether they have any direct patient contact or not.** This includes all specialists! Please ask all visiting medical staff to wash hands, if they have not already done so.
- **Hand washing / gel application before and after each patient contact** is mandatory in addition to hand washing on entry to the ICU. Hand washing should also be performed between different procedures on the same patient, before and after using gloves, gowns, masks or eye protection for any reason, and sneezing or coughing (full list in DOH document Infection Control).
- As part of Standard Precautions, gloves must be used during direct or potential contact with a patient's blood, secretions or body fluids, mucous membranes or non-intact skin. Masks, eye protection and impervious gowns must be used in addition when there is a likelihood of splashing or splattering of blood and body fluids. Additional precautions are required if there is particular risk of airborne, droplet or skin contact spread of organisms.
- Blue impervious gowns and gloves must be worn when attending all multi-resistant organism patients, and green Microshield or alcohol gel used for hand washing.
- We recommend the use of uniform 'scrubs' for medical staff during clinical work, although this is not compulsory. You order your own scrubs online <http://www.ada.com.au/systems/nswhealth>.
- Neckties should not be worn during clinical work, and we would prefer you not to wear hand jewellery or watches. As a minimum, hand jewellery and watches should be removed before performing any invasive procedure. Professional dress standards are otherwise expected, and shoes should be made from an impervious material and covered.
- Visitors must wash their hands or apply hand gel before and after visiting patients, but they are not required to wear blue gowns unless they move between patients.

What is an "effective hand wash"?

A neutral detergent (such as the white Microshield) will cause disruption of the lipid membrane for most microorganisms (including bacteria, viruses and fungi) on the hands if the liquid is applied over all the surface of the hands for 10-15 seconds (the so-called "social hand wash"). Mechanical removal of microorganisms will also occur as the solution is rinsed off.

A liquid soap solution containing chlorhexidine (such as the green Microshield) will have residual antimicrobial activity, because some chlorhexidine will remain on the skin surface after the soap component has been rinsed off.

Alcohol gel has quicker and more effective general antimicrobial action (across the widest range of microorganisms) compared to other antiseptics, as long as the gel has dried on the skin surface.

The alcohol gel is recommended for routine hand washing during patient contact (apply gel for 10-15 seconds and allow hands to dry).

If the hands are visibly soiled, the antimicrobial activity of any skin cleanser is reduced, and therefore soap and water should be used first to remove soiling from the skin surface, and alcohol gel applied when the hands are visibly clean.

A “surgical” fingertip to elbow 2-minute chlorhexidine liquid scrub is required for all procedures.

It is also good practice to do a fingertip to elbow 1-minute scrub with liquid soap before and after each shift.

NB: Skin that is infected or inflamed has markedly increased capacity to shed organisms, and should be covered by either an occlusive waterproof dressing or gloves

How to discharge a patient from ICU

Patients should be discharged from the ICU when they no longer require intense medical or nursing supervision for their acute condition, or there has been a limitation directive to guide future care.

1. All discharges must:

- Be approved by the duty ICU consultant
- Be discussed with the parent team prior to patient transfer, especially any **potential** or **continuing problems**

2. Notify the Acute Pain Service of patients who require their supervision on the wards ie anyone with a PCA or epidural (particularly if those were started by the ICU staff). During office hours, page the CNC for Pain Management (Maria on 17267) during office hours, or the Anaesthetic registrar on for pain service (pager 17071), or fill in a PCA form headed "Nepean Hospital Acute Pain Service" and leave that form in the white folder in Recovery

3. Limitation or non-escalation of treatment directives must be discussed with the parent team and clearly documented prior to discharge. The duty ICU Specialist will discuss this with the consultant of the parent team, but it is also helpful for junior staff to contact their peers

4. An ICU discharge summary (from Intensys) must be completed and a copy included in the patient notes. Give another copy to the ward clerk to send off to the patient's local doctor and to any other referring doctor (GP's or other specialists/hospitals). If the patient is going home or to another hospital, the discharge summary is done through Powerchart so that Medical Records can access it. Get the duty Specialist/SR to review the summary before you print it

5. Write any fluid orders onto a ward chart and review the drug chart (stop any unsuitable medications and rechart suitable medications)

6. If a patient dies, then:

- A death certificate and cremation form must be completed unless the patient is referred to the Coroner. Junior staff should discuss the diagnosis with the duty Specialist or SR before filling out the forms
- Notify the Specialist of the ward team (*first thing in the morning* if death occurred overnight)
- Consent for a post-mortem should be obtained if appropriate
- The **Coroner** should be notified of:
 - Death due to trauma or suicide
 - Death due to unnatural or unknown causes
 - Any death "that was not the reasonably expected outcome of a health related procedure". This criterion replaces mandatory reporting of deaths within 24 hours of an anaesthetic or surgical procedure. Guidelines to the interpretation of this criterion are in the Policy Directive.
 - All deaths of patients who were from psychiatric or residential care provided by an organisation (there are some exceptions- see Policy Directive)
 - All deaths while in police custody

Penrith Police must be notified of any coronial referral. However, the police are only there to provide continuity of identity for the Coroner, they do not need to be told why the death of the patient has been referred to the Coroner! Try to discourage the police from using the bay as a crime scene.

Reference: Coroner's Act 2009 and Department of Health Policy Directive PD2009_083- a copy of this and other documentation is found in the end-of-life folder in ICU 2.

Policy for requesting a Post-Mortem examination

The policy for requesting a post-mortem examination is as follows:

1. **Special consent forms exist.** This form has been developed for neonates and a standard form for other than neonates is available in ICU, Medical Administration and from the After Hours Nurse Supervisors.
2. **Consent** for a non-Coronial post-mortem must be sought from the senior available next-of-kin by a senior medical officer involved in the care of the deceased. Senior medical officer means a Registrar or Specialist. Interns and Residents are specifically excluded from obtaining consent.
3. A **social worker** must be present at the time of the request for post-mortem. The Social Work Department is aware of this requirement and will provide the necessary support on request. Medical officers should also note that **social work support must be offered to families when a Coronial post-mortem is required.** Social work support is available 24 hours a day.
4. **A Designated Officer of the hospital who has no personal interest or clinical involvement in the case must give authority for a non-Coronial post-mortem.** Designated Officers are appointed by the hospital and are a requirement of s5 of the *Human Tissue Act 1983*. A list of Designated Officers is held at the switchboard and by the Pathology Department. The Designated Officers are available 24 hours a day and are After-hours Nurse Supervisors and other nursing staff during normal hours.

When requesting a post-mortem you must contact the pathologist or pathology registrar on duty (during the next available office hours), otherwise nothing will happen.

