GUIDELINE FOR IMPROVING OUTCOME AFTER ANAESTHESIA AND CRITICAL CARE

COLLEGE OF ANAESTHESIOLOGISTS AND INTENSIVISTS OF SRI LANKA

2017
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ICUs- Separate Attachment-
Design
Location
Human resources
Equipment
Specifications
Data collection
Skills development
PREAMBLE

Adverse Outcome after Anaesthesia has been defined as “the occurrence of an unanticipated complication or death during or following anaesthesia that may be attributable to an anaesthetic” (Lee: Lum 1996)

Anaesthesia is a specialty which has undergone rapid development to enable the most complicated surgical procedures of infinite duration in medically and surgically complicated patients to be conducted safely. To derive complete advantage of these developments and to have a safe outcome after anaesthesia, it is necessary to have the required conditions for the practice of safe anaesthesia.

Anaesthesia creates a non-physiological state which is inherently unsafe. (Aitkenhead A). It is the responsibility of the anaesthetist, after inducing anaesthesia to maintain all parameters at normal physiological levels. Adverse outcomes after anaesthesia have been documented from all over the world. (To err is human 2000, Claessen 2015, Clergue F 2011) The majority of medical errors and poor outcomes in hospitalized patients are due to Anaesthesia and complications in the peri operative period. (Haller et al 2011). The majority of
preventable deaths in a hospital are due to complications with anaesthesia or peri operative events and problems. It has also been shown that these events due to errors, safety and quality issues not only affect lives of people but cost governments enormous sums of money and are a drain on the health systems.

Safety during surgery and anaesthesia is an issue of global concern, and many international authorities and institutions have initiated action to minimize these events. The WHO has developed a safety checklist, and has produced regional strategies to counter this problem. The World Federation of Societies of Anaesthetists, the Royal College of Anaesthetists, and the Patient Safety Movement of the USA are making concerted efforts to address this major issue. The working agenda of the World Federation of Societies of Anaesthesiologists is Safe Anaesthesia for Everybody-Today.

The safety of the patient has to be paramount in all types of health care, particularly in Anaesthesia as,

1. Anaesthesia does not have any curative or therapeutic value, therefore it is not acceptable to have complications or deaths attributable to anaesthesia whatever the circumstances
2. The highest incidence of preventable hospital deaths occur during the peri operative period

Adverse events in health care occur due to (Adapted from WHO regional strategy – South East Asia 2008)

1. Unsafe practice- unsafe surgery, unsafe anaesthesia, unsafe use of injections, poor hand hygiene, unsafe blood products, inferior quality medical equipment
2. Communication failure and ineffective teamwork
3. Poor systems within the organizational structure

The burden is as follows:

1. In developed countries 1 in 10 patients harmed while receiving hospital care
2. In the USA 44000-98000 medical error deaths annually
3. At any given time 1.4 million people worldwide suffer from hospital acquired infections
4. In the USA one medication error/hospitalised patient/day and 7000 deaths per year
5. Unsafe surgery leads to 7 million complications and 1 million deaths per year
6. At least 50% of medical equipment is unusable or only partly usable—resulting in substandard diagnosis and treatment. The devices sold in South East Asia domestic market are often manufactured outside regulatory frame work and may not meet international standards. (Regional strategy for patient safety in the WHO South East Asia region.)

7. Developing countries account for 77% of all reported cases of counterfeit and substandard drugs. (Regional strategy for patient safety in the WHO South East Asia region)

Statistics are available globally for adverse effects and mortality after anaesthesia and critical care. In Sri Lanka, except for the newspaper reports which occur frequently, official data are not available. The critical event report collection of the College of Anaesthesiologists, in spite of under reporting concluded that many critical events do occur in our operating theatres.

Outcome is affected by

1. Human resources- shortages, knowledge and skills
2. Safety issues
3. Quality issues
4. Lack of equipment
5. Equipment malfunction

Patient safety has three components: a set of guiding principles, a body of knowledge and a collection of tools.

1. The principles are that the tendency for things to go wrong is both natural and normal, rather than an opportunity to find someone to blame; safety can be improved by analysing errors and critical incidents, rather than pretending they have not happened; and humans, machines and equipment are all part of a system, the component parts of which interact to make the system safe or unsafe.

2. Knowledge is largely taken from other safety-critical, high-reliability industries such as mass transportation and nuclear power and includes an understanding of how accidents arise and how they can be prevented.

3. Tools include critical incident reporting (Helsinki declaration on patient safety during anaesthesia 2010)

Improving patient safety thus requires a national strategy involving a wide range of actions in

1. Performance improvement,
2. Infection control,
3. Safe use of medicines,
4. Equipment safety,
5. Safe clinical practice
6. Providing a safe environment of care.
   (Regional strategy for patient safety in the South-East Asia region)
OUTCOME MEASUREMENT

It would be necessary to measure outcome to plan for improvements. It is important to assess the nature and scale of harm to patients and establish a system of reporting and learning at the national level. (WHO)

It is recommended that a sustainable method be developed for outcome measurement.

The importance of outcome measurement is that it would
1. Be a measurable quantity to measure performance (such as the maternal mortality rate)
2. Enable corrective measures to be taken
3. Be a measure of justification of funds spent

It is recommended that the following be reported.
1. Outcome after anaesthesia
2. Critical events in operating theatres
3. Post-operative death rate – Initially this can commence with the primary admission

Outcome after Anaesthesia
1. On the form. (Appendix 1)
a. This is a post-operative morbidity record, to assess outcome as well as an early warning score. It would enable the nurses and the medical officers to suspect a potential developing complication to alert the consultants. At the time of discharge it would enable outcome to be assessed.

b. The form should be filled as part of routine post-operative care and if the danger zones are approached the consultants should be informed.

   An anaesthetist should see the patients post operatively within the first 24 hours. This should be routine duty of the anaesthetist. Appropriate numbers of anaesthetic medical officers should be provided to conduct both pre-operative and post-operative assessments.

c. On discharge, or death of the patient the data and contents should be recorded and made available to relevant institutions.

d. The Director of the institution should be made accountable and the MRO of the institution responsible for retaining the data. It should be the responsibility of the medical officers to fill and act on the information contained. The Consultants involved should see that the form
is filled and appropriate action taken by the medical officers.

2. Critical events in the operating theatre
   The prescribed form should be used. (Appendix 2)
   The event should be reported within 24 hours.
   The Consultant Anaesthetist or in the absence, the senior MO should be accountable to the Director of the institute
   Confidentiality will be retained. The data would only be used for remedial and corrective measures.

3. A national post-operative death rate should be measured at least as a start. Initially this can be measured during the primary admission, and later on should be developed to measure at pre-determined time intervals including after discharge

   It is important to have outcome data for emergency laparotomies, fractured hips, ICU outcomes. Measures should be taken to officially obtain these data.
HUMAN RESOURCES

1. It is essential that a Consultant Anaesthetist should be available at all hospitals where anaesthetics are administered. The College is of the view that anaesthetics should not be administered without consultant anaesthetist cover.

2. Anaesthesia is a specialty where there is always a risk of an unanticipated complication. The absence of a Consultant would deny the patient of the best possible care, and compromise safety.

3. Therefore it is not possible for the College to provide guidelines for MOs in Anaesthesia who are working unsupervised. However in the interest of patient safety, the College recommends that medical officers in anaesthesia, who are working without supervision should not anaesthetize, the following categories of patients
   (a) ASA 4 and over
   (b) In the presence of cardiac complications
   (c) In the presence of renal failure and liver failure
      (In the event of elevated urea, creatinine, abnormal electrolytes, elevated liver enzymes, abnormal coagulation profile, the advice of a consultant physician should be sought as to the diagnosis)
In the presence of a compromised airway
Diagnosed placenta previa, placenta accreta
Children less than 5 years
Major + surgery
Where post-operative ICU care is required or anticipated
Surgical procedures where major blood loss is anticipated.
Procedures where the duration is anticipated to be over four hours.

These recommendations would not apply under life saving circumstances and where it is probable that the patient will not be able to withstand delays and transfers.
In this kind of situation the advice of the Consultant Anaesthetist of the nearest station should be sought.
However these are only guidelines, and since as said before it is not possible to anticipate all the possible problems and complications which can occur. It is emphasized and reiterated that for either following or not following these guidelines, the College of Anaesthesiologists and Intensivists of Sri Lanka, the Consultants whose advice was sought and the medical officer who administered the anaesthetic cannot be held liable for whatever problem, complication or
outcome. The College reiterates that for optimal safety and outcome, no anaesthetic should be administered without the supervision of a Consultant Anaesthetist.

4. A medical officer should undergo supervised training by a Consultant, and certified as such before being allowed to practice anaesthesia alone, without immediate supervision, even in stations with Consultant Anaesthetists.

5. There should be a dedicated nurse, technician or trained orderly assigned to assist the anaesthetist.

6. Every anaesthetized patient should have an anaesthetist (medical officer) in attendance at all times.

It is recommended that Category 4 (Teaching Hospitals) and Category 3 hospitals, should always have their quota of the required number of Consultant Anaesthetists and vacancies which arise filled as a priority.

A formula to calculate the number of Consultant Anaesthetists required per station can be = no of routine lists per day held simultaneously = number of CAs

7. Allocation of medical officers for Anaesthesia should be based on
(a) Number of routine lists per day  
(b) Number of emergency lists per day  
(c) Extra person to relieve for meals etc  
(d) Adequate extra number to cover for leave  
(e) For pre-operative and post-operative rounds  
(f) Number of ICU beds

As at present there are 410 medical officers of all grades providing anaesthesia in Sri Lanka. This is approximately one anaesthetist for fifty thousand people, where the recommended level is one for twenty thousand. Australia and New Zealand have a ratio of 1 anaesthetist for eight thousand five hundred people.

Therefore a major recruitment drive is required and continuous training and educational programmes, particularly for junior medical officers should be conducted.
ACQUIRING KNOWLEDGE AND SKILLS

Even for a trained Anaesthetist there should be opportunity for developing and practicing skills.

It has been proven that Anaesthetic morbidity and mortality is mainly due to
1. Mismanagement of airway
2. Insertion of central lines
3. Management of haemorrhage
4. Inadequate patient evaluation (38-42% of deaths)
5. Incorrect and sub optimal pre-operative management
6. Human error (51-77% of deaths)
   (Clergue,Haller, Laroche 2011)

The College should run CPD courses on the above in collaboration with the Department of Health, and it should be made mandatory through the department that these courses are attended.

The College and the Department of Health should collaborate to run courses in
1. Airway management
2. Management of haemorrhage
3. CPR
4. Management of Anaphylaxis
5. Management of trauma
6. Use of ultrasound
7. Insertion of central lines
8. Patient safety
9. Communication skills, team work, leadership skills
10. Management skills
11. Development of soft skills

The College should develop guidelines and check lists and implement through the authority of the Department of Health. The implementation of the WHO safety guidelines which have been officially adopted by the Ministry of Health should be implemented through circular. Hospital administration should ensure compliance and accountability.

1. WHO safety check list (Appendix 5)
This is used worldwide at present. It has shown to reduce errors in a significant manner. In Sri Lanka errors still occur due to wrong identity, wrong site of operation, and failure to anticipate problems and possible complications. The WHO safety check list has been adopted for official use by the Ministry of Health. However this is not implemented as intended. In some
hospitals it is not used at all. In some it is used by nurses only to obtain a signature. For proper usage of this form it is recommended to develop a chain of accountability.

2. Pre-operative assessment form (Appendix 6)
The College has prepared the above form. This will ensure that all patients are assessed in a uniform manner. It would ensure that all required areas are covered and documented. It would enable adequate preparation of the patient to optimize before surgery. Even if the actual attending anaesthetist is a different person it would make sure that all the required information is available.

It is recommended to
(a) Circulate the form to all hospitals
(b) Ensure compliance by circular to director and the Consultant Anaesthetist or senior MO Anaesthesia.
(c) The form would be part of a complete perioperative anaesthetic chart. It should be attached to the BHT and be part of the patients legal documentation.
CATEGORISATION OF HOSPITALS

In Sri Lanka the categorization of hospitals are as follows –

Teaching
General
Base
District

Whilst this categorization can remain for administrative purposes, we propose that this be changed for functional purposes by considering the type and amount of surgical procedures that can be done, in a particular hospital. This would depend on

1. Anaesthetic resources
2. Recovery facilities
3. ICU facilities
4. Blood bank, laboratory and radiological facilities
5. Multi-disciplinary input particularly cardiology, nephrology, microbiology and haematology facilities

This categorization can be used to allocate human resources, Consultants in Anaesthesia, Critical care, Pain and other subspecialties. The provision of equipment can be based on this categorization, ensuring only items which are of use and which
would be utilized, are purchased to particular hospitals. This would make utilization of resources more efficient.

Category 4- All teaching hospitals

Category 3- Presence of more than a single Consultant surgeon, Consultant Obstetrician, Consultant Anaesthetist, other surgical specialties, Cardiology, Nephrology or physician with Nephrology interest, Radiology, Blood bank with Consultant Haematologist, Consultant Microbiologist. Availability of ICU with ability to ventilate, invasively monitor, adequately staffed

Category 2- Single surgeon, Obstetrician, Consultant Anaesthetist, no specialists in para clinical specialties

Category 1- No Consultant Anaesthetist

The procedures to be carried out

Category 4 and 3- All procedures possible, however required Anaesthetic staff has to be provided

Category 2- Procedures where post-operative complications are anticipated and multi-disciplinary input required should not be done.
All lifesaving and emergency procedures should be done.

Category 1 - Patients with an ASA 4 and over should not be done, unless it is a lifesaving procedure,
The following should not be done as elective procedures
A) ASA 4 and over patients
B) where major blood loss, post-operative ventilation, post-operative cardiac problems, are anticipated should be transferred
C) Major + procedures should not be done
D) Diagnosed major placenta praevias, placenta accreta should not be done
E) Children under 5 years should not be done

REF- WFSA/WHO
These guidelines are to provide safety to patients taking into consideration the facilities and resources available.
Having a functional classification would enable the hospital grade to change with changing facilities and resources.

It is important for all hospitals to have data on the procedures done, and a post-operative death rate should be monitored.
EQUIPMENT LIST

Category 4- All teaching hospitals
Category 3- Presence of more than a single Consultant surgeon, Consultant Obstetrician, Consultant Anaesthetist, other surgical specialties, Cardiology, Nephrology or physician with Nephrology interest, Radiology, Blood bank with Consultant Haematologist, Consultant Microbiologist.

Availability of ICU with ability to ventilate, invasively monitor, adequately staffed (These would generally include all provincial general hospitals)

1. Separate OTs for complex procedures, cardiac theatres, neuro theatres, transplant theatres, vascular theatres, major gynaecological and oncology theatres
2. Anaesthesia workstation for each operation theatre (High end, low flow, electronic blending, monitoring of gases, monitoring of ventilation etc)
3. Multipara monitor with 2-3 leads ECG + ST analysis, NIBP, SpO2, ETCO2, Inhalational agent monitoring, temperature monitoring, IBP monitoring
minimum 2 transducers + Minimally invasive Cardiac output monitor or Oesophageal Doppler cardiac output monitor.

4. Non-invasive cardiac output monitor for sharing between two OTs

5. Difficult airway management equipment - for hospital
   - Video Laryngoscope
   - Flexible intubating endoscope
   - Intubating Laryngeal mask-Fastrach

6. Rapid Infusor

7. Ultrasound for vascular access and regional blocks

8. Patient warmer - 1 for each OT

9. Fluid warmer-1 for each OT

10. Depth of Anaesthesia monitor -

11. Nerve stimulator for nerve blocks and NM monitoring–

12. Patient controlled analgesia pumps-

13. Syringe pumps-

14. DVT pumps-

15. Non-invasive haemoglobin monitor-

16. Cuff BP monitor for each OT –

17. Opti flow machines –

18. OT – Tables with electrical control

19. Gas pipe lines for oxygen, air, nitrous oxide and vacuum – particularly for new constructions

20. Older hospitals oxygen/ nitrous oxide and medical air cylinders
21. Defibrillators for each suite
22. Electrical suction devices
23. Adult and paediatric resuscitator sets
24. Patient transfer boards
25. Monitor with NIBP, ECG, Spo2 for tables where regional blocks given

Other categories of hospitals-single specialty, single consultant anaesthetist or MO Anaesthesia only

Anaesthesia workstation (conventional)
Fluid warmers –
Syringepump- 2 per OT
Laryngoscopes
Electrical suction device for anaesthetists use
Defibrillator for each suite

Pressure bag for infusions 1 for each OT
Adult and Paediatric resuscitator sets,
Oxygen cylinders or concentrators
Multi parameter monitors- ECG, SPO2, ETCO2, NIBP, TEMPERATURE
Cuff BP monitors
Patient transfer boards
Syringe pumps
Non invasive Haemoglobin monitor
OT table – manual
Peripheral nerve stimulator
Monitor with NIBP, ECG, SPO2 for giving regional blocks

**Recovery Areas**

It is strongly recommended that separate purpose built recovery areas be made available.

Oxygen and suction via pipe lines at least 4 ports for an OT complex of 8 OTs.

At least one port where an anaesthetic work station could be connected

Monitor with NIBP, SPO2 ECG, ETCO2
Patient warmer
Defibrillator
Fluid warmer

**Intensive Care Units**

Category 4 and 3

ICU ventilators with all modes for all beds
Multipara monitors for all beds
Cardiac output monitors-
Infusion pumps- 1 per bed
Syringe pumps – minimum 6 per bed
DVT pump – 1 per bed
Patient warmer – 1 per bed
Rapid infusor – 1 per unit
Fluid warmer- 1 per bed
Ultrasound machine with cardiac and vascular probe
TOE only if trained personnel available
Blood gas machine/ electrolyte machine for each unit
Video laryngoscope
Transport ventilator
Transport monitor
Brain function monitor for cardiac and neuro ICUs
ICP monitoring for neuro ICUs
CRRT- If nephrology available only
Defibrillator

Category 1 and 2
Transport ventilator
Transport monitor
Rapid infusor
Infusion pumps 4 for each bed
Patient warmer
Defibrillator
DATA COLLECTION

The availability of performance data such as maternal mortality, neonatal death rates, immunization data, incidence data of various diseases has enabled Sri Lanka to improve outcome in these areas to international standards.

Performance data following surgery, anaesthesia and critical care are equally important. The availability of data will enable identification of areas which need attention, improve outcome, decide on the resources and equipment required. The incidence of perioperative complications is a matter of global concern, and the WHO, the WFSA, and the Royal College of Anaesthetists (UK), Patient Safety Movement (USA) have all taken initiatives to address this issue. The National Audits in the UK are aimed to gather this data.

We propose that hospital directors are entrusted with the responsibility of collecting data on-
1. Perioperative complications
2. Post-operative death
3. Data on reason for ICU admission
4. Critical events in the intra operative period.
5. ICU outcome
The College of Anaesthesiologists and Intensivists should also have a data base, on which to make performance evaluations with the aim of improving services, and for justification of requests for human resources and equipment.

The College should collect data on

1. Critical incidents in the peri operative period
2. Outcomes from selected procedures
3. Post-operative complications and deaths
4. ICU outcomes
5. Pain relief

The College established a Data Collection and Research Centre for this purpose.

The main problem is Sri Lanka is non-reporting and lack of interest in reporting adverse events. Denial and complacency arise from this. Quality control or records units should be established in all hospitals and these officers through the hospital directors should be held responsible for reporting.

Performance data maybe made a pre requisite when requests for equipment are being processed.
THE COMPONENTS OF PATIENT SAFETY

1. Product Safety- All products should be registered in Sri Lanka. The registration process should include an evaluation of the product by the College of Anaesthesiologists and Intensivists. Amongst the factors to be considered are, international recognition and registration of the product and the manufacturing plant and sales reports and performance reports in other countries. Past record of the local agents. Performance record of the product in the country in the past.

2. Safety of administration -Labelling of syringes. This should be made mandatory and labels should be provided. Blood and component checks before administration

3. Safety checks- All life dependent equipment such as Anaesthesia work stations, ventilators, monitors should be checked on a daily basis, before being used on patients. The sisters in charge and the anaesthetist should be held responsible for checking of equipment before use. It is recommended that a diary be maintained for each individual item
4. Preventive equipment maintenance programmes - All equipment should have service agreements to ensure optimum maintenance. This should be included in the procurement agreement.

5. A data base on the equipment purchased and a record of breakdowns should be maintained. The College of Anaesthesiologists has also commenced to maintain a data base. The BIOMED engineering section of all hospitals should be made accountable to return information to the date base.

6. Poor quality drugs and consumables- Suboptimal production of consumables and drugs in this region is high. The low cost of these products make them freely available in the Sri Lankan market. These have led to several reports of poor performance. It should be ensured that the production plant as well as the product should be internationally recognized. Registration should not be granted without.

7. Patient safety- Patients should be sent to operation theatres on trolleys with side bars and accompanied by a nursing officer, who should hand over the patient to a nursing officer in the operation theatre. Pillows, drapes should be
provided. Before leaving the ward, a check should be carried out by the nursing officer accompanying the patient as to
(a) Identity and Identity tag
(b) Consent for surgery
© Pre-operative preparation carried out
(d) Pre medication and anaesthetist’s instructions followed
(e) Allergies indicated
(f) Operation site marked

8. Safety of Services- Critical incident reporting, equipment failure reporting should be done. Post-operative rounds by an anaesthetist in the first 24 hours in addition to that being done by the ward staff. Pain relief rounds to be done. Acute pain services for post-operative pain Post-operative mortality, morbidity and unanticipated ICU admissions should be discussed
THEATRE PROCEDURE

1. The operation list- For all procedures, an operation list should be sent to the theatre, and telephone exchange as soon as possible after the decision is made. The list should be in the order that surgery would be performed. This should consist of Name of the patient, age, sex, BHT no, and the operation specifying the side where appropriate. It should also consist of the name of the surgeon, the date and time of the operation, the unit from which the patient is from, preferably the name of the Anaesthetist. The person who prepares the list should sign it at the bottom. The operation list should be informed to the anaesthetic team. Once submitted, the operation list or the order in which surgery will be performed should not be changed unless such change is a dire necessity. When such changes are made it is incumbent on the surgical team to personally inform the operation theatre nursing staff and the anaesthetist of such change.

2. Operation register- Every procedure done in the operation theatre should be registered. The operating slips or lists should be stored for at least 5 years
3. Sterility- Sterility should be strictly observed for all procedures

4. WHO Safety Check list- Should be checked and filled by the receiving nurse, surgeon, anaesthetist and recovery nurse

5. There should be only one patient in the operating theatre at a given time. Multiple tables should not be used.

6. Consent form- A signed consent form should be present for any patient being brought into the theatre.

7. Anaesthetic chart- Should be maintained for all patients, where a general anaesthetic, regional anaesthetic, sedation, or a local block has been administered by an anaesthetist.
RECOVERY FROM ANAESTHESIA

Recovery from Anaesthesia, is as an important period, as undergoing anaesthesia. This is a period during which the patient emerges from the state of anaesthesia. Until the patient has fully recovered from the effects of the administered anaesthetic, the problems, complications and dangers would be similar to the state of anaesthesia.

To ensure safety of the patient during this period, the following are recommended.

1. Every theatre complex should have a dedicated recovery area.
2. This should be within the theatre complex
3. There should be separate bays for individual patients.
4. Each bay should have- oxygen supply, suction apparatus and monitor capable of measuring SPO2, ECG, non-invasive blood pressure
5. The recovery area should have a defibrillator, anaesthesia machine and ventilator, facilities for intubation, tracheostomy, central vascular access, a patient warmer, a fluid warmer
6. Each patient should have a trained nurse to look after the patient
7. The anaesthetist must personally hand over the patient to the nurse in the recovery area.
8. The patient has to be monitored till fully functional.
9. The patient has to be seen by an anaesthetist, prior to discharge from the recovery area.
10. The patient should be accompanied to the ward by a trained nurse.
POST OPERATIVE PAIN RELIEF

Post-operative pain, can be debilitating and adversely affect outcome. Therefore active measures should be taken to relieve post-operative pain.

1. The anaesthetist should prescribe the pain relief medicines.
2. All hospitals should establish an acute pain service under the supervision of consultant anaesthetists. The pain consultant posts which are already established, and are vacant should be immediately filled.
3. An acute pain service team should comprise, trained anaesthetic MOs and pain nurses lead by a pain consultant to provide dedicated 24 hour service.
4. Regular assessment and record of pain to be made mandatory.
5. Regular in-service training to be provided for all members of acute pain service on a priority basis.
6. All required drugs and equipment, should be available.
7. The analgesic drugs should be written in the anaesthetic chart.
8. Introduce formal ‘drug prescription chart’ for all regular and once only prescriptions to minimize prescription and administrative errors
9. The required equipment would be  
   a. PCA pumps  
   b. Ultrasound  
   c. Nerve stimulator and needles  
10. The Faculty of Pain Medicine, of the College of Anaesthesiologists and Intensivists of Sri Lanka, should conduct regular workshops, develop guidelines / protocols and monitor the development of pain services through audits / research conducted.
POST OPERATIVE PERIOD

The immediate post-operative period, is as important as the intra operative period.

The recovery period has been addressed before.

1. Post-operative monitoring
   It is recommended that an early warning score system of monitoring be used in the first 24 hours at least, for early identification of any potential problem.
   A monitoring chart has been designed by the college for this purpose, and is recommended to be used. Early identification will prevent post-operative complications which result in increased morbidity and mortality and increased costs.

2. Adequate ICU facilities and monitoring equipment as listed elsewhere should be made available.

3. A special area for immediate post-operative patients, will facilitate monitoring and care
COMMUNICATION

It is important for the Anaesthetist to establish links of communication and rapport with the patient and relations.

This should be done at the pre anaesthetic clinic or the pre-operative visit

After assessment of the patient, the plan of anaesthesia, the optimization and preparation required, the possible complications and their solutions, the requirement for ICU facilities should be explained. Possible adverse outcomes should be explained.

It is important to document the discussions and the salient points in the BHT.
The establishment of Pre Anaesthetic clinics, would be helpful to
1. Adequately assess the patients, order investigations as required, refer to specialists if needed, attend to preparations and optimization.
2. This would minimize the identification of problems on admission or just prior to surgery
3. It would save on bed occupancy and therefore be more economical
SUMMARY OF RECOMMENDATIONS

1. To fill the consultant cadre posts
2. To have adequate training for MOs providing anaesthetic services without supervision by consultants
3. Standard equipment for theatres based on procedures performed
4. Quality of drugs to meet safety standards
5. The use of a standard peri operative anaesthetic chart
6. The use of the WHO safety check list
7. The use of a standard first 24 hour post-operative monitoring chart
8. Strict adherence to recommended theatre procedure
9. Good recovery facilities
10. Establishment of acute pain services
11. Properly designed and equipped ICUs
12. Data collection to be made compulsory and accountable
Appendix
1. Post-operative morbidity form
2. Critical event
3. Audit form for Laparotomy
4. Audit form for Fractured hips
5. WHO safety check lists
6. Anaesthetic chart
### Regional Technique

**Spinal / Epidural / CSE**
- Position: Sitting / Lateral
- Entry Level: 
- Local Infiltration: 2% Lidocaine
- **Spinal**
  - No. of attempts: 
  - Needle size: G Type: 
  - LA dose + additive: 
  - Fentanyl/Morphine: 
  - Sensory Level: L/S R/S 
  - Motor Block: L/S R/S 

**Epidural**
- No. of attempts: 
- Needle size: G Type: 
- Loss of resistance to Air/Saline
- Catheter size: G 
- Length in space: cm
- Skin Level: cm 
- LA dose + additive: 
- Fentanyl/Morphine: 
- Sensory Level: L/S R/S 
- Motor Block: L/S R/S 

**Nerve Block**
- US guided: 
- LA: 
- PNS guided: 
- LA dose + additives: 

### Notes

### Events

<table>
<thead>
<tr>
<th>Event No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anaest. start</td>
</tr>
<tr>
<td>2. Op start</td>
</tr>
<tr>
<td>3. Tourniquet on</td>
</tr>
<tr>
<td>4. Tourniquet off</td>
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### Monitoring

- Machine check
- ECG
- NIBP
- IBP
- SpO2
- Capnography
- CVP
- Cardiac Output
- Agent/Gases monitor
- Temperature
- BIS
- Neuromuscular monitor

### Positioning

- Eyes taped/padded
- Pressure points padded
- TEDS/DVT pump
- Warm air blanket/heating mattress
- Warm fluids
- NG tube
- Urinary catheter

### IV Fluids

- Crystalloids:
- Colloids:
- Blood/Blood Products:

### Vol.

- TOTAL IN cc
- BLOOD LOSS cc

### Time

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### SpO2/FiO2

ETCO2

RR/Airway Pr.

IV Fluid
Blood Loss
Urine Output
GUIDELINE
For
INTENSIVE CARE UNIT DESIGN
WORKING GROUP

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Guideline for Intensive Care Unit Design
Faculty of Critical Care Medicine
College of Anaesthesiologists & Intensivists of Sri Lanka
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These are guidelines only and describes an optimum ICU design for a unit caring for adult patients. The individual design team should identify essential & optional components for their particular unit.
INTRODUCTION

Intensive care unit is a distinct organisational & geographic entity for clinical activity & care, operating in cooperation with other departments integrated in a hospital. It is preferably an independent unit or department with controlled access that functions as a closed unit under the full medical responsibility of the ICU staff in close concert with the referring medical specialists.

An ICU should accommodate as a minimum at least 6 beds with 8-12 beds considered as the optimum. Larger ICU may create separate specialised functional sub units with 6-8 beds sharing the same geographical, administrative and other facilities.

To establish a critical care unit in a hospital in Sri Lanka, it is strongly recommended do so only in centers which has a minimum of two Consultant Intensivists/ Anaesthetists, so that 24/7 cover to the unit can be guaranteed.
Levels of Care in ICU

Levels of Critical Care for Adult Patients (ICS)

| Level 1 | Patients recently discharged from higher level of care or those in need of additional monitoring/clinical interventions, clinical input or advice or patients needing critical care outreach service support |
| Level 2 | Patients needing pre-operative optimisation or extended post operative care or those stepping down to Level 2 care from Level 3, patients receiving single organ support or basic respiratory support |
| Level 3 | Patients receiving advanced respiratory support alone or a minimum of 2 organs supported |

Several levels of care can be integrated into the same ICU in a flexible organisation model. In a high dependency unit (HDU), maximum level of care provided should not exceed level 2.

The choice to organise a HDU & a ICU separately or have a mixed ICU/HDU can be made depending on the requirements of the individual hospital.

A mixed unit may be preferred in our setting where available manpower can be used efficiently, depending on the work load for the day. There can be flexibility of the number of beds of different levels that can be managed on a particular day based on the activity of the patients where, when there is concentrated high activity in some beds, other beds on offer may only be able to provide a lower level of care.
In a mixed unit, basic structural design should be at the highest level so that, in an event the patient needing a higher level of care, instead of moving the patient within the unit to a adequately equipped bed space, necessary equipment may be brought to the patient bedside at any time.

Depending on the infrastructure available in the particular hospital, it might be prudent to have a single level of care ICU (eg Level 2 only). This is relevant to our country as certain types of hospitals (eg Base Hospitals) lack multidisciplinary input that is required to function a Level 3 ICU.

Thus it is strongly recommended that when setting up a critical care unit, the type of hospital & the expertise (cardiology, nephrology etc) and services available are taken in to consideration and based on that, appropriate level of ICU is decided.

A guide to requirements to set up an ICU is as below.
Level 1
- Recommended for.....hospitals
- Ideally 6-8 beds
- Incharge to be a Consultant Intensivist/Consultant Anaesthetist/other suitable consultant
- Provides resuscitation & short term cardiorespiratory support
- Non invasive monitoring
- ABG analysis - desirable
- Ability to safe transfer to secondary or tertiary care centre
- Availability of basic clinical laboratory facilities (FBS, Blood glucose, Electrolytes, liver & renal function tests, imaging [X-ray & USS] & ECG
- Blood Bank
- Microbiology support - local or distant

Level 11 (Level 1 requirements plus)
- Recommended for larger general hospitals
- Bed strength 6-12
- Incharge to be a Consultant Intensivist/Consultant Anaesthetist/Other suitable consultant
- Invasive/Non Invasive Ventilation; Ability to ventilate long term
- Invasive monitoring
- Transcutaneous pacing
- Laboratory support for 24 hours
- CT, MRI - desirable
- Strong Microbiology support with facility for fungal identification
- Nurse:patient ratio 1:1
- Support of Cardiology & other super specialities of medicine & surgery

Level 111 (Level 11 requirements plus)
- Recommended for tertiary level hospitals
- Bed strength of 10-12, with one or multiple ICUs as per requirement of the institution
- Preferably a closed unit
- Multidisciplinary unit headed by Consultant intensivist/Consultant Anaesthetist
- All latest monitoring methods
- Bedside 2D Echo, USS & Xray
- Renal Replacement therapy
- Bedside Bronchoscopy
- Supported by blood bank & blood component therapy
Design of an ICU requires

• Knowledge of regulatory standards (we expect this document to subsequently evolve into one)
• Expertise of critical care practitioners who are familiar with the special needs of this patient population
• Decision of level/levels of care that particular unit would provide

Designers must consider the requirements of the daily workflows as well as look at the long term function of the unit. An effective ICU design must be flexible enough to accommodate changing care practices & advances in the technology.

3.1

THE DESIGN TEAM

Should consist of following
• Intensivist/Anaesthetist
• Clinical Microbiologist
• Administrator
• Finance officer
• Architect / Biomedical engineers
• Nurse in charge
• Any other person with special expertise
• Manufacturers/ suppliers of clinical & support equipment & furnishings

Coordinator is the most important person who coordinates with everyone involved. Intensivist or any other consultant in charge is best suited to be the coordinator.
DESIGN CONSIDERATIONS

When designing the unit attention must be given to the following aspects.

- Allocation of adequate funds
- Level of ICU / Levels of care provided
- Multidisciplinary or specialised ICU - to prioritise equipment
- Location in the hospital
- Number of beds
- Adequate Human Resources/ training
- Structural designing
- Patient safety and prevention of infection programmes
- Transition in case of relocation of an existing unit during construction

After finalising the project proposal, a time frame should be fixed for completion and the deadlines strictly adhered to.

It is advisable that engineering work be done in a manner that facilitate repairs whenever needed without jeopardizing patient care.
DECIDING ON THE NUMBER OF INTENSIVE CARE UNIT BEDS

Number of intensive care beds will depend on the data available from the hospital and current/future developments of the hospital.

Number of ICU Beds recommended in a hospital are usually 1-4 per 100 hospital beds.

ICUs having <6 beds are not cost effective and also they may not provide enough clinical experience and exposure to skilled human resources of the ICU. At the same time ICU with bed strength of >24 may have to be administered as pods of 6-12 beds.

Recommendations suggest that efficiency may be compromised once total number of beds crosses 12. Therefore, it is recommended that total bed strength in ICU should be between 6 to 12.

The Canadian Department of National Health and Welfare has developed a formula for calculating the number of ICU beds required based on the average census in the existing unit and the desired probability of having an ICU bed immediately available for a new admission. (refer appendix....)
DESIGN RECOMMENDATIONS

4.1 LOCATION

- Safe, easy & fast transport of a critically ill patient should be priority in planning its location. Therefore, the ICU should be located in close proximity to ETU/ER, Operating theatres, trauma ward, medical imaging department and functional testing facilities (e.g. Catheter lab, endoscopy).

- Close proximity is desirable to diagnostic facilities, blood bank, pharmacy, dialysis unit etc. If pneumatic tube systems are used to transport specimens & computers are used for transmitting test results, the physical proximity is less important.

- No thoroughfare can be allowed via ICU.

4.2 ENTRY/EXIT POINTS OF ICU & CORRIDORS/DOORWAYS

- There should be single entry/exit point to ICU for patients. A separate entrance for supplies should be designed which may be used by the staff as well. However it is required to have emergency exit points in case of emergencies and disasters.

- Entry should be through two sets of double doors and both sets should not open at the same time.
Dedicated entrances should have video camera monitoring capability and telephone or intercom to allow communication between ICU staff & visitors. A buzzer system with telephone contact from outside the unit to an access control desk is recommended.

Access control measures should be in place. Close proximity cards rather than swipe cards or key pads should be used as they offer better infection control.

Corridors, lifts and ramps should be spacious enough to provide easy movement of bed/trolley of critically ill patient. They should be 2.5 m minimum width & should be high enough to allow unobstructed transport of patients and support equipment.

A separate supply corridor for supplying & servicing as well as removal of soiled items is useful to minimise disruption of patient care activities.

Doorways should be minimum of 1 m in width

4.3

INDIVIDUAL AREAS/ROOMS

Overall ICU floor plan and design should be based upon patient admission patterns, staff and visitor traffic patterns and the need for support facilities such as nursing station, storage, clerical space, administrative and educational requirements and services etc.

The floor plan should be designed to accommodate the following areas. Need for certain areas/rooms may be decided by the design team based on the requirement, space & budget.
A. Patient areas

I Bed Spaces
II Isolation rooms
III Assisted Shower Rooms/ Patient Toilet – wheel chair
IV Management Base – Nursing / Management Station

B. Clinical Support spaces

I Storage rooms
II Equipment Storage area/ Parking Bay
III Laboratory area
IV Nourishment preparation area
V Utility Rooms – Clean Utility & Dirty VI Utility
VII Decontamination Room
VIII Clinical Equipment Service Room (Optional)
IX Procedure Room

C. Staff Areas

I Offices
II Rest Rooms
III On call Rooms
IV Changing rooms (optional)
V Conference & Teaching Area

D. Public Areas

I Reception
II Visitor Waiting Area
III Quiet Room/ Consultation Room
PATIENT AREAS

I. BED SPACES

- Patients must be stationed so that direct or indirect (e.g. by video monitor) visualization by healthcare providers is possible at all times. This permits the monitoring of patient status under both routine and emergency circumstances.
  - Patient area could either be of ward type or single room type;
  - Ward type ICU should allow at least 225 square feet per bed
  - Room type - 250 square feet per room with minimum width being 15 feet.
  - In addition there should be 100 to 150% extra space to accommodate other areas required for the unit, as detailed below.
  - There should be an unobstructed corridor / circulation space of at least 2.5m width, in the unit.
  - It may be prudent to make one or two bigger rooms /areas which may be utilised for patients who undergo major bedside supports such as renal or hepatic replacement therapy, ECMO and have large array of equipment attached to them.
  - It is recommended that there should be a partition/separation between rooms/ patient areas as patient privacy is desired. Standard curtains soften the look and can be placed between two patient areas. However they are displaced and become unclean easily and patient privacy is disturbed. Fabrics used should be durable, colourfast, flame and static resistant.
  - Doorways to the bed spaces/rooms should be wide enough & appropriately placed to allow an ICU bed along with any attached equipment to pass easily.
• In ICUs with a modular design, patients should be visible from their respective nursing substations. Sliding glass doors and partitions facilitate this arrangement, and increase access to the room in emergency situations.

• Patient should be oriented so that they can see the nurse but not the other patients.

• All patient areas/rooms should possess a daylight source. Ideally should allow a direct view of outdoors, preferably overlooking a garden, courtyard or other natural setting.

• Clear floor space is space not occupied by the patient, fixed room furnishings & equipment. Each room/patient area should be designed to accommodate portable bedside x-ray, Ultrasound and other equipment such as ventilators and intra aortic balloon pumps etc. Single patient rooms

• should have an optimal clearance of 4 feet at the head & foot of the bed and not less than 6 feet on each side of the standard critical care bed.\(^{(16)}\)

• A minimum ceiling height of 3m is required at the bed spaces.

II. **ISOLATION ROOMS** –

10% of the intensive care unit beds (1 or 2 per 10 beds) may be used exclusively for isolation of patients such as those with burns, serious contagious infections or immunocompromised. These rooms may have 20% extra space than other rooms.

The ratio may be higher (5-6 per 10 beds) in special ICUs (burn units, transplantation units etc)\(^{(12)}\)

Isolation rooms should be equipped with an anteroom of at least 3 square metres for hand washing, gowning and storage of isolation material.

Separate pathway for evacuation of contaminated material is recommended.
**Negative pressure isolation rooms**

These are for isolation of patients infected/suspected to be infected with organisms that spread via airborne droplet nuclei of <5µm in diameter.

Windows of these rooms do not open. They have greater exhaust than supply air volume, with pressure difference of 2.5 Pa.

Clean to dirty airflow i.e. direction of the airflow is from the outside space into the room. Air from the room is preferably exhausted to the outside, but may be recirculated provided it is through high efficiency particulate arrest (HEPA) filter.

**Positive pressure isolation rooms**

These are to provide protective environment for patients at highest risk of infection e.g. neutropenia, post transplant.

These rooms should have greater supply than exhaust air. Pressure difference of 2.5 – 8 Pa preferred. Positive airflow relative to the corridor (i.e. air flows from the room to the outside space). HEPA filtration is required if air is returned.

Same isolation room may be used for both positive & negative isolation by using a method of conversion of air from negative to positive or vice versa.
SERVICES PER PATIENT AREA/ROOM

Each bed space should include

a) An electric or manual ICU bed (refer section 8)
b) A high backed chair (refer section 8)
c) Medical Utility Distribution Systems
d) A clinical hand wash basin (section 7)
e) Storage (Section 6)

Medical utility distribution systems are used for mounting & organising electrical, medical gas and other medical utility outlets. There are several options available.

1. Flat head wall configuration - mounted on the wall at the head end of the bed. Allows outlets to be easily arranged but may create problems during a crisis as head end may be cluttered with connecting wires/lines.

2. Column configuration - has an array of outlets on a non-movable vertical column attached to the floor & ceiling. Non movable suspended variant is available too.

3. Boom configuration - consists of a movable articulated arm(s) which could be either ceiling mounted or wall mounted. Ceiling mounted twin armed pendant offer maximum flexibility in positioning & accessing utilities.

Accessory shelves, brackets and poles may be mounted on these devices allowing optimal positioning of all support devices such as monitors, computers, communication devices, IV pumps etc, subjected to a maximum weight that can be supported.
UTILITIES PER BED AREA/ROOM

• Electrical outlets -
  Grounded 240 volt electrical outlets with 30 ampere circuit breakers
  16-28 unswitched single socket outlets per bed. 50% of them to be connected to the hospital emergency power system/ uninterrupted power supply (UPS) & these sockets should be clearly labelled/colour coded.
  Positioned about 3 feet above the floor. If it is flat head wall design, the utility outlets be distributed on either side of bed.
  (Suggested amperage of outlets - 15A, 2, 5A – 3 and rest 13A)

• Medical Gas - 2-3 oxygen outlets

• Vacuum - 2-5 (290 Hgmm)

• Compressed air - 1-2

• Water supply -
  From a certified source, if haemodialysis is to be done.

  Hand washing sinks equipped with elbow/knee/foot or sonar operated faucets must be available near the entrances to the patient modules or between every two patients in the ward type units.

• Communication system – telephone outlet
• Data ports
• Alarm system – patient & staff emergency call
• Lighting - refer section 5.2
III. ASSISTED SHOWER ROOMS/ PATIENT TOILET

One shower room (8 m$^2$) & a toilet (4.5 m$^2$) should be designed per 6 - 8 beds which should have space for a wheel chair movement. \(^{(3)}\)

4.3.B

MANAGEMENT BASE - CENTRAL NURSING/ADMINISTRATIVE STATION

- The size of this area will depend whether or not there are individual workspace per bed for patient files, monitoring charts etc. Individual workstations are recommended to minimise cross infections and when they are available, the central station will function for administrative work for both doctors & nurses.

- Careful consideration of what level or type of activity that will occur in the central station will ensure adequate space planning.

- All/ nearly all monitors and patients must be observable from here, either directly or through central monitoring system. Most ICUs use the central station, serving six to twelve beds arranged in an L, U or circular fashion.

- Some ICUs have unit pods/modules of about four or five beds, each served by a separate workstation. Nurses assigned to patients in the pod form a team.

- The space should accommodate shelves for forms/library, satellite pharmacy, computer terminals and printers, telephone ( including a direct dialing connection), intercom & emergency alarm system etc.

- A drug preparation area too may be included here.

- It is also important that a certain amount of storage space is provided for equipment, linen, instruments, medicines, disposables, stationary and other articles. All these cupboards should be labelled.
4.3C

CLINICAL SUPPORT SPACES

4.3.C (I)

STORAGE AREA/ROOM

Sufficient storage spaces/room outside the patient area is essential. The storage room/s should be easily accessible for nursing & medical staff. Ideally it should have an approach from the patient area and from the supply route.

Important to decide what to be stored

▪ By the bedside - Those supplies used repeatedly and in emergencies
▪ At the Central Nursing Station
▪ Store adjacent to ICU
▪ Remote central store

When medications are kept at the bedside, the storage should be lockable; these stores can store medicines, disposables, records, injections etc.

Bedside supply carts that are stocked for different subsets of patients can make storage in the room more efficient; for example, surgical, medical, trauma patients, cardiac patients where needs are different.

It is recommended to group supply by activity, like Chest tray, Central line tray, skin care tray, catheterisation tray, Intracranial pressure tray etc. They be labelled by name or colour code.

CLEANERS ROOM

A 3-4 sq meter space per 8 beds are recommended for storage of cleaning equipment & material. Housekeeping material should not be used interchangeably with public areas.
4.3C (II)

EQUIPMENT STORAGE AREA/ PARKING BAY

EMERGENCY EQUIPMENT & SUPPLIES

Provisions should be made for storage & easy retrieval of one or more emergency trollies with emergency life support equipment & drugs, 'difficult airway trolley', central venous access trolley, bronchoscope trolley etc.

This area may be a corridor or an alcove and should have an uninterrupted power supply to charge the equipment's batteries.

The trolley locations should be clearly labelled.

NON EMERGENCY EQUIPMENT

An area must be provided for the storage & securing of patient care items that are not in active use such as ventilators, IV pumps, transport ventilators, US scanners, Doppler machines etc.

Horizontal storage may be planned for other equipment.

Space should be adequate for access, easy location of desired equipment and easy retrieval.

Sufficient number of electrical outlets should be available in this area too, to permit recharging of battery operated items.

4.3C (III)

LABORATORY AREA

An area for point of care laboratory testing (blood gas machine, TEG etc) should be available with adequate bench space.

At least 10-12 electric outlets, a sink, storage space for consumables and sharp disposal utensil should be available in this space.
4.3C(IV)

NOURISHMENT PREPARATION AREA/ ROOM

This could be a separate room or any other identified area within the unit. Should have a food preparation surface, sink with running water, microwave oven and a refrigerator.

Hand washing facility should be located in or near the area.

4.3C (V)

CLEAN & DIRTY UTILITY ROOMS

These should be two completely separate spaces with separate access and without any interconnection. They should be air conditioned.

CLEAN UTILITY
A space of about 15 sq meters.
Used for storage of all clean & sterile supplies (eg linen). Should contain a work counter and hand washing station.
Shelving & cabinets (easy to clean) for storage must be located high enough off the floor to allow easy access to the floor underneath for cleaning.

DIRTY UTILITY
A space of about 25 sq meters.
Should contain a clinical sink and facility to clean soiled utensils (bed pan) etc with faucets.
There should be adequate countertop space & space for cleaning supplies.
Separate covered containers must be provided for soiled linen & waste material. Special containers should be provided for sharps.
Removal of soiled items & waste should occur through a separate corridor.
All air supplied to the dirty utility room should be extracted.

Refer environmental requirements below for details of air conditioning requirements.

This may be used as the waste hold until they are taken away.

4.3C(VI)

CLINICAL EQUIPMENT DECONTAMINATION ROOM

A second dirty utility room for dismantling & cleaning of used equipment is desirable. This can be used to clean reusable items, trolleys etc as well.

4.3C (VII)

CLINICAL EQUIPMENT SERVICE ROOM (OPTIONAL)

Equipment needs servicing as per manufacturer’s instructions but this cannot be allowed within the patient areas in the unit. Thus a room/area for this purpose is very useful considering the large number of equipments being in used in critical care units.

4.3C (VIII)

PROCEDURE ROOM

May be optionally important for specific units (burns, pacemaker implantation etc). All bedside facilities should be available along with high intensity lighting and a scrubbing sink. Facilities should be adapted to the specific tasks that this room is designed to carry out.
4.3D

STAFF AREAS

4.3 D (I)

OFFICE AREAS

Consultant's Office
Equipped with telephone, intercom and alarm registration in the ICU.

A computer terminal with access to patient monitoring systems is highly desirable.

Nurse's Office
Office space for sister/head nurse with separate telephone extension, intercom, notice board, alarm system.

4.3 D (II)

REST ROOMS

May have separate areas for differed staff categories.

Can be located in or near the unit & provide a private, comfortable & relaxing environment. It needs to be linked to the ICU by telephone/inter communication system and emergency alarm should be audible within.

Comfortable seating, secured locker facilities, nourishment storage & preparation facilities & toilets should be available.

4.3 D (III)

ONCALL ROOMS:

On call rooms for members of the staff should be available as dictated by the schedule of their rota and should be situated preferably within or adjacent to the unit.
Separate rooms for male & female staff members as well as different categories of staff must be available.

4.3.D (IV)

CONFERENCE ROOM

This room would have multiple purposes like multidisciplinary meetings & staff teaching and can be used to store reference material.

It should be linked to the ICU by telephone/telecommunications and emergency/cardiac arrest alarms should be audible from within.

Should have adequate seating facilities; collapsible chairs may be used.

4.3 E

PUBLIC AREAS

4.3 E (I)

RECEPTION

Should be located in the area where visitors enter the unit. This may be combined with a visitor waiting lounge.

Instructions should be clearly marked and should be multilingual, guiding them to the correct desired location.

A buzzer system with a speaker/telephone contact to an access control desk within the unit is useful as it is not always possible to have a receptionist to man this area.
4.3 E (II)

VISITOR ROOM/ WAITING ROOM

Should have seating facilities (1.5 - 2 seats per bed) for the visitors with soothing decor and comfortable seating.

Warm colours, indirect soft lighting and windows are desirable.

May be combined with the reception area or consultation/quiet room in the event of space constraints.

Educational materials and lists of hospital and community-based support and resource services can be displayed.

A toilet should be available adjoining this room.

4.3 E (III)

CONSULTATION ROOM/QUIET AREA

A private room with about 15 sq meter area is recommended for conversations between interdisciplinary team members & families.

This room should ideally have direct access from the unit & from the relatives waiting area.

Every effort should be taken to protect the privacy of the patient & their family when designing this room.
ENVIROMENTAL REQUIREMENT

5.1

VENTILATION & TEMPERATURE CONTROL SYSTEM

- The ICU should be fully air-conditioned which allows control of temperature, humidity and air change.
- Suitable and safe air quality must be maintained at all times. Air movement should always be from clean to dirty areas.
- It is recommended to have a minimum of six total air changes per room per hour, with two air changes per hour composed of outside air. Where air-conditioning is not universal, cubicles should have fifteen air changes per hour and other patient areas at least three per hour.
- For critical care units having enclosed patient modules, the temperature should be adjustable within each module to allow a choice of temperatures from 16 to 25 degrees Celsius.
- For rooms having toilets, the required toilet exhaust of 75 cubic feet per minute should be composed of outside air.
- The dirty utility, sluice and laboratory area need five changes per hour, but two per hour are sufficient for other staff areas.
- Central air-conditioning systems and re-circulated air must pass through appropriate filters. High Efficiency Particulate Arrestance (HEPA) filters are recommended.
  - It is recommended that all air should be filtered to 99% efficiency down to 5 microns.
  - Heating when indicated, should be provided with an emphasis on the comfort of the patients and the ICU personnel.
  - Isolation rooms may have a choice of positive or negative operating pressure (relative to the open area) and is described in section 2.2.2
5.2

**LIGHTING**

Light in room

Natural Light – Access to outside natural light is recommended by regulatory authorities in USA.

Data suggests that synthetic artificial daylight used in work environment may deliver better results for night time workers.

It may be helpful in maintaining the circadian rhythm.

Natural lighting in the unit can decrease power consumption and the electrical bill which is so relevant to local circumstances.

Access to natural light also means one may have access to viewing external environment which may be developed into a pleasant area.

Light for Procedures

High illumination and spot lighting is needed for procedures, like placing central lines etc. Recommended spotlighting should be shadow free 150 foot candles (fc) strength.

Light required for general patient care

It should be bright enough to ensure adequate vision without eyestrain.

Overhead lighting should be at least 20-foot candles (fc).

Glare created by reflected light should be diffused

Light switches should be strategically located to allow some patient control and adequate staff convenience.

The Illuminating Engineering Society of North America published useful guidelines on this subject.
5.3

ELECTRICITY SUPPLY

Power failure in ICU is a serious issue. ICU should have its own power back up system in place. Uninterrupted Power Supply (UPS) system is preferred for the ICU. Otherwise the supply should be connected to the emergency power supply of the hospital.

5.4

MATERIALS & FINISHES \(^{10, 11}\)

To enhance infection control, materials & finishes throughout the unit should be easy to maintain and clean and deter growth & spread of pathogens.

Surfaces

Surfaces are at risk of spills & high impact damage.

Avoid use of laminates in clinical areas as they provide sites for mould growth and also avoid surfaces and areas that trap water.

They should be non porous & smooth; without fissures, open joints or crevices that can retain or permit the passage dirt/liquid.

Floor

The ideal floor should be easy to clean, non slippery, able to withstand rough use and absorb sound while enhancing the overall look and feel of the environment. They should be chemically inert and resistant to antiseptics.

Carts and beds equipped with large wheels should roll easily over it.

Should be made of seamless, resilient sheet goods and should extend up the wall a short distance to form a smooth junction with the wall.
Carpets should be free from edges which create a hazard for movement of wheelchairs, walkers etc.

Vitrified non-slippery tiles may be the best option which can be fitted into reasonable budgets, easy to clean and move on and may be stain proof.

Ceiling

Material used should be those that can be easily cleaned thoroughly with routine house cleaning equipment.

They should be non friable & smooth and ideally free from fissures, joints and crevices where dust & particles could lodge.

Should ideally absorb sound.

Ceiling design may be enhanced by varying the ceiling height, softening the contours, gridded lighting surfaces, painting it with a medley of soft colours rather than a plain background colour, to make it more patient and staff friendly.

Walls

Walls should be finished with material that can be easily cleaned and they should be durable with ability to absorb sound.

Flame retardant, mildew resistant material with visual appeal is preferred.

Can have a height up to 4 – 5 ft finished with similar tile as of floor.

For rest of the wall should be painted with a soothing colour with glass panels on the head end may be a good choice.
NOISE CONTROL IN ICU

The International Noise Council recommends that the noise level in an ICU be under 45 dBA in the daytime, 40 dBA in the evening and 20 dBA at night (dBA is a scale that filters out low frequency sounds and is more like the human hearing range than plain dB)

Noise level monitors are commercially available. If the unit noise exceeds that level, a light comes on or flashes to remind the staff to decrease the noise level.

ROOM DECOR & FURNITURE / FURNISHING

Pleasant surroundings promote comfort for patients & staff. Scenes of nature in greens & blues have been shown to decrease stress levels in patients.

Selection of images may be incorporated in to the ceilings as well for the patients who are supine.

Providing the patient with a place to keep a few small personal items of his or her own make the environment more familiar and personalized.

Refer box for suggested furniture/furnishing
PATIENT AREA FURNITURE/ FURNISHING

- ICU bed
  Chair suitable for use by the patient (with cleanable covers) - a chair/sofa type chair on wheels with safety belt or vault is recommended for mobilising the patient and making him sit during recovery.
- Bedside medical storage with a work surface to prepare patients drugs- secure & able to store medications, IV fluids & other supplies that are needed on frequent or emergency basis
- Storage cupboard for patient's personal belongings
- Additional chair for visitors
- Soiled linen collection hamper
- Container for trash
- Container for hazardous waste/sharps
- Work surface for the patient's ICU notes with space for other records, radiological films etc. Over bed table with several shelves is suitable.
- Chair for the nurse
- 24 hour Clock
- Calendar
  -
  -
  -
Hand Hygiene and Prevention of Infection

- Hand washing stations should be readily accessible throughout the unit.
- Systems using water & water free can be used.
  - The system with water should have a sink with hot & cold water, a faucet with easy on-off & temperature mixing capabilities, cleansing agents & a means for drying hands.
  - Sink should be free standing, have an offset drain to prevent splashing of the contents of the plumbing trap, be deep enough to prevent splashing and designed for excellent drainage; water should drain back in to the sink.
  - Areas around the plumbing fixtures should be sealed, moisture resistant and designed with splash protection. Dry work areas & counters should be located out of splash range of the sink. Joints at walls & floors should be covered or tightly sealed.
  - One wash basin per 2 beds may be accepted for a ward type unit.
  - Waterless system is an alcohol based anti-microbial instant hand rub, and every bed should have such a source. Each sink can have a hand rub dispenser too. They should be available at other clinical areas in the unit where they are deemed necessary. They should be also available at all entrances to the unit.
- No dirty/soiled linen/material should be allowed to stay in ICU for long times for fear of spread of bad odour, infection and should be disposed off as fast as possible. Dirty linen should be replaced regularly at fixed intervals.
- All surroundings of ICU should be kept absolutely clean and green if possible.
8

**WASTE DISPOSAL AND POLLUTION CONTROL**

- It is important that all government regulations be strictly complied with.
- It is mandatory to have four covered bins (Yellow, blue, Red, Black) provided for each patient or may be one set between two patients which save space and funds.
- Waste material should be kept covered in the dirty utility or other suitable disposal hold until they are taken away.

9

**DISASTER PREPAREDNESS**

- All ICUs should be designed to handle disasters both within ICU and outside ICU.
- A floor plan and evacuation plan of the ICU should be displayed in a highly visible place.
- Within ICU may be fire, accidents and infection or unforeseen incident and outside the ICU may be major or minor disasters like fire, accidents, terrorist acts etc.
- There must be an emergency exit in ICU to rescue patients in times of internal disaster. There should be provision for some contingency room within hospital where critically sick patients may be shifted temporarily. HDU may be the best place if beds are vacant. Post op recovery area & ETU are other possibilities.
- There should be adequate firefighting equipment inside ICU and protection from electrical faults and accidents.
- ICU is a location for infection epidemics, therefore, it is imperative that all protocols and recommendation practises about infection control and prevention are observed and if there is a break out, adequate steps taken to control this and disinfect the ICU if indicated.
### EQUIPMENT RECOMMENDATIONS

This is a guide only and is not a complete list.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Per bed space</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Bed</td>
<td>01 + 01 extra</td>
<td>Capable of attaining chair &amp; Trendelenburg positions With provision for CPR</td>
</tr>
<tr>
<td>Pressure relieving mattress</td>
<td>01 + 01 extra</td>
<td></td>
</tr>
<tr>
<td>Medical Utility Distribution System</td>
<td>01</td>
<td>Refer 4.3 A (i) Ceiling mounted twin arm pendants are favoured</td>
</tr>
<tr>
<td>Multi Parameter patient monitoring unit</td>
<td>One per Bed + one extra + 01 extra</td>
<td>Modular – 2 Invasive BP, SpO₂, NIBP, ECG, RR, Temp, ETCO₂ Preferably with a transport module</td>
</tr>
<tr>
<td>Critical Care Ventilators</td>
<td>01</td>
<td>With paediatric and adult provisions, graphics and non invasive modes, each should have heated humidifier</td>
</tr>
<tr>
<td>Transport Monitor</td>
<td>01 per 6 beds</td>
<td>With an additional battery</td>
</tr>
<tr>
<td>Transport Ventilator</td>
<td>01 per 6 beds</td>
<td>With an additional battery</td>
</tr>
<tr>
<td>Non invasive Ventilators</td>
<td>2 per 6 beds</td>
<td>With provision for CPAP and IPAP</td>
</tr>
<tr>
<td>Infusion Pumps</td>
<td>2</td>
<td>Volumetric with all recent upgraded drug calculation</td>
</tr>
<tr>
<td>Syringe Pump</td>
<td>4</td>
<td>With recent upgraded drug calculation</td>
</tr>
<tr>
<td>Feeding Pump</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Defibrillators</td>
<td>2 per 6 beds</td>
<td>With transcutaneous pacing</td>
</tr>
<tr>
<td>Blood Gas Analyser</td>
<td>01 per 6 beds</td>
<td>Arterial blood gases, electrolyte lactate assessment</td>
</tr>
<tr>
<td>Ultrasound Machine</td>
<td>01 per unit</td>
<td>Linear, curvilinear &amp; echo probes</td>
</tr>
<tr>
<td>Glucometers</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>Intermittent Leg Compression pumps</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>CRRT/HD machines</td>
<td>2</td>
<td>per 6 level 3 beds</td>
</tr>
<tr>
<td>Cardiac Output Monitor</td>
<td>01</td>
<td>Per 6 beds Trans Oesophageal Echo for units with trained personnel</td>
</tr>
<tr>
<td>Portable X ray unit</td>
<td>01 per 6 beds</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Quantity</td>
<td>Unit</td>
</tr>
<tr>
<td>----------------------------</td>
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<td>-------</td>
</tr>
<tr>
<td>Videolaryngoscope</td>
<td>01</td>
<td>Per unit</td>
</tr>
<tr>
<td>Fibreoptic Bronchoscope</td>
<td>01</td>
<td>Per unit</td>
</tr>
<tr>
<td>Respirometer</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>ETT cuff pressure monitors</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>Patient Warmers</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>Fluid warmers</td>
<td>03</td>
<td>Per unit</td>
</tr>
<tr>
<td>ACT machine</td>
<td>01</td>
<td>Per unit For specialised units</td>
</tr>
<tr>
<td>Spinal Board</td>
<td>01</td>
<td>Per unit</td>
</tr>
<tr>
<td>Patient transfer board</td>
<td>02</td>
<td>Per 06 beds</td>
</tr>
<tr>
<td>Refrigerators</td>
<td>03</td>
<td>Per unit For drugs, patient meals &amp; for staff</td>
</tr>
<tr>
<td>Computers</td>
<td>2</td>
<td>Per unit With internet, a printer</td>
</tr>
<tr>
<td>Difficult Airway Trolley</td>
<td>01</td>
<td>Per unit</td>
</tr>
<tr>
<td>Resuscitation Trolley</td>
<td>01</td>
<td>Per 06 beds</td>
</tr>
<tr>
<td>Resuscitator baos</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>Laryngoscopes</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>Stethoscopes</td>
<td>01</td>
<td></td>
</tr>
</tbody>
</table>

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