T E Oh: Intensive Care Manual

Organization Aspects

Chapter 1: Organization of Intensive Care Units

T E Oh

An Intensive Care Unit (ICU) is a specially staffed and equipped hospital ward dedicated to the management of patients with life-threatening illnesses, injuries, or complications. It has been suggested that the ICU developed from the postoperative recovery room or the poliomyelitis epidemic in the early 1950s, when the use of long-term artificial ventilation resulted in reduced mortality. However, modern Intensive Care or Critical Care medicine is not limited to postoperative care or mechanical ventilation. It is a specialty which evolved from the experience of respiratory and cardiac care, physiological organ support, and Coronary Care Units (CCUs, which were established in the early 1960s). Benefits of centralizing special equipment, staff, and facilities to treat critically ill patients and to avert complications (or reduce their severity) became recognized. The 1970s saw a heightened interest in Intensive Care, with research into the pathophysiological processes, treatment regimens, and outcomes of the critically ill, and the founding of specialty journals, training programmes and qualifications dedicated to Intensive Care. Intensive Care today is a separate specialty, and while some period of training in an ICU is valuable to all specialties, it can no longer be regarded as "part" of anaesthesia, chest medicine, general surgery, or any acute discipline.

Role of the ICU

The definition and delineation of roles of hospitals in a region or ICU Organization area are necessary to rationalize services and optimize the use of resources. Each ICU should similarly have its role in the region defined, which should support the defined duties of its hospital. In general, district and general hospitals require ICUs which involve only monitoring and close observation. An ICU which uses complex management and requires investigative backup should be located in a large tertiary referral hospital of the region. Three levels of ICUs can thus be classified.

1. Level I - District Hospital

A Level I ICU has a role in small district hospitals. It may also be called a "high dependency unit", rather than an ICU. Such a unit allows for close nursing observation and ECG monitoring. Immediate resuscitation is possible, but only short term (i.e. less than 24 h) ventilation should be undertaken.

2. Level II - General Hospital

A Level II ICU is located in larger general hospitals. It is capable of undertaking more prolonged ventilation, and has a resident doctor and access to physiotherapy, pathology and radiological facilities at all times. More complex forms of life support (i.e. dialytic therapies), invasive monitoring (i.e. intracranial pressure monitoring), and investigations (i.e. CT scans)

would not normally be provided. It should support the role of its hospital (i.e. area trauma centre).

3. Level III - Tertiary Hospital

A Level III ICU is located in a major tertiary referral hospital. It should provide all aspects of Intensive Care required by its referral role. The unit is staffed by specialist intensivist with trainees, critical care nurses, allied health professionals, and clerical and scientific staff. Support of complex investigations and imaging, and by specialists of all disciplines required by the referral role of the hospital, is available at all times.

Type, Size, and Site of an ICU

Health planning policies may rationalize services by hospitals within a geographical region, so as not to unnecessarily duplicate expensive services. Hence, within each classification, an ICU may not be able to provide Intensive Care for all sub-specialties, or may need to be more oriented towards a particular area of expertise (eg, neurosurgery, cardiac surgery, burns, or trauma). Also, an institution may organize its Intensive Care beds into multiple Units, under separate management control by different specialists, ie, Medical ICU, Surgical ICU, Burns ICU, etc. While this may be appropriate in certain hospitals, Australasian experience has favoured the development of general ICUs. Thus, with the exception of dialysis units, CCUs, and neonatal ICUs, critically ill patients are admitted to the hospital's single ICU, and managed by specialist intensivists. Regions with dedicated paediatric hospitals, of course, have specialist paediatric intensivists.

The number of ICU beds in a hospital usually ranges from 1-2 per 100 total hospital beds. This would depend on the role and type of ICU. Units which routinely admit a large proportion of short-stay, less critically ill patients (eg, postoperative monitoring following elective major surgery), would require more beds than ICUs with "high dependency" beds sited elsewhere in the hospital. ICUs with less than 4 beds are considered not to be cost effective, whereas those with over 12-16 (non-high dependency) beds may be difficult to manage.

The ICU should be sited in close proximity to relevant acute areas, ie, operating rooms, casualty, CCY, labour ward, and acute wards. Critically ill patients are at risk when they are moved. (See Chapter 3, Transport of Critically Ill.) There should be sufficient numbers of lifts, and these, with doors and corridors, should be spacious enough to allow easy passage of beds and equipment - vital points often ignored by planning "experts". Ready access to investigational departments (eg, Radiology and Organ Imaging) and pathology laboratories is also important.

Design of an ICU

There should be a single entry and exit point, attended by the Unit receptionist/clerk. Through traffic of goods or people to other hospital areas must never be allowed. An ICU should have areas and rooms for public reception, patient management and support services (Table 1).

Table 1. *Physical Design of A Major ICU*

Reception Area
- Reception foyer
- Waiting room for visitors (with telephones and beverage facilities)
- Distressed ("crying") / interview room
- Overnight relatives' room

Patient Areas
- Open multi-bed ward(s)
- Single bed isolation rooms
- Central nurse station (including drug storage
- Specialized rooms/beds if necessary, for -
  - procedures/minor surgery (eg, tracheostomy)
  - haemodialysis
  - burns
  - use of bypass or intra-aortic balloon pump machines

Storage and Utility Areas
- Monitoring and electrical equipment
- Respiratory therapy equipment
- Disposables and central sterilizing supplies
- Linen
- Stationery
- Fluids, vascular catheters, and infusion sets
- Non-sterile hardware (eg, drip stands and bed rails)
- Clean utility
- Dirty utility
- Equipment sterilization

Technical areas
- Laboratory
- Workshop for repairs, maintenance, and development

Staff Areas
- Lounge/rest room (with facilities for meals)
- Change rooms
- Toilets and showers
- Offices
- Doctors' on call rooms
- Seminar/conference room

Other Support Areas
- Cleaners' room
- Plant room/alcove.

1. Patient Areas

Each patient bed area requires a *minimum* floor space of 200 ft^2 (18.5 m^2), with single rooms being larger, to accommodate patient, staff and equipment without overcrowding. The ratio of single-room beds to open-ward beds would depend on the role and type of the ICU. Single rooms are essential for isolation cases and (less importantly) privacy for conscious long-stay patients. Positive/negative pressure air conditioning for single isolation rooms are expensive and of unproven value.

Bedside service outlets should conform to local standards and requirements (including electrical safety and emergency supply). Three oxygen, 2 air, 4 suction, and 16 power outlets with a bedside light are optimal for a Level III ICU. How the services are supplied (eg, from floor column, wall mounted, or bed pendent) depends on individual preferences, as each design has its pros and cons. There should be room to place or attach additional portable monitoring equipment, and as much as possible, equipment should be kept off the floor. Space for charts, syringes, sampling tubes, pillows, suction catheters, and patient personal belongings are best arranged in bed dividers. Lead-lining these dividers will help minimize X-ray radiation risks to staff and patients.

All central staff and patient areas must have large clear windows. Lack of natural light and windowless ICUs give rise to patient disorientation and increased stress to all. Since critical care nursing is at the bedside, manning of a central nurse station is less important than in a CCU. Nevertheless, the station should be sited so as to allow all patients to be seen from it. This station usually houses a central monitor, drags cupboards, drugs/specimens refrigerator, telephones, laboratories-linked computer, and patient records. Sufficient numbers of non-splash hand wash basins should be built close to all beds, with each single room having one. There is need for at least one multi-display X-ray viewer in each multi-bed ward. Proper facilities for haemodialysis, such as filtered water, should be incorporated.

2. Storage and Supporting Services Areas

Most ICUs lack storage space. Storage areas should total a floor space of about 25-30% of all the patient and central station areas. Frequently used items (eg, IV fluids and giving sets, sheets, dressing trays, etc) should be located closer to patients than infrequently used or non-patient items (eg, more sophisticated monitoring devices).

Floor areas for supporting services (Table 1) should make up about 20-25% of the patient and central station areas. Clean and separate utility rooms must be separate, each with its own access. Disposal of soiled linen and waste must be catered for, including contaminated items from infections patients. Facilities for estimating blood gases, electrolytes, haemoglobin, haematocrit, and osmolality, with a microscope being available, are usually sufficient for the Unit laboratory. Larger ICUs may require a satellite pharmacy within the Unit. A good communication network of phones/intercoms is vital to locate and inform staff quickly. An special paging code eg "1111" will enable instant summoning of ICU staff in emergencies. Adequate arrangements for offices, doctor on-call rooms, staff lounge (with food/drinks facilities), wash rooms, and teaching complete the Unit.

Equipment

The quantity and level of equipment will depend on the role and type of ICU. Level I and II ICUs will obviously require less than a Level III Unit (Table 2). For example, a 2-channel bedside monitor should suffice for a small district hospital ICU, whereas a major teaching hospital ICU should be equipped with monitors able to display at least 4 physiological signals. Monitoring devices and ventilators are discussed in Ventilators, Lung Function Tests, Haemodynamic Monitoring, and Neurological Monitoring. Equipment should be chosen by experienced intensivists, as so often, much expensive but inappropriate or unsuitable equipment is bought by inept or less knowledgeable people.

Table 2. *Equipment in A Major ICU*

Monitoring
- Bedside and central monitors
- 12-lead ECG (paper) recorder
- Intravascular and intracranial pressure monitoring devices
- Cardiac output computer
- Pulse oximeters
- Pulmonary function monitoring devices
- Expired CO_2 analyzers
- Cerebral function/EEG monitor
- Patient/bed weighers
- Temperature monitors
- Enzymatic blood glucose meters

Radiology
- X-ray viewers
- Portable X-ray machine
- Image intensifier

Respiratory Therapy
- Ventilators, bedside and portable
- Humidifiers
- Oxygen therapy devices and airway circuits
- Intubation trolley (airway control equipment)
- Manual self-inflating resuscitators
- Fibreoptic bronchoscope
- Anaesthetic machine

Cardiovascular Therapy
- Cardiopulmonary resuscitation trolleys
- Defibrillators
- Temporary transvenous pacemaker
- Intra-aortic balloon pump
- Infusion pumps and syringes

Dialytic Therapy
- Haemodialysis machine
- Peritoneal dialysis equipment
- Continuous arterio-venous haemofiltration sets

Laboratory
- Blood gas analyzer
- Selective ion (electrolyte) electrode analyzers
- Osmometer
- Haematocrit centrifuge
- Microscope

Hardware
- Dressing trolleys
- Drip stands
- Bed restraints
- Heating/cooling blankets
- Pressure distribution mattresses
- Sterilizing equipment (eg, autoclave and glutaraldehyde bath).

Staffing

The level of staffing also depends on the type of hospital. A large hospital ICU requires a large team of people (Table 3).

Table 3. *Staff of A Major ICU*

Medical
- Director
- Staff specialist intensivists
- Junior doctors

Nurses
- Charge Nurses
- Nurses
- Nurse educator

Allied Health
- Physiotherapists
- Pharmacist
- Dietician
- Social worker
- Respiratory therapists

Technicians

Secretarial
- Secretary
- Ward clerk

Radiographers

Support Staff
- Orderlies
- Cleaners.

1. Medical Staff

Career (full time or near full time) intensivists are responsible for the clinical management of patients referred tot he ICU in countries which have developed Intensive Care medicine as a separate specialty or subspecialty. The ICU Director is one of such specialists. Hospitals of countries without discrete training programmes in Intensive Care or recognition of the specialty, may adopt a multidisciplinary "management-in-consultation" concept. In this way, a team (usually anaesthetists) looks after the day-to-day and emergency aspects, but co-manages the case with the primary specialist. Whilst appearing democratic, lines of responsibility may at times be unclear, and expert coverage or acquisition of knowledge or experience may not be optimal if individuals do not spend too much time in the Unit.

Junior medical staff in the ICU may be Intensive Care trainees, but should ideally also include trainees of other acute disciplines (eg, anaesthesia, medicine, and surgery). For a Level II or III ICU, it is imperative that adequate supervision of junior doctors, with ready access to specialists, is present.

2. Nursing Staff

The level of nursing staffing shall also depend on the type of ICU. Major ICUs should have a majority of their nurses experienced in critical care nursing. Courses or training programs in critical care are valuable if creditable. The actual total numbers of nurses for an ICU must take into account night shifts, and annual, sick, or study leave. At all times, all critically ill patients must have 1:1 nursing. Occasionally, very unstable patients requiring complex therapy (eg, dialytic therapy) requires 2 nurses most times. Practical staff numbers can be derived from work statistics and types of patients.

3. Allied Health

Major ICUs should have 24 hour access to physiotherapists and radiographic services. Access to other therapists, dieticians, and social workers should also be available. A dedicated ward clinical pharmacist is invaluable. Respiratory therapists are allied health personnel trained in, and responsible for, the equipment and clinical aspects of respiratory therapy, a concept well established in North America, but not Britain, Europe, and Australasia. Technicians, either as a member of the ICU staff, or seconded from biophysics departments, are necessary to service, repair, and develop equipment.

4. Other Staff

Provision should be made for adequate secretarial staff, ie, secretaries and ward clerks. Transport and "lifting" orderly teams make much sense, reducing physical stress and possible injuries to nurses and doctors. If no mechanical system is available to transport specimens to the laboratories (eg, air pressurized chutes), sufficient and reliable manual labour must be provided to do this day and night. Contact is made with the local chaplains, priests, or officials of all religions, when there is need for relevant services. Their role in counselling and consoling distressed relatives is invaluable.

Operational Policies

Clear cut administrative policies are vital to the functioning of an ICU. These include clinical management responsibilities (see above), admission, discharge, and referral policies. Lines of management must be delineated for all staff members, and their job descriptions defined. The Director must have final, overall authority of all staff and their actions in the Unit, although in other respects, each group may be responsible to their respective hospital heads, eg, Nursing Director.

Policies for the care of patients should be formulated. They should be unambiguous, and periodically reviewed and changed if necessary, and be familiarized to all new staff. Certain policies are universally applicable, eg, antibiotic policies and compulsory hand washing before and after examining patients. Others depend more on local situations and personal beliefs, eg, donning gowns and shoes before entering the ICU, a ritual not proven to reduce cross infection.

Continuing Education and Research

Major ICUs, like any teaching hospital department, must have on going academic programs. There should be regular meetings to review clinical management, journals, and new developments. Audit and peer review exercises will document and improve the quality of care. Teaching programs must be instituted for trainees, nurses and other health care workers. Research has to be encouraged and pursued.

Ethics in Intensive Care

Professional ethics in patient care, research, and conduct towards medical and other professional colleagues must be scrupulously upheld. In addition, ICUs with their high technological and life support systems, are vulnerable to legal, moral, and ethical controversies of "euthanasia" or over-enthusiastic treatment; extreme opposite convictions of which are represented by the "right-to-life" and "voluntary euthanasia" groups. Considerable difficulties are caused by public misconceptions of medical practices, and differences in the use and interpretation of terminology, which are not helped by irresponsible public media.

Euthanasia

The acceptance of death by the diagnosis of brain death from brain stem function tests are now well established. (See Chapter 42, Brain Stem Death.) Terminating life support on

a patient with proven brain death should no longer have any legal or ethical implications. Euthanasia, on the other hand, can be viewed as three types:

1. "voluntary euthanasia", or intentional killing of those who have expressed a competent, freely made wish to be killed;

2. professionally assisting suicide; and

3. homicide by agreement of all parties except the subject, who may or may not survive intensive therapy, when death is not imminent (i.e. newborns with congenital defects and ventilated patients with chronic debilitated diseases).

Advocates of euthanasia, as specified above, may argue that it is morally justified in certain cases, as the ultimate outcome is "good" and "best" for the patient. However, euthanasia cannot be ethically justified, because any direct and active action to terminate life, *with known intent,* is always wrong.

Withdrawal or Withholding of Treatment

The withdrawal or withholding of treatment which sustains or prolongs life has been unfortunately called "passive euthanasia", a term which is both inaccurate and misleading. Allowing a patient to die by withdrawing treatment proved to be of no benefit, or not starting treatment judged to be of no benefit, when death is usually inevitable (albeit not always invariable), cannot be morally or ethically equated with euthanasia, as the intentions are different.

Legal Considerations

Probably in nearly al countries (certainly in Canada, Britain, Australia, and New Zealand), there is no provision to allow euthanasia ("mercy killing") or the assistance of suicide to be legally treated differently from homicide. Law reform enquiries have examined the rights (to die) of competent subjects with incurable terminal or incapacitating illnesses. However, some considerations pose difficulties, such as possible personal motives, wrong or incompetent diagnosis and/or prognosis, the degree of intolerable incapacitation, and the assessment/validation of the patient's mental competence. Consent of the patient to undergo euthanasia cannot be relevant, as it is a consent to an unlawful act. The rights of incompetent patients for euthanasia cannot be relevant, as it is a consent to an unlawful act. The rights of incompetent patients for euthanasia or to refuse care, are even more complex. On the other hand, withdrawal or withholding of treatment was found to be different by a recent Australian enquiry into dying, in that "the non-application of medical treatment does not in itself constitute the cause of death, where a medical practitioner is acting in good faith".

In the USA, while euthanasia is illegal, it is now established that competent patients have a legal right to refuse medical care. This right to "death with dignity" has at times been extended by courts to incompetent patients. Most States have adopted "living will" laws permitting patients to provide written instructions about what medical interventions they would or wound not want, if they become incompetent. As these "wills" are made in advance without knowing the nature of one's future incapacitation (or indeed that it will occur), the

laws, by necessity, lack precision. Some laws require certification of the competence of the subject, and others apply only to patients with a "terminal" condition or when death is imminent. Consequently, difficulties in interpretation of the legislations arise. One other difficulty is that the law may be interpreted to indicate that all medical measures must be applied to those patients who have not made a living will.

Most US States also have laws covering an enduring power of attorney, which nominates another person ("healthy proxy") to make treatment decisions on one's behalf, in the event of incompetence. This concept could allow for the cessation of unwanted treatment, even life sustaining treatment, but could not involve the possibility of an illegal act, such as direct killing. The legal status of the above living will and enduring power of attorney documents are largely untested outside the USA, but these issues should not be confused with euthanasia and the associated ethical difficulties of doctors who directly bring about the death of their patients.

Practical Considerations

There are occasions in the ICU when all treatment, including the most sophisticated and expensive, do not influence outcome. Apart from the financial cost to the community, the emotional cost to the relatives (as well as staff), to keep the patient alive "to the very end", is heavy. Family and friends become hostages to technology, when life support treatment, instead of saving a life, delays inevitable, imminent death. In such cases, intensivists should consider the appropriateness of continuing or starting "aggressive" treatment and examine the ethical basis of their decisions. Not every patient requires an "all out" effort. At all times, consideration must be given to the best interests of (a) the patient, (b) the family, and (c) the community in that order.

Communication with the relatives is all important. Frank and honest discussions must be held with them. The clinical situation, treatment given, and judged prognosis must be explained clearly, avoiding medical terms. Their views and opinions must be sought and respected, but they must never be placed in a position where they are (or feel that they are) forced to make a treatment decision affecting the patient. This may otherwise lead to feelings of guilt, bitterness, or confusion if the patient dies. Also, the patient's best interests may not be represented by the relatives, especially if there are feuding family factions. The ICU staff must have unwavering patience in dealing with the relatives, some of whom react differently under the stress. Some relatives want "everything" to be done. Others may become aggressive. Commonly, some do not accept the situation, and do not appear to retain repeated explanations of bad prognosis. It is good practice for the same one or two staff members (eg, intensivist and bedside nurse) to communicate with each set of relatives. This will help promote comfort and trust, and avoid misunderstandings in communications. Any personal biases expressed in informal loose talk by any staff member, is irresponsible and unethical.