Chapter 1

General Aspects of Care

LEARNING OBJECTIVES

After going through this chapter, you will be able to:

- Review the history of critical care nursing.
- Integrate the principles of critical care nursing.
- Identify the legal and ethical aspects in critical care nursing.
- Design critical care unit.
- Identify the nosocomial infections in critical care unit.
- Implement infection control measures in critical care unit.
- Formulate nursing care plan for critically ill patients.
- Apply nursing process in critical care unit.
- Describe risk factors and related nursing measures to prevent development of pressure ulcers in critical care unit.
- Prepare a framework for understanding death and dying.

CHAPTER OUTLINE

- The Evolution of Critical Care: Historical Perspectives
- Critical Care Nursing
- Principles of Critical Care Nursing
- Scope of Nursing Practice in Critical Care Units
- Legal and Ethical Aspects in Critical Care Nursing
- Role of a Nurse in Critical Care Units
- Planning of a Critical Care Unit
- Nosocomial Infections and Their Control in Critical Care Units
- Psychosocial Components of Care in Critical Care Units
- Nursing Process in Critical Care Unit
- Communication in Critical Care Nursing
- Counseling
- Pressure Sore Prevention and Management in Critical Care Units
- Delirium, Agitation, Sedation, Analgesia
- Coma and Brain Death
- Death and Dying

THE EVOLUTION OF CRITICAL CARE: HISTORICAL PERSPECTIVES

Forty years of development in critical care and critical care nursing, and its rise as a recognized specialty in nursing practice is examined from historical perspectives. Critical care units have evolved over the last four decades in response to medical advances. During the Crimean War, in the 1850s, Florence Nightingale recognized the need to consider the severity of illness in bed allocation of patients and made a separate area near the nursing station for critically injured British soldiers. Some identify this as the beginning of intensive care. She reduced the mortality from 20% to 2% in the battlefield of Crimea by creating the concept of **"Intensive Care".**

In 1927, Dr Walter Dandy of Johns Hopkins Hospital arranged a special area for increased monitoring of his postoperative neurosurgical patients. From the early 1950s through the 1990s—an era in which radical and unprecedented changes occurred in the care of patients (those severely ill, and all others as well) with the development and growth of intensive/critical care units in hospitals. Modern critical care began with the development of new technology, specifically the iron lung and negative pressure ventilation used during the 1952 polio epidemic. Dr Bjorn Ibsen described the provision of this respiratory care in the Proceedings of the Royal Society of Medicine (Fig. 1.1). The impetus for initiating these units was multifactorial and complex. The factors included the acute shortage of civilian registered nurses (RNs) during and following World War II, innovative surgical procedures developed in caring for wounded servicemen that later carried over to civilian hospitals, vastly overcrowded hospitals, and the hospitals having unacceptably high mortality rate among postoperative patients. In 1953, Dr William McClenahan was the first to recommend and establish-against opposition, a separate unit for critically ill patients. Hospital administrators quickly recognized that these centrally located units were far better models to meet the fast-changing needs of these patients.

Fig. 1.1: Dr Bjorn Ibsen

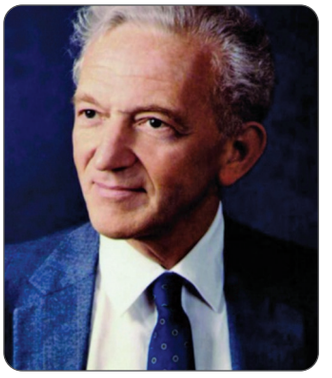


Fig. 1.2: Dr Peter Safar

As surgical techniques advanced, it became necessary that postoperative patients required careful monitoring and thus came the recovery room, where maximum use of medical, nursing and auxiliary personnel was made available with all devices for life saving measures.

Among the first modern critical care units opened in 1959 were at the University of Southern California and the University of Pittsburgh, both staffed by specially trained critical care physicians. Mechanical ventilators first became commercially available in the 1960s, followed by increasing use of automated monitoring of vital signs with alarms.

Anesthesiologist Dr Peter Safar (Fig. 1.2), a pioneer in critical care medicine and a three-time Nobel prize nominee for medicine, is known as the father of cardiopulmonary resuscitation (CPR). He established the concept of **"Advanced support of Life".**

UNITED STATES OF AMERICA

The first application of this idea of advanced support of life in United States was pioneered by Dr William Mosenthal at Dartmouth Hitchcock Medical Center. In 1960, the importance of cardiac arrhythmias as a source of morbidity and mortality in Myocardial Infarction was recognized. At the same time, newer horizons in cardiothoracic surgery came with refinements in intraoperative membrane oxygen technique. Thus, the need for critical care units became more obvious. In 1953, Manchester Memorial Hospital opened a four-bedded progressive care unit. Later on, an eight-bedded unit at Philadelphia was started. By 1957, there were 20 units in USA and by 1958, the number increased to 150. During 1970's, the term critical care unit came into existence which covered all types of specialty units.

The rapidly increasing number of critical-care nurses soon collectively organized a national group, the **American Association of Critical-Care Nurses (AACN)**, which developed standards of care, a core curriculum to educate new nurses entering the field, and a national examination to certify nurses' knowledge and competency in critical care.

These efforts continue to guide the education and clinical competence of intensive-care nurses.

The central contextual forces that led to the development of intensive care units in the 1950's and 1960's are:

- The expansion of American Hospital System and Hospital Insurance.
- Architectural, hospital changes toward private and semiprivate accommodations.
- Reallocations of direct patient care responsibility and creation of new forms of care.

Important Milestones of AACN

1969: AACN founded to help educate nurses

1971: AACN changed name to American Association of Critical-Care Nurses, a specialty nursing organization committed to a health care system driven by the needs of patients and families where critical care nurses make their optimal contribution.

1980: Critical Care Nurse, bimonthly clinical practice journal launched to provide current, relevant and useful information on the bedside care of acutely and critically ill patients.

1999: CCNS specialty certification introduced for the acute/critical care clinical nurse specialist educated at the graduate level to provide care to adult, pediatric or neonatal patients.

2007: CCRN-E specialty certification introduced as renewal option for nurses primarily working in a tele intensive care unit (ICU) monitoring acutely and/or critically ill adult patients from a remote location.

2012: "AACN Scope and Standards for Acute Care Nurse Practitioner Practice" published.

2014: AACN (as part of Critical Care Societies Collaborative) supported ABIM Foundation's Choosing Wisely initiative by identifying five routine critical care practices that may not be necessary or could be harmful

2019: Founded in 1969, AACN celebrates 50 years of acute and critical care nursing excellence, serving more than 120,000 members and over 200 chapters in the United States. AACN celebrates all that nurses have accomplished during the last half century, while honoring their past, present and future impact on the evolution of high-acuity and critical care nursing.

UNITED KINGDOM

Intensive care was developed in UK as a medical specialty as a result of some extraordinary circumstances and the involvement of some extraordinary people. In 1952, the polio epidemic in Copenhagen demonstrated that tracheostomy with intermittent positive pressure ventilation saved lives. Those infected with tetanus (common in agricultural areas) soon benefited and the delivery of care was built with the development in war-time shock tents of triage, monitoring, transfusion and teamwork. At the same time, a number of different specialists, including respiratory physiologists, anesthetists and commercial manufacturers of respiratory equipment improved the possibilities of emergency treatment. These advances were rapidly extended to the care of postoperative patients, particularly with developments in cardiac surgery.

The average cost of funding is:

- $838/bed/day/Neonatal ICU
- $702/bed/day in Pediatric ICU
- $1328.bed/day in Adult ICU

At St Thomas' Hospital, London, Ron Bradley devised a mobile trolley of diagnostic equipment that was moved around the hospital as a rapid response unit. Dedicated units appeared in the early 1960s in Cambridge, London and Liverpool; and later specialist care units were created for prenatal, cardiac and dialysis patients, bolstered by specific department of health building guidelines. The importance of specialist nursing care led to the development of nurse training, education and the eventual appointment of nurse consultants in the NHS in 1999. The specialty of intensive care was granted "Faculty" status by the General Medical Council in 2010. Introduced by Professor Sir Ian Gilmore, this transcript includes, inter alia, the development of cardiac catheters, monitoring equipment, data collection techniques and the rise of multidisciplinary, national audit, and scoring systems. As the medical technology advanced, more and more sub specialties such as cardiothoracic, renal, coronary, respiratory and neurosurgical units were established. Thereafter, critical care units underwent reformation in their design, facilities, and nurse patient relationship and nurse physician relationship.

INDIA

Critical care in India is picking up and needs to strike a deeper root because of the increasing demands of an ever growing population. However, it is encouraging to note that every other hospital has a unit of Intensive Care, small or big. The history of critical care in India, dates back to sixties and seventies wherein many units were established in Mumbai, Delhi and other Metropolitan cities and also Christian Medical College and Hospital, Vellore, South India**. The first intensive care units were established in the late 1950s**. Each year, about 5 million patients are admitted to intensive care units in India. Some of the hospitals had a general unit from which more specialized units were embarked later on. During the same time, hospitals in Mumbai such as Jaslok Hospital, Breach

Candy Hospital started the intensive care and this pattern was units followed by Hinduja Hospital and many others. The units offered overall intensive care including mechanical ventilatory support.

By end of the seventies, most of the hospitals established their own well-equipped multi-specialty units or unitary specialty units. Most of well-equipped critical care units are confined to medium and large hospitals in major cities of India. This trend will continue in the future leaving a large disparity of need for ICU beds for the ever growing population of India. Other alternative for this problem could be to build high dependency areas in every ward. No hospital is complete without a critical care unit. Critical care units are being incorporated more and more into the hospital structure. As the facility expands, they get diversified into more specialized critical care units.

The annual national and international congresses like 2019 Pulmonary, Thoracic and Critical Care Conference (2019 PTCC), contributed a lot to make a strong pool in the growth of critical care in India and worldwide. At a time when very few Indian specialists could attend international meetings such as ISICEM, ESICM or SCCM, the 2019 PTCC international conference was planned this year in India, where the presence of these specialists from around the world did wonders to raise the level of scientific standards and act as appropriate models for the average ICU physicians and doctors in India.

Critical Care Society in India

The transformation of the development of critical care occurred in the early 1990s. A group of Indian doctors/professionals gathered for training in Western Countries, founded the Indian Society of Critical Care Medicine (ISCCM) in 1993. They began to discuss and exchange the knowledge. They had about 7,000 members and covered 80 Indian cities until the end of 2014.

With a view to promote the research advancement in the field of critical care, Episirus Scientifica is committed to bring together leading experts of medical professionals, researchers, engineers, and scientists. The challenge for critical care nurse today is not the monetary investment but the need to examine long-standing conflicts, character traits and social factor of patients and families.

CRITICAL CARE NURSES SOCIETY

Critical Care Nursing is the field of nursing with a focus on care of the critically ill and hemodynamically unstable patients. Critical Care Nurses work in a variety of departments including the EMS and ICU's and are most pivotal members of the health care system. The Critical Care Nurses Society (CCNS) is the national organization of these nurses who are charged with responsibility of caring for acutely and critically ill patients. The society was launched in the year 2011 under the leadership of Dr Jaya Kuruvilla, founder President and Dr Kavita Bhalekar founder General Secretary. CCNS is like an oasis for Critical Care Nurses who want to step up their involvement and make a difference for themselves and their profession.

The society aims at:

- Promoting academic and scientific activity in the field of Critical Care Nursing.
- Encouraging research in the field of Critical Care Nursing.
- Organizing continuing nursing education and training programs, meeting and conferences in Critical Care Nursing.
- Publishing scientific papers, journals, monographs and textbooks.
- Seeking affiliation with national and international associations and societies.

In line with the objectives, CCNS has already become the full member of World Federation of Critical Care Nurses. CCNS also conduct many educational programs for nurses in collaboration with industry partners and institutions. Critical Care Nursing practice standards are developed by CCNS and approved by Maharashtra Nursing Council. Few hospitals have got their ICU's accredited by CCNS for Critical Care Nursing Excellence. Journal of Critical Care Nursing (JCCN) is the official organ of Critical Care Nurses Society.

MUST KNOW

- The concept of Florence Nightingale, of recognizing the need of keeping serious patients near the nurse's station was the beginning of the 'Intensive Care'.
- Though western countries have gone far too ahead, India is also showing an upward trend in having more critical care units attached to almost all hospitals.
- The need to have specialization in critical care nursing is felt more than ever before. And ssmany hospitals are conducting short-term courses in critical care nursing. Continuing education in critical care nursing has become part of educational programs in the hospitals.

ASSESS YOURSELF

1. Write short note on evolution of critical care.
2. Enumerate the historical landmarks which have led to the modern critical care nursing.
3. Write short note on history of critical care in USA and UK.
4. Write short note on history of critical care in India.

CRITICAL CARE NURSING

TERMINOLOGY

- **Critical care unit:** It is defined as the unit in which comprehensive care of a critically ill patient who is deemed recoverable is carried out. **Critical care unit** is a specially designed and equipped facility staffed by skilled personnel to provide effective and safe care for dependent patients with life-threatening or potentially life-threatening problems. And then the practical problem of defining the critically ill patient arises.
- **Critical care nurse:** A critical care nurse is a licensed professional nurse, who is responsible for ensuring that acutely and critically ill patients and their families receive optimal care.
- **Critical care nursing:** It is a specialty within nursing that deals specifically with human responses to life-threatening problems. Critical care nursing in any type of unit demands providing best care possible, which requires more than being knowledgeable, highly trained and experienced. One cannot give best care by oneself. Excellent care is possible with the help of others. Successful partnership can bring about wonders in critical care units. The essence of team spirit is the pathway to success in management of most difficult situations in any critical care unit.
- **Critical illness:** It is a life-threatening illness usually associated with cellular hypoxia as a result of cardio respiratory dysfunction leading to multiple organ failure.

THE AIM OF THE CRITICAL CARE

It is to see that one provides a care such that patient improves and survives the acute illness or tides over the acute exacerbation of the chronic illness.

CONCEPT OF CRITICAL CARE NURSING

The concept of intensive care nursing took its root from Florence Nightingale, who is the founder of modern nursing. She placed the seriously ill patients near the nurse's station for closer and better observation and care. During 1970's, the term critical care unit came into practice which covered all types of special care units. Pediatric intensive care units and special care units for babies also came up as it was necessary to have separate units with special equipment and devices for the care of the newborn and children.

Caring for acutely ill patients and their families is a privilege. Nurses have the opportunity to promote optimal outcomes during one of the most vulnerable times in patient's lives. Intensive care units came about as the outgrowth of recovery room. When the surgical techniques advanced, postoperative patients required careful monitoring, and thus came the concept of recovery room where maximum use of medical, nursing and auxiliary personnel is available along with life saving devices.

Advances in respiratory assist devices and cardiothoracic surgery brought advancements of Respiratory Intensive care units. Coronary care units could be the first of its kind available in a very small hospital where patients with coronary heart disease and arrhythmia are treated. With renal transplantation taking a full stride in many hospitals, the renal units came into existence. Then came sub specialty unit for renal dialysis. There are medical intensive care units, surgical intensive care units, burns unit and neurosurgical units in many hospitals apart from the ones mentioned before.

With all these, the concept of intensive care nursing with specially trained nurses and physicians, became well established. Thus biomedical knowledge, new technology and rising public expectation created new pressures and revolutionized the practice of nursing. Critical care unit has its advantages and disadvantages. The advantage is that it provides better and more organized care. The main disadvantage is of a hostile environment contributing to anxiety, emotional stress, loneliness and a greater risk of developing nosocomial infections.

7 C'S OF CRITICAL CARE NURSING

The 7 C's of critical care nursing are illustrated in Figure 1.3.

1. **Compassion:** Compassion is how care is delivered through relationships based on empathy, respect and dignity and can also be defined as intelligent kindness. It is central to how people perceive the care they receive.
2. **Communication:** Communication is central to successful caring relationships and for effective team working, and is the key to an efficient working environment, with benefits for service users and staff alike. Listening is as important as what is said and done.
3. **Courage:** Courage enables us to do the right thing for the service users in our care, to speak up when we have concerns and to have personal strength and vision to innovate and to embrace new ways of working.

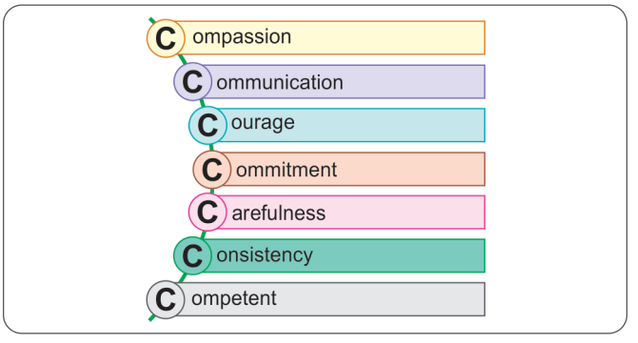
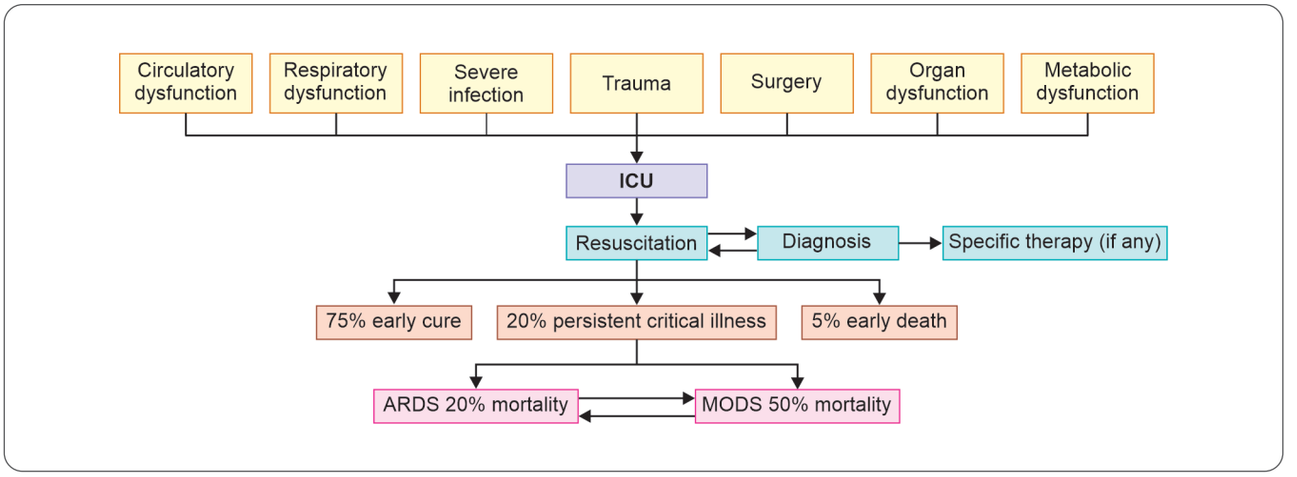


Fig. 1.3: 7 C's of critical care nursing

Flowchart 1.1: Care of the critically ill patient



4. **Commitment:** We need to build on the commitment set out in the Priory Mission Statement to take action, to make the vision a reality for all, and to meet challenges as they arise.
5. **Carefulness:** Individuals receiving care expect it to be right for them at the time of their stay with Priory, whether long or short-term. The care we deliver must be to help improve the lives of the people we care for, support and educate.
6. **Competence:** Competence means that all those in caring roles must have the ability to understand service users' health and social needs, and have the expertise, clinical and technical knowledge to deliver effective care and treatments based on research and evidence.
7. **Consistency:** It will ensures consistent delivery of care across the service.

The care of the critically ill patient is summarized in Flowchart 1.1.

STAGES OF CRITICAL ILLNESS

There are two stages of critical illness, the reversible and the irreversible. Critical care medicine is based on principles that recognize cellular dysfunction at the reversible stage and ensure adequate supportive treatment before irreversible changes occur.

1. **Reversible stage of critical illness:** Oxygen transport to the tissue is increased. There is tachypnea, tachycardia, increased cardiac output and a low blood pressure. Peripheries are warm and flushed. This is an early reversible stage-warm shock. The next stage of cold shock is characterized by a failing cardiac output, cold and clammy peripheries, poor capillary filling and cyanosis.
2. **Irreversible stage of critical illness:** When oxygen demand exceeds oxygen supply, anaerobic metabolism takes place. This leads to metabolic acidosis and if it remains unchecked, a state arrives in which even if oxygen supply is restored, the cells are unable to utilize it. This is the point of irreversible damage, which precedes cellular death. The microcirculation fails and cells become hypoxic, and cellular damage occurs.

Pathophysiological Change Stages

Cardiac

Cardiac output: The regulation of cardiac output is complex in critically ill patients. It depends on following factors:

- **Tissue factor:** The cardiac output is controlled by tissue needs for oxygen nutrients. Each organ has a built in mechanism of auto regulation of blood flow mechanism through arterial dilatation and vasoconstriction.
- **Neurohormonal effect:** Neurohormones play a major role in regulating cardiac output. Neurohormonal activation happens in a patient with acute circulatory failure. These mechanisms maintain adequate blood supply to the brain, heart and other vital organs while reducing blood supply to the peripheries.
- **Intrinsic cardiac mechanisms:** The heart has significant reserve which enables to increase the cardiac output. Cardiac output is increased by increased heart rate and stroke volume.
- **Cardiac rate and rhythm:** The cardiac rate is important in maintaining the cardiac output. Both tachycardia and bradycardia affect cardiac output adversely. Rhythm disturbances—even in normal heart can reduce the cardiac output, much more in diseased hearts.

Pulmonary

Basic concepts of gas exchange:

- Efficient gas exchange in the lungs requires:
  - Adequate alveolar ventilation
  - Even ventilation-perfusion ratio
  - Diffusion of oxygen across the alveolar wall
- **Adequate alveolar ventilation:**
  - The pressure of CO_2 in the arterial blood is a good indicator of alveolar ventilation ($PaCO_2$)
  - The CO_2 is released into the alveolus by ventilation, the greater the ventilation the lower is the concentration of CO_2 in the alveolus.
  - The alveolar concentration is balanced between alveolar ventilation and the rate at which CO_2 is evolved (vCO_2).
  - There is good evidence to show that blood $PaCO_2$ is very close to the alveolar $PaCO_2$
    - **Normal $PaCO_2$ — 35–45 mm Hg**
    - **High $PaCO_2$—Hypoventilation**
    - **Low $PaCO_2$—Hyperventilation**
- **Alveolar oxygen:** Fresh oxygen from the inspired gas enters alveoli during ventilation. The oxygen diffuses through the alveolar wall into the blood perfusing the alveoli. For any given concentration of oxygen in inspired gas (FiO_2), the alveolar concentration of oxygen (FAO_2) is balanced between alveolar ventilation (VA) and the oxygen taken up (VO_2) by the blood perfusing the ventilated alveoli.
- **Oxygen transport:** The transport of oxygen to the tissues is the vital function of cardiorespiratory system (Fig. 1.4). Normal arterial oxygen doesn't ensure oxygen transport. It depends on cardiac output.

Efficient critical care should ensure an adequate cardiac output and arterial oxygen content.

Ventilation Perfusion Ratio

Uneven ventilation perfusion or ventilation perfusion mismatch is an important cause of hypoxia or poor arterial oxygenation. Diffusion of oxygen across the alveolar wall into the capillaries perfusing the alveoli and carbon dioxide from the capillaries into the alveolar space does not match. Thus severe diffusion defect may contribute to low $PaCO_2$. It may also lead to uneven compliance within the lungs and thereby resulting in ventilation perfusion mismatch.

The most dramatic changes are seen in the lungs. This clinical condition is referred to as adult respiratory distress syndrome (ARDS), a syndrome with multiplicity of predisposing factors. It is the final common pathway of respiratory failure in critical illness. Hypoxic pulmonary capillary damage leads to an increase in capillary permeability and fluid leaks out into the pulmonary interstitial. Alveolar cell damage occurs and loss of alveolar volume as well as edema leads to a defective gas exchange. The ensuing hypoxia is severe and refractory to ventilatory support.

In every critical illness, adequate oxygen delivery or oxygen transport to the tissues is crucial for proper function of different organ systems. Oxygen delivery is dependent on cardiorespiratory function. Cardiorespiratory failure brings about decline in the clinical state of critical illness. Cardiac failure has effect on the pulmonary function and gas exchange. Respiratory failure in turn worsens cardiac function. A vicious circle of both, ultimately leads to death.

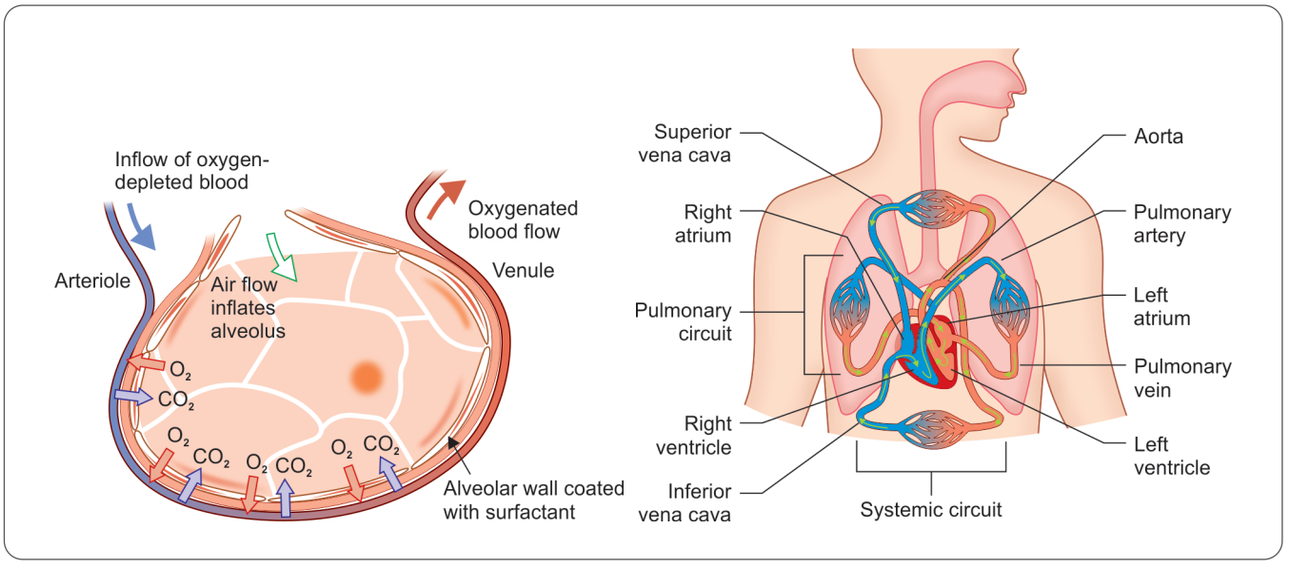


Fig. 1.4: Transport of oxygen in cardiorespiratory system

Multiple Organ Failure

Other organs like liver also suffer from hypoxia and hepatic failure. This may be reflected in increased serum bilirubin, alkaline phosphatase, and serum albumin. There is decreased production of coagulation factor, increased platelet activity and increased accumulation of micro-aggregates, finally resulting in disseminated intravascular coagulation (DIC). Renal failure with falling urine output is an almost invariable accompaniment to failing circulation. Cellular failure may also be reflected in central nervous dysfunction as well as in compromised endocrine response to stress. All these constitute the elements of a vicious cycle, which negate the possibility of spontaneous recovery.

The basic function of a critical care unit is to initiate cardiorespiratory and systemic support during the reversible stage of critical illness. The prognosis of critically ill patients depends on early detection and prompt treatment. Monitoring of cardiorespiratory function is of prime importance in the assessment of adequacy of treatment.

FACTORS PREDISPOSING TO CRITICAL ILLNESS

Factors contributing to critical illness are shown in Figure 1.5. The following conditions require intensive or critical care:

- Acute life-threatening illnesses which are potentially reversible
- Acute illnesses with potential and likely to occur life-threatening complications.
- Monitoring of vital parameters of patients with signs and symptoms that suggest the possibility of an evolving life-threatening illness.
- Acute or immediate life-threatening complication or a crisis in a chronic illness.

CCU/ICU

Types of ICUs

There are three types of ICUs

1. **Open units:** Any attending physician with hospital admitting privileges can be the physician of record and direct ICU care. (All other physicians are consultants)
   Disadvantages:
   - Lack of a cohesive plan
   - Inconsistent night coverage
   - Duplication of services
2. **Closed units:** An intensivist is the physician of record for ICU patients. (Other physicians are consultants), All orders and procedures are carried out by ICU staff.
   Advantages:
   - Improved efficiency
   - Standardized protocol for care

   Disadvantages:
   - Potential to lock out private physician
   - Increase physician conflict
3. **Transitional units:** Intensives are locally present, shared, co-managed care between ICU staff and private physician. ICU staff is a final common pathway for orders and procedures.
   Advantages:
   - Reduced physician conflict
   - Standard policies and procedures usually present

   Disadvantage:
   - Confusion and conflict regarding final authority and responsibilities for patient care decision

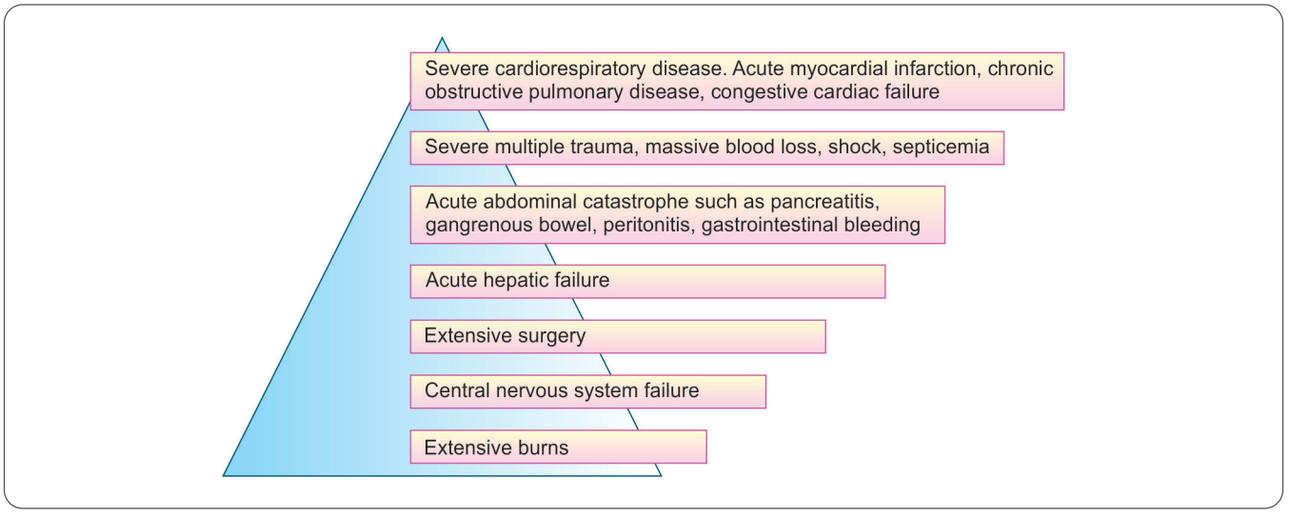


Fig. 1.5: Factors contributing to critical illness

Classification of ICUs

- **Level I:** This can be referred to as high dependency, where close monitoring, resuscitation, and short-term ventilation <24 hours has to be performed.
- **Level II:** This is located in general hospital, undertake more prolonged ventilation. Must have resident doctors, nurses, access to pathology, radiology, etc.
- **Level III:** This is located in a major tertiary hospital, which is a referral hospital. It should provide all aspects of intensive care required.

MUST KNOW

- Critical care unit is a specially designed and equipped facility staffed by skilled personnel to provide effective and safe care for dependent patients with life-threatening or potentially life-threatening problems.
- Different specialty units have come about as medical science advanced and diversified into specialty.
- Critical illness is a state of threatened, generalized cellular hypoxia as a result of cardio respiratory dysfunction which can be either primary or secondary.
- The two stages of critical illness are reversible and irreversible stages. Critical care medicine is based on principles that recognize cellular dysfunction at the reversible stage and ensure adequate supportive treatment before it becomes irreversible.
- Critical care nurse with her assessment skills, identifies the different stages of illness, plans and implements care and notifies the physician whenever it is required to be notified.

ASSESS YOURSELF

1. Compare reversible stage of critical illness with irreversible stage of critical illness.
2. List the factors predisposing to critical illness.
3. Describe the pathophysiological changes in irreversible stage of critical illness.
4. Which are the 7C's of critical care nursing?

CRITICAL THINKING SKILLS

A 76-year-old patient with metastatic brain tumor already on treatment for heart failure is admitted to the critical care unit. Describe the pathophysiology and distinguish between reversible and irreversible stage of the illness.

PRINCIPLES OF CRITICAL CARE NURSING

The principles followed by a nurse in critical care nursing are enumerated in Figure 1.6.

ANTICIPATION

The first principle in critical care is anticipation. One has to recognize the high risk patients and anticipate the requirements, complications and be prepared to meet any emergency. A unit properly organized with all necessary equipment and supplies are mandatory for smooth running of critical care unit. The nurse in critical care unit (CCU) should know what is happening to the patient and anticipate all possible events and complication in the immediate future. He/she should also communicate her finding to the concerned physician as soon as she becomes aware of it.

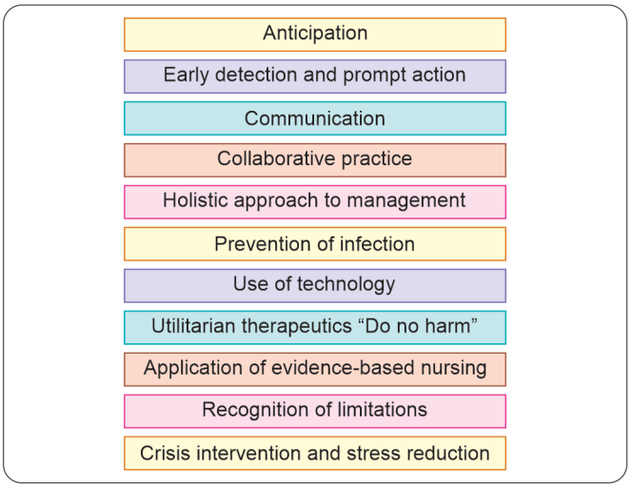


Fig. 1.6: Principles of critical care nursing

EARLY DETECTION AND PROMPT ACTION

The prognosis of the patient depends on the early detection of variation, prompt and appropriate action to prevent or combat complications. The patient in critical care unit has life-threatening illnesses with serious dysfunction involving one or more organs. The early diagnosis and identification of the problem is imperative for correct management. Monitoring of cardio-respiratory and neurologic function is of prime importance in assessment enabling to detect minute changes in the clinical condition of the patient.

COLLABORATIVE PRACTICE

Critical care, which has originated as technical subspecialized body of knowledge, has evolved into a comprehensive discipline requiring a very specialized body of knowledge for the physicians and nurses working in the unit. Collaborative practice between the physicians and the nurses working in the critical care unit fosters a partnership for decision making and ensures quality and compassionate patient care. Collaborative practice is more and more warranted for critical care—more than in any other field.

COMMUNICATION

Intraprofessional, interdepartmental and interpersonal communication have a significant importance in the smooth running of unit. Collaborative practice of communication model unlike the traditional practice model enhances better outcome as far as patient, nurse, physician and hospital are concerned. This model centers around the patient, fosters individual clinical decision-making, uses integrated medical records and joint review of care.

HOLISTIC APPROACH TO MANAGEMENT

The patient in CCU is to be viewed in an overall perspective with interrelated functions of interrelated organs. Although there are many specialists who are involved in the management of care, the primary physician should take hold of the situation and should not allow diversity affecting the decision making process. It is a question of experience, wisdom, knowledge and occasionally intuition that one makes a person capable of an appropriate decision. The nurse in the unit has a pivotal role in keeping all threads together, keeping the patient in central focus. Too many specialists and super-specialists individually looking after a critically ill patient do more harm than benefit to the patient.

PREVENTION OF INFECTION

Nosocomial infection costs a lot in the health care services. Critically ill patients requiring intensive care are at a greater risk than other patients due to the already immune compromised state because of antibiotic usage and stress, invasive lines, mechanical ventilators, prolonged stay and severity of illness and environment of the critical care unit itself. The sources of infections are wounds, indwelling catheters, invasive lines, ventilator, hematogenic, and urinary route. The most common organisms responsible for nosocomial infections are *Escherichia coli*, Pseudomonas species, *Staphylococcus aureus* and occasionally *Clostridium tetani*. Quality nursing care combined with a vigilant surveillance program is required to minimize the incidence of infection. The ways of minimizing nosocomial infections are effective hand washing, routine cleaning of the unit, concurrent and terminal disinfection procedures and regular culture examination from the potential ports at different places in the critical care unit. Strict practice of barrier nursing and reverse isolation procedures wherever indicated, also minimize the nosocomial infections.

USE OF TECHNOLOGY

The final analysis of good care should rest upon doctors and nurses taking care of the patients, not on the machines. Sophisticated gadgets should be used as adjunct rather than replacement of clinical skill. The mere availability of machines don't warrant for indiscriminate use of them. In the same way, nonavailability of them shouldn't incapacitate the care giver.

UTILITARIAN THERAPEUTICS "DO NO HARM"

Do not subject the patient to procedures and investigations which add to pain and suffering when one is sure of not producing an eventual benefit to the patient. The risk benefit ratio should always be considered in all clinical decisions taken in the unit. The therapeutic interventions at all-time are aimed at well-being of the patient rather than the need of the caregiver or the hospital.

APPLICATION OF EVIDENCE-BASED NURSING

Evidence-based medical and nursing practice is the mantra of the present day clinical practice. It is important to judge the clinical effectiveness of treatment options and interventions through scientifically tested and proven database. It is further important to gather evidence to ensure that the interventions carried out are not injurious to the patients. Evidence-based nursing can be considered as one aspect of nursing practice while emphasizing the holistic approach to patient care. It is also important to adhere to sound ethical principles while conducting research studies in critical care unit. As most of the nursing studies are not pure experimental studies, it is possible to maintain safety of patient and to be able to generate database. However, one shouldn't underestimate the value of humanistic approach to 'caring" as nursing is all about caring than curing.

RECOGNITION OF LIMITATIONS

Critical illness is associated with high morbidity and mortality and very often it is beyond the capacity of the team to revert the situation. The primary responsibility lies with the physician concerned in determining the limits, and recognizing the futility of certain interventions. Learning the limits is not very easy. It comes with experience and gauging the individual cases on its merits and demerits. There are studies which showed that nurses became depressed when the patients whom they have looked after, expired and many nurses feel guilty and take up the responsibility on them, and viewed it as their own inefficiency. It should at all times be avoided. Otherwise nurses in CCU can become **stressed out** and **burned out** soon.

CRISIS INTERVENTION AND STRESS REDUCTION

Partnerships are formulated during crisis. Bonds between nurses, patients and families are stronger during hospitalization. As patient advocates, nurses assist the patient to express fear and identify their grieving pattern and provide avenues for positive coping. Listening is a skill to be developed by every critical care nurse, to handle the extreme complex feeling of patients who are in crisis situation. Empathy is the attitude to be developed by the critical care nurse to make herself a good counselor to the patients.

Sudden illness or trauma can throw the family of the critically ill patient into a state of crisis. At such situations, the family requires significant support from the critical care nurses to survive the crisis. Family in crisis usually presents with high anxiety, denial, anger, remorse, grief and the need for reconciliation. Proper assessment determines the strengths and weaknesses and deficit on family perception, situational support and coping. Critical care nurses form a link between patients and families.

Critical care nurses themselves undergo job stress due to many factors. They need to be supported personally, professionally and spiritually which would be part of management strategies in every critical care unit. Ongoing educational opportunities would enhance the staff morale. Research is to be developed to improve the standard of nursing intervention in critical care unit.

Critical care nurse needs to understand the pathophysiology of critical illness and apply the principles of critical care nursing to make the nursing practice unique and comprehensive for the patients who are admitted to the unit with varying degree of severity of illness that may also have bleak future as far as outcome is concerned.

MUST KNOW

The principles of critical care nursing are:

- Anticipation
- Early detection and prompt action
- Collaborative practice
- Communication
- Holistic approach to management
- Prevention of infection
- Use of technology
- Utilitarian therapy "Do no harm"
- Application of evidenced-based practice
- Recognition of limitations
- Crisis intervention and stress reduction

ASSESS YOURSELF

1. Describe the principles of critical care nursing.
2. How can the principle of crisis intervention and stress management applicable in critical care nursing?

CRITICAL THINKING SKILLS

Following a bomb explosion there are three patients at ER. One 15-year-old with hand bruises and two pregnant women with abdominal wound and ambulance arrives with another 80-year-old man who suffered a head injury. You may expect more patients brought from bomb explosion site.

Q. 1. How would you apply the principle of anticipation in preparing to receive the patients to ICU?

SCOPE OF NURSING PRACTICE IN CRITICAL CARE UNITS

The nursing practice in critical care unit is highly challenging and complex. Critical care nursing is fast evolving as a specialty to meet all these challenges. The scope of critical care nursing varies in different areas.

The areas identified with scope for critical care nursing are shown in Figure 1.7.

CLINICAL PRACTICE

The critically ill patient is a complex person in a complex environment. The nursing care of critically ill patient is challenging as identifying the individual patient's response to illness as well as to treatment. The nurse who monitors the patient continuously, needs to have sound knowledge, technical and clinical judgment skills. He/she follows systematic approach in assessing, planning, implementing and evaluating the care provided to the patient.

The nurse requires having broad knowledge of sciences, pathophysiology and interpersonal relations. To make the clinical practice more effective in the unit, it is necessary to have policies, procedures, protocols of care and quality assurance programs incorporated.

- **Policy:** Policy is a course of action for dealing with a particular matter or situation by a political party, government or an organization.
- **Procedure:** Procedure is a set of actions necessary for doing something.
- **Protocols:** The ceremonial system of fixed rules and accepted behavior especially used by companies, institutions and organizations is known as protocol. The critical care unit should have policies, procedures and protocols of care to guide the provision of care, to maintain uniformity and ensure quality. There should be clear cut policies for admission, discharge, transfer, emergency, safety procedures and infection control.

EDUCATION

A range of factors continue to influence critical care nursing education provision, including government policies at national and state levels, funding mechanisms and resource implications for organization and individual students, education provider and healthcare sector partnership arrangements, and tensions between workforce and professional development needs.

Scope ranges from Diploma programs in critical care to expansion of certificate and fellowship program with Speciality and superspeciality

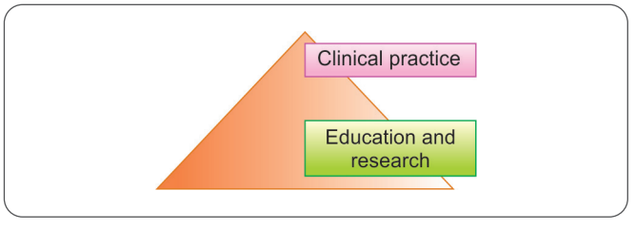


Fig. 1.7: Scope of critical care nursing

RESEARCH

Critical Care Nursing speciality offers wide range of opportunities in conducting evidence-based practices in order to improve patient outcome.

- Quality indicators
- Health care associated infection
- Patient safety initiatives
- Emotional well-being of nurses
- Stress and burnout among nurses

CRITICAL CARE NURSE: A CHANGING ROLE

As the practice becomes more sophisticated, the nurses are demanded to rise to the occasion. He/she needs to be qualified to practice. The former clinical experience when hired is an asset to the nurse. The average critical care nurse practices in the field for about five years and then gets transferred to other units or leaves the country or the profession which results in rapid turnover.

Four factors to be considered while hiring critical care nurses:

1. Sound interpersonal relationships
2. Technical qualifications
3. Educational background
4. Clinical experience

It is found that those persons with '**hardiness**' with a personal constellation of **challenge, commitment** and **courage** is able to suit better to the situation in a critical care unit. Assertiveness and ability to function independently must be inherent or learned. Additional post basic qualification in critical care nursing must be mandatory as a prerequisite to appointment, so that qualifying examinations for license and registration ensure quality. Unfortunately, it is in a very primitive stage in many countries around the world.

Front Line Nurse Caregiver

They are first level professional nurses who provide direct patient care to the assigned patient, the ideal ratio being 1:1. He/she assesses plans and implements patient care in collaboration with physician concerned and participates in health education and discharge planning. Identifying alteration in patient's health status is another major responsibility.

Nurse Incharge

He/she is accountable for nursing care management of the CCU. He/she plans and directs the patient care on priority basis. He/she is responsible for ensuring safety, comfort and quality patient care for which she needs to ensure a conducive physical environment and adequate equipment and supplies. Documentation being an important aspect should be carried out wherever required.

Nurse Manager

He/she serves as the supervisor in the clinical specialty and works within general methods and procedures, exercising considerable amount of decision making to select the proper course of action. The job requires knowledge of policies and procedures, regulation of special clinical nursing responsibilities and supervisory techniques. He/she should provide a framework for stability, continuity and growth of team and the organization. Apart from the traditional roles, new roles are being developed.

Critical Care Clinical Nurse Specialist (CNS)

The CNS is considered as the clinician, researcher consultant and manager.

The clinical nurse specialist roles are:

- Monitor and evaluate quality of care.
- Provide formal and informal education.
- Promote, collaborate with and facilitate conduct of research and research utilization.
- Provide expert care by direct care or consultation.
- Serve as a role model for clinical staff.

Case Manager

Case management models provide framework for incorporating advanced practice as an integral component of care delivery system.

The roles of a case manager are:

- Facilitating early discharge.
- Promoting appropriate utilization of resources.
- Achieving desired outcomes.
- Promoting and formalizing collaborative practice.
- Fostering satisfaction of nurse, physician and patient.

There is some overlapping of the role of clinical nurse specialist and case manager. Today's health care environment demands innovation and leadership from nursing professional. Clinical nurse specialist provides leadership. He/she can also function as case manager by being accountable for resulting patient outcomes. Under this model, CNS's clinical expertise and consultation skills can be utilized to support the development of an effective coordination among critical care nurses.

Nurse Practitioner

They are advanced practice registered nurses, educated and trained to provide health promotion and maintenance through the diagnosis and treatment of acute illness. They can also examine patients, diagnose illness, and prescribe diagnostic tests, therapeutic modalities, and medications as per protocol of the institution.

Clinical nurse specialist is a post graduate nurse with preparation in a specialized area of nursing practice. As per International Council of Nurses, she is a registered nurse who has acquired the expert knowledge base, complex decision making skills, and clinical competencies for expanded practice, the characteristics of which are shaped by the context and/ or country in which he/she is credentialed to practice. They can incorporate research into nursing practice by identifying clinical problems in consultation with staff nurses for finding out evidence-based practice which can improve patient outcomes.

MUST KNOW

The following areas are identified with scope for critical care nursing:

- Clinical practice
- Education
- Research

The following are the scope of practice in clinical practice:

- Front line nurse
- Nurse incharge
- Nurse manager
- Clinical nurse specialist
- Case manager
- Nurse practitioner

ASSESS YOURSELF

1. Write a short note on scope of critical care nursing.
2. Write short notes on the following:
   - Clinical nurse specialist
   - Nurse practitioner
   - Case manager
   - Short note on role of evidence based practice in critical care nursing.
3. Justify the following statement:
   - Critical care nurse: A changing role

LEGAL AND ETHICAL ASPECTS IN CRITICAL CARE NURSING

To understand nursing ethics in critical care nursing one must understand both critical care nursing and nursing in general. Ethics do set standards but those standards are more than minimum expectation. Ethics also identify ideals. The specific concerns of ethics in nursing fall under normative ethics.

In critical care nursing, the complex and technical nature of nursing function requires knowledge of values important to the practice of nursing.

The values of **Autonomy, Advocacy** and **Accountability** are traditional values in nursing profession, which are quite apt for critical care nursing.

AUTONOMY

Autonomy is the term that is derived from Greek words, **'autos'** meaning self and **'nomos'** meaning law or rule. The central idea of autonomy is self-rule.

Autonomy means the autonomic choices and autonomous actions of an individual. Even normal rational adults at times lose the capacity for autonomy because of an injury, period of emotional disturbance or under the influence of substances.

It is better to concentrate on discussion on autonomous actions rather than decisions and autonomous persons. An autonomous decision is one that is based on the decision maker's values utilizes adequate information and understanding and is free from coercion or restraint and is based on reasons and deliberation. Autonomous actions are those that stem from autonomous decision rather than from the person being forced to act or restrained from acting in a certain way. When one makes decision, the person is under the influence of many factors. The Nurse should make sure that the patient is aware of his/her rights to make choices. But he/she should be sure that he/she is physically and mentally able to make the correct choices from the options available and has the necessary information to do so. The broad principle of autonomy yields too many specific rules for health care providers. The best known of this is the rule of informed consent, which specifies that they must obtain permission from the patient before doing any procedure on him/her. Although, they generally are most conscious about obtaining consent in the form of written document before an invasive or risky procedure. When patients refuse treatment, medication, or diagnostic tests the health care providers are morally obligated to respect the decision and to refrain from forcing the patient to take the medication or accept the test or treatment.

Autonomy can also serve as the basis for duties of truth telling. One way in which the health care providers can interfere with the person's right to make free choices is by withholding important information or by deceiving the person in some way. If they withhold some of the information, they are interfering the patient's ability to make a rational decision that is in line with his or her values and preferences and they are thus violating the principle of autonomy. But it is unreasonable to expect every fact that is known about a proposed intervention to be provided to the patient. This is not only a practical impossibility but also ineffective that it is likely to confuse most people who don't have the background information. The ideal might be to try to provide exactly as much information as the individual patient needs in particular instance to understand the proposed treatment.

ACCOUNTABILITY

Accountability refers to being answerable to what is the being done. It is the value related to the social responsibilities of nursing and to the moral and legal requirements of nursing practice. The value of accountability is seen, as superior moral standard in nursing that provides foundation for the relationship required in critical care nursing and the basis for high quality care.

ADVOCACY

It means active support of an important cause. The role of the advocate is to assert the patient's choices or desires.

There are three models of advocacy which can be applied to nursing practice:

1. **Right protection model:** As per this model, the Nurse has the responsibility to be the defender of patient's rights against health care system which turns into, violating the patient's rights.
2. **Value-based decision model:** Advocacy can be viewed as value-based decision model. This allows the nurse to help the patient to discuss his needs and make choices that are most consistent with the patient's values. The nurse provides information to the patient. In this model, the nurse doesn't impose any value on the patient, but helps to explore all possibilities and then make a decision.
3. **Respect for persons model:** The patient is viewed as an individual with dignity in this model and the nurse keeps the basic human values of the patient in mind and acts to protect his human dignity, privacy and self-determined choices. This is highly applicable in critical care unit where there is tendency for anyone to become mechanically and technologically oriented.

COMMON ETHICAL AND LEGAL ISSUES IN ACUTE CARE

Two major issues in acute care are advance directives and treatment withdrawal.

1. **Advance directives:** It refers to any document that is enacted by an individual before becoming ill, specifying one's wishes regarding treatment, should one be unable to express them later on.
   The two forms of advance directives are:
   i. **Living wills:** Generally, it takes effect only when the patient is terminally ill and is unable to voice his/ her wishes. Under these two conditions, the living will directs that no life sustaining treatment is to be administered. Some living will forms include more specific directions regarding the individual wishes for withholding food and fluid or other specific treatment modalities. The presence of living wills can be quite helpful to care givers who are faced with treatment decision for patients who can no longer speak for themselves.
   ii. **Durable power of attorney for health care:** A second type of advance directives is more broad and flexible than a living will. It goes into effect only when the individual has lost decision-making capacity. It is helpful in seeking any life supporting treatment but also questions related to blood transfusions, antibiotic therapy and surgical procedures.
2. **Treatment withdrawal:** Withholding and withdrawing treatment: Decisions to forge life-sustaining treatment have major consequences on the patient, family and health care providers. In order to protect the interest of patients and their families, critical care nurses should be aware of the appropriate decision making process. The most difficult term to define in this connection is **'Death'.** It can be defined in terms of cardiopulmonary death and brain death in situations like chronic persistent vegetative state and anencephalic newborns. When the person has suffered brain death he is legally dead.
   The difficult issue arises with patients who are terminally ill with irreversible conditions. Who makes the decision to withdraw life-sustaining technology? In case of patients with decision making capacity, informing and communicating would help him to make decision of withdrawing life-sustaining treatment himself.
   The **'Will'** of the patient or advance directives given by the patient or the decision of the 'next of kin' can be taken into consideration for the best interest of all individuals concerned. The author had an experience of witnessing the child's mother requesting for withdrawing lifesaving equipment. The child suffered from retinoblastoma and had undergone surgery. He was on ventilatory support for more than 2 months. When an advanced decision is made regarding withholding life sustaining treatment, a medical order as to this effect '**No Code**' may be written in the patient's records. The critical care nurses must be knowledgeable about the issues, controversies and strategies in conflicting situations as these. They also need to do the documentation thoroughly in patient's records.

To summarize the role of the critical care nurse in withholding and withdrawing treatment:

- Decisions are to be made in admitting these patients to critical care units
- Assisting the patient or the significant others in clarifying the values
- Providing the information and clarifications of issues
- Maintaining truthfulness in disclosure of information
- Encouraging a collaborative decision making
- Documenting the decision
- Caring for the patient who is dying and involving the family and others.

ETHICAL CONTROVERSIES

Futile Therapy

As technology has developed to sustain life, critical care professionals have struggled to determine the proper circumstances under which life-sustaining treatment should be limited. Despite general agreements that competent patients can refuse life sustaining treatment and the health care professional are not obligated to provide futile care, and

the critical care professionals are now questioning whether patients or their significant others must authorize the provision or withdrawal of useless or futile medical therapy.

Futility

Means useless interventions futility can be defined in each situation by a competent patient, authorized significant others, health care professionals. While providing futility care, the nurses and other health care professionals suffer a sense of hopelessness, which can even lead to depression. While addressing the issues of futility care, it is better to facilitate an open dialogue and an environment that fosters communication and collaboration among professionals, patients and families. It is the responsibility of the health care professionals to educate patients and their significant others regarding the obligations and responsibilities in decision making. Every critical care unit should have policies and procedural safeguards for implementation of the strategies with regard to futility care.

The situations where questions of futility arise in the critical care setting are:

- Burdens of treatment outweighing the benefits.
- Undesirable quality of life.
- Death is imminent.
- Patient or significant other refuses or demand lifesaving treatment.
- Effectiveness of treatment is questioned.
- Resources are limited by way of finance or personnel.

Euthanasia

It is the most debatable topic in medical field. Euthanasia under strict clauses and safeguards is legalized in Holland. It may soon be legalized in western world. Advocates of Euthanasia invoke the ethical principle of Beneficence arguing that the act brings good or end of suffering to the patient. It must also be understood that withholding or withdrawing treatment, when it is certain that such treatment will not benefit and death is inevitable, doesn't constitute euthanasia. Some call it as passive euthanasia because the intent is not to kill but to prevent prolongation of the act of dying.

The outcome or diagnosis of a terminal illness is not always shared with patient in our country whereas in west it is patient who has the right to know about the condition and he may decide whether it has to be shared with the family. This is another complex situation which arises in CCU more often than other. Although it is primary responsibility of the physician to make a decision, the nurse needs to be aware of her responses which should be in congruence with physician's decision.

Euthanasia includes voluntarily or intentionally facilitating the end of patient's who expresses, a competent, freely made wish to die because of pain or suffering experienced by him/her. It is the medically assisted suicide at the patient's insistence and wish. The patient is not involved in the decision. It is not always possible to quantify suffering. Suffering is a state of mind, which may undergo changes under different social pressures and obligations. There are many questions that need to be answered before such a decision is made. At no point, it turns out to be a chance to eliminate one's life. The issue needs to be addressed at different levels before an actual decision is taken.

LEGAL ASPECTS IN CRITICAL CARE NURSING

- **Nonmaleficence:** It refers to doing harm with a purpose of achieving good. For example, amputation is done in a patient with gangrene. Many treatment procedures carried out in the patient are harmful to the patient. In most of the situations, it is the responsibility of the nurse who may be partly doing harm while not necessarily making decision. Taking responsibility for the action may be viewed as following orders. That doesn't protect the nurse legally and ethically. It is important for each nurse to examine and evaluate a situation to determine if harm is being done or if the risk of harm is too great. The nurse must not stop analyzing. He/she must actively decide and act on the basis of evaluation. Whenever possible, he/she should use the mechanisms and processes available within the institution as a vehicle for minimizing harm to the patient.
- **Beneficence:** It directs to do good by relieving suffering and restoring good health. It not only includes technical expertise but also human qualities, which are pushed aside in comparison to the expanding medical technology.
- **Standing orders:** Standing orders are the policies made by the hospital management in relation to administration of medication/treatment procedures without the already written medical orders during an emergency and in some other situations. Every critical care unit should have them made and these should be available for nurses thereby the nurses are protected and patients are ensured safe care.
- **Medicolegal case:** All patients admitted after accidents, suicide attempts, burns and assaults are medico legal cases, which should be notified to police through proper channel. If such patients die, body is handed over only after police clearance is obtained. This is also applicable in case of discharge of a medico legal case.
- **Valuables in critical care unit:** Patients who are admitted to the unit with gold, jewelry, cash and other expensive and valuable items are at a risk of losing them. If the responsible relative is available, they can be handed over to that person immediately. Otherwise a list of articles in

duplicate is made, signed by the person receiving and a witness. Thereafter, the articles with the list are kept in safe custody until they are handed over to the **next of kin** of the patient or patient himself when he becomes well. It is absolutely necessary to identify who is **the right next of kin**.

- **Informed consent:** An informed consent or an operative permit form is signed by the patient and witnessed. Granting permission to have an operation/treatment, performed as described by the patient's physician.

Medicolegal requirement:

- To ensure that the patient understands the nature of treatment including the potential complications.
- To indicate that the patient made the decision without pressure.
- To protect the patient against unauthorized procedures.
- To protect the hospital staff and the hospital against legal action by a patient who claims that an unauthorized procedure was performed.

- **Prior to signing an informed consent:** The patient should be told in clear and simple terms about what is going to be done, the risks and possible complications, disfigurement and removal of parts. Client should have general idea of what to expect in the early and the late postoperative period and have opportunity to ask any questions.
- **Circumstances requiring a permit:** Any surgical procedure where scalpel, suture, hemostasis or electrocoagulation, entrance into body cavity, general anesthesia, local infiltration and regional blocks are used, a written permit is required. Admission to critical care unit requires many of these procedures being done and it is not practical to obtain consent at each occasion. Therefore, it is advisable to get the consent signed at the time of admission itself.
- **Consent issues:** Nurse needs to ensure that the patient/competent and responsible adult relative of the patient signs the consent form of the hospital.

LIABILITY RISK ISSUES IN CRITICAL CARE NURSING

Effective health care and maintenance requires a partnership of trust between the nurse and the patient. However, the critical care nurse has more and more accountability for professional practice. Further critical care nursing has evolved into a highly technical specialized field, increasing the risk of liability. The critical care nurse has to be prepared to identify the liability risk issues and the measures to reduce them in actual practice. Following are the liability risk issues in a critical care unit.

Standard of Care

A high standard of care is expected from all categories of staff working in the unit. The nurse is responsible for all treatment and care procedures carried out. As part of housekeeping responsibility it is her duty to ensure adequate supplies and optimal functioning of all equipment and devices required for carrying out care. Negligence is the failure to exercise that degree of care, which a responsible person would exercise under the same circumstances.

Negligence on the part of the nurse, in any aspect of care, can result in a high liability risk for herself and the hospital. He/she should adhere to policies and protocols of the unit with regard to admission, transfer and discharge of patients and administration of medications and standing orders. Many units are faced with understaffing and lack of experienced nurses due to rapid turnover of staff nurses. Nurse manager has the responsibility to plan staffing in such a way as to cover all shifts with the available experienced staff along with the inexperienced staff thereby standard of care need not be compromised.

Administration of Medication

The nurse needs to practice all rules of administration of medication in critical care unit.

Standing Orders

Standing orders should be formulated in consultation with management, medical director and nurse manager, which should be made available to the staff and followed strictly.

Incident Report

At any occasion if there is violation of normal rules, an incident report is to be made confidentially. The main purpose of which is to make the individual aware of the mistake/negligence so that such acts could be avoided in the future rather than as a punitive measure.

End of Life Issues

Decisions to Forego Life Sustaining Treatments

Decisions to forego life sustaining treatments are very common in hospital settings. It is difficult to make such decisions for all personnel concerned including patients, their families and the caregivers.

The model for this decision should encompass a collaborative and enduring approach that promotes patient's interests and well-being. Through this process a plan of care that reflects patient's interests, goals, and values are developed. However, the patient may determine that the current plan imposes treatments that are more burdensome

than beneficial, and may choose to forgo new continued. The patient's interests are best served when information regarding the issue is discussed among the caregivers, patient and family in an open and honest manner. In patients without decisional capacity, the determination to withdraw or withhold treatment is made by the identified surrogate. If the wishes are known to the surrogate, decisions are made in that direction. In cases, where the surrogate is not acting in the interests of the patient, health professionals have a moral obligation to negotiate right decision for the patient. Critical care nurses should intervene when the best interest of the patient is in question. If the efforts do not resolve the differences, one should look for alternate surrogate who takes interest in the patients.

No Code, Withholding, Withdrawing Life Support Orders

Medical orders for not resuscitating with-holding or withdrawing life support should be written down in the patient's records by an authorized physician working in the unit.

Witnessing

As the legal implications of practice increases, nurses are wanted as witnesses in the court of law and otherwise. Witnessing can be for medico legal case.

When a nurse is asked to be the witness, following guidelines can be followed:

- Inform nursing administration
- Be prepared to answer any questions to describe the standard and to define nursing and the nurse's role
- Have belief in yourself and explain the reason for your action
- Limit the answer to yes, no or I don't know or I don't recall
- Maintain good posture, dress professionally and be relaxed and take time to think and answer
- Testify only to your expertise
- Avoid vague and blank statements.

While working in critical care unit, the nurse has to be aware of the legal implications. Communications should be maintained between patient, family, physician and supervisor. Documentation is the most important aspect of nursing, which can protect the nurse and the hospital during many conflicting situations. Documentation should be factual, descriptive, accurate, concise, timely, relevant, definite and specific and it is important to mention the patient's response. There are times when a nurse is asked to be the witness for making the **'Will'** by the patient, while he is in the critical care unit.

Common Causes of Liability

Common causes of liability are fall of patients, use of restraints, equipment malfunction, and errors in administration of medication and treatment, failure to observe and report changes in patient's condition, application of heat and subsequent burns, accidental disconnection from lifesaving machines.

A nurse working in the critical care unit should be aware of the legal implication, elements of negligence, process of handling medicolegal cases and witnessing. He/she should document in clear, concise, legible, accurate manner all the relevant information. Her best defense against negligence is to follow the standard of care.

MUST KNOW

- The ethical values followed in critical care nursing are Autonomy, Advocacy and Accountability. The models of advocacy are Right protection model; value-based decision model and Respect for Persons model.
- Common ethical issues in Critical care are advance directives, and treatment withdrawal.
- Ethical controversies stem around futile therapy, withholding and withdrawing treatment.
- Legal aspects consist of application of the principle of Non maleficence and the use of standing orders and the responsibility with regard to Medico-legal cases. Responsibility with regard to valuables in CCU be collected, list and document with witness and keep in safe custody until it is handed over to the patient or the next of kin which is identified accurately.
- Common causes of liability issues are fall of patients, use of restraints, equipment malfunction, errors in administration of medication and treatment, failure to observe and report changes in patient's condition, application of heat and subsequent burns, and accidental disconnection from life saving devices leading to death or complication.

ASSESS YOURSELF

1. Explain legal and ethical issues in critical care nursing.
2. Write short notes on:
   - Advance directives and living will
   - Informed consent
   - Euthanasia
   - Futile therapy—ethical controversies
   - Models of advocacy
   - Medico-legal case
   - Valuables in critical care units
   - Nonmaleficence
   - List and discuss the liability issues in critical care nursing

CRITICAL THINKING SKILLS

The patient expressed his desire not to undertake life saving measures to prolong life. However, the patient's relative insist on starting and sustaining life saving measures.

Q. 1. What would be the factors considered before the physician makes a decision?

Q. 2. What is the nurse's role in the situation?

ROLE OF A NURSE IN CRITICAL CARE UNITS

Critical care units began as an outgrowth of post anesthesia room. They are equipped with sophisticated monitoring and emergency equipment which is readily available and staffed by personnel, qualified and experienced with access to all support departments.

The critically ill patient has life-threatening or potentially life-threatening health problems which require continuous monitoring and intervention to prevent complications and to restore health. Thus, continuous patient surveillance and interventions to tackle and prevent complications along with participating in the treatment and care become the major role of the nurse in the critical care units.

The nursing philosophy is accomplished by combining critically ill patient in an environment with specially trained nurse's, appropriate equipment, adequate supplies and ancillary health personnel. Within this environment, the patient's need for close observation and immediate treatment can be met. Critical care units have grown and developed. Critical care nursing has been recognized as a professional specialty within the field of nursing. Critical care medicine specialty has evolved, which has increased nursing requirements for in-depth knowledge in the area of specialty.

NURSE-PHYSICIAN COLLABORATION

Nurses appreciate and value a physician for:

- Staying near when a patient's condition deteriorates.
- Keeping the family informed of patient's condition.
- Listening to nurse's concern related to patient's condition.
- Teaching nurses about new therapy and intervention.
- Recognizing the nurse's maximum efforts and assisting her in emergency situation.

There is no other area where a collaborative effort by the nurses and physicians is required than in critical care unit and the primary focus remains the patient. The need for open communication should not be underestimated. A physician's attitude of openly valuing nursing boosts nursing staff morale, which indirectly improves the quality of patient care.

Establishing a sense of team spirit is highly rewarding. Responsibility of physician in relation to practice of policies and protocol make it easy for the nurse to run the unit smoothly. What type of patients should be admitted to the unit and how long a patient should stay, and should be decided on the basis of policies and client's condition. If these rules are not strictly adhered to, the critical care unit is likely to end up as a VIP unit or a chronic care unit.

NURSE AS CAREGIVER

Critical care nurse is a qualified nurse by virtue of experience or specialized training and is responsible to provide direct patient care to all patients admitted to the critical care unit. He/she uses sound scientific knowledge in using nursing process while delivering nursing care to patients. He/she needs to ensure adequate supplies, equipment in optimal working condition and be available to meet all emergencies that may occur in the unit. He/she is also responsible to maintain the records and reports, which are used in the unit. He/she forms a liaison between the patient, family and other members of the team. Thus, the nurse in the critical care unit has multifaceted roles to play.

NURSE AS CARE COORDINATOR

Critical care nurse is one member of the team involved in the care of critically ill patient. The nurse provides round the clock care and continuity while other health professionals visit the patient. By virtue of this, she becomes the coordinator of patient care activities. He/she delivers care with a holistic approach.

Critical care nursing is defined by American Association of Critical Care Nurses as the utilization of nursing process in the intervention and prevention of life-threatening situations. A highly skilled collaborative and multidisciplinary team supports the patient and family towards realistic goals.

The importance of leadership in the role of the nurse manager is critical to effective health care delivery. The essential leadership skills required in a nurse manager in the unit are creation of a vision, the building of trust and maintenance of motivation, facilitating change and creation of work environment which is conducive to patient's welfare and staff's learning. The nurse manager in the unit is responsible for managerial functions of planning, organizing, staffing, leading and controlling. He/she functions as a clinical expert

as well. The participatory leadership style has been found to be effective in attracting and retaining nurses in the critical care unit. The unit should have a medical director who is responsible for the treatment of patients, utilization of unit beds and standards of care. Together with the director, the nurse manager contributes toward the smooth functioning of the unit. In times of crisis, he/she may be expected to employ authoritarian style of leadership.

MUST KNOW

- Critical care nursing is defined by AACN as the utilization of nursing process in the intervention and prevention of life-threatening situations.
- Role of the nurse in CCU is most important. He/she functions as care giver, nurse incharge, care coordinator, nurse as a manager, nurse manager, clinical nurse specialist and nurse practitioner.
- Nurse physician collaboration is of utmost importance for the efficient functioning of the CCU. Establishing a sense of team-spirit in the unit is highly rewarding. Developing the policies, protocols, standing orders in collaboration makes the functioning easy. Admission criteria can avoid confusion while accepting patients to CCU.
- Thus, the nurse in the critical care unit has a multifaceted and challenging role to play ultimately ensuring optimal patient outcome, decreased length of stay and job satisfaction for the nurses.

ASSESS YOURSELF

1. Describe the different roles of nurse in critical care unit.
2. Write short notes on:
   - Nurse as care coordinator
   - Nurse physician collaboration
   - Nurse as caregiver

CRITICAL THINKING SKILLS

Q.1. Explain the extended and expanded role of nurse in critical care unit.

PLANNING OF A CRITICAL CARE UNIT

The critical care unit (CCU) is a specially designed and equipped facility, staffed by skilled personnel to provide effective and safe care for patients with life-threatening or potentially life-threatening health problems. Critical care services require specialized facilities and equipment, especially trained nursing staff and a wide range of support services.

The patients admitted to the ICU are the most critically ill, and while they account for only 5–10% of all patients in the hospital, the charges associated with their stay in the ICU account for 20–35% of hospital costs. These costs are due to the complexity of these illnesses, greater use of interventions, and close monitoring necessitated by ICU patients. This atmosphere of high cost, high stress, and a highly vulnerable patient population provides an excellent opportunity to evaluate this area of the hospital, through the lens of hospital sustainability and environmental stewardship, for ways to decrease costs, improve patient outcomes, and increase satisfaction among patients, staff and visitors. It is necessary to provide, optimal care at the lowest possible cost for which an integrated plan for intensive care services is required.

Critical care is ideally given in a centralized unit by trained medical and nursing staff using centralized equipment. A good unit uses the infrastructure of a well-equipped general hospital, and has the back up and support of sophisticated, investigations, imaging techniques, physiotherapists, respiratory technicians, specialists and super-specialists and nurses specialized in critical care nursing and specialists in different fields of medicine and surgery. General critical care necessitates a holistic approach to the ravages of life-threatening illness. Many hospitals arrange for hospital chaplain to provide

spiritual care to the patients and relatives, when it is most required. Extensive planning is obviously required to achieve holistic care. Some hospitals have generalized units whereas larger hospitals have specialized critical care units such as Burns unit, Neonatal unit, Coronary care unit, Postoperative cardiothoracic unit and Renal units.

CLASSIFICATION OF CRITICAL CARE UNITS

Critical care units may be classified into three levels depending on the staffing and support facilities of the hospital.

1. **Level I:** It is a high dependency unit, which could be either separate or attached to a general ward. Patient nursed in these units are those who require special observation following an uncomplicated myocardial infarction or surgical procedures. These units undertake only immediate resuscitation, short-term ventilation and cardiac monitoring. The nurse patient ratio is 1:3 and the medical staffs are not present in the unit all the time.
2. **Level II:** This level of critical care unit is capable of providing prolonged mechanical ventilation but does not have access to comprehensive support facilities. Nurse patient ratio is 1:2 and junior medical staff is available in the unit all the time and consultant medical staff is available if needed. The unit has educational programs and may be involved with major teaching unit in research.
3. **Level III:** It is a comprehensive critical care unit, which serves as major teaching and referral center with cardiothoracic, and neurosurgical facilities. Medical staff is in the unit all the time and the nurse patient ratio is 1:1. These units have teaching and research obligations. Whatever may be the type of unit, it has to incorporate many features to provide continuous monitoring and appropriate interventions such as mechanical ventilation. The economic investment and the mechanism to ensure economic viability of the unit must be clearly understood before starting a unit as it is an expensive proposition both for the hospital and for the patient and the families of those admitted to ICU. A recent study showed that the numbers of average ICU beds in UK are 6 and in US 11–12.

SIX COST BLOCKS OF ICU CARE

The six cost blocks of CCU/ICU care are tabulated as follows:

Cost block 1: Capital equipment	This has high initial expense as most of the equipment is imported.
Cost block 2: Estates	This includes depreciation, maintenance and utilities required to maintain ICU structure.
Cost block 3: Non clinical support services	These include laundry, uniforms, catering, sterilization and administrative costs.
Cost block 4: Clinical support services	This includes cost of all clinical support services such as imaging, Dialysis and Physiotherapy
Cost block 5: Consumables	This includes the major expenses which are basically reusable items and non-reusable items
Cost block 6: Manpower costs	This includes major expenses of salary and other benefits to the employees

LOCATION

It is easier to design a unit as an integral part of a new hospital. However, it is often necessary to adapt existing part of a hospital which inevitably imposes a number of design limitations, particularly with regard to space.

The location is decided depending on the type of patient to be treated. For example, if the unit is used for care of surgical patients, it is best cited near the operating/recovery room.

CCU also has a special and close relationship with casualty and emergency department, with laboratory, radiology cum imaging department and with physiotherapy department (Fig. 1.8). Other specialized units prefer to have them as part of their own department where the patient care is based on the concept of progressive care. That is from intensive care to intermediate care and then to general patient care area.

The ICU/CCU also has a special relationship with accident and emergency department, laboratory, radiology and imaging department.

Every good CCU should be closely associated with a high dependency ward or a step down unit. Such a combination enables the CCU to be reserved for patients who truly deserve critical care. It also enables a quicker turnover and, therefore, a more economic, efficient and correct use of critical care. It reduces mortality and morbidity in patients recovering from critical illness, as these patients are often poorly observed and attended in general wards.

If the plan is to have one critical care unit in the whole hospital, it should be centrally located and should be easily accessible to all the departments in the hospital. It is ideal at lower floors and if not possible, have a vertical location connected with a well-functioning elevator leaving adequate space for inward and outward movement.

The site of the unit whether made from an existing facility or as a new site, one should ensure that patient can see the daylight and be aware of the day night variation. While designing the interior of the unit, it is necessary to minimize the noise and the possibility of cluttering of equipment around each bed.

Placement of ICCU in a Hospital

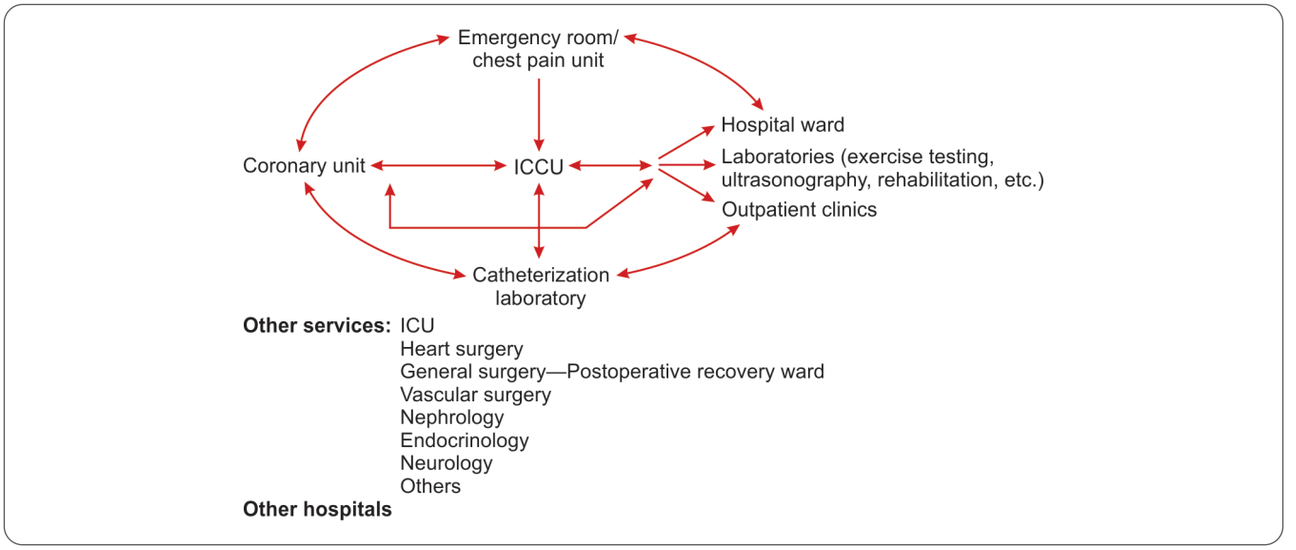


Fig. 1.8: Relationship of the intermediate coronary care unit with other units and services

Mnemonics

The total design must take into account the following areas, which can be given by an acronym PNEUMATICS_V which need space.

PNEUMATICS_V is:

1. **P** = Patient care
2. **N** = Nursing
3. **E** = Eating(clean area for food preparation and delivery)
4. **U** = Unclean area for equipment and dirty linen
5. **M** = Medication storage
6. **A** = Administration
7. **T** = Teaching
8. **I** = Infection elimination area
9. **C** = Clean area for equipment and linen
10. **S** = Storage for back up equipment
11. **V** = Visitors

CRITICAL CARE UNIT SIZE

Determining the optimal critical care unit size:

- The beds can be organized into general beds or specialized beds.
- 6–8 beds is the ideal size to be served from one nursing station, even though a maximum of ten to twelve beds can be accommodated.
- The minimum beds in any unit should be at least four to utilize the facilities effectively.

What should be the team composition in planning ICU?

The team should consist of the ICU specialist, nursing administrators and supervisors, hospital administrator, architect, engineer and interior designer. It is a good idea to take input from patients and families who can participate in patient care.

FEATURES OF CRITICAL CARE UNIT

As a general rule, at least as much floor area is required for non-patient use (storage, cleaning, maintenance, and visiting) as required for patient care area. The British Medical Association recommendation is 200–300 square feet. This includes 3 feet between head of bed and the wall.

- This is necessary for carrying out procedures like endotracheal intubation.
- Space between beds is essential not only to accommodate bulky equipment but also to allow access to patients.
- The total floor space required for a critical care unit depends on the number of beds, the unit design, the number and size of utility spaces such as store room, equipment room, linen room, clean and dirty utility room, pantry and changing room.
- Each unit should have separate isolation rooms, conference room, and adjacent visitor's waiting room. Ideally there can be two sections, clean and dirty, so that patients who have potential source of infection can be segregated (Fig. 1.9).
- There should be single room and barrier nursing facility for those units which will admit patients with infectious diseases and those who are immune compromised.
- The units with clean and dirty sections need to duplicate the facilities. The nursing staff should be separate for both dirty and clean sections.

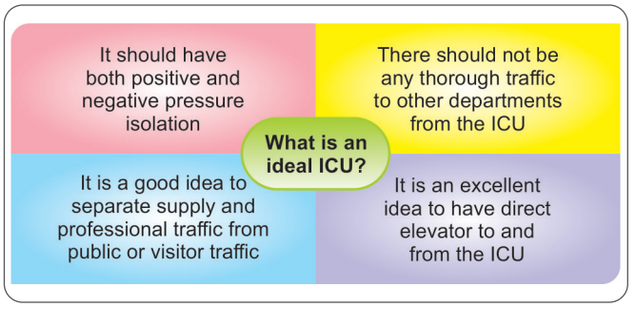


Fig. 1.9: Requisites of an ideal ICU/CCU

- There is a practical problem of restricting the traffic between the two sections. A compromise could be the use of partial cubicle.
- Beds are separated by glass partitions where the patient can be observed from the central nursing station while allowing the infection to contain within itself.

A MODEL CCU ROOM

The critical care unit can be X-shaped or U-shaped or semicircle so as to have good observation.

The design of the unit should take into consideration the integration and smooth functioning of three areas of importance, the patient area, the staff area mainly for doctors and nurses and the support area (Fig. 1.10).

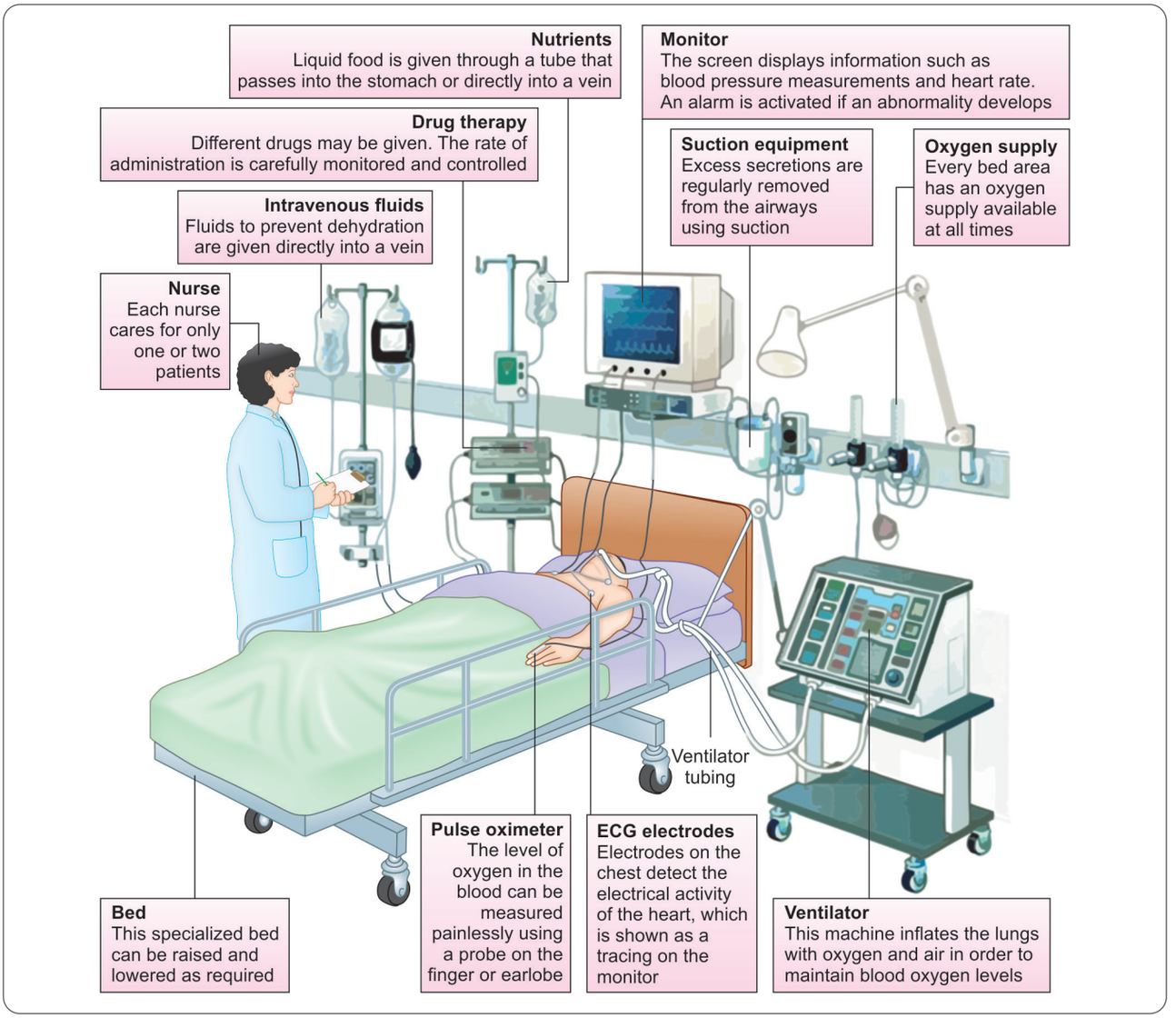


Fig. 1.10: Model CCU setup

The design of the CCU should meet four basic requirements:

1. Direct observation of the patient by nursing and medical staff.
2. Surveillance of physiologic monitoring
3. Provision and efficient use of routine and emergency diagnostic procedures and therapeutic interventions
4. Recording and maintenance of patient information

The unit should be air conditioned for the sake of patients, equipment and staff, temperature adjusted around 68°–72°F.

There are many designs which can be selected for the given place to plan the critical care unit. Individual rooms are recommended to minimize cross infection, reduce noise level and provide privacy for conscious patients.

The major advantage of partitioned cubicle is that it allows privacy and provides easy access to the patient. In such arrangement, death or an acute crisis can remain as an isolated event without affecting the well-being of other critically ill patients.

Each patient's bed area is supplied by an oxygen outlet attached to a flow meter, a central suction outlet and adequate number of power outlets. They should be wall mounted to save the space and allow easy movement.

Walls and floors are ideally made with glazed tiles or other material, which can be easily washed and disinfected. All wood items should be covered with washable material.

Lighting

Critical care implies continuous observation. The unit must be well lit. Background illumination from ceiling should be color corrected so that minor degrees of cyanosis or jaundice cannot be masked. Lighting should be as natural as possible. In addition, portable spotlight should be available. Each bed should be provided with a night lamp. During night, bright light can be put off for a patient who helps them to get oriented to diurnal variation. Many hospitals are changing from incandescent lighting to fluorescent, and now to light emitting diodes (LED), since both labor and energy expenditure are saved.

Visual Disturbance

Most of the lights in the room are bright lights. The CCU rooms may not have natural light. Natural light can be used as much as possible. Then patients can be exposed to more natural sunlight.

Solar Gain

Sunlight coming into rooms can add wanted heat in the winter or unwanted heat in the summer. Nurses can develop a system for optimizing the use of blinds to help control room temperature. Closing blinds on the sunny side of buildings on summer days can help prevent overheating and the need for more air conditioning wherever applicable as per geographic location.

Temperature and Humidity

The temperature extremes can add burden to the ill patient. Adequate air exchange should be possible, twenty times per hour is recommended. If air conditioning units manipulate temperature and movement of air, but not humidity, excessive drying of skin and mucous membranes may occur. Therefore, air conditioners should have humidity control to provide comfort. Isolation rooms should incorporate non recirculating air control that maintains slightly positive pressure for reverse isolation or slightly negative pressure for conventional isolation. Wall thermometers should be ideally placed to check the efficiency of air conditioning systems.

Temperature Setting

Newer hospital buildings may have digitally controlled heating and cooling systems. These will be set for optimal temperatures and air exchanges. Hospital facilities personnel have a challenging job to keep a building comfortable, hygienic, and energy efficient.

Noise

The CCU has very noisy environment with alarms, beepers, overhead pagers, and staff conversations. A vacuum cleaner sound is 70 dB (A) and sound of lawn mower is 90 dB (A). These are significantly higher than the levels recommended by the US Environmental Protection Agency, which recommends hospital sound levels should not exceed 30 dB (A).

The typical CCU has average sound levels of 55–70 dB (A), with pagers and alarms recoded at 84 and 79 dB (A), respectively, with peak sound levels in the CCU from 100 dB (A) to 120 dB (A).

Noise in the CCU environment has been shown to cause sleep disturbances, and there is a positive correlation between CCU delirium related to sleep deprivation and CCU sound levels. Noise also triggers the human stress response, which can result in delayed wound healing, hypertension, increased heart rate and ischemic heart disease. Nurses working in the CCU may also be negatively impacted by the noisy environment. While nurses may not identify noise in the CCU as an issue for staff, the effects of noise may result in increased stress, increased irritability, and decreased patient safety due to delayed response to alarms in the noisy environment.

There are a number of ways nurses can be charge agents to reduce the noise in the CCU. Alarms can be set on the basis

of patient needs, not to the default, so that unnecessary alarms do not sound. Staff conversations have been found to be one of the largest contributors to hospital noise. Therefore, a personal check should be observed.

Other Facilities

All other facilities required in a CCU are summarized here:

Nurse's station	Nurse's station should be planned permitting direct visual observation of patients with facilities for charting, telephone, placement of patient's record and central cardiac monitoring systems. It is difficult when the beds are in straight line. In that case, two nurse's station may be required. The distance between the central station and the patient bed should be conveniently short but not too short as to obstruct movement of equipment and personnel. It should provide seating arrangement, a telephone hookup with connection to central exchange of the hospital. An alarm button which is activated when there is a cardiac arrest or a dire emergency will alert the doctors promptly. The space between the nursing station and the patient bed should be kept free except for a mobile emergency cart with emergency drugs and equipment such as defibrillator. The nurse's station, which is the nerve center of the unit, should be close enough to the patients to permit observation of the patient. The proximity of the nurse's station to the patient saves the energy for nurses and influences patients' confidence. An emergency call system for nurses both from bed to nurse's section and from nurse's section to nearby unit is desirable. The station should have adequate space for storage of files, records and supplies and it should also have seating arrangement for two nurses and one doctor.
Hand washing facilities	Convenient to nurse's station, drug distribution area, pantry, clean and dirty utility area and individual rooms especially in the isolation rooms should be made available. The taps should be elbow operating or peddle operating.
Respite spaces for family and staff	Providing comfortable places for the family and friends to recharge may increase their ability to cope with the stress and anxiety of having critically ill loved one in the ICU, helping integrate the family into the care of the patient. These respite spaces may include a lounge with comfortable seating and soothing colors on the walls. If a television is placed in the room, it is preferable to have individual speakers, with on and off switches, placed next to seats so that disturbances to others in the room and the ICU in general are kept to the minimum.
Staff toilet room	It should be clean with all facilities for maintaining hand hygiene.
Changing room	It should be separate for men and women with shoe rack and individual cupboards for storing personal articles of nursing and other personnel.
Workroom	Clean workroom appropriates with working and storing for clean and sterile supplies. This shall include the work counter and hand washing facilities and a window with collapsible doors through which supplies can be received thereby limiting the entry of supply man into the unit.
Clean and dirty utility room	Here facilities for flushing the bedpans and automatic bedpan washers are installed.
Drug distribution station	Medicine trolley and dangerous drug's cupboards are centrally located.
Clean linen storage	Clean linen must be stored in a clean dry place that prevents contamination by aerosols, dust, moisture and vermin and is separated from used linen.
Pantry for storage and preparation of food	It is important to store food safely to stop bacteria from spreading and to avoid food poisoning.
Emergency equipment storage	The visible label of "**Emergency facility**" easily directs people to the facility to put emergency equipment into a closed or other storage area so that it is safe.
Conference room	Case presentations, continuing education programs and meetings can occur in conference rooms.
Duty doctor's room	The duty doctor room allows easy access to the doctor in duty in emergency.
Laboratory	It is an added facility if a mini lab can be set up in the CCU.
Clean and soiled utility rooms	A soiled utility room (or sluice room) is a necessity for every long-term care facility and hospital. A well-designed soiled utility room is the key to preventing the spread of infection and provides great cost savings for any facility.
Storage room	It is a storage area of patient items like clean linens, sterile supply, etc. It can have working counter and storage cabinets.

Electrical System

A safe electrical system is essential to prevent shock hazards. Special precautions must be taken when care of patient requires any type of electrically operated devices. Portable fire extinguisher should be fitted at convenient places. Ongoing education on the use of such equipment need to be conducted. The electrical system should be connected to the generator for the use at the time of power failure. The switches and power point for the same to be situated within the units. A study conducted by the author to identify stress among critical care nurses, brought out that frequent power failure resulting in non-functioning of life saving devices was one of the factors which were most stressful. The generator connections are mandatory for critical care units in order to sustain life saving devices during power failure and the generator should take over immediately in case of power failure.

Bed

Mechanically operated beds, which can be adjusted to various positions, and levels are recommended. The base and the mattress should be firm enough to enable to carry out resuscitative procedures. A detachable rail at the head end of the bed allows for easy access to endotracheal intubation. Bed with side railing and easily movable one for transfer with a locking system is desirable for CCU. Each patient bed area be supplied by an oxygen outlet attached to flow meter, by a central suction outlet and by suitable power outlet.

Each bed area should have large windows allowing natural light. All the outlets are wall mounted to allow for easy movement. Ideally there should be one washbasin for 2 beds, each having an antiseptic solution either sterillium solution or Hibiscrub as per the protocol of the hospital. The practice of hand washing is mandatory before and after patient's exposure by doctors and nurses. Appropriate antiseptic solution is kept at the foot end of the bed.

Number of Beds

Estimation of Bed Need

The first step in planning is estimating the number of intensive care beds needed in any unit. Considering the number of patients seeking CCU care, average length of stay in the unit and occupancy rate and applying the formula developed by planning agencies, one lakh population needs 14–15 CCU beds. Present trend is to have 10–20% of the hospital beds to be ICU beds.

Additional Beds

The number of additional ICU beds needed in an institution is calculated basing on the average daily census of patients needing CCU care and desired bed availability.

Average daily census is equal to the number of admissions to CCU × length of stay in CCU/365

Applying the formula developed by the planning agencies, a hospital with 500 intensive care admissions with average 7–8 days stay per year result in an estimate of 9–11 beds. Another way to determine the number of beds is to quote the figure of 1 bed for 100 general patients.

However, the figure to be decided by the usage of keeping the statistics over a period of time and depending on whether the hospital is a referral hospital and caring to various specialties such as coronary, neurology, cardiothoracic and renal. Ideally the number of beds in one unit should not exceed 10–12 and the minimum should be four catering to both the sexes. ICU with less than four beds is not cost effective.

Equipment

A great deal of expensive and sophisticated equipment is required and the choice depends on the type of unit (Fig. 1.11).

Much electrical equipment uses energy when plugged in and even when the equipment is turned off. Hospital beds, IV pumps, code carts, and more may be among them. It is important to check with the Biomedical Engineering department, but it may be possible to prevent this vampire power loss (power spent on plugged in equipment even when fully charged). It may be possible to leave beds, pumps and other equipment unplugged when not in use. The recommended equipment for critical care units can be classified into monitoring, resuscitative, and supportive.

Monitoring Equipment

Electronically monitored parameters of cardiac, respiratory, and perfusion status provide essential information for routine and acute management of each patient. ECG, invasive and noninvasive blood pressure, central venous pressure, end tidal CO_2, pulse oximetry and skin and/or core temperatures are routinely monitored. Monitoring of cardiac output, chamber pressures, systemic and pulmonary pressures and resistance, and oxygen consumption may be required in specific instances.

Electrocardiogram monitoring equipment is an essential component of the critical care unit. ECG monitoring is accomplished by attaching electrodes to the patients skin and connecting these electrodes to ECG oscilloscope monitors at both locations while small units have one or the other. The monitors are usually equipped with a meter or digital read out that displays the heart rate and rhythm and alarm systems activated when the heart rate exceeds preset upper or lower limits. An ECG machine should be available so that a complete 12 lead diagnostic ECG can also be taken when necessary.

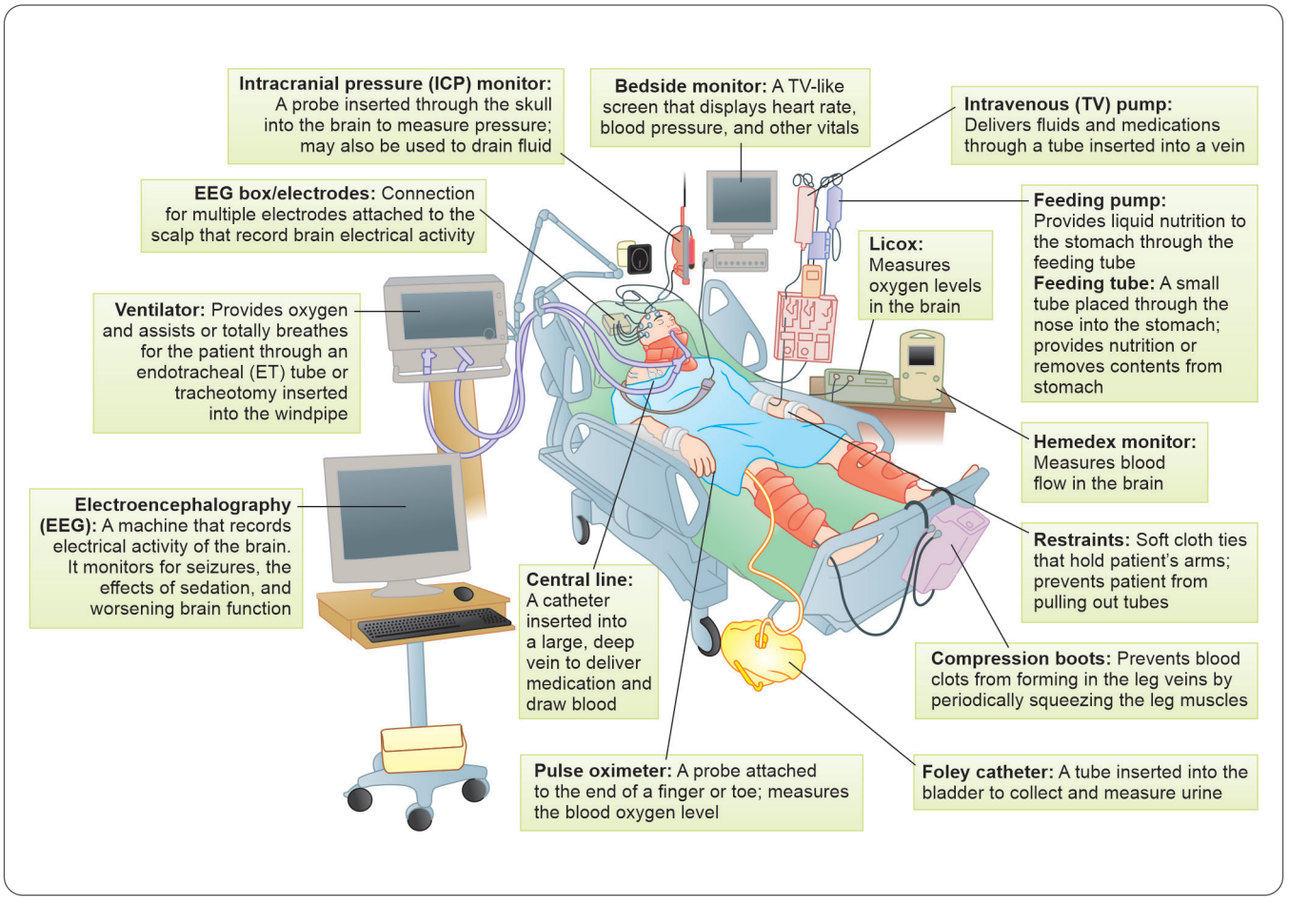


Fig. 1.11: List of equipment in CCU

Other parameters monitored are blood pressure, central venous pressure, oxygen saturation, end tidal carbon dioxide, respiratory rate and temperature. Cardiac output and pulmonary wedge pressure monitoring are indicated in specific cases. Monitors may have several channels to accommodate the display of these various parameters.

Computerized monitoring system with facilities for a printout may be situated as peripheral and centrally placed modules. Specialized equipment is required for monitoring respiratory function. Blood gas analyzers provide information regarding acid base status, hemoglobin, and electrolytes. Bedside monitoring of blood sugar levels with electronic equipment is useful to monitor diabetic patients on insulin infusions and patients on TPN. Access to a spirometer for measuring tidal volume and vital capacity is also recommended.

Resuscitative Equipment

Resuscitative equipment is essential in the management of patients with life-threatening conditions such as arrhythmias, respiratory failure. Each unit should be equipped with a crash trolley containing emergency drugs, fluids and equipment. This is wheeled to the patient's bedside during resuscitation and ensures that needed supplies are available.

Venturi masks, endotracheal tubes, laryngoscopes and Ambu bags form part of a crash trolley. Other resuscitative equipment include, suction and oxygen cylinders.

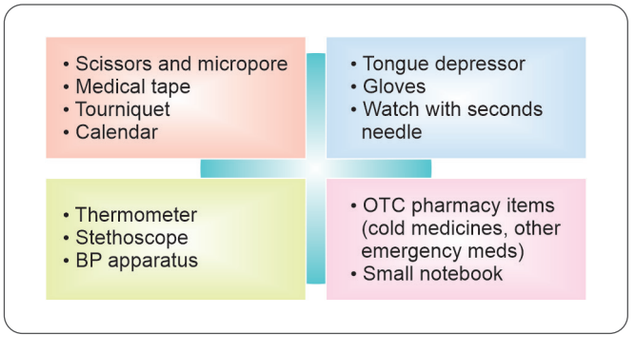
A pacemaker and a defibrillator are recommended for each unit. Ventilators and emergency equipment should be readily available.

Supportive Equipment

Special CCU beds are available with flat washable surface, detachable head end to facilitate resuscitation, holes for intravenous drip stands at convenient places, easy moving side rails, adjustable head and foot end and adjustable height. Alternating pressure air mattresses are used to prevent pressure sores, for those who are prone to develop them. All infection control protocols are carried out to prevent infection in these patients who are prone to them. To provide additional protection for patients, who are highly susceptible to infection, laminar air flow systems are used. Laminar airflow produces a constant flow of filtered air over the patient and reduces exposure to bacteria.

List of Supportive Equipment

- Clocks, calendars and lights with varying intensity for day and night are necessary in the critical care unit, to help patients to get oriented to the time, day and date.
- Portable X-ray equipment, portable image intensifier, arterial blood gas analyzer, portable ultrasound machine, equipment for respiratory therapy can be stored in separate store rooms.



- Medication preparation area can be separate or in the Nurse's station as per availability of space. Equipment in medication area includes a countertop, a medication refrigerator, a Narcotic cupboard and a wash basin.

Computer Monitors/TVs

It is important to work with the information technology (IT) department to optimize energy savings while providing critical readiness of computers. Some hospitals use computer power management software. Televisions in patient room present similar issues, if they are left on night and day to provide soft light, background noise, or distraction. Consider whether it is truly needed, and if not, turn off the TV. Especially any time a patient is discharged or a room is unoccupied; ensure that the television is off.

Waste

The largest creator of waste is thought to be the operating rooms, and CCU/ICUs may be second. In one of the few published evaluations of waste in the ICU, a 10-bed ICU at a 320-bed hospital produces 5% of the total hospital waste. Actions required are:

- **Recycle:** Recycling opportunities vary across the nation, depending on what markets exist for specific materials.
- **Reformulate kits:** While recycling is important, reducing the use of resources in the first place is the most effective way to reduce waste.
- **Segregate carefully:** Specialized waste treatment is both expensive and energy intensive. Proper segregation and disposal of waste at the bedside can save energy and money.
- **Reuse:** There are often many opportunities for reuse of tube, trays, or other containers. These can be collected and given away or used in the ICU.
  - **Understand cost of waste:** Nurses are often unaware of the costs of energy and waste. When more aware, it is easier to make decisions aligned with efficiency.
  - **Use of reusable gowns:** After decades of disposable products, including isolation gowns, there is some movement toward reusable cloth gowns. They are often cost-effective and more comfortable, and they reduce waste.
  - **Rethink contact isolation:** Intensive care unit nurses can establish plans to reduce pre stocking of all patient rooms so that only the equipment needed for the next shift is included. Nurses can avoid bringing any equipment and linen into room until just before use.
  - **Reduce toxic chemical:** Exposures to toxic chemicals in the CCU can occur from a number of sources such as air, dust, products, and food. By evaluating the types of products being use in exposure sources, nurses can advocate for an environment that is healthier for patients and staff.
  - **Environmentally preferable purchasing:** A crucial way that nurses can reduce the number of toxic chemicals being introduced onto the unit is to become a member of the purchasing committee. By engaging in environmentally preferable purchasing, a purchasing approach that evaluates goods and services for their effects on human health and the environment, this committee can evaluate goods across the life cycle from production to disposal, avoiding products that have the potential to harm human health and the environment.
    - **Reduce linen waste:** Washing hospital linen takes energy, water, and chemicals. Typically any linen that enters a patient room requires washing even if it was not used by the patient. Nurses can decrease the amount of linen waste by planning ahead, using only what is needed and checking to see what is already in the room before getting more.

Paper Waste

The electronic health record should in theory reduce the amount of paper used. There are many opportunities to reduce paper waste in the CCU. Nurses can request that laboratory orders or reports are not automatically printed. Paperless CCU is becoming the norm of the time in many sophisticated CCUs.

Food Waste

Many hospitals have adopted a system providing meals on demand, when patients are ready to eat. In the CCU, nurses are

often decision makers about meals and servings. They can order only what the patient is likely to eat, knowing that more can be ordered if need arises. Likewise, staff can reduce unneeded food for employees to reduce waste and poor nutrition.

Note:

DEHP

Di-ethylhexyl phthalate (DEHP) is a chemical additive found in a number of products including flooring, food packaging auto upholstery, and shower curtains. It is present in many articles used in CCU such as IV bags and tubing, nasogastric tubes, urinary catheters, and blood administration sets. DEHP is a plasticizer added to polyvinyl chloride to make it flexible. DEHP can easily leach out of the product into patients during procedures such as medication administration, blood transfusions, total parenteral nutrition and dialysis.

Effects: It can enter body through inhalation, ingestion and dermal contact on a daily basis. According to Environmental Protection Agency (EPA), the dose of 20 µg/kg/day poses the risk of hepatomegaly. Above 50 µg can result in testicular toxicity and ovarian toxicity.

Precautions: As it has many toxic effects safer use of PVC free and DEHP free alternatives must be chosen. (Singh Sai, 2018)

Cleaning Chemicals

A new technology that is being embraced by ICUs and other high-infection/high-risk areas is the use of UV light technology to reduce infection and HAI rates. The UV lights break the molecular bonds in the organism's DNA, rendering them incapable of reproduction.

Fragrances

It may be an allergen or respiratory irritant. Staff and visitors should also be made aware when switching to nonscented cleaning products that the same high level of cleaning is still occurring but the fragrance they associate with cleaning will no longer be apparent.

Personal Care Products

Personal care products used in the hospital are similar or the same as those used in the home. The laws governing chemicals used in personal care products allow almost any ingredient to be used in these products.

Energy

When ICU nurses can reduce the amount of energy used, they are reducing risks to human health. There are a number of solutions to decrease energy use, as well as provide savings to the health care facility through decreased energy costs.

Energy Star-rated Equipment

Direct care nurses may not feel they have a lot of input into purchasing decisions about equipment choices. However, at the same time, nurses are responsible for nursing practice decisions and outcomes. Therefore, with every decision that impacts nursing practice, a nurse should be involved in the decision at some point. This could be as a member of the purchasing committee or as giving input as a nurse who will be using the equipment. Table 1.1 numerates 10 steps adopted for environmental sustainability in CCU.

TABLE 1.1: Ten steps to environmental sustainability in the critical care unit

1.	Develop plan for turning off lights, computer monitors, and televisions when not in use.
2.	Develop system for maximizing optimal temperatures using thermostat settings, blinds, and lighting.
3.	Reduce waste by recycling, reusing, using reusable gowns, and not opening equipment until you are certain it is needed.
4.	Reduce overtreatment of waste by carefully segregating infectious, pharmaceutical, hazardous, and landfill waste.
5.	Adopt or increase remanufacturing of single-use devices.
6.	Eliminate chemicals as much as possible.
7.	Encourage your hospital to switch to green cleaning products.
8.	Join or create a green team.
9.	Create an action plan to follow standards.
10.	Join organizations, such as the Alliance of Nurses for Healthy Environments and Health Care without Harm, to stay educated and inspired, Green hospital initiatives.

Cross Infection

The prevention of cross infection is a problem in the unit and should be considered in planning and in spacing of beds. Provision of single rooms, barrier-nursing facilities should be considered for units with infection or immunocompromised patients. All surfaces should be able to withstand germicide. Each of the patients in the barrier nursing area should be cared for by a nurse specially assigned. Contaminated instruments, linen, equipment should be treated in separate utility room. Adequate facility for hand washing should be available. All staff should change into clean gown before entering the unit and it is wise to regard the unit as an extension of operating room as per the protocol of the hospital. There are machines to instantly cover the footwear as a measure to prevent infection. Casual visiting should be discouraged and high standard of cleanliness must be maintained. Periodic check by Microbiology department is necessary to identify any potential source of infection.

Factors Affecting Patient's Well-being

The critical care environment produces adverse effects on the patient:

- However, designing the unit with large windows through which patient can have access to outside view is advisable.

- The color of the unit should be as aesthetically pleasing as possible and conducive to recovery with minimum sensory deprivation.
- Use of clocks with night and day in different colors, large calendars and lights with varying intensity during the night will help the patient to get oriented.
- Visiting policy of CCU vary from institution to institution. Family members must be made comfortable in a waiting room and reassured that they will be called if there is any change in the condition of the patient. A statement as the patient needs rest usually helps the family to understand the restriction.

Admission Criteria

Criteria are formulated as per the type of services offered by the unit and the policy of the institution. Some units have a list of those who are not suitable for admission to critical care unit, such as terminally ill patient who require more than standard nursing care.

Nursing Charts

The nursing chart or a flow sheet is a monitoring aid that record data chronologically to allow rapid review in a form, which is easily interpretable. Electronic record system is in use in many hospitals.

The chart should include recording of:

- **Vital signs:** These include temperature, pulse and respiratory rate. If the patient is mechanically ventilated, the mode, peak air way pressure, expired tidal volume, air way temperature, inspired oxygen percentage, pulse oximetry measurements, sputum amount and color.
- **Cardiovascular parameters:** These include blood pressure, central venous pressure and Swan Ganz Pressure Measurement.
- **Central nervous system parameters:** These include an assessment of patient's state of consciousness, pupillary changes, reflexes and motor responses which could be recorded in a Glasgow coma scale incorporated into the routine flow sheet.
- **Fluid balance parameters:** These include intravenous and gastrointestinal fluid input and gastrointestinal and urinary output recording along with measurement of any drainage present.

Flow sheet should have provision for recording of the laboratory investigation such as blood count, ABG, Renal function tests and liver function tests.

STAFFING

Paradoxically, so many doctors have an interest in some aspects of the treatment and it is difficult to decide who is overall in charge of patient. Many have tried with different category. A specialist in critical care medicine is the most ideal if one can find such a person. Otherwise the most specified areas are anesthesiologist and surgeons. The need to train physicians in critical care medicine is also beginning to be recognized. The level of physician coverage that is required for the unit should be addressed. This aspect depends on hospital size. One full time physician available throughout is necessary. Most guidelines provide for availability of specialist Intensivist within 20 minutes in the larger hospitals. Some agencies believe that a committee can do overall direction. The unit should have two other trained doctors for 10–12 beds along with junior doctors.

Ancillary personnel recommended are:

- Safety officer
- Biomedical engineer
- Secretary
- Administrative coordinator
- Clerk/typist
- Dietitian
- Respiratory therapist
- Social worker
- Physical therapist
- Laboratory technician
- Clergy man
- Receptionist
- Cleaning staff

Building Teams

Hospitals are constantly remolding, updating, or rebuilding teams to address issues such as infection control, injury prevention, and process efficiency. Nurses can also contribute meaningfully on the health and safety of products and on the energy efficiency of buildings and equipment.

Nursing Staff

The importance of the nursing staff is very significant. The recommendations deal with ratio of nurses to patients and the need for adequate training. The ideal ratio is considered to be one nurse per patient. However, it is recognized that manpower limitations prevent this from not being realized in most setting. Most guidelines set a ratio of one nurse for three patients as maximum. Allowing for sickness and holiday, it requires 4.25 nurses per bed plus one sister in charge in each shift. It is ideal to have a senior nursing officer as overall in charge. Guidelines also stress the need for training of nursing personnel. Training should include orientation program reinforced by continuing education programs.

Nurses Engagement

Engaging staff in the effort to reduce the environmental impacts of ICU care offers many opportunities for education and idea generation. To a busy nurse in an adrenalin-filled

ICU, reducing waste or saving energy may not be top of mind. To other nurses, who work hard to reduce waste, recycle, save energy, and water at home, it can be frustrating experience to come to work and recognize the amount of resources use inherent in their daily work. Learning more about the links between resources use and health can help provide guidance and support for changing the ways we practice.

HEALING ENVIRONMENT

The ICU, where you find the most vulnerable, critically ill patients in the hospital, can actually be among the areas which are least conducive to healing. It is a fast paced, noisy environment that may increase the stress for the patient and family and decrease their ability to heal. Besides increasing the health and well-being of patients and visitors, a healing environment may increase staff satisfaction and improve retention and commitment to the job.

MANAGEMENT POLICY

Management policies and procedures are essential to the effective and efficient operation of the critical care unit.

It should include the following aspects:

- The patients to be served by the critical care unit
- The type of CCU services provided
- Relationship of CCU to other units and departments
- Management of the unit
- Admission and discharge criteria
- A system of informing the physician about the changes in the condition of the patient
- Use of standing orders
- Location and storage of medication supplies and special equipment
- Method of care delivery
- Method of procurement of drugs, equipment and other supplies
- Responsibility for maintaining the emergency drug system
- Regulation regarding visitors to the unit. It should be geographically closely associated with emergency department, operating theater, recovery room and other intensive care areas. Design and the facilities depend on the size and the type of services provided.

MUST KNOW

- Critical care units are of different levels depending on the staffing and support services.
- They are either general units or specialized units depending on the type of patients catered to. Critical care services require specialized facilities and equipment especially trained nursing staff, medical staff and wide range of support services.
- Design and location and number of beds are chosen carefully to ensure safe and effective patient care.
- Environmental sustainability is yet another area where nurses can be change agents in bringing out a healing environment for the patients, significant others and the staff working in CCU.
- It is also important to offer cost effective care to the clients needing critical care.
- Nurse has to be assertive to involve herself in planning the unit, purchasing and in maintaining the Unit.
- Standard operating procedures, policies and protocol can be developed for running the unit smoothly while ensuring quality.

ASSESS YOURSELF

1. Write the role of the nurse in planning a CCU.
2. Write short notes on the following:
   - Levels of critical care units
   - Calculation of optimal number of beds for a CCU
   - Facilities required in a critical care unit
   - Monitoring equipment
   - Resuscitative equipment
   - Staffing
   - Environmental sustainability in CCU

CRITICAL THINKING SKILLS

Q. 1. What key components will you consider while designing a 40-bedded critical care unit?

NOSOCOMIAL INFECTIONS AND THEIR CONTROL IN CRITICAL CARE UNITS

Nosocomial infections are ones that develop during hospitalization and are not present or incubating at the time of admission to the hospital. They manifest within 48–72 hours. Nosocomial infections cost the health care industry a large sum every year. In 1979, Bennett et al. noted that hospital acquired or nosocomial infections affect nearly two million patients each year in USA. Apart from the heavy expense incurred on them to the tune of 5–10 billion dollars each year, nearly 3% of these patients die as a result of hospital acquired infection (Fig. 1.12).

SIGNIFICANCE OF NOSOCOMIAL INFECTIONS

- Increases ICU stay by 4.3 days
- Increases hospital LOS by 4–9 days
- Increases cost — $20,000–40,000 per episode
- Estimates of CRBSI cost/year for nation >$1.2 billion
- Pressure from legislatures, consumer groups, third party payers and regulatory agencies has resulted in mandatory public reporting of nosocomial infections.

REASONS OF NOSOCOMIAL INFECTIONS

Critically ill patients requiring CCU care are at a greater risk for nosocomial infections in comparison with the other patients in the general ward for following reasons:

- They often have underlying conditions or diseases that compromise their host defenses.
- They are often exposed to invasive procedures, some of which are done as emergency. During this emergency treatment, traditional infection control practices may be violated.
- They are often close to other highly susceptible or infected patients a situation that allows ample opportunity for cross infections since contacts between patients and staff is frequent.

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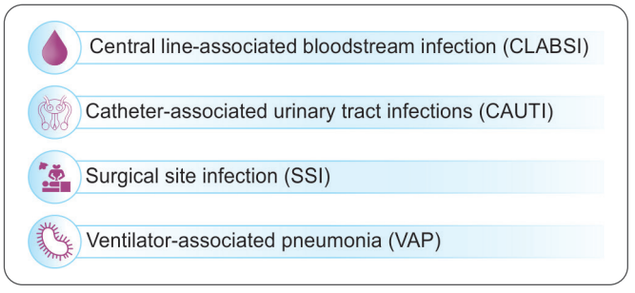


Fig. 1.12: Nosocomial infections

- CCU's often become the reservoirs of antibiotic resistant microorganisms. Most of these patients have poor nutritional status and covered by heavy antibiotic usage thereby resistance to infection is reduced.
- Use of mechanical ventilators makes them more prone to infections.
- Length of stay in CCU. As the length of stay in CCU becomes more they are more prone to infections.
- In 1970s, surveillance data showed an incidence of six to eight nosocomial infections for every 100 admitted patients.
- Progressive increase in the incidence in 1990.
- US CDC has estimated that 88,000 patients die as a result of nosocomial infections in US hospitals. A Multicenter, prospective cohort surveillance of device-associated infection by the International Nosocomial Infection Control Consortium (INICC) in 55 ICUs of 8 developing countries including India revealed an overall rate of 14.7% HAI corresponding to 22.5 infections per 1000 ICU days.
- Nosocomial Infection: Vital role of indwelling catheters unquestionable.
- 87% of primary bloodstream infections associated with central lines.
- 86% of nosocomial pneumonia associated with mechanical ventilation.
- 95% of urinary tract infections associated with urinary catheters.
- Percentage of *Staphylococcus aureus* isolates reported as MRSA.
- As many as half of all the hospitalized patients and virtually all CCU patients receive antibiotics.
- Patient-to-patient transmission very common in CCU.

SOURCES OF NOSOCOMIAL INFECTIONS

The most common sources of infections are wounds; indwelling catheters, ventilators, suctions, nebulizers (Table 1.2), respiratory, blood and urinary systems.

Organisms (Table 1.3)

Microbes, which cause infection, fall into the groups of bacteria, viruses, fungi and protozoa.

Bacteria are perhaps the most numerous and widely distributed of the microorganisms.

Enterococci are the second most common bacteria isolated from nosocomial urinary tract infection and it is the third most common cause of nosocomial bacteremia.

They are classified into:

- Gram stained (Gram stained bacteria is classified into Gram-positive and Gram-negative).
- Acid fast bacilli
- Spirochetes

TABLE 1.2: Sources of infections

Gram-positive Bacteria	
Staphylococci	Which are seen as clusters, positive coagulase test indicates Staphylococcus aureus.
Staphylococcus aureus	This is the normal flora in the nose of 10–30% normal people. Skin infections caused by this are boils, carbuncles, abscess, surgical wound infections, neonatal skin infection, sepsis, deep tissue infections, including septic arthritis and septicemia.
Staphylococcus epidermis	Found normally in the nose of skin flora of healthy people. Diseases caused include endocarditis after heart surgery, shunt infections in infants, infections of hip joint prosthesis.
Streptococcus	There are different types. They are pneumonia, S. viridans, β. hemolytic streptococci group A, B, C, D.
Groups A	5% of the population has hemolytic streptococci in the throat. Diseases include sore throat, scarlet fever, otitis media, skin infections, wound infections, rheumatic fever and acute glomerulonephritis.
Group B	A normal site is perineal skin and lower vagina. Main diseases associated include neonatal septicemia and meningitis.
Group D (S. faecalis)	Normal flora in intestine. Diseases produced are sore throat, skin infections, septicemia and endocarditis.
Strepto pneumoniae	It is a normal flora of throat and nose. Diseases include Otitis media, mastoiditis, pneumonia, meningitis and septicemia.
Streptoviridans	It is normal flora in the mouth. Diseases produced include dental caries, liver abscess.
Bacillus species	This includes B. anthracis, which causes anthrax in man and animal.
Corynebacterium species	These include C. diphtheria. These are commonly isolated in skin or throat. This also causes urinary tract infections or bacterial endocarditis affecting a prosthetic heart valve.
Clostridium species	Clostridium tetani and clostridium perfinges (welchii) which are common causes of outbreaks of tetanus and gas gangrene in critical care units.
Gram-negative Bacteria	
Neisseria species	These include N. gonorrhea, N. meningitides. These are oxidase positive Neisseria meningitidis present in the nasopharynx of 5–30% of general population and these are the ones causing bacterial meningitis.
Enterobacterial	Includes *E. coli*, *Klebsiella*, *Proteus*, *Salmonella* and *Shigella*.
E. coli	It is a normal flora in the large intestine and it can cause wound infections, abdominal sepsis, septicemia and urinary tract infections. *Salmonella* and *Shigella* cause infections of gastrointestinal tract.
Pseudomonas	The common ones are *Pseudomonas aeruginosa*, occurs in the fecal flora of patients. Most pseudomonas species may be isolated from moist environment sites in the hospital including contaminated suction apparatus, contaminated ventilators and humidifiers. Diseases produced are wound infections, chronic osteomyelitis, eye infections.
H. influenzae	These include H. influenza and other hemophilus species frequently found in the normal throat flora and nasal flora causing diseases like *H. influenzae*.

TABLE 1.3: Profile of organisms

Profile of organisms isolated from patients in the ICU	
Site	**Common pathogens**
Blood	• *Klebsiella pneumoniae* • *Candida albicans* • *Pseudomonas aeruginosa and Acinetobacter*
Lower respiratory tract	• *Acinetobacter baumannii* • *Pseudomonas aeruginosa* • *Klebsiella pneumoniae* • *Escherichia coli*
Wound	• *E. coli* • *Pseudomonas* • *Acinetobacter* • *S. epidermidis* • Methicillin-resistant *Staphylococcus aureus* (MRSA) • Methicillin-sensitive *Staphylococcus aureus* (MSSA)
Urinary tract	• *E. coli* • *Pseudomonas* • *Enterococcus species* • *Klebsiella* • *Candida species*

MAJOR INFECTIONS IN CCU

Nosocomial Pneumonia

It is the most dreaded complication that can occur in critically ill patients in hospital within a period of more than 48 hours. The incidence varies from the type of units and type of hospital. The risk is more in intubated and ventilated patients.

Reasons

- Impairment of defense mechanisms of an ill patient
- Easy access of dangerous pathogens to the lower respiratory tract.

Pathogenesis

Nosocomial pneumonia is due to aspiration of infected material from the mouth or pharynx. The oropharynx is colonized by aerobic Gram-negative bacteria within 5–10 days. Invasive diagnostic and therapeutic procedures promote aspiration and transfer of infected material (Flowchart 1.2).

Factors Predisposing to Nosocomial Pneumonia

- **Host factors:**
  - Overwhelming infections or serious illness, e.g., severe sepsis, prolonged shock, burns, severe trauma or following major surgery.
  - Background factors, e.g., chronic lung diseases, diabetes mellitus, cardiac, renal or hepatic dysfunction, advanced age, underlying malignancy, malnutrition
  - Total parenteral nutrition.
- **Therapeutic interventions:**
  - Endotracheal intubation or tracheostomy with mechanical ventilator support
  - Use of invasive procedures (including central lines)
  - Nasogastric tube
  - Use of corticosteroids or chemotherapy
  - Prolonged use of antibiotics
  - Colonization of upper GI tract with Gram-negative bacteria following use of antacids/H_2 antagonists
  - Use of high FiO_2 whilst on mechanical ventilation.
- **Environmental factors:**
  - Overcrowding
  - Overall unclean environment (unfortunately so frequently seen in developing countries)
  - Transmission chiefly through contaminated hands of ICU personnel
  - Increased prevalence of multiple, resistant organisms.

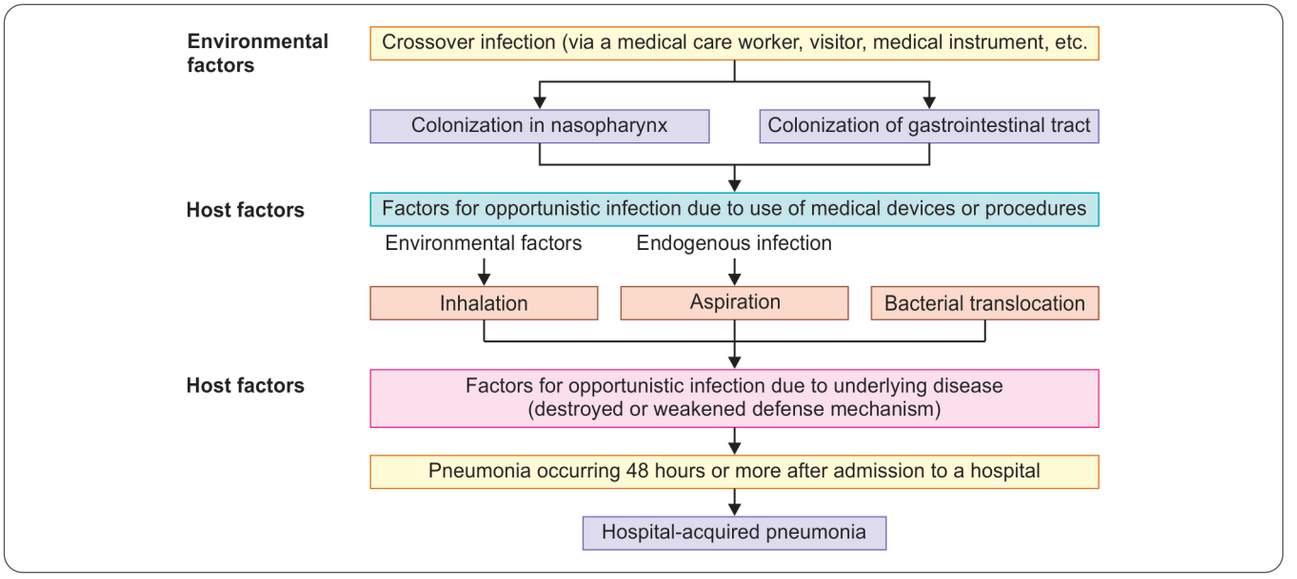
Ventilator Associated Pneumonia (VAP)

VAP is the most common cause of nosocomial pneumonia. It is noted that nearly half of the cases of VAP occurred during first 5 days of mechanical ventilation.

What is a Bundle?

- A group of best practices with respect to a disease process, that individually improve care, but when applied together result in substantially greater improvement. Thousands of individuals and organizations have joined campaign which targets Zero of HAIs.
- The advantage of bundle is so well established that it should be considered standard of care.

Flowchart 1.2: Pathogenesis of nosocomial pneumonia



Incidence

- Pneumonia occurring >48 hours after hospital admission and not developing at time of hospitalization- hospital acquired pneumonia (HAP)
- 80% of cases of HAI are ventilator-associated pneumonia after 48 hours of intubation
- 5–10 cases per 1000 hospital admissions
  - Incidence of 9–26% in ICU patients.
  - Can be >50% in certain ventilated patient populations.
- 10–15 cases per 1000 ventilator days.
- Cumulative risk roughly 1% per day of intubation

Clinical Diagnosis

- Fever, leukocytosis, purulent sputum and in VAP purulent tracheal secretions.
- Chest X-ray shows new progressive alveolar infiltrate
- Bacteriological examination
- Sputum and endotracheal aspirate examination
- Positive blood culture

Antibiotic Therapy

- Appropriate antibiotic therapy is to be started after obtaining the specimens for examination. The common ones used are monotherapy with second generation cephalosporin, or third generation cephalosporin or augmentin.
- Prompt treatment after confirmation of infected agent through culture
- Subsequent modification of antibiotic regime as per culture sensitivity
- Avoid prolonged use of antibiotics
- Persevere with the same antibiotic regime if there is a good clinical response even if this is contrary to culture reports
- Consider de-escalation of therapy in appropriate
- Stop antibiotics if no growth reported-unless the patient has severe sepsis and no other cause for sepsis is evident.

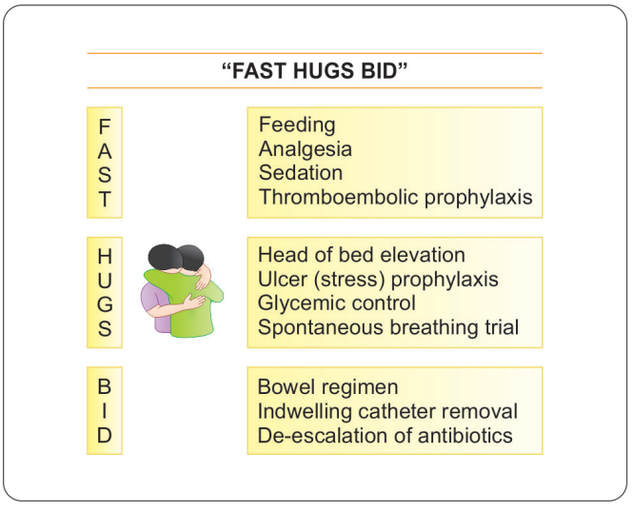
Principles in Treatment Strategy in VAP

Prevention

It is important to reduce the morbidity, mortality and the hospital expense. Prevention of aspiration, particularly the aspiration of patients in prone position is utmost important. Patients on nasogastric tube feeding should have their head end elevated to 45° angle. Patients should be turned frequently. Mobility in bed will help to prevent stagnation of secretion, thereby, atelectasis and infection. Meticulous asepsis should be followed while suctioning. Hand washing before and after having contact with patient is utmost important. All respiratory equipment should be disinfected and sterilized. Oral hygiene is of paramount importance to prevent colonization of bacteria in the oral cavity.

Prevention of Nosocomial Pneumonia

- Use of small bore versus large bore gastric tubes
- Continuous versus bolus feeding



- Gastric versus small intestine tubes
- Closed versus open suctioning methods
- Kinetic beds
- Implementation of educational programs for caregivers and frequent performance feedback and compliance assessment
- Strict alcohol-based hand hygiene
- Avoidance of tracheal intubation and use of Non Invasive Ventilation when indicated
- Daily sedation vacation and implementation of weaning protocols.
- No ventilator circuit tube changes unless the circuit is soiled or damaged.
- Aspiration of sub glottic secretions
- Oral care with chlorhexidine
- Avoid stress ulcer prophylaxis in very low-risk, patients for gastrointestinal bleed, and consider use of sucralfate when indicated.
- Semi-recumbent patient positioning
- Post pyloric feeding in patients who have impaired gastric emptying

Ten commandments of prevention of VAP are given in Table 1.4.

TABLE 1.4: Ventilator-associated pneumonia: 10 commandments of prevention

1. **"Thou Shalt Cleanse Thy Hands."**
   - ICU patients are the main reservoir for VAP pathogens, transported on the hands of HCWs
   - Alcohol-based solutions may be better than handwashing
   - Gloves are Good but Don't substitute for handwashing
2. **"Thou Shalt not Lay Thy Ventilated Patient Flat on the Bed"**
   - Supine Positioning
   - If you're intubated in the ICU, you are probably aspirating
   - You probably have reflux too
   - Gastric tubes makes reflux even more likely
   - Gastric colonization often precedes tracheal colonization
3. **"Thou Shalt not Keep Intubated Thy Patient Who Doesn't Need It" Weaning off the Vent**
   - Intubation is the single most powerful predictor of nosocomial pneumonia
   - Intubation is a continuous risk for development of pneumonia
   - Standardized Weaning Protocols are Superior to Physician-Directed Extubation
   - Non-physician HCWs can be used for early extubation strategies

   Weaning off the Vent
   - Sedation Vacation
   - Why? Has been demonstrated to reduce overall patient sedation
   - Promotes early weaning
   - Potential to increase time to extubation.
   - Identified issues and concerns
   - Increases potential for self extubation
   - Increases potential for pain and anxiety of patient
   - Increases episodes of desaturation
4. **"Thou Shalt Consider the Mask Before the Tube"**

   NIPPV in COPD:

   "Data from good quality randomized controlled trials show benefit of NPPV as first line intervention in all suitable patients for the management of respiratory failure secondary to an acute exacerbation of COPD."
5. **"Thou Shalt Leave Thy Patient's Nose Alone" If you have to, not in the nose…Naso vs. Orogastric Tubes**
6. **"Thou Shalt Use Antibiotics Appropriately"**

   Fewer Antibiotics for VAP?

   Shortening the length of treatment may help to contain the emergence of multi resistant bacteria in the intensive care unit (ICU). What's the "optimal" duration of antimicrobial treatment for VAP? 7–10 days.
7. **"Thou Shalt Consider Sucking Subglottic Secretions" Continuous Removal of Subglottic Secretions**
8. **"Thou Shalt Use HME Devices"**
9. **"With Good Conscience, Thou Shalt Reduce Stomach Acid in Thy Ventilated Patients"**

   Stress Ulcer Prophylaxis
10. **"Thou Shalt Consider Tracheostomy In Thy Patient Who Shall Need Prolonged Support"**

Catheter Related Infections

The catheters commonly used in CCU are central venous lines, Intra-arterial line, Swan Ganz catheter and indwelling urinary catheter. These catheters are used for either infusion of fluids or diagnostic and monitoring purposes or infusion of antimicrobial agents. All catheters entering central or peripheral veins or arteries are prone to get infected. They are the major causes of sepsis in CCU (Table 1.5 and Fig. 1.13).

Diagnosis

- Local inflammation/phlebitis at site
- Features suggestive of thrombosis of large vein
- Sepsis with no other apparent reason
- Microbiological evidence of contaminated infusate
- Candidal retinitis in patients on parenteral nutrition

TABLE 1.5: Diseases and catheter related factors

Underlying diseases	Catheter–related factor
Severe illness with high APACHE score	Clumsy or difficult insertion
Neutropenia	Insertion into the femoral vein or artery
Immunocompromised patient	Poor catheter care
Transplant patient	Occlusive dressing
Prolonged ICU stay	Duration of catheter >7 days
Source of sepsis, e.g., intra-abdominal suppuration	Parenteral nutrition
Massive surgery	
Mechanical ventilation	
Prolonged use of systemic antibiotics	

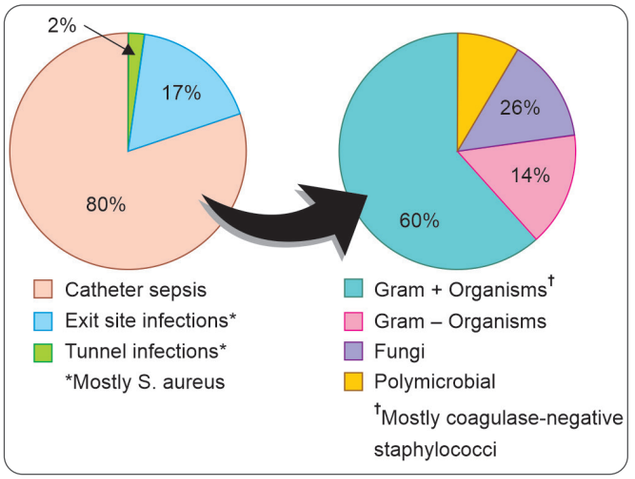


Fig. 1.13: Important risk factors for intravascular device related bloodstream infections

Laboratory Diagnosis

- Blood culture
- Culture of catheter tips
- Gram staining of catheters

Management of Catheter Related Infections

Entry Site Infection

- Short-term catheters suspected to be causing infection should be removed. It is not advisable to remove long-term catheter such as Hickman's catheter. They can be treated with local bactericidal ointments.
- Long-term catheter such as Hickman's catheter may require removal of a catheter. The tunnel needs to be surgically opened and infection cleared. The antibiotic regime should include preferably Vancomycin, third generation Cephalosporin or an Aminoglycoside.

Catheter Related Sepsis

Short-term catheters are removed and antibiotic regime is started preferably with third generation cephalosporin for 5–10 days along with amino glycoside. MRSA infections are treated with use of vancomycin. If the patient does not improve with antimicrobial therapy, amphotericin B is started. Intravenous heparin also may be required.

Prevention of Catheter-Related Infection

Summary of recommendation for prevention is given in Table 1.6.

- Meticulous skin preparation before insertion of percutaneous catheters using Povidone iodine or chlorhexidine.
- Strict aseptic technique of surgical hand washing, wearing of gloves, gown and mask as per protocol of the unit.
- Meticulous care of inserted catheter.
- The duration for which catheter is inserted in central and peripheral line varies with protocol of the unit. However, it is noted that frequent change of catheter is not advocated. Swan Ganz catheter may be removed in 3–4 days.

TABLE 1.6: Summary of recommendations from guidelines for prevention of intravascular catheter related infection (2011)

Subject	Recommendations
Placement of central venous catheter	Use ultrasound guidance to place central venous catheters to reduce the number of Cannulation attempts and mechanical complications (category IB)
Skin preparation	Use 0.5% chlorhexidine for skin preparation and dressing changes. If there is contraindication for Chlorhexidine, use tincture of iodine or 70% alcohol (category IA) or any other antiseptic as per protocol.
Catheter site dressing regiments	Use a chlorhexidine impregnated sponge dressing for temporary short-term catheters in patients older than 2 months of age if Catheter line-associated bloodstream infection is not decreasing despite adherence to basic prevention measures (category IB)
Patient cleaning	Use 2% chlorhexidine wash for daily skin cleaning (category II)
Catheter securement device	Use suture-less securement device to reduce the risk of infection for intravascular catheter (category II)
Antimicrobial lock solutions	Use prophylactic antimicrobial lock solution in patients with long-term catheters who have a history of multiple Catheter line-associated bloodstream infection despite optimal maximal adherence to aseptic technique (category II)
Anti-microbial impregnated central venous catheters	The use of a chlorhexidine or silver sulfadiazine impregnated to minocycline or rifampicin impregnated catheter is recommended in patients whose catheter is expected to remain >5 days.
Needleless intravascular catheter systems	Use a needleless system to access IV tubing (category IC). When a needleless system is used, a split septum valve may be preferred over mechanical values, due to increased risk of infection with the mechanical valves (category II)
Performance improvement	Use hospital specific or collaborative based performance improvement initiatives in which multifaceted strategies are bounded together to improve compliance with evidence-based practice (category IB)

- The catheters in peripheral lines are removed after 5–7 days.

Complications of Catheter-Related Infections

The earlier the catheters are removed, the lesser the chances of infection.

- Septic thrombophlebitis
- Disseminated fungal infection

Urinary Catheter Associated Infections

The presence of indwelling urinary catheter predisposes the patient for urinary infection. The longer the catheter the more the chance of urinary tract infection. Ascending infection from bladder can result in Pyelo-nephritis. The urinary bacteria are able to adhere to the mucosal cells within the bladder. There is increased chance of multiplication of pathogenic bacteria.

Risk Factors

- Prolonged duration of catheterization
- A break in the closed sterile system of drainage
- Poor catheter care
- Urethral trauma
- Diabetes Mellitus
- Pre urethral colonization with pathogenic bacteria
- Compromised immune status

Diagnosis

Symptoms

- New onset or worsening of fever
- Rigor
- Delirium
- Lethargy
- Suprapubic pain
- Hematuria

Investigations

- Positive urine bacterial culture
- Leukocytosis
- Positive blood culture
- Ultrasonography, IVP, CT scan

Treatment

Catheter is removed. Suitable antibiotic therapy is started. If patient requires catheter, a new one is inserted. Selection of appropriate antibiotic is carried out considering various factors. Presence of candida requires antifungal agents such as Amphotericin. Medicated bladder washes are also found to be effective. Practices for indwelling catheter insertion and CAUTI bundle are given in Tables 1.7 and 1.8.

TABLE 1.7: Practices for indwelling catheter insertion

Recommended practices for indwelling catheter insertion and maintenance
• **Catheter insertion:** ▪ Properly trained personnel ▪ Hand hygiene ▪ Smallest bore catheter ▪ Aseptic technique and sterile equipment
• **Catheter maintenance:** ▪ Sterile, continuously closed drainage system ▪ If there is break, replace catheter, collecting system, and connection ▪ Consider using pre connected, sealed catheter-tubing junction.
• **Maintain unobstructed urine flow from bladder to drainage bag:** ▪ Avoid tube kinking ▪ Keep bag below bladder ▪ Empty bag regularly ▪ Separate collecting containers from each patient
• **Standard precautions for catheter and collecting system manipulation**

TABLE 1.8: CAUTI bundle

N	**NEED for catheter assessed:** Refer to indications, scan bladder, consider alternative, document reason.
O	**OBTAIN** patient consent, **OFFER** patient education.
C	**COMPETENCY:** Clinicians who insert catheters must have documented competency.
A	**ASEPSIS:** Maintain asepsis during insertion and while catheter is in place.
U	**UNOBSTRUCTED flow:** No kinks or loops, catheter secured, bag below bladder level and off the floor.
T	**TIMELY catheter removal and documentation:** Nurse initiated (refer to guidelines)
I	**INFECTION RISK:** Collect urine specimen only when clinically indicated.

GENERAL RECOMMENDATIONS FOR INFECTION CONTROL IN CRITICAL CARE UNIT

Hand Hygiene

- Personnel should adhere to strict hand washing between all patient contacts and as when otherwise indicated.
- Washing facility should be provided at convenient locations throughout the CCU and in each of its isolation room.
- Antiseptics such as Hibiscrub, sterillium or any other agent as per protocol should be made available for hand washing.

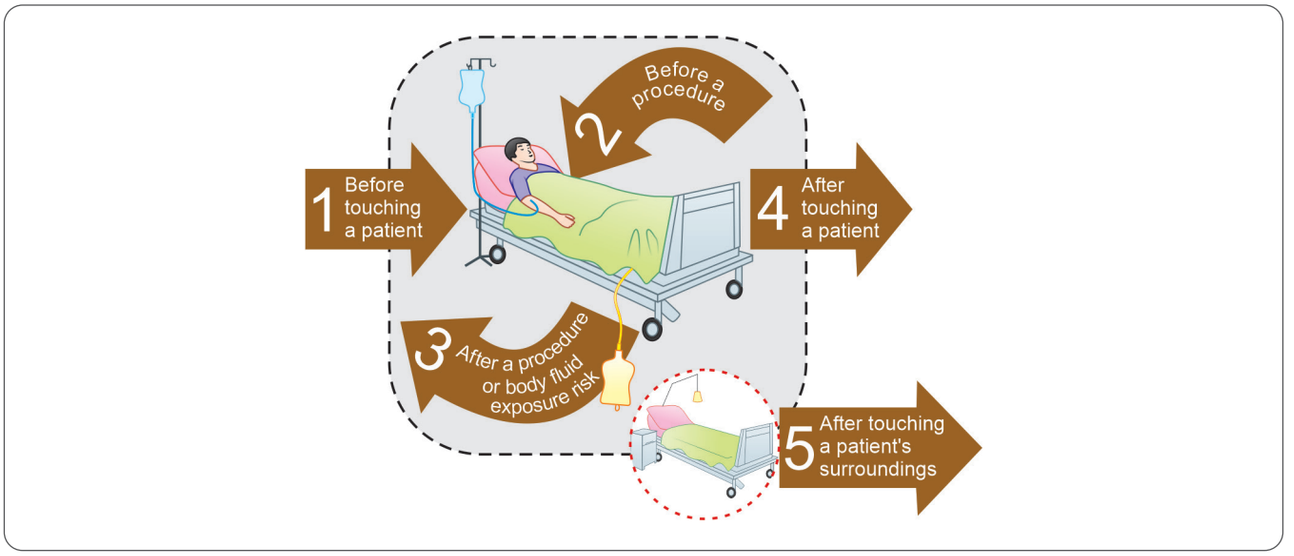


Fig. 1.14: Five moments of hand hygiene

- Gloves should be worn for high-risk patient contacts.
- Five moments of hand hygiene are shown in Figure 1.14.

Patient Related

- **Spacing patients:**
  - Sufficient space should be provided around each patient for equipment and for the passage of personnel to decrease the likelihood of infection transmission by direct contact.
  - There should be adequate ventilation and air-conditioned with adequate exhaust fans wherever needed.
- **Isolation in intensive care unit:** Appropriate isolation facilities should be available in CCU if infected patients requiring isolation are admitted to these units. However, quality of care should not be compromised because of isolation.
- **Aseptic technique:** There should be adequate preparation of the patient's skin for emergency procedures such as insertion of intravenous and urinary catheters, cannulas, tracheostomies, Swan Ganz catheters, central venous pressure lines, monitoring devices, not-withstanding the urgency with which many of these procedures are carried out.
- **Proper clothing:** Complete attire with a clean gown, cap, and shoes, should be worn by all individuals working in the units. There should be changing rooms in the unit to practice this effectively.
- **Visiting:** Visiting privileges to seriously ill patients in the CCU is to be determined as a policy and limited, as the traffic in this area should be kept to a minimum. It is preferred to limit visiting to a specified length to time and to limit the total number of visitors to a level consistent with efficient operation of the CCU.

Cleaning

Standard operational procedure pertaining to cleaning practices should be written and strictly adhered to because of the high probability of environmental contamination in the CCU.

Cleaning as a Routine

- All horizontal surfaces should be washed down daily and as needed with soap and water first and an approved germicidal solution.
- Floor should be cleaned daily and as needed using a wet vacuum and an appropriate germicidal solution.
- When disposable mops are used, they should be disposed and if non-disposable mops are used, they should be bagged separately after use and sent to laundry. A fresh batch of germicidal solution should be used for each mopping.
- Dry dusting and cleaning should be avoided.
- Use double bucket technique for wet mopping. In this technique, soiled water is not wrung into the solution used for mopping but is held in separate bucket. Redistribution of soil is minimized because soiled water is not added to the floor via the mop.
- All spills of blood and blood products, exudates and other body fluids should be wiped up immediately using a germicidal solution.

Cleaning of Fixtures, Sinks and Closets

- Hand washing facilities, service sinks, bathroom fixtures, bedpan flushers and dirty utility rooms should be thoroughly cleaned daily or multiple times.
- Blood clots, blood and blood products provide an excellent medium for growth of microorganisms and should not be left without cleaning.

Cleaning of Patient Rooms

Concurrent cleaning of the room should be conducted as a routine using approved technique and germicidal solution.

Terminal Cleaning

- All floors should be wet vacuumed after removing all used articles from the room. Floor should be mopped using double bucket technique using an approved germicidal solution. Walls are cleaned with a germicidal solution after being washed with soap and water.
- All horizontal surface including bed frames, stands, chairs should be washed. All pieces of equipment and any fomites that cannot be cleaned should be sent to central sterile supply department. Use double bagging technique for contaminated articles.
- All equipment used, should be washed and disinfected using appropriate germicidal solution.
- Curtains should be changed when the room is terminally cleaned. Cubicle curtains in critical care areas should be laundered on a regular basis.
- Regular thorough cleaning of the unit should be planned and carried out during the lean periods of occupancy.
- Surveillance is the responsibility of all personnel who care for the hospitalized patient. Personnel who are engaged in routine patient care must practice routine surveillance on their patients. Certain conditions and treatment may cause some patients to be more susceptible to nosocomial infections. Patients who are immunocompromised and with lowered defense mechanism are vulnerable thus, meticulous care should be taken.
- Patients, who are receiving intravenous therapy, hyper-alimentation, indwelling Foley's catheter care, antibiotic steroids or anti neoplastic drugs should be carefully observed for signs and symptoms of infection.
- The observance of correct shelf life of hospital sterilized items
- Routine checking for the sustained integrity of prepackaged, pre sterilized items.
- Decontamination, disinfection and sterilization practices.
- The proper management of infectious waste on all wards.

Environmental Sampling (Culturing)

Routine environmental microbiological sampling can play an important role epidemiologically in the following:

- Investigations of particular problems within the hospital such as an outbreak of infection.
- Microbiologic sampling of personnel is appropriate when there is evidence of exogenous source in outbreaks of infection such as staphylococcal, streptococcal and salmonella. Nosocomial spread of gram-negative bacilli such as klebsiella, proteus or Pseudomonas is also detected by personal sampling. Nose or throat culture in personal, when indicated. Sampling may serve as a useful tool for education, training and research.

Specific Indications for Routine Microbiologic Sampling

Routine microbiologic sampling is appropriate in specific instances as for equipment such as sterilizers which should be microbiologically monitored. Clinical surveillance may provide epidemiological evidence associating particular pieces of medical equipment with specific infections in patients, such equipment, should be monitored by microbiologic culturing periodically.

RISK OF NOSOCOMIAL INFECTIONS IN CRITICAL CARE UNIT

Any patient who enters the hospital and requires certain procedures may be susceptible to acquiring in nosocomial infection. When these procedures are carried out with the utmost care and with infection control in mind and if the patient is not immunocompromised, the risk of infections is minimized. The procedures that may increase the risk of nosocomial infection in a critical care unit are:

Intravenous Therapy

Intravenous therapy is an integral part of patient care especially in seriously ill patients. An IV system offers a ready means of direct access to patient's vascular system for hemodynamic monitoring and administration of fluid and medications.

IV systems also provide a potential route for microorganisms to enter the vascular system by passing normal defense mechanisms

These organisms can cause serious infection if they are allowed to enter and proliferate in the IV cannula, wound or IV fluid. Thus, IV therapy is a potential source of nosocomial infection, which can even result in serious illness, or death for hospitalized patients. During IV infusion therapy, strict aseptic technique should be followed during all stages of the procedures. Cannulas and IV infusion sets should be changed every 48–72 hours in long-term use.

- **Heparin locks:** Heparin locks are frequently used for prolonged regular administration of medication. The injection site should be thoroughly cleaned. Blood allowed to remain in the tubing for any length of time, can provide an ideal breeding place for microorganisms. The site should be changed every 72 hours. Faulty or inadequate care of heparin locks needles could lead to many problems.
- **IV infusion pumps:** These are devices for automatically delivering IV fluids at a pre-selected flow rate. The use of IV infusion pumps is increasing in critical care units. The number of tubing's connections that the pump requires increases the possibility of contamination and subsequent infection. Pumps must be thoroughly cleaned on all surfaces between each patient use.

Total Parenteral Nutrition (Hyperalimentation)

Total parenteral nutrition is a therapeutic procedure whereby the total body nutritional and fluid requirements are supplied intravenously. Because of the presence of a direct route into the vascular system, there is potential complication of sepsis. Practicing strict infection control measures at all stages of administration can reduce the risk of infection.

Wound Care

Surgical dressing: The dressing serves to protect the wound against contamination. If not carried out aseptically, it can itself be a source of infection.

Invasive Pressure Monitoring

Invasive pressure monitoring devices are increasingly being used in the care of critically ill patients when direct measurement of certain physiological pressures is essential. Infection is the main disadvantage observed in pressure monitoring devices. Infection at the site of the arterial catheter placement is more common when a surgical cut down is used for placement of the monitoring catheter and the risk of developing a local infection of the catheter site is very high. The risk of septicemia from such infection has also remained high.

To prevent infection, the tracheostomy site should be cleaned and the inner cannula is changed using aseptic technique while disposable portex tracheostomy. Inner cannula need not be changed but whole set to be changed every 3–4 days.

Common Causes of Infection in Invasive Pressure Monitoring Devices

- Contamination of transducer.
- Local infection at the site of an indwelling catheter.
- Resterilization of disposable transducer.
- Contamination of the inter space between the transducer surface and protective closure membrane.
- Contamination of the stopcocks and sampling ports.

Tracheostomy Care

The patient with tracheostomy is at a risk for acquiring an infection because the tracheostomy establishes a direct line of communication between the environment and broncho pulmonary tree. The normal upper respiratory passage is bypassed and it leaves a higher chance of respiratory infection. Inspired air is normally humidified whereas on tracheostomy it is dry and irritates the mucosa resulting in pulmonary impairment. Added to this, the usual impaired immune status of the critically ill patient makes him vulnerable to infections.

Suctioning

This is one procedure done for patients on tracheostomy, mechanical ventilation or airway obstruction.

The following infection control measures to be followed while doing suctioning:

- Sterile saline solution is used for tracheal lavage and clearing the tubes.
- Separate catheters should be used for tracheal suctioning/oral and nasal suctioning.
- Suction bottle should be changed every 12 hours or more frequently.
- Suction bottle should be washed and re-sterilized before reuse.
- Portable suction should have an exhausted filter.
- Washing hands and following aseptic technique is mandatory during procedure.
- Tracheostomy and ET tube suctioning catheters to be sterilized or discarded after each use.
- Sterile gloves to be worn while suctioning.

Catheterization

The urinary tract is the most common site of nosocomial infection mostly due to urinary tract instrumentation such as catheterization. No patient should be catheterized unless it is absolutely necessary.

Meticulous aseptic technique should be followed while doing catheterization and while on indwelling catheter is required for a long time. A closed drainage system should be maintained at all times. The distal end of catheter and proximal end of drainage tube are most common sites of entry for ascending urinary tract infection.

Paying attention to certain factors that give rise to urinary tract infection can minimize the risk of infection:

- Faulty techniques in which pathogenic organisms are introduced into the bladder as the catheter is inserted.
- Trauma to the urethral mucosa by forceful insertion of catheter or inflating of balloon when it is still in urethra or removal of catheter without deflating balloon can result in infection as well as serious injury.
- Prolonged use of indwelling catheter coupled with inadequate care of it can result in infection.

Procedures for Collecting Specimens for Culture

Blood culture, urine culture, sputum culture, cerebrospinal fluid culture are the usual ones carried out in a critical care unit. Strict aseptic technique is mandatory in carrying out these procedures. Specimen should be sent to the laboratory without any delay. The nurse working in the critical care unit must be conscientious at all times about the risk of infections and practice and simple rules of aseptic technique to reduce infection.

Compliance to hand washing standards on average is only 11–40% for nurses, residents and attending physician. **Hand washing is the single most important procedure for preventing the transmission of disease.** Nosocomial infection or chain of events and chain of transmission are shown in Figures 1.15 and 1.16.

Infection Control—Other Steps

- Use private rooms
- Dedicated equipment for each patient
- Minimize in-room expendable supplies
- Monitor caregiver's compliance
- This process involves:
  - Implementing ICU model of care
  - Daily rounds and daily goals

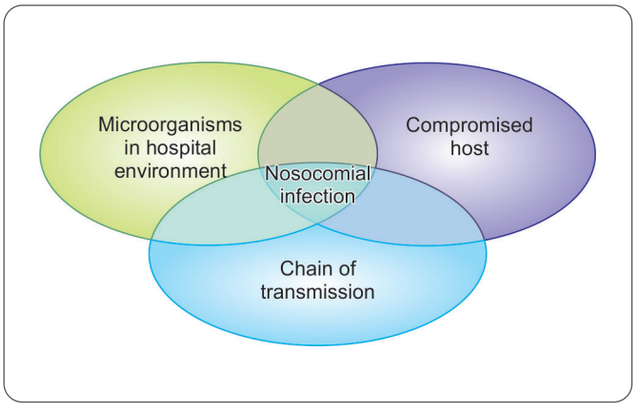


Fig. 1.15: Nosocomial infection—chain of events

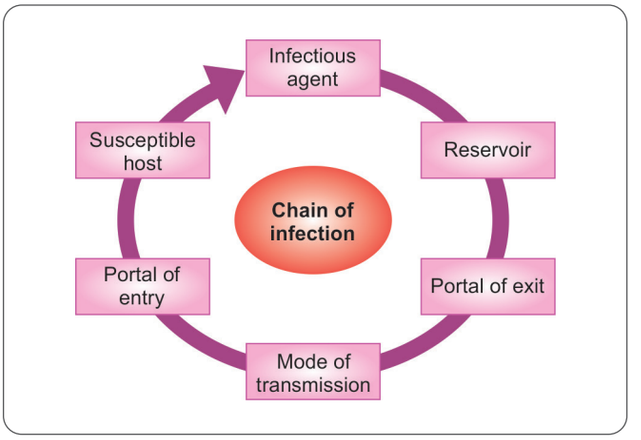


Fig. 1.16: Chain of transmission

  - Use of care Bundles
  - Formation of rapid response team
- Implementation of this process to improve length of stay, ICU mortality and overall hospital mortality.
- Targeting Zero infection rate, toward eliminating Hospital-Acquired Infections
- Infections contracted during a hospital stay are a significant cause of death across the world.
- Bacteria lurking on a medical device, bed rail, a bandage or a caregiver's hands find their way into a patient's body via a surgical wound, a catheter, a ventilator, or some invasive procedure resulting in a serious infection.
- IHI has targeted on reducing the Hospital acquired infections. All of which according to CDC, account for an estimated 50 percent of all HAI-related deaths.
- Despite the efforts to comply with the standards for prevention, control and investigation of HAI, the number of infections remains unacceptably high.

The Thought Forward

- Which is the most populated country after China?
- Which country is home to the most dreaded microbial infections?
- Where are critical patients admitted in anticipation of best care and vigilance?
- Why is there an upward trend in morbidity and mortality rates in ICU despite the topnotch facilities and personnel at our disposal?
- Could it happen in my organization? How do we do it?

CENTRAL VENOUS CATHETER

- Increasing use in ICUs
- Serving a vital role in the management of critically ill patients.

- Approximately, 48% of all ICU patients have CVCs at some point during their hospital stay.
- CVCs disrupt the integrity of the skin, leading to a portal for pathogen entry and subsequent CVC related BSI.

Indications for CVC Placement
- Rapid delivery of pharmacotherapeutic drugs or compounds
- Volume resuscitation
- Hemodynamic instability/need for monitoring
- Lack of sustainable peripheral access
- Dialysis therapy
- Long-term parenteral nutrition

Placement of a central venous catheter solely for ease of phlebotomy in a patient with adequate peripheral veins is strongly discouraged.

CVC Criteria

Patient with CVC has at least one of the following signs or symptoms: Fever, chills, or hypotension and at least one of the following:

Risk for BSI during the process of CVC Care:
a. Central vein >>> Peripheral vein
b. Femoral >>> IJ > Subclavian

- Common skin contaminant and is cultured from two or more blood cultures drawn on separate occasions
- Common skin contaminant is cultured from at least one blood culture from a patient with CVC
- The Physician institutes appropriate antimicrobial therapy
- Signs and symptoms and positive laboratory results are not related to an infection at another site.

CVC Care

- **Patient positioning:**
  - Occasionally overlooked
  - Ensure patient is both comfortable and lying flat (or in slight Trendelenburg).
  - Consider sedation and analgesia issues before starting the procedure.
  - Several other steps can also optimize a provider's performance: Adjusting the bed height, turning on all the lights, and handing off pagers.
- **Hair removal:**
  - If hair must be removed prior to line insertion, clipping is recommended.
  - Shaving is not appropriate because razors cause local skin abrasions that subsequently increase the risk for infection.
- **Skin prep: Chlorhexidine**
  - Used as an antiseptic
  - Provides better skin antisepsis than other agents (e.g., Povidone-iodine)
  - Use during CVC insertion
  - Must allow time for solution to dry
  - In neonates under 30 days old, a lower concentration of Chlorhexidine (0.5% as compared with 1–2%) should be used.
- **Maximal barrier precautions:**
  - CVCs should always be placed using maximal barrier precautions
  - Maximal barrier precautions are also recommended for any guide wire exchanges
  - **Prophylactic antibiotics:** Prophylactic treatment prior to CVC insertion is not recommended. Prophylaxis with intravenous vancomycin or any other suitable agent during CVC insertion did not reduce the incidence of CVC-related infections. Use of antimicrobial ointments not recommended
- **Antibiotic/antiseptic-impregnated catheters:** Antiseptic/antibiotic impregnated CVCs can significantly reduces BSI at least in catheters remaining in place up to 30 days.
  - Several types are available:
    - Rifampin-minocycline
    - Chlorhexidine-silver sulfadiazine
  - Experts recommend using antibiotic impregnated catheters only if the infection rate remains high
  - Despite adherence to other proven strategies, minimize multiple attempts and distractions
  - Catheter site dressing
    - No routine change
    - However, if blood is oozing from the catheter insertion site, absorbent gauze dressing is preferred.
    - Dressing should always be changed if it is loosened, or soiled.
- **Manipulating and accessing lines**
  - Excessive manipulation increases the risk for CVC related BSI.
  - Limit the number of times a line is accessed
  - Perform non-emergent blood draws at scheduled times prior to accessing any line
  - Hand hygiene
  - Wear gloves
  - Sterilize with an alcohol swab (friction is key)
  - Pay keen attention to the potential for touch contamination when accessing a hub.
- **Catheter removal and replacement**
  - Daily review.
  - Prevents unnecessary delays in removing lines.
  - Inspection of the site for signs of a possible infection.
  - If purulence is ever noticed at the insertion site, remove the catheter immediately.
  - Placement of a new catheter over a guide wire in the presence of bacteremia is unacceptable.

- Replacing catheters at scheduled time intervals does not reduce rates of CVC-related bacteremia.

CVC Removal

Exposes patients to risk of air embolus:

- Patient should lie flat.
- Instruct patient to take in a deep breath, and then pull the line when the patient exhales.
- Apply firm pressure to the site for at least 5–10 minutes, longer if the patient has an underlying bleeding tendency.

- Surveillance for CVC-Related BSI
- Building a collaboration

CRBSI Prevention Bundle

- Hand hygiene
- Maximal barrier precautions upon insertion
- Chlorhexidine skin antisepsis
- Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters
- Daily review of line necessity with prompt removal of unnecessary lines

MUST KNOW

- CVC insertion is a **'Doctor Phase'** while daily CVC maintenance is seen as a **'Nursing Phase.'**
- Teamwork and shared responsibility is essential for infection reduction.
- Knowledge alone is not sufficient for changing behavior—you must also take the necessary actions.
- If you have any questions about something in the ICU, ask someone.
- If you have suggestions to improve care in the ICU, speak up.
- Scheduled time intervals do not reduce rates of CVC-related bacteremia.
- Nosocomial infections carry significant mortality and morbidity risks particularly when it affects the patients in critical care units.
- The ICU environment is more conducive for harboring of pathogenic bacteria and hence, the possibility of infection. Nosocomial pneumonia is most common out of which the commonest being VAP.
- Intravascular catheter associated blood stream infection and Urinary catheter associated infections are the most common ones in critical Care Units.
- The risk factors, diagnosis, treatment and prevention are described under each of the infections. The bundles which are the grouping of preventive and treatment modalities are explained at the end of the chapter. The role of the nurse is very crucial in prevention and management of these infections.

ASSESS YOURSELF

1. Describe nosocomial infection in critical care units
2. Write short notes on:
   - Infection control in CCU
   - Ventilator associated pneumonia
   - Catheter related blood stream infection
   - Catheter related urinary infection
   - CRBSI prevention bundle

CRITICAL THINKING SKILLS

A 40-year-old woman with history of asthma reported to ER with shortness of breath, tachypnea and audible wheezing. She had no relief with prescribed inhaler so she was shifted to medical ICU. On admission, she appears anxious, fearing of death, presents with tachycardia 110 bpm, RR 40/min, decreased breath sounds, with wheeze on inspiration and expiration. Oxygen saturation 85% on room air.

Q. 1. What should be the further management of this patient?

Q. 2. What should you include in the health education plan while being transferred out from ICU?

PSYCHOSOCIAL COMPONENTS OF CARE IN CRITICAL CARE UNITS

EMOTIONAL RESPONSE TO ILLNESS OF PATIENTS AND THEIR SIGNIFICANT OTHERS

Illness is an abnormal process in which any aspect of person's functioning is altered as compared to previous level, when an individual's hemodynamics is disturbed. His coping mechanisms also fail. There is considerable relationship between the emotional response to illness and adaptation.

Stress and Adaptation

Stress is defined as any adjective demand that requires an adaptive response. Stress is a condition in which the human system responds to changes in its normal balanced state. A stressor is anything that causes stress. As with stress the perception and effects of the stressor are holistic and highly individualized. Stressors are neither positive nor negative but rather have positive or negative effects as the person responds to change. Illness acts as a stressor.

Adaptation is the series of responses made by the individual in reaction to stressors. These responses are constant as the individual strives to maintain balance in both internal and external environment. The end results of adaptation are optimal functioning in all dimensions.

Stress and adaptation are major components in health and illness and strongly influence nursing care. Stress is manifested in different ways. The usual responses are:

Anxiety

Anxiety is defined as an uneasy feeling of impending danger. Anxiety is more of an alarm signal than a negative type of stress. **Illness** threatens one's source of wholeness, containment, security and control. The physiological and behavioral manifestations can be observed and they may vary from individual to individual and are familial and culturally learned. Lot of valuable energy is directed at it. It should be directed to eliminate the stressor. The goal of nursing care is to promote equilibrium, so that the energy could be utilized for healing and recovery.

In a study conducted by Mathew M, identifying the emotional factors experienced by patients in a surgical intensive care unit, it was found that 78% of them experienced anxiety. The anxiety level was more during first two days and increased again as the ICU stay prolonged.

It is not very easy to eliminate stress especially in a critical care unit when there is a **sense of inadequacy** about mere existence of life and it can result in anxiety. The nurse needs to explore the usual coping patterns and how well they can be used to eliminate the present stress. Patient needs to modify the existing coping patterns so that a homeostatic equilibrium is achieved. Nursing measures that reinforce a sense of control and autonomy can be tried wherever possible. Allowing small choices and participating them into the care goes a long way to reduce anxiety and to feel self-worth.

Another cause of anxiety for a patient in critical care unit is **social isolation** in the midst of a more socializing crowd of strangers. The sick person in a critical care unit cannot identify himself with the rest. The severity of the illness and fear of dying separate him from relatives. The efficiency and activity engulfing him increase his sense of separateness, as he lies isolated in his bed.

Thirdly, the **security of the patient** is questioned. Many people associate CCU stay with severity of illness and death of relatives and friends. But for the nurse it is a place where there is more vigilance for safety of life.

Coping with Anxiety

- **Positive thinking:** Patients are encouraged to think positively and verbalize the internal turmoil that is going on. He can be encouraged to talk to others or to speak accurately about himself. Allowing him to participate in decision making can reduce his sense of helplessness.
- **Relaxation and mental imagery:** These are useful techniques to help to reduce their tensions. In this process, patient is encouraged to imagine himself in a very pleasant experience. Technique, which induces deep muscle relaxation, can be used in decreasing the anxiety.

Anger

Anger is a strong emotional response characterized by feeling such as resentment, dislike, and feeling of vengeance when this is directed to the self it is labeled as guilt. Anger is the function of loss or grief. The relationship between loss and anger is well established. Breakdown of the denial defense mechanism is followed by a stage of anger. People who possess particular type of personality feel angry to themselves and others. They are perfectionists and time and efficiency oriented, when they are faced with inefficiency they explode with anger.

Depression

Depression is a stage of mourning marked by low self-esteem. It is a universal finding among patients in critical care units particularly when hospitalization is prolonged. In Mathew M's study in a surgical intensive care unit, it was found that 21.7% of patients were depressed. Depression is manifested as anorexia, or over eating, constipation, loss of initiative, decreased energy, lack of pleasure and overall pessimism. The patient should be allowed to grieve providing empathetic support.

Fear

Fear is induced in these patients in the critical care unit due to many factors. The very nature of the environment with its complicated machinery produces fear in the patients. It can be fear of the unknown, fear of death, fear of being attached to machines, and fear of being disconnected from the machine. All these can be reduced by an understanding nurse, who takes time to talk to, explain the progress and listen to the patient.

Denial

Denial is the refusal to accept the reality of a situation cognitively or affectively. It is the initial human response to loss. The loss may be actual or perceived. Rather than accepting the loss as real, they cope with their situation by denying the existence of loss. Denial can be positive coping response to a certain extent. But if the patient continues to deny it can result in fear and depression. Denial of a critically ill patient represents the flight mechanism. Engel reports that the person who responds to loss with feeling of hopelessness and despair are more prone to sudden death.

Denial may serve as the period when the patient's resources are blocked by shock and can be regrouped for the battle ahead. The principle of intervention consists of not stripping away the defense of denial but in supporting the patient and acknowledging the situation. The nurse should accept and recognize the patient's illness. She should communicate the acceptance through her tone of voice, facial expression and use of touch.

NURSING DIAGNOSIS AS APPLIED IN CRITICAL CARE UNIT RELATED TO PSYCHOSOCIAL COMPONENTS

Patients admitted in the intensive care unit (ICU) have life-threatening illnesses requiring a range of high-level interventions and the responses to that treatment can be unpredictable. Within this context of intensive care, the nursing contribution involves meticulous observation and skilled intervention, the provision of basic hygiene, nutrition and prevention of harm, as well as the provision of emotional and psychological support to both the patient and their families.

- Disturbances in body image related to illness.
- Social isolation related to therapeutic management.
- Sensory perceptual alteration related to therapeutic environment.
- Fear related to nature and outcome of illness.
- Anxiety related to outcome of illness and financial concerns
- Powerlessness related to loss of control and dependence on others and machines.
- Communication impaired.
- Coping ineffective-individual.

Common Psychological Problems in Critical Care Unit

- Stress
- Anger
- Depression
- Anxiety/fear
- Post traumatic stress disorder (PTSD)
- Delirium
- Helplessness and hopelessness
- Sleep patterns and sleep quality
- Low self-esteem
- Body image problem.

Nursing Interventions

Psychological Support and Information to Family

- Consider the needs of the patient's family.
- Establishes open communication with the patient and family.
- Familiarize the family with the physical surroundings of ICU.
- Informing the family of the visiting hours and visitation policies.
- Provide frequent progress reports about their patient's condition.
- Encourage family participation and involvement in patient care whenever the patient's condition allows through guiding and observing the family while participating in hygienic care, feeding.
- Arranges for visits proactively and encourage open visitation policies.

Communication Impaired

- Provide the patient with his or her eyeglasses or hearing aid (if applicable) before assessing the patient's ability to communicate.
- Complete explanations from staff members regarding any procedures to help decrease the patient's stress.
- The caregiver can use verbal and nonverbal communication skills.
- Nonverbal communication may include sign language, gestures, or lip reading.
- If the patient is unable to use these forms of nonverbal communication, helpful devices include pencil and paper, and picture or alphabet boards, use erasable marker board, etc.

Promote Comfort

- The nursing goal for meeting the patient's comfort needs depends on what comfort need the technician is addressing.
- Comfort needs include keeping the patient clean and dry, preventing urine scald and skin break down, seeing to the patient's mental well-being, performing range of motion exercises, assessing the patient for pain and providing proper pain management.
- It is imperative that the technician be observant of signs associated with pain. Individually these signs do not indicate pain, but collectively and given the patient recent history an assessment regarding pain should be rendered.
- Provide analgesia as appropriate, document efficacy after each dose.
- Administer sedation as indicated, if required.

Powerlessness/Hopelessness

- Allow the patient to express feelings and perceptions.
- Express hope to the patient with realistic comments about the patient's strengths and resources.
- Assist the patient determine aspects of life that are under his or her control.
- Allow the patient to assume responsibility for self-care, such as setting realistic goals, scheduling activities, and making independent decisions.
- Aid the patient determine aspects of life events that are not within his or her ability to control. Discuss feelings related with this lack of control.
- Encourage the patient to examine spiritual supports that may provide hope.
- Administer antidepressants as indicated.

Sensory and Perceptual Alteration

- Employ active listening
- Provide information
- Help clarify options
- Optimize identification and use of resources
- Regulate sensory stimulation
- Allow visiting as per CCU rules
- Return as much control of self and environment to the person as possible
- Employ relaxation techniques and mental imagery
- Use touch as a therapeutic device
- Optimize physiologic functioning
- Establish optimal and alternate methods of communication
- Reduce sensory overload
- Avoid sensory deprivation
- Orient them to time, place, date and day
- Encourage to experience diurnal variation
- Provide empathetic support

ADVERSE EFFECTS OF CRITICAL CARE UNITS ON PATIENTS

The environment of critical care unit is complex, life-threatening and alien to the patient. The depersonalization of the patient and staff with the ICU dress, use of all kinds of machines and jargons makes the environment vulnerable for the patient. The psychosocial support needed in the critical care units is more demanding than the physical and mechanical. Under such circumstances, the nurse needs to take up the role of a negotiator, to the needs of the patient. The most common adverse effects are:

- **Sensory overload:** The noise produced by the machines, alarms, clicks multiplied with indiscriminate talking and calling out for people all add sensory overload. The bright lights are on for 24 hours of the day without allowing for any diurnal variation. Physical planning can aim at soundproof unit. It is perhaps not feasible to control noise in the critical care units completely. But it is essential that nurses exert a conscious effort to reduce noise in such an environment. There can be dim and bright light and the later can be put off during occasions when it is not necessary to carry out any treatment and procedures especially during night.
- **Sensory deprivation:** It is variety of symptoms following a reduction in the quantity or the degree or structure or quality of sensory input. Behavioral changes are noted following exposure to sensory deprivation for varying length of time. They include presence of illusions, delusions, hallucinations, loss of sense of time and restlessness. Patients faced with difficulty in coping with illness have an increased susceptibility to severe responses of sensory deprivation. Use of touch as a means of communication can reduce sensory deprivation.
  A time away from the routines or while carrying out care well spent in talking can mean a lot to the patient. Use of clocks and calendars help orient them to date and time. A concern for creating an environment intended to diminish the effects of sensory deprivation should be developed in any critical care unit.

The following are the nursing diagnoses applicable for patients undergoing adverse effects in CCU:

- Social isolation related to therapeutic management.
- Sensory perceptual alteration related to therapeutic environment.
- Powerlessness related to loss of control and dependence on others and machines
- Communication impaired.

STRESS AMONG CRITICAL CARE NURSES

Nursing has been identified as a stressful occupation. Health Authorities 1988 report in the public sector included nursing as one of the four high stress occupations together with police, social works and teaching **(Roger D, Poppy N, 1993)**.

Critical care nursing involves excessive physical and emotional stress due to the very nature of the environment which is that of a closed one, isolated from the rest of the hospital. In a critical care unit, there is constant use of sophisticated machines and equipment amidst which a nurse is expected to work calmly and efficiently at all times.

Nurses encounter stress while facing death of patients in the critical care units who they have nursed carefully and they perceive this as a failure of their work. A sense of inadequacy prevails among nurses as they lack confidence in handling the patients and the equipment.

Stress is an imbalance between demand and the ability to cope with it. Stress response results when the individual fails to cope with a stimulus. **Shouk Smith** defined it as the body state of tension, which result from external or internal stressors. External or internal stressors trigger a stress response. External stressor is an environmental event such as disasters or being taken seriously ill very suddenly. Internal stressors are our own responses to wide range of events and situations.

The common stressors are threat of physical violence, changing work place, moving house, rows with partner, paying bills, sickness, separation and death.

One popular way of defining stress is to link it with life events. Life event scales are available which can be used to score stress. Life event scales are based on the assumption that there is a certain capacity for coping. But every event we experience requires adaptation or change. Each event thus makes a demand on our coping resource and as the number of event increases, the resource also diminishes, until eventually the demand exceeds the supply and then we suffer from stress. Stress is not determined by the event itself but by the way we respond to it. There are few events, which can be avoided or changed. On the other hand, one can change responses.

Voges et al identified following job stressors:

- **Stressors specific to the job or task:** These include such things as caring for the dying, violent, patients with multiple injuries, counseling the bereaved.
- **Role ambiguity:** This results from lack of job clarity and uncertainty about the range of task to be performed.
- **Role conflict:** Results from a series of incompatible demands made by the job.
- **Work load:** Caused by variations in the amount of work one has to do, for example, things happening too quickly or not having enough things to do.
- **Interpersonal relations:** Stress levels are high when there is poor interpersonal relationship.
- **Job conditions:** The physical nature of the work place, the type of organization, its rules and regulations, can produce stress.

To understand stress and to respond appropriately, we need to know about attention, emotion, detachment and communication.

Scaly studied nurses under stress (Roger D, Poppy N,. 1993). It was found that nurses under stress snap and argue with others, make other members of the staff as scapegoat, blame another shift nurse for the things that have gone wrong, be defensive with colleagues, adopt a busy behavior, show intolerance of others behavior or ideas, respond to others with dullness and silence.

A number of writers have noted the relevance of the social skill approach for nursing practice. As members of multidisciplinary team, the nurses often provide crucial link for many desperate approaches to treatment. They are also expected to develop skills which help them deal with the problems experienced by their patients and the families.

Additional demands are made because of the use of provider purchaser terminology which might make it difficult for nurses to speak enthusiastically about offering a high quality service when they are often constrained by limited resources. **In all these issues, stress and communication are extricable.** Stress causes poor communication and which in turn causes stress leading to a spiral of conflict that leaves everyone dissatisfied. Furthermore, communication is the medium through which stress is expressed.

A communication skill makes the emotion easier. The expression of emotion itself may be a coping mechanism. Mutual trust is the basis of good communication organizational problems that always revolves around poor communication and poor communication is both the cause and result of stress. When the communication is poor, the effects of low morale and dissatisfaction are evident.

'Relate': The essence of communication should be applied wherever necessary.

R : Recognition
E : Eye contact
L : Listening
A : Attitude
T : Turn
E : Expression

The notions **'Striking'** and **'Stroking'** capture the role of communication in stress. Striking is undesirable, who can increase the intensity of stress whereas stroking by way of positive criticism can ease the stress and improve the morale of the staff.

Personal skills in coping can develop so that emotional involvement is minimized and interpersonal skills can be applied which allow communication by feedback mechanism rather than criticism, thereby reducing stress. Feedback offers comments on work and not the person by which communication can be sustained and stress is avoided (Roger D, Poppy N, 1993).

As morale of staff, job satisfaction and communication skill improve the reduction stress. Symptoms of stress are the outward signs. The cause of stress a preoccupation with emotional upset and the outcome is not just the misery for ourselves but to everyone we come in contact. The body is provoked into the usual fight or flight response. The repeated elevation of adrenaline and cortisone and other hormones exert a continuous strain on the cardiovascular and immune function. It is this mechanism that explains how the stress is transformed into physical illness.

Effects of Stress

Behavioral

- **Short-term:** Overindulge in drugs, alcohol, smoking, accidents, impulsive behavior, poor relationship with others, poor work performance.
- **Long-term:** Marginal family breakdown, social isolation.

Physical

- **Short-term:** Headaches, backache, insomnia, indigestion, chest pain, nausea, dizziness, excessive sweating and trembling.
- **Long-term:** Heart disease, hypertension, ulcer, poor general health.

Emotional

- **Short-term:** Tiredness, anxiety, boredom, irritability, and depression, lack of concentration, low self-esteem apathy.
- **Long-terms:** Depression, neurosis, nervous breakdown, suicide.

Transference of Stress

Stress can be transferred between different groups. For example, when nurses are stressed, the patients and family get worried about the quality of care and make more demands in order to ease their stress which in turn makes the nurse more stressed. Thus, a vicious circle is created which can only have a negative contribution to patient's well-being.

Research on Stress

When scientists in Australia measured the crucial role of immune system, it was found that the lymphocytes are less responsive to antigens after exposure to prolonged stress. Stress and sickness rates were higher during staff shortage (Cop.) G. 1986.

Jo Ann Griff reported the result of a readership survey among nurses working in critical care units in USA which showed that the highest among all other reasons for leaving critical care areas was stress (33%) (Jo et al., 1988) documented shift schedule system as one of the major factors of causing stress and burn out among nurses. It was also found that the longer the time nurse had been on the shift the greater the job related stress.

James Goront (1980) in a comparative study found that ICU nurses were more stressed than even air traffic controllers.

Huckabay and Jagler (1979) revealed that physical work load, communication problem with doctors and administrators and death of the patients ranked as factors that are most stressful.

The data from stress audit (N-1800) of ICU nurses in USA (1980) indicated that inadequate staffing pattern, lack of support in dealing with death and dying, inadequate workspace and unresponsive nursing leadership as factors producing stress.

G. Foster (1972) found that nurses from critical care units showed significantly more depression irritability, resentment than non-ICU nurses.

N Ford and Seark (1988) demonstrated that nurses working in one of the critical care units expressed very little distress and showed high levels of job satisfaction contrary to the popular belief of increased levels of stress in critical care units.

Jaya Kuruvilla J (1990) in a study conducted by the author in critical care units of Christian Medical College and Hospital, Vellore, India, to identify stress among critical care units.

Factors Identified as Most Stressful

- Frequent power failure resulting in nonfunctioning of life saving device
- Blamed for failures of treatment and death of patient
- Lack of cooperation among staff
- Doctors decision of admit patient to CCU against policy of CCU
- Lack of adequate work space
- Frequent duty changes
- Disagreement with physician over patient care treatment

Critical Care nursing is most demanding. CCU is a real pressure cooker with the staff constantly coping with crisis. The work in critical care unit is not to everyone's taste which requires repetitive routines, attention to tiny details, sharp, quick and irreversible observation, high level of concentration and effective use of highly sophisticated equipment and all in a very limited amount of space with virtual obstacle of cords

and wires. This highly charged atmosphere is filled with succession of emergencies, frequent failures, and quick turnover of patients all conspire to make the atmosphere impersonal (Jo A G Al Pach1988).

Nurses are expected to treat a patient as a patient as a whole rather than an individual. A critically ill person is transfigured by his condition, his true personality is hidden behind the mask of his illness. The nurse in her enthusiasm to provide holistic care tries to humanize but is hindered by the invasion of high technology. Noise induced stress, as predictor of burnout in critical care nurses has also been documented. Personnel and patient's experience sensory overload of are seen in the critical care unit. The hissing of oxygen valves, beeping of the monitors and ventilators, bright lights and the unit personnel prodding and probing are common.

Junior medical staff works in a unit for a short period of time while nurses are permanently there and often resent doctors requesting alteration in usual treatment and procedures. At times, there are communication problems, nonavailability of doctors during critical intervention or lack of adequate response from them. The critical care unit has a high mortality compared to the general wards. But the medical profession is oriented toward preserving life. This paradox leads to a situation in which death is seen as a bitter defeat or failure after the hard struggle. Continuous close contact with a distressed frightened family can also drain a nurse's emotional battery at an alarming speed. To guide and support the grieving family during this process requires emotional strength on the part of the nurse.

Loneliness creeps in while caring for a patient for 6–8 hours where the patient doesn't give any feedback. This can cause intense frustration to the nurses. Nurses working in the general section regard CCU nurses as different and they feel isolated from the rest of the nurses. Nurses new to the critical care unit feel guilty when they discover that they have missed some vital detail or cannot operate sophisticated equipment. The depth of knowledge required for this field of nursing can be too demanding even for the experienced nurses. The jargon that is used confuses the new nurse. She has to learn a new language of Jargons.

Pressures of working continuously understaffed, physical and psychological strain of long work schedules, shift rotation, impact of job on the family life, lack of authority, dealing with poorly trained people, lack of cooperation, equipment, mechanical and electrical failure are some of the other factors resulting in stress.

Measures to Combat Stress in Critical Care Units

In most of the studies, stress appears to be more common in younger, less experienced and low ranking nurses who spend more time with patients. This brings for the necessity of positive ways to help the younger nurses to cope with stress. Individual differences such as education, past experience, culture and personality type also play a key role in determining stress response.

Attention control, detachment and communication skills are used in stress management.

Stress management is not about pretending it is not there. It is there. It hasn't changed but one's perception can be changed and the aim of stress management is to bring this point of resolution.

Our perception to the situation has to be changed. Emotion is a human response, which is so damaging if it has to go on dwelling trying to anticipate the future or rewrite the past.

Relaxation routine will cause less fatigue, headache and more relaxed attitude.

Relaxation plays a prominent role in stress management program. It allows the body to switch back to the natural state. At the same time one should not exaggerate the effect of relaxation, which is short lived. Tension of the body is created by the attitude of the mind. As long as the attitude of the mind remains in place the tension also will return. Thus, the effect of relaxation is palliative.

Nurses must be educated to suggest reduction of stressors and setting realistic views of tasks in relation to the self. Social support refers to a group of people available who can be approached when one experiences stress.

Counseling can get into the real issue of stress.

In a survey done among 61-community psychiatry nurses, 81% responded that peer group support is an effective way of stress management.

While in-depth counseling requires the services of a professional counselor, there is also room for informed counseling from individuals who have learned basic counseling techniques. Workshop can orient nurses to learn the methods and skills, which are necessary to deal with stress as relaxation techniques and yoga.

Other Solutions Proposed

- Ensure that nursing staff have time for breaks and meals, preferably together which can enhance staff morale.
- Provide more time off to minimize the effect of stress.
- Provide paid mental health days' vacation and sabbaticals.
- Lower nurse patient ratio to safe and reasonable level.
- Provide sufficient number of competent staff at each shift.
- Treat nurses with respect accorded to other health professionals.
- Discourage pressurizing the staff to work on their off days.

- Incorporate critical care nursing in basic nursing program.
- Provide orientation and on the job educational program.

CCU nurses should talk to the patients even if they are not getting any response.

This will help them to:

- Empathize with patients
- Release their own emotions/stress
- Create a lively atmosphere.

SUMMARY

The psychosocial components of critical care nursing are divided into patients and their significant others and the nursing staff working in critical care units. Adverse effects of critical care unit on patients are discussed separately. Measures to combat stress both in patients and nursing staff are given adequate attention.

MUST KNOW

- Stress is identified as an integral part of critical care units mainly due to the very nature of the complex and fear of prognosis of the illness with which patient is admitted.
- The common emotional responses to critical Illness are Anxiety, Anger, Depression, Fear, and Denial.
- The measures to cope up with anxiety are explained in detail.
- Nursing Diagnosis applicable for the psychological responses of ICU patients listed also with the appropriate Nursing interventions.
- The major adverse effects of Critical care units on patients are sensory overload and sensory deprivation. Stress among nurses is a common feature in any critical care units.
- The effects of stress are behavioral, physical, and emotional. Measures to combat stress are explained in detail.
- It is necessary for management to create a conducive environment for nurses to work while taking care of the stress and emotional responses to critical illness and hospitalization.

ASSESS YOURSELF

1. Discuss the psychosocial components of critical care nursing.
2. Discuss stress among nurses working in critical care units.
3. Write short notes on:
   - Emotional response to illness
   - Coping with anxiety
   - Adverse effects of CCU on patients
   - Stress and Burnout among health care members
   - Effects of stress
   - Measures to combat stress in CCU
   - Sensory overload
   - Sensory deprivation

CRITICAL THINKING SKILLS

Patient has malignancy for which he has received the first cycle of chemotherapy. Following the chemotherapy, the white cell count remained low for a prolonged period. During this period, he develops sepsis with ARDS and needs mechanical ventilation. He has developed pneumothorax on ventilation and his ARDS does not seem to be recovering. Patient was married about a year ago and has a one-month-old baby. His mother is a medical practitioner who had lost her husband 15 years ago in a motor vehicle accident. Her daughter had a severe head injury in the accident and is on therapy for seizures. Patient also had multiple fractures. Following the accident he had recovered after multiple hospitalizations. Patient's mother wants all therapy to be carried on. Discuss how the mother will cope with this situation.

NURSING PROCESS IN CRITICAL CARE UNIT

Nursing process is a deliberate problem solving approach to the health care and nursing needs of patients. It is a data collecting, decision making process that incorporates evaluation and subsequent modification as feedback mechanisms that promote the ultimate resolution of the patient's nursing diagnosis. American Association of Nursing Diagnosis defined nursing process as the diagnosis and treatment of human responses to actual or potential health problems. It is the application of scientific problem solving to nursing care, which is used to identify patient's problems to systematically plan, to implement nursing care and to evaluate the results of care.

Use of care plan provides scientific systematic basis for nursing care in all health care setting. ***So there is much more in critical care set up as the needs and problems are complex. In critical care unit for making the use of suitable care plan, combination of two models such as Maslow's Hierarchy of needs and Roy's Adaptation model were found effective.***

MASLOW'S HIERARCHY OF NEEDS

Abraham Maslow divided the human needs into physical and psychosocial needs. Maslow defined five levels of needs, physiological well-being, physical safety, affection, love and relationship, self-esteem and self-actualization. Basic human needs are met or unmet in many ways. Lower level needs always remain but because there is a reduction in need tension, the person is able to move to higher level needs (Fig. 1.17).

A person's pursuit of higher level needs indicates that he is moving toward psychological health and well-being. Such a hierarchy of needs is a useful organizational framework for assessment of patient's strengths, limitations and need for nursing interventions. It is applicable in assessing, diagnosing, planning, implementing and evaluating patient care.

Kalish's Expanded Hierarchy

In an expansion of Maslow's model, Kalish restructured the first two levels of Maslow's pyramid (physiological and safety/security needs) into three levels and identified more specific subcategories (Fig. 1.18).

The base level is labeled survival, the second level stimulation, and the third level safety. The refinement of these subcategories can further assist the nurse in identifying the priorities for planning client care. It includes the understanding and acceptance of others about both giving and receiving love and feeling of belonging to others, friends, peers and families, neighborhood and communities. When the needs are not met, they feel lonely and isolated. They may withdraw physically and emotionally or they may become overly demanding and critical. These behaviors are a cue that unmet needs are present. Nurses should consider these needs while planning care for a patient especially in critical care unit where the visitors are not allowed to enter including family and friends in the care of patients is a challenge for a critical care nurse. Establishing a nurse client relationship based on mutual understanding, trust, communication and respect for privacy is of utmost importance.

Self-Esteem Needs

The next highest priority on the hierarchy is self-esteem, the need to feel good about oneself, to feel proud and a sense of accomplishment. Self-esteem gives the individual confidence and independence. Self-esteem is affected by many factors when a person's role changes such as loss of job position. It can be seriously affected because responsibilities and relationships have also changed. Other factor which may affect self-esteem

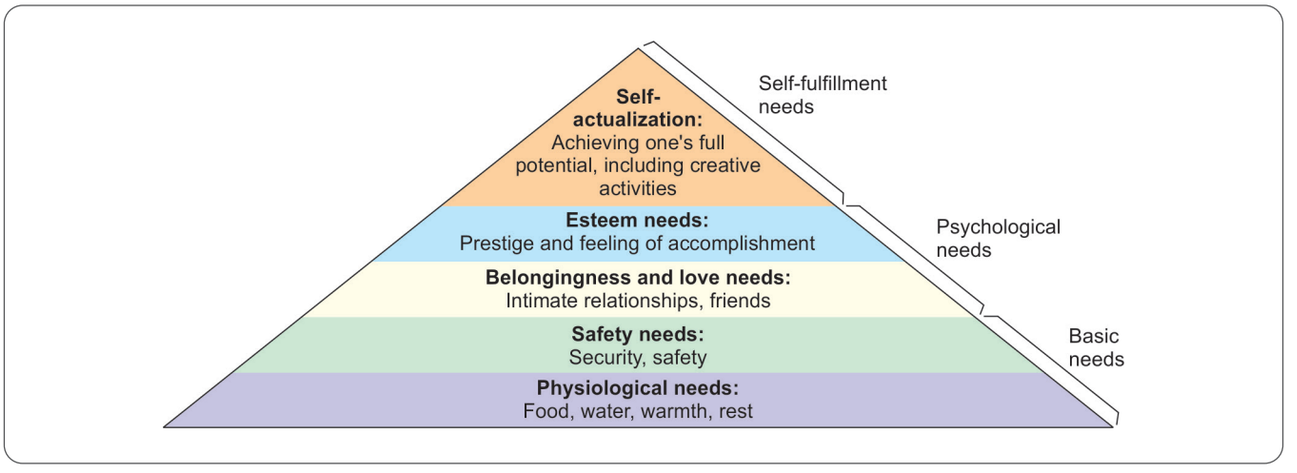


Fig. 1.17: Maslotw's law of needs

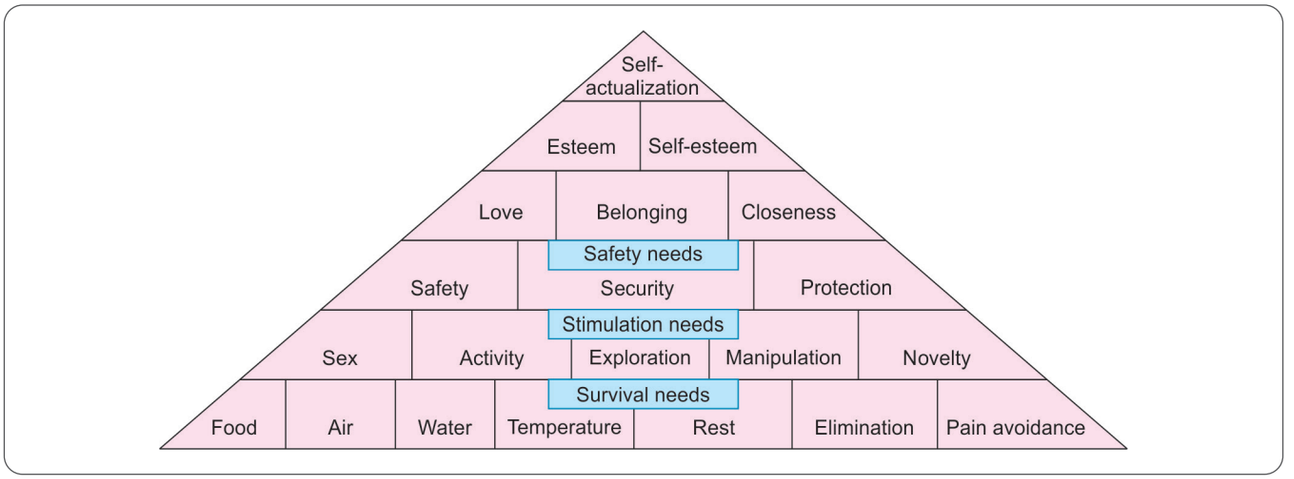


Fig. 1.18: Kalish's expanded hierarchy

is body image. Nurses can meet client's self-esteem needs by accepting values and beliefs encouraging clients to set attainable goals and facilitating family support.

Self-Actualization

Maslow estimated that only 1% reach self-actualization. It is the need to reach one's potential through full development of one's unique capabilities. The process of self-actualization is one that continues throughout life.

Maslow lists following qualities when one achieves self-actualization:

- Acceptance of self and others
- Focus of interest on problems outside or self-ability to be objective.
- Feeling of happiness and affection for others.
- Respect for all persons.
- Ability to discriminate between good and evil

To meet this need, the nurse must focus on strength and possibilities rather than on problems. Nursing interventions are aimed at caring for the total person providing a sense of direction and hope and teaching aimed at maximizing them.

Applying Maslow's Theory

The Hierarchy of basic needs allows the nurse to place the client on the health illness continuum and to incorporate the health models in meeting the needs in critical care units, as in any other health care set up.

Maslow's Hierarchy of needs is applicable in assessing and implementing and evaluating client care. Several nursing diagnosis can be formulated on basic level of needs. It provides route to holistic care.

It can be used with all ages, in all health care setting and in both health and illness. As the nurse identifies and carries out interventions to meet needs, he or she must remember that this is only a framework or guideline and that in actuality, each individual persons sets priorities and meets needs that are most important to that person. Basic human needs are related and may require nursing actions at more than one level at a given time. In a critical care unit, patient is forced to rely much on the nurses to meet even the basic needs. The nurse whose responsibility is to help the patient meet his needs and resolve his problems must recognize the fact that some problems can be neither eliminated nor solved. In relation to such a patient, the nurse's role is to help him to make mature objective, compensatory, mechanisms for the continued existence.

ROY'S ADAPTATION MODEL

Sister Callista Roy first published her conceptual model of adaptation in the 1970's (Fig. 1.19). The focus of Roy's model is the set of processes by which a person adapts in a clarified bio psychosocial system in constant interaction with a changing environment. When the demands of environmental stimuli

Fig. 1.19: Sister Callista Roy

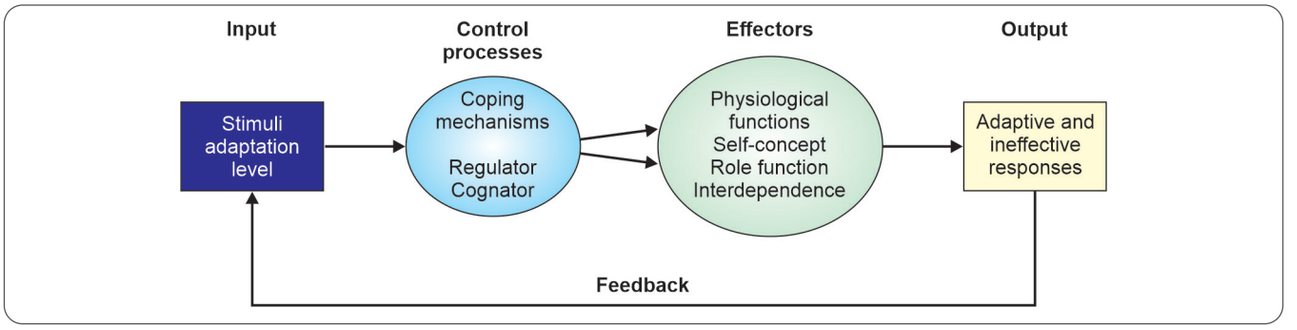


Fig. 1.20: Roy's adaptation model

are too great or the person's adaptive mechanism are too low, the person's behavioral responses are ineffective for coping.

- Roy (1984) views the **person's adaptive system** that functions as a whole through interdependence of its parts (Fig. 1.20).
- The system consists of input, control processes output and feedback.
- **Inputs are stimuli** from the external environment and the internal self-including information from the regulatory mechanism.

Roy describes two basic internal processes used in adaptation, the regulator subsystem and the cognator system.

- **Output is the adaptive and ineffective behavioral responses of the person. Feedback is information regarding the behavioral responses** that is conveyed as input in the system. Stressors called stimuli affect each person. The person's ability to adapt to changing stimuli is determined by the person's adaptation level.
- **The regulator subsystem** receives and processes changing stimuli from the external environment and the internal self through neural chemical endocrine channels. It produces automatic unconscious reactions on target organs or tissues.

The regulator and cognator subsystems produce behavioral responses in four effector modes:

- Physiological
- Self-concept
- Role function
- Interdependence

- **The cognator subsystem** receives varying internal and external stimuli involving psychological and social factors. Physical and physiological factors include bodily responses from the system.

Health is defined as a state or process of facing and becoming an integrated and whole person (Roy 1984). Through adaptation, the person's energy is freed from ineffective coping attempts and can be used to promote integrity healing and enhance health of integrity.

Nursing is considered as the science and practice of promoting adaptation for holistic functioning of person through application of the nursing process. Nursing aims to increase the person's adaptive responses by decreasing the energy needed to cope in a given situation so that there is more energy for other human processes.

Application of Roy's Adaptation Model in Nursing Process

Roy's model of the Nursing Process has two levels of assessment. In the first level assessment, the nurse assesses the person's adaptive and ineffective behavior in each of the four modes.

1. The physiological mode includes oxygenation, nutrition, elimination, activity and rest, skin, integrity, the senses, fluids, electrolytes, neurological and endocrine function.
2. The psychosocial adaptive mode includes self-concept, role function and interdependence. Self-concept mode consists of the individual feelings and beliefs at a given point in time. This mode includes psycho integrity, physical self, personal self, self-consistency, self-concept and self-esteem.

After assessing the problems concerning these modes, the nurse proceeds to assessment of second level which includes determining the focal, contextual and residual stimuli which contribute to the ineffective or adaptive behavior.

3. The third mode is role function, which includes role position, role performance, and social integrity instrumental and expressive behavior.
4. The fourth mode focuses on ability to love, respect and value others. This includes nurturing significant others and support system patient may present with problems concerning each of these modes.

Environment includes internal and external stimuli which are focal, contextual and residual stimuli. Environmental stimuli include all conditions, circumstances, and influences surrounding and affecting the development and behavior of the person.

- The focal stimuli **are those immediately confronting the person.**
- Contextual stimuli **are the stimuli present within the person or the environment.**
- Residual stimuli **are beliefs, attitudes or traits that have an effect on the person's present situation.**

Roy's Model views the person as an adaptive system that responds to internal and external environmental stimuli in four adaptive modes, physiological, self-concept, role function and interdependence. Nursing promotes person's adaptation level by manipulating the environmental stimuli to reduce ineffective responses and enhance adaptive responses. Roy's model encompasses bio-psychosocial factors and as broad enough to apply any individual in all components of the nursing process (Figs 1.21 and 1.22).

It is an excellent tool for assessing and analyzing the client's health pattern and identifying nursing diagnoses. Nursing interventions are directed toward changing focal, contextual and residual stimuli.

The focus of Roy's model is the set of processes by which a person adapts in a clarified bio psychosocial system in constant interaction with changing environment when the demands of environmental stimuli are too great, the person's adaptive mechanism are too low, the person's behavioral responses are ineffective for coping. She views the person's adaptive system that functions as a whole through interdependence of its parts.

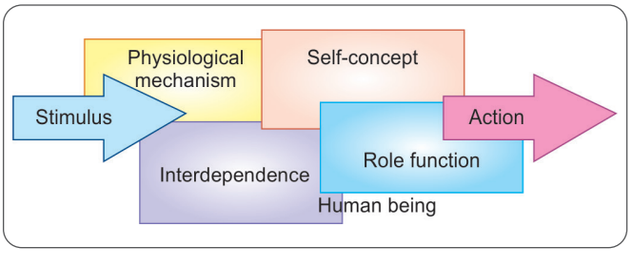


Fig. 1.21: Roy's adaptation model

According to Roy, assessment is directed to assessment of behavior and assessment of stimuli, which gives direction to nursing diagnosis, goal setting, intervention and evaluation and critical thinking in Roy Adaptation Model. **The nursing diagnosis** is derived from two assessment levels that are ineffective or require reinforcement.

Nursing goals are identification of those adaptive behavioral outcomes.

The nursing interventions to achieve these goals aim to manage focal, contextual or residual stimuli by removing, decreasing, increasing or altering the stimuli.

Evaluation is a reassessment of attainment of the goal of adaptive behavior.

Critical thinking based on Roy's adaptation model is given in Table 1.9.

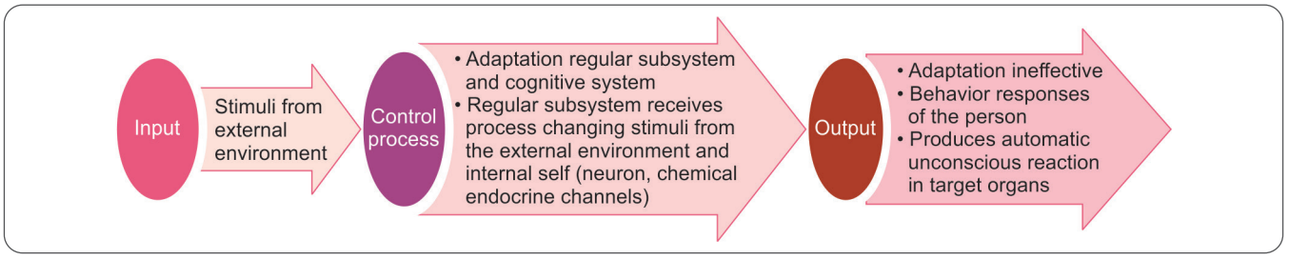


Fig. 1.22: Roy's adaptation model—behavioral responses

TABLE 1.9: Critical thinking based on Roy adaptation model

Phases of process	Physiological adaptive mode	Interdependence adaptive mode	Self-concept adaptive mode	Role function mode
Assessment of behavior	Oxygenation	Significant other	Physical self	Instrumental • Primary role • Secondary role • Tertiary role
	Nutrition	Giving	Body sensation	
	Elimination	Receiving	Body image	
	Activity and rest	Support system	Personal self	
	Protection	Giving	Self-consistency	Expressive • Primary role • Secondary role • Tertiary role
	Senses	Receiving	Self-ideal	
	Fluids and electrolytes		Moral-ethical-spiritual self	
	Neurological function			
	Endocrine function			

Contd...

Phases of process	Physiological adaptive mode	Interdependence adaptive mode	Self-concept adaptive mode	Role function mode
Assessment of stimuli	Focal stimuli	Focal stimuli	Focal stimuli	Focal stimuli
	Contextual stimuli	Contextual stimuli	Contextual stimuli	Contextual stimuli
	Residual stimuli	Residual stimuli	Residual stimuli	Residual stimuli
Nursing diagnosis	Statement of behaviors with most relevant stimuli	Statement of behaviors with most relevant stimuli	Statement of behaviors with most relevant stimuli	Statement of behaviors with most relevant stimuli
Goal setting	Behavior	Behavior	Behavior	Behavior
	Change expected	Change expected	Change expected	Change expected
	Time frame	Time frame	Time frame	Time frame
Intervention	Management of stimuli	Management of stimuli	Management of stimuli	Management of stimuli
	Alter	Alter	Alter	Alter
	Increase	Increase	Increase	Increase
	Decrease	Decrease	Decrease	Decrease
	Remove	Remove	Remove	Remove
	Maintain	Maintain	Maintain	Maintain
Evaluation	Observation of behaviors after interventions have been completed to see whether the goals are achieved	Observation of behaviors after interventions have been completed to see whether the goals are achieved	Observation of behaviors after interventions have been completed to see whether the goals are achieved	Observation of behaviors after interventions have been completed t to see whether the goals are achieved

STEPS OF NURSING PROCESS

Assessment

It is the foundation of the nursing process. Assessment means accumulation of facts from a variety of sources organizing them and drawing logical conclusions. By a careful and constant monitoring and assessment, a nurse is able to identify the pathophysiological changes at an early stage which helps in initiating supportive treatment, the adequacy of which is again continuously assessed. The purpose of this process is to provide planned intervention directed toward areas of greater need.

Accurate data collection leads to identification of the client's health status, which may assist in formulating nursing diagnoses and direction for nursing implementation and alleviation of client's problems. The main focus of data collection is the client's responses to these problems. These responses can be biophysical, psychosocial or spiritual in nature. Thus it is the organized and systematic and purposeful collecting of data about a patient or family's current or future health which is essential to permit grouping or clustering of data for analysis.

Types of Data

- **Subjective data:** It is the data of individual view of situation, e.g., pain.
- **Objective data:** It is observable data like respiratory rate, blood pressure, weight, edema.

Methods of Data Collection

Data are collected by means of three methods:

1. Interview

Pertinent history is collected. It allows the nurse to acquire specific information required for diagnosis and planning. It facilitates nurse patient relationship. The nurse needs to control the direction of interview. The nurse should use the least amount of authority necessary to obtain the information needed within the time allowed. Subjective data are obtained through effective communication and interviewing skills.

2. Observations

These are processes of objectively noting data or cues through the use of sense. Nurse uses the senses in many ways to observe the client's characteristics of appearance and function, content and process of interaction and relationship environment.

Objective data can be collected through the sense of sight, touch and healing. By using these sensor characteristics of appearance and function, content and process of interactions

and environment can be observed. Maintaining accuracy in observing clients is important. Measurements are form of observation, which is a means of obtaining objective data.

3. Physical Examination

It is carried out and it may also involve use of instruments in ascertaining the extent, dimensions, rate, rhythm, quantity and size. This is explained in detail with a conceptual model later on.

Documenting Data

The recovering of subjective and objective data is facilitated by a format, which allows the nurse to note the sequence and methods. The data may be organized in many ways. It may be entered on a database or a health history or assessment form formulated by agency.

Guidelines for Data Collection

Systematic format is used for data collection; specific nursing and related models are used as guides for data collection. The data is comprehensive and multi focal. Socioeconomic, political, biophysical, developmental, cultural and psychological and spiritual influences are taken into consideration while collecting data. A variety of sources such as client, family, significant others, health care personnel, printed documents and written records are used. In a critical care unit, nurse may not be able to use the client as a primary source of data as much as in other health care setting owing to the severity or emergency nature of the condition at the time of admission. Appropriate methods are used for data collection. The data are verifiable. The data collected by the use of interview, observation and measurement can be substantiated and can be used to validate client's statements. The data collection is a continuous process. Data are recorded and communicated appropriately.

Use of Models for Data Collection

Nursing and related models provide systematic direction for data collection. The major concepts provide categories within which to collect data.

Maslow's Hierarchy of Needs and Roy's Adaptation Model

It is used as a basis for data collection in the critical care unit. Abraham Maslow divided human needs into physical and psychosocial needs. He describes five levels of needs. Only when lower level needs are met one can move toward higher level needs. Such a hierarchy of needs is a useful organization framework for assessment of patients, strength, and limitation and need for nursing intervention.

Roy's Model

- Roy provides a multi focal approach in her first levels of assessment of patient with four modes of adaptation. The physiological mode includes activity and rest, nutrition, elimination, oxygenation, fluid and electrolytes, endocrine function, skin integrity, the senses and neurologic function.
- The self-concept mode incorporates physical self and personal self.
- Role function involves role performance and role mastery.

The need for affection, adequacy, support system and family are all parts of the interdependence model.

Assessment and Critical Scoring in Critically Ill

Optimized distribution of medical and financial resources is of crucial importance in the delivery of health care. To this end, critical care physician has to make decisions as to which patients are likely to derive the maximum benefit from admission to a critical care unit. Illness scoring systems have been introduced to formulate some degree of priority for ICU admission (Table 1.10). They are useful in Triage as well. The evaluation of severity of illness in a critically ill is made through the use of severity scores. Severity scores are instruments that aim at stratifying patients based on the severity of illness, assigning to each patient an increasing score as their severity of illness increases.

TABLE 1.10: Types of ICU scoring systems (specific)

Head injury	Glasgow Coma Scale
Burns	Rule of 9 and age and mortality
Trauma	Injury severity Score (ISS) Trauma score
Ischemic Heart disease	NYHA and AHA classification
Pancreatitis	Ranson's scoring criteria
Liver Failure	Model of End stage Liver disease
Subarachnoid hemorrhage	World Federation of Neurophysician's score
Organ dysfunction score	Sequential Organ Failure Assessment (SOFA) Multi Organ Dysfunction Score (MODS) Logistic Organ dysfunction system (LODS)
Cancer	Cancer Mortality Model(CMM)
Renal Failure	**Rifle:** Risk, Injury, Failure, Loss and end stage kidney Classification
Delirium	Confusion Assessment Method (CAM) Richmond Agitation and Sedation Score (RASS)

Purposes

- To quantify severity of illness for hospital and health care system. To enhance decision making such as resource allocation.
- To assess ICU performance and compare the quality of care in different ICUs and within the same over time.
- To assess the impact of planned changes on patient outcomes
- To assess the prognosis of individual patients. To enable making appropriate decisions.

Uses

- Compares observed and predicted outcome for patients.
- Assesses ICU performance, in comparison to other ICUs.
- Predicts mortality, prognosis, length of stay in ICU for patients

Physiological Abbreviations

- **APACHE:** Acute Physiology and Chronic Health Evaluation
- **SAPS:** Simplified Acute Physiology Score
- **MPM:** Mortality Probability Models
- **TISS:** Therapeutic Intervention Scoring System and those evaluating organ dysfunctions
- **LODS:** Logistic Organ Dysfunction System
- **MODS:** Multiple Organ Dysfunction Score
- **SOFA:** Sequential Organ Failure Assessment

Physiological abbreviations and their invention year are given in Table 1.11.

TABLE 1.11: Physiological abbreviations and their invention years

Characteristics	Invention years
APACHE	1981
SAPS	1984
APACHE II	1985
MPM	1985
APACHE III	1991
SAPS II	1993
MPM II	1993
SAPS III	2005
APACHE IV	2006
MPM III	2007
SOFA	1994
MODS	2005
LODS	1996
CPIS	2000
TISS	1996

TABLE 1.12: APACHE score

APACHE score			
	ROC	Prediction at 50% probability	Calibration
APACHE II	0.85	85.5	
APACHE III Version (H)	0.90	88.2	47.7
APACHE III Version (I)	Unpublished	Unpublished	24–2
APACHE III Version (H) in 2003–04 cohort	Unpublished	Unpublished	24–2

Acute Physiology and Chronic Health Evaluation (APACHE)

The APACHE score is the best-known and most widely used score with good calibration and discrimination (Table 1.12).

The original APACHE score was developed in 1981 to classify groups of patients according to severity of illness and was divided into two sections:

1. Physiology score to assess the degree of acute illness.
2. Preadmission evaluation to determine the chronic health status of the patient.

APACHE II Score

- The APACHE II scoring system was released in 1985 and included a reduction in the number of variables to 12 (Table 1.13).
- The APACHE II scoring system is measured during the first 24 hours of ICU admission with a maximum score of 71. A score of 25 represents a predicted mortality of 50% and a score of over 35 represents a predicted mortality of 80%.

  APACHE II score is sum of:
- Acute physiology score (Table 1.15)
- Age
- Chronic health score

  The APACHE II score (0–71)

  Total APACHE II = A + B + C
- A → APS points
- B → Age points
- C → Chronic health points (Table 1.14)

Predicted mortality = 3.517 + (Score APACHE II) 0.146

Predicted mortality (adjusted = 3.517 + (Score APACHE II) 0.146 + diagnostic category weight

- **Immunocompromised**
  - Receiving therapy reducing host defenses (immunosuppression, chemotherapy, radiation therapy, long-term steroid use, high dose steroid therapy) or
  - Has a disease interfering with immune function such as malignant lymphoma or Leukemia.

TABLE 1.13: APACHE II scoring system

The APACHE II Score									
Physiologic variable	**High abnormal range**					**Low abnormal range**			
	+4	+3	+2	+1	0	+1	+2	+3	+4
Rectal temp (°C)	≥41	39–40.9		38.5–38.9	36.38.4	34.35.9	32–33.9	30–31.9	≤29.9
Mean arterial pressure (mm Hg)	≥160	130–159	110–129		70–109		50–69		≤49
Heart rate	≥100	140–179	110–139		70–109		50–69	40–54	≤39
Respiratory rate	≥50	35–49		25–34	12–24	10–11	6–9		≤5
Oxygenation • $FIO_2 \geq 0.5$ record $A–aDO_2$ • $FIO_2 < 0.5$ record PaO_2	≥500	350–499	200–349		<200 $PO_2 > 70$	PO_2 61–70		PO_2 55–60	PO_2 <55
Arterial pH	≥7.7	7.6–7.69		7.5–7.59	7.33–7.49		725.732	7.15–7.32	<7.15
HCO_3 (mEq/L)	≥52	41–51.9		32–40.9	22–31.9		18–21.9	15–17.9	<15
K (mEq/L)	≥7	6–6.9		5.5–5.9	3.5–5.4	3–3.4	2.5–2.9		<2.5
Na (mEq/L)	≥100	160–179	155–159	150–154	130–149		120–129	111–119	≤110
S. Creat (mqm/dL)	≥3.5	2–3.4	1.5–1.9		0.6–1.4		<0.6		
Hematocrit (%)	≥60		50–59.9	46–49.9	30.45.9		20–29.9		<20
TLC (10^3/cc)	≥40		20–39.9	15–19.9	3–14.9		1–2.9		<1
GCS									

Age-score
<44 → 0
45–54 → 2
55-64 → 3
65–74 → 5
≥75 → 6

GCS		
15 → 0	14 → 1	13 → 2
12 → 3	11 → 4	10 → 5
9 → 6	8 → 7	7 → 8
6 → 9	5 → 10	4 → 11
3 → 12		

TABLE 1.14: Chronic health points

History of severe organ insufficiency	Points
Nonoperative patients	5
Emergency postoperative patients	5
Elective postoperative patients	2

- **Hepatic insufficiency if:**
  - Biopsy proven cirrhosis
  - Portal hypertension
  - Episodes of upper GI bleeding due to portal hypertension
  - Prior episodes of hepatic failure, coma or encephalopathy
- **Cardiovascular insufficiency if:**
  - Heart Association Class IV
- **Respiratory insufficiency if:**
  - Severe exercise restrictions due to chronic obstructive or vascular disease.
  - Documented chronic hypoxia, hypercapnia, secondary polycythemia, severe pulmonary hypertension
  - Respiratory dependency
- **Renal insufficiency if:**
  - On chronic dialysis

The APACHE III Scoring for Chronic Health Condition (Comorbid condition)

1. AIDS → 23
2. Hepatic failure → 16
3. Lymphoma → 13
4. Metastatic cancer → 11
5. Leukemia/multiple myeloma → 10
6. Immunosuppression → 10
7. Cirrhosis → 4

TABLE 1.15: Acute physiologic score (APS)

Apache II score

Age point	
≤44 years	0
45–54 years	0
55–64 years	3
65–74 years	5
≥75 years	6

Chronic health points	
Non-operative, or emergency post-op and condition below*	5
Elective operative and any condition below*	2
*Cirrhosis w/portal hypertension of encephalopathy class IV angina, chronic hypoxia, ↑CO_2 or polycythemia; chronic dialysis; immunocompromised	

Total APACHE Score = AP + CHP + APS

Sum age points (AP) + Chronic health points (CHP) + Acute physiologic score (APS) points.

*1 sum all variables 1–12 for acute physiologic score (APS) (use one variable each for 5 and 9).

Use the word value from the preceding 24 hours.

Apache II: A severity of disease classification system. Crit care med 1985;13:818-29

Acute physiologic score*1 (APS)

Physiologic variable		Points								
		4	**3**	**2**	**1**	**0**	**1**	**2**	**3**	**4**
1	Temp°F	≤85.9	86.0–89.5	89.6–93.1	93.2–96.7	96.8–101.2	101.3–102.1		102.2–105.7	≥105.8
	°C	≤29.9	30–31.9	32–33.9	34–35.9	36–38.4	38.5–38.9		39–40.9	≥41
2	HR, bpm	≤39	40–54	55–69		70–109		110–139	140–179	≥180
3	MAP, mm Hg	≤49		50–69		70–109		110–129	130–159	≥160
4	RR, bpm	≤5		6–9	10–11	12–24	25–34		35–49	≥50
5	**Oxygenation:** Use A-a Gradient (5a) if FiO_2 ≥0.5 or use PaO_2 (5b) if FiO_2 < 0.5									
5a	A–a Gradient					<200		200–349	350–499	≥500
5b	PaO_2	≤54	55–60		61–70	>70				
6	Na^+ (S, mmol/L)	≤110	111–119	120–129		130–139	150–154	155–159	160–179	≥180
7	K^+ (S, mmol/L)	≤2.4		2.5–2.9	3.0–3.4	3.5–5.4	5.5–5.9		6.0–6.9	≥7.0
8	Cr (S, mg/dL)			<0.6		0.6–1.4		1.5–1.9	2.0–3.4	≥3.5
9	Arterial pH is preferred, Use venous HCO_3 if no ABGs.									
9a	pH (arterial)	≤7.14	7.15–7.24	7.25–7.32		7.33–7.49	7.5–7.59		7.6–7.69	≥7.7
9b	HCO_3 (venous)	≤14	15–17.9	18–21.9		22–31.9	32–40.9		41–51.9	≥52
10	WBC, cells/uL	≤1.0		1.0–2.9		3.0–14.9	15–19.9	20–39.9		≥40
11	Hct, %	≤20		20–29.9		30–45.9	46–49.9	50–59.9		≥60
12	GCS coma	Score = 15–GCS score (see below, record e.g., "GCS 9 = E2 V4 M3 at 17:35h".)								

Score	Mortality
0–4	4%
5–9	4%
10–14	15%
15–19	25%
20–24	40%
25–29	55%
30–34	75%
>34	85%

Glasgow Coma Scale (GCS) **Teasdale G. Jannett B. Lancet 1974,2:81–84.*

Eye opening	Best verbal	Best motor	Points	
		Follows commands	6	**Score:** *Sum points (eye + verbal + motor categ)*
	Oriented	Localizes pain	5	
Spontaneous	Confused	Withdraws to pain	4	
To command	Inappropriate words	Flexor response	3	Server ≤8 Mod = 9–12. Minor ≥13.
To painful stimuli	Incomprehensible	Extension (abnl)	2	
No response	No response	No response	1	

APACHE III Score

APACHE III, released in 1991, was developed with the objectives of improved statistical power, ability to predict individual patient outcome, and identify the factors in ICU that influence outcome variations but it is far more complex than the two previous scoring systems (Table 1.16).

TABLE 1.16: APACHE III

APACHE III

Eyes open spontaneously or to painful/verbal stimulation				
Verbal / Motor	Oriented	Confused conversation	Inappropriate words and incomprehensible sounds	No response
Obeys verbal command	0	3	10	15
Localize pain	3	8	13	15
Flexion withdrawal/decorticate rigidity	3	13	24	24
Decerebrate rigidity/no response	3	13	29	29

APACHE III

Eyes open spontaneously or to painful/verbal stimulation				
Verbal / Motor	Oriented	Confused conversation	Inappropriate words and incomprehensible sounds	No response
Obeys verbal command				16
Localize pain				16
Flexion withdrawal/decorticate rigidity			24	33
Decerebrate rigidity/no response			29	48

Physiological Variables and Total Score (0–299)

- Acid-base disturbances
- GCS score — based on the worst
- Age score
- 7 Comorbidities (Cardiac, Respiratory and Renal failures excluded) Chest 1991, 100:1619–1636.

APACHE IV Score

The APACHE IV scoring system was published in 2006.

Limitations:

- Complexity—has 142 variables.
- But web-based calculations can be done.
- Developed and validated in ICUs of USA only.

Comparison of survivors and non survivors is given in Table 1.17 and comparison of mortality in APACHE IV score groups is given in Table 1.18.

Simplified Acute Physiology Score (SAPS)

- Designed to simplify then existing APS or APACHE
- 14 variables scored from 0 to 4 (age, GCS, HR, SBP, temp., RR, UO, B.urea, hematocrit, TLC, serum glucose, sodium, potassium, bicarbonate)
- Worst values in 24 hours used
- Developed in 679 patients
- APACHE and SAPS scores in same population showed comparable results
- Mortality increases (0–80%) with increasing SAPS Score (Table 1.19)
- Cut-off of 14 had sensitivity and specificity of 0.56 and 0.82.

The SAPS score was first released in 1984 as an alternative to APACHE scoring.

- The original SAPS score is obtained in the first 24 hours of ICU admission by assessment of 14 physiological variables, but no input of pre-existing disease was included.
- It has been superseded by the SAPS II and SAPS III, both of which assess the 12 physiological variables in the first 24 h of ICU admission and includes weightings for pre-admission health status and age.

SAPS II

- First scoring system to use statistical modeling techniques
- 13,152 patients (65% - developmental cohort, 35%-validation cohort)
- Not applicable for patients younger than 18 years, burns patients, coronary care and cardiac surgery patients.

TABLE 1.17: Comparison of survivors until hospital discharge and non survivors (*n* = 195).

	All (195)	Survivors (*n* = 168)	Nonsurvivors (*n* = 27)	*P* values
Age, Years, mean (S.D.)	48.18 (11.13)	47.83 (10.92)	50.41 (12.33)	0.265
Male	171	149	22	
Female	24	19	5	
MELD, mean (S.D.)	18.09 (10.55)	16.87 (9.61)	25.70 (12.92)	0.002
APACHE IV, mean (S.D.)	41.32 (21.95)	35.86 (15.58)	75.26 (25.47)	<0.001
Surgical time, hours, mean (S.D.)	7.41 (1.61)	7.27 (1.58)	8.26 (1.60)	0.002
An hepatic time, hours, mean (S.D.)	42.30 (10.14)	41.76 (8.84)	45.59 (16.09)	0.370
Cold ischemia time, hours, mean (S.D.)	7.13 (2.71)	7.11 (2.81)	7.23 (3.20)	0.688
Pred. hosp. death%, mean (S.D.)	3.76 (7.79)	2.30 (3.77)	12.84 (16.18)	<0.001
Pred. ICU LOS days, median (IQR)	3.49 (2.39, 4.82)	3.21 (2.21, 4.21)	5.5 (5.05, 6.03)	<0.001
Actual ICU LOS days, median (IQR)	3.71 (2.38, 5.47)	3.5 (2.34, 32.33)	8 (2.67, 32.75)	0.001
SMR; 95% CI	3.68; 2.38~4.96			

TABLE 1.18: Comparison of the mortality in APACHE IV score groups (n = 195).

	Group total	Nonsurvivors	APACHE IV	Actual mortality rates (%)	Actual mortality rates 95% CI	Pred. mortality rates (%)
All	195	27	41.32 ± 21.95	13.85	8.96~18.64	3.76
<30	65	0	21.77 ± 5.65			0.69
30~60	104	8	42.82 ± 8.18	7.69	2.57~12.81	2.62
>60	26	19	84.19 ± 21.62	73.08	52.00~88.00	16.00

TABLE 1.19: SAPS score/mortality

SAPS score	Mortality
4	
5–6	10.7 ± 4.1%
7–8	13.3 ± 3.9%
9–10	19.4 ± 7.8%
11–12	24.7 ± 4.1%
13–14	30.7 ± 5.5%
15–16	32.1 ± 5.1%
17–18	44.2 ± 7.6%
19–20	50.2 ± 9.4%
>20	81.1 ± 5.4

Variables

- Physiological variables, age, type of admission, underlying AIDS, metastatic or hematological malignancy
- Worst values recoded in 1st 24 hours are used

This scoring system is mostly used to (Table 1.20):

- Describe the morbidity of a patient when comparing the outcome with other patients.
- Describe the morbidity of a group of patients when comparing the outcome with another group of patients

Logic = β0 + β1 (SAPS II score) + β2 [in (SAPS II score+1)]

- Area under ROC for SAPS was 0.8 whereas SAPSII has a better value of 0.86
- Calibration- C-3.7 (p-0.883)
- Probability of death is given by the following equation:

TABLE 1.20: Scoring system

Parameter	Value (score)						
HR			<40 (11)	40–69 (2)	70–119 (0)	120–159 (4)	>160 (7)
SBP			<70 (13)	70–99 (5)	100–199 (0)	>200 (2)	
Temperature					<39°C (0)	>39°C (3)	
PaO_2/FiO_2	<100 (11)	100–199 (9)	>200 (6)				
UO (mL)		<500 (11)	>500 (4)		>1000 (0)		
S.Urea					<28 (0)	28–83 (6)	>84 (10)
TLC (10^3/cc)				<1(12)	1–20 (0)	>20 (3)	
K*				<3(3)	3-4.9 (0)	>5 (3)	
Na*				<125 (5)	125–144 (0)	>145 (1)	
Bicarb			<15 (6)	15–19 (3)	>20 (0)		
bilirubin					< 4(0)	4–5.9 (4)	>6 (9)
GCS	<6 (26)	6–8 (13)	9–10 (7)	11–13 (5)	14–15 (0)		

Age	Score
<40	0
40–59	7
60–69	12
70–74	15
75–79	16
>80	18

Chronic Disease:
- Metastatic cancer-9
- Hemat. Malig-10
- Aids-17

Types of administration:
- Sched.
- Surgical-0
- Medical-6
- Emer-surgical-8

SAPS III

- 16784 patients
- Scores based on data collected within 1st hour of entry to ICU
- Allows predicting outcome before ICU intervention occurs
- Better evaluation of individual patient rather than an ICU
- Not effected by Boyd Grounds effect
- But less time for collecting data and can have greater missing information

Sequential Organ Failure Assessment (SOFA)

- Organ dysfunction is a process rather than an event.
- Time evaluation of MODS allows understanding of disease process or influence of therapy.
- Designed for patients with sepsis and, hence, named initially as "Sepsis related organ failure assessment".
- Previously known as Sepsis-related Organ Failure Assessment because it was initially developed in 1994 to describe the degree of organ dysfunction associated with sepsis in mixed, Medical-Surgical ICU patients.
- Nowadays, it has since been validated to describe the degree of organ dysfunction in various ICU patient groups with organ dysfunctions not due to sepsis.
- The SOFA score involves six organ systems (respiratory, cardiovascular, renal, hepatic, central nervous, coagulation), and the function of each is scored from 0 (normal function) to 4 (most abnormal), giving a possible score of 0–24 (Table 1.21).
- Mortality rate increases as number of organs with dysfunction increases.
- Unlike other scores, the worst value on each day is recorded.
- A key difference is in the cardiovascular component; instead of the composite variable, the SOFA score uses a treatment-related variable (dose of vasopressor agents).

Maximal (highest total) SOFA score: It is the sum of highest scores per individual during the entire ICU stay. A score of >15 predicted mortality of 90%.

Mean SOFA score (ΔSOFA): It is the average of all total SOFA scores in the entire ICU stay. ΔSOFA for 1st 10 days is significantly higher in non-survivors.

Multiple Organ Dysfunction Score (MODS)

- The MODS scores six organ systems: Respiratory (PO_2/FiO_2 in arterial blood); renal (serum creatinine); hepatic (serum bilirubin); cardiovascular (pressure-adjusted heart rate); hematological (platelet count) and

TABLE 1.21: Sofa score

Variables/points	1	2	3	4
Neurological Coma score: Glasgow	13–14	10–12	6–9	<6
Pulmonary PaO_2 (mm Hg)/FiO_2	<400	<300	<200 with respiratory support	<100 with respiratory support
Cardiological Mean systolic arterial Pressure (mm Hg)	<70	Dopamine ≤6 or Dobutamine (what ever dose)	Dopamine >5 or Adrenaline ≤0.1 or Noradrenaline ≤0.1	Dopamine >15 or adrenaline >0.1 or noradrenaline >0.1
Renal blood creatinine µmol/L (mg/L)	110–170 (1.2–1.9)	171–299 (2.0–3.4)	300–440 (3.5–4.9) or <500	>440 (>5.0) or <200
Hematological platelets 10^2/L	<150	<100	<50	<20
Hepatic blood bilirubin µmol/L (mg/dL)	20–32 (1.2–1.9)	33–101 (2.0–5.9)	102–204 (6.0–11.9)	>204 (>12.0)

CNS (Glasgow Coma Scale) with weighted scores (0–4) awarded for increasing abnormality of each organ systems.

- Scoring is performed on a daily basis.
- Total score ranges from 0–24.
- Area under ROC 0.936.
- MODS predict mortality to a greater extent than Admission MODS score.
- Objective scale to measure organ dysfunction in ICU
- MODS score correlates well with mortality and ICU stay in survivors
  - 0% mortality for score 0
  - 25% mortality for score 9–12
  - 50% mortality for score 13–16
  - 75% mortality for score 17–20
  - 100% mortality for score >20
- Greater the organ systems that have failed (score >3), higher the mortality
- MODS parameter criteria are shown in Table 1.22

Logistic Organ Dysfunction System (LODS)

- Worst values in 1st 24 hours of ICU stay.
- Worst value in each of six organ systems.
- Total score ranges from 0–22.
- Good calibration and discrimination (area under ROC 0.85)
- LODS parameters criteria are shown in Table 1.23.

Clinical Pulmonary Infection Score (CPIS)

- A score developed to establish a numerical value of clinical, radiographic, and laboratory markers of pneumonia (Table 1.24).
- Serial measurements of the CPIS could be used to identify survivors versus non-survivors as early as day 3 of therapy.
- The CPIS correlated with mortality rate.
- CPIS scores >6 suggest pneumonia.
- CPIS is an important variable to monitor during VAP therapy. Patients with VAP having CPIS ≤6 can safely discontinue antibiotics after 3 days.

TABLE 1.22: MODS parameters criteria

System	0	1	2	3	4
Respiratory PO_2/FiO_2	>300	226–300	151–225	76–150	<75
Renal serum creatinine (mmol/L)	<100	101–200	201–350	351–500	>500
Hepatic serum bilirubin (mmol/L)	<20	21–60	61–120	121–240	>240
Cardiovascular (PAR)	<10	10.1–15	15.1–20	20.1–30	>30
Hematological platelet count (100/mL)	>120	120–80	80–50	50-20	<20
Neurological	15	14–13	12–10	9–7	<7

Score	ICU Mortality	Hospital mortality
0	0%	0%
1–4	1–2%	7%
5–8	3–5%	16%
9–12	25%	50%
13–16	50%	70%
17–20	75%	82%
21–24	100%	100%

TABLE 1.23: LODS parameters criteria

System		Value (Score)				
Neurological	GCS	14,15 (0)	13–9 (1)	8–6 (3)	5–3 (5)	
Cardiovascular	HR	>140 (1)	140–30 (0)	<30 (5)		
	SEEP	>270 (3)	240–269 (1)	70–89 (1)	69–40 (3)	<40(5)
Hematological	TLC (1000/cc)	<1 (3)	1–2.4 (1)	2.4–50 (0)	>50 (1)	
	Platelet (10^3/cc)	<50 (1)	>50 (0)			
Respiratory	PO_2	<150 (3)	>150 (1)			
Hepatic	Bilirubin (mg/dL)	<2 (0)	>2 (1)			
	PT	0–2.9 s (0)	3 s (1)			
Renal	Urea (mg/dL)	>120 (5)	119–60 (3)	59–35 (1)	<35 (0)	
	Creatinine (mg/dL)	>1.16 (3)	1.59–1.2 (1)	<1.2 (0)		
	UO (L/24 hr)	>10 (3)	10–0.75 (0)	0.75–0.5 (3)	<0.5 (5)	

TABLE 1.24: Clinical pulmonary infection score (CPIS)

Score	0	1	2
Temperature	≥36.5 and ≤38.4	≥38.5 and ≤38.9	≥39 and ≤36.4
TLC	≥4 and ≤11	<4 or >12	
Tracheal secretions	None	Non-purulent	Purulent
Oxygenation PaO_2/FiO_2 mm Hg	>240 or ARDS		≤240 and no ARDS
Chest radiograph	No opacity	Diffuse (patchy opacities)	Localized opacity
Progression of radiographic opacities	No progression		Progression (after HF and ARDS excluded)
Culture of tracheal aspirate	Pathogenic bacteria culture in rare/few quantities or no growth	Pathogenic bacteria cultured in moderate or heavy quantity	

TABLE 1.25 MPM criteria

Variable	1	0
Level of consciousness	Coma/deep stupor	No coma/deep stupor
Admission	Emergency	Elective
Prior CPR	Yes	No
Cancer	Present	Absent
CRF	Present	Absent
Infection	Probable	Not probable
Previous ICU admission in 6 pro	Yes	No
Surgery before ICU admission	Yes	No
SBP		
HR	10 beats/min relative risk	
Age	10 years relative risk	

Mortality Probability Model (MPM)

- Not applicable for patients <14 years, patients with burns, cardiac/cardiac surgery patients.
- **MPM score (Table 1.25):**
  Admission MPM (MPM0) → 11 variables
  MPM at 24 hours (MPM24) → 14 variables
  MPM at 48 hours (MPM48) → 11 variables
  MPM over the time (MPMOT) → (MPM24-MPM0) (MPM48-MPM24)
- Probability is derived directly from these variables.
- MPMOT predicted better than MPM0 for long-term patients.

Therapeutic Intervention Scoring System (TISS)

- Measuring sickness severity based on type and amount of treatment received (Table 1.26).
  Both clinical and administrative applications:
  - Assessing severity of illness
  - Determining resource requirements
  - Assessing use of critical care facilities and function
  - Not standardized
- Daily data collected from each patient on 76 possible clinical interventions

TISS Four classes of patients recognized:

- **Class I** <10 points does not require ICU
- **Class II** 10–19 Points 1:2 Nurse : Pt ratio
- **Class III** 20–39 points 1 ICU nurse
- **Class IV** >40 Points 1:1 nurse : Patient ratio
  Comparison of scoring scales is given in Table 1.27.

TABLE 1.26: Therapeutic intervention scoring system

Therapeutic intervention scoring system							
4 Points				**3 Points**			
1.	Cardiac arrest and/or counter shock within past 48 hours	Yes	No	1.	Central IV hyper alimentation (includes renal, cardiac, hepatic failure fluid)	Yes	No
2.	Controlled ventilation with or without PEEP	Yes	No	2.	Pacemaker on standby	Yes	No
3.	Controlled ventilation with intermittent or continuous muscle relaxants	Yes	No	3.	Chest tubes	Yes	No
4.	Balloon tamponade of varices	Yes	No	4.	IMV or assisted ventilation	Yes	No
5.	Continuous arterial infusion	Yes	No	5.	CPAP	Yes	No
6.	Pulmonary artery catheter	Yes	No	6.	Concentrated K^+ infusion via central catheter	Yes	No
7.	Arterial and/or ventricular pacing	Yes	No	7.	Nasotracheal or orotracheal intubation	Yes	No
8.	Peritoneal dialysis	Yes	No	8.	Blind intratracheal suctioning	Yes	No
9.	Induced Hypothermia	Yes	No	9.	Complex metabolic balance (frequent intake and output)	Yes	No
10.	Pressure-activated blood infusion	Yes	No	10.	Multiple ABG, Bleeding, and/or STAT studies (>4 shift)	Yes	No
11.	G-Suit	Yes	No	11.	Frequent infusion of blood products (>5 units/24 hours)	Yes	No
12.	Intracranial pressure monitoring	Yes	No	12.	Bolus IV medication (nonscheduled)	Yes	No
13.	Platelet transfusion	Yes	No	13.	Vasoactive drug infusion (1 drug)	Yes	No
14.	IABP (Intra Aortic Balloon Pressure)	Yes	No	14.	Continuous anti-arrhythmia infusions	Yes	No
15.	Emergency operative procedures (within past 24 h)	Yes	No	15.	Cardioversion for arrhythmia (not defibrillation)	Yes	No
16.	Lavage of acute GI bleeding	Yes	No	16.	Hypothermia blanket	Yes	No
17.	Emergency endoscopy or bronchoscopy	Yes	No	17.	Arterial line	Yes	No
18.	Vasoactive drug infusion (>1 drug)	Yes	No	18.	Acute digitalization—within 48 hours	Yes	No
19.				19.	Measurement of cardiac output by any method	Yes	No
20.				20.	Active diuresis for fluid overload or cerebral edema	Yes	No

TABLE 1.27: Comparison of scoring scales

Comparison of scoring scales										
Study	Year	Country	APACHE II		APACHE III		SAPS II		MPM II	
			χ^2	ROC	χ^2	ROC	χ^2	ROC	χ^2	ROC
Sirio	1992	Japan		0.78						
Oh	1993	Hong Kong		0.89						
Rowan	1993	UK	79	0.83						
Rowan	1994	UK	81	0.83					251	0.74
Wong	1995	Canada		0.86						
Castella	1995	Europe		0.85		0.86		0.85		0.81
Apolone	1996	Italy					71	0.8		
Bastos	1996	Brazil			400	0.82				
Moreno	1997	Portugal	33	0.79			29	0.82		
Beck	1997	UK	99	0.8	130	0.84				

Comparison of scoring scales										
Study	Year	Country	APACHE II		APACHE III		SAPS II		MPM II	
			χ^2	ROC	χ^2	ROC	χ^2	ROC	χ^2	ROC
Moreno	1998	Europe					218	0.822	437	0.786
Goldhill	1998	UK	181							
Zimmerman	1998	US			48	0.89				
Sirio	1999	US			2407	0.9				
Pappachan	1999	UK			312	0.89				
Makgraf	2000	Germany		0.832		0.846		0.846		
Capuzzo	2000			0.8				0.8		
Arabi Y	2000	S. Arabia		0.83				0.79		0.85
Livingston	2000	UK	366	0.753	67	0.795	142	0.784	452	0.742
Beck	2003	UK	232	0.835	443	0.867	257	0.852		
Kim	2005	Korea			2.58	0.981	4.37	0.978		0.941
Greater A	2007	Thailand	66	0.91			54	0.88		

Scores for surgical patients

Thoracoscore (thoracic surgery)
Lung resection score (thoracic surgery)
Euroscore (cardiac surgery)
Ontario (cardiac surgery)
Parsonnet score (cardiac surgery)
System 98 score (cardiac surgery)
QMMI score (cardiac surgery)
Early mortality risk in redocoronary artery surgery
MPM for cancer patients

Scores for pediatric patients

PRISS (Pediatric RISK of Mortality)
P-MODS (Pediatric MODS)
DORA (Dynamic objective risk assessment)
Period (Pediatric logistic organ dysfunction)
PIM II (Pediatric index of Mortality II)
PIM (Pediatric index of Mortality)

Scores for trauma patients

Trauma score
Revised trauma score
Trauma and injury severity score (TRISS)
A severity characterization of trauma (ASCOT)

Organ Dysfunction and/or Infection (ODIN)

Documentation

The Organ Dysfunctions and/or Infection (ODIN) model assesses the number and type of organ dysfunctions in the intensive care patient. This information can be used to predict the patient's outcome (Tables 1.28 and 1.29 definition of organ dysfunction are given in Table 1.30).

TABLE 1.28: Organ dysfunction and/or infection (ODIN)

Organ System		Finding
Respiratory	OR	PaO_2<60 mm Hg on FiO_2 0.21
		Need for ventilatory support
Cardiovascular (excluding patients showing hypovolemia, with CVP <5 mm Hg)		Systolic arterial pressure <90 mm Hg with signs of peripheral hypo perfusion
	OR	Continuous infusion of vasopressor or inotropic agents required to maintain systolic pressure >90 mm Hg
Renal (excluding patients on chronic hemodialysis before hospital admission)		Serum creatinine >3.4 mg/dL (300 µmol/L)
	OR	Urine output <500 mL in 24 hours or <180 mL in 8 hours
	OR	Need for hemodialysis or peritoneal dialysis
Neurologic		Glasgow coma scale <= 6 in the absence of sedation at any time during day
	OR	Sudden onset of confusion or psychosis
Hepatic		Serum bilirubin >5.9 mg/dL (100 µmol/L)
	OR	Alkaline phosphatase >3 times normal
Hematologic		Hematocrit <= 20%
	OR	White blood cell count <2,000 per µL
	OR	Platelet count <40,000 per µL
Infection (with clinical evidence of infection)		2 or more positive blood cultures
	OR	Presence of gross pus in a closed space
	OR	Source of infection determined during hospitalization, or at autopsy in case of death within 24 hours

TABLE 1.29: ODIN score and mortality

ODIN score	Mortality
0	2.6%
1	9.7%
2	16.7%
3	32.3%
4	64.9%
5	75.9%
6	94.4%
7	100%

Where:

- Conversion of Bilirubin mg/dL to µmol/L is 17.1; Reverse 0.0585
- Conversion of Creatinine mg/dL to µmol/L is 88.4; Reverse 0.0113

Logistic Regression Analysis = (–3.59)
+ (1.09 if respiratory dysfunction)
+ (1.19 if cardiovascular dysfunction)
+ (1.18 if renal dysfunction)
+ (0.86 if hematologic dysfunction)
+ (0.57 if hepatic dysfunction)
+ (0.99 if neurologic dysfunction)
+ (0.53 if infection present) probability of death = (1/(1 + EXP (–q) P

ODIN Score = (1 if respiratory dysfunction present)
+ (1 if cardiovascular dysfunction present)
+ (1 if renal dysfunction present)
+ (1 if neurologic dysfunction present)
+ (1 if hepatic dysfunction present)
+ (1 if hematologic dysfunction present)
+ (1 if infection present)

Interpretation:

- Maximum score = 7
- Minimum score = 0

Prediction of outcome using logistic regression analysis is given in Table 1.31.

TABLE 1.30: Definitions of organ dysfunction

Variables
• Respiratory dysfunction (presence of one or more of the following): ▪ PaO_1 <60 mm Hg on FiO_2 = 0.21 ▪ Need for ventilatory support • Cardiovascular dysfunction (presence of one of more or the following, in the absence of hypovolemia): ▪ Systolic arterial pressure <90 mm Hg with sign of peripheral hypoperfusion ▪ Continuous infusion of vasopressor or inotropic agents required to maintain systolic pressure >90 mm Hg • Renal dysfunction (presence of one or more of the following): ▪ Serum creatinine >300 mmol/L ▪ Urine output <500 mL/24 hours or <180 mL/8 hours ▪ Need for hemodialysis or peritoneal dialysis • Neurologic dysfunction (presence of one or more of the following): ▪ Glasgow coma scale ≤6 (in the absence of sedation at any one point in day) ▪ Sudden onset of confusion or psychosis • Hepatic dysfunction (presence of one or more of the following): ▪ Serum bilirubin >100 μmol/L ▪ Alkaline phosphatase >3 × normal • Hematologic failure (presence of one or more of the following): ▪ Hematocrit ≤20% ▪ White blood cell count <2000/mm^3 ▪ Platelet count <4000/mm^3 • Infection (presence of one or more of the following associated with clinical evidence of infection): ▪ 2 or more positive blood cultures ▪ Presence of gross pus in a closed space ▪ Source of the infection determined during hospitalization, or at autopsy in case of death within the 24 hours

TABLE 1.31: Prediction of outcome using logistic regression analysis

Variables	Coefficient	Odds-ratio	p-value
Constant	–3.59		<0.0001
Cardiovascular dysfunction	1.19	3.28	<0.0001
Renal dysfunction	1.18	3.25	<0.0001
Respiratory dysfunction	1.09	2.97	<0.0001
Neurologic dysfunction	0.99	2.69	<0.0001
Hematologic dysfunction	0.86	2.36	0.011
Hepatic dysfunction	0.57	1.78	0.055
Infection	0.53	1.70	0.002

ODIN

- Easily available data (within the first 24 hours of admission), when precise diagnostic evaluation is not possible
- Less subjectivity
- Easy calculation
- Discrimination comparable to SAPS II and APACHE II

Critical care scoring is given in Table 1.32.

The value of scoring system is making decisions in patients under critical care that should be used with caution. The ability of the experienced person is far superior to the decisions dictated by scoring scales. In the final analysis, clinical judgment can never be replaced by any scoring system or scale.

A full patient assessment is usually initiated by a complete systematic history with physical examination, investigations, diagnosis and appropriate treatment. It is not always feasible when assessing the deteriorating or critically ill patient. Assessment of the critically ill and their family is one of the major responsibilities of the nurse working in the unit. Though assessment is vital part of critical care, the feasibility of assessment at the time of admission should be taken care of.

It can be compromised:

- If the patient is bleeding profusely
- If the LOC is compromised
- If in severe breathlessness

History Taking is Inappropriate and Unsafe Under these Circumstances

Crucial to developing competency in assessing critically ill patient and their families is a consistent and systematic approach to assessment. If not, there is every possibility of missing out on some important detail or subtle signs. Assessment should focus first on the patient and then on the technology. The patient should be the focal point of assessment with technology augmenting the information obtained from direct assessment. There are two approaches to the assessments, head to toe assessment or systems approach to assessment.

The assessment in fact starts from the time she receives the information about arrival of a patient to the unit. This information comes from different sources such as A and E, operation room, outpatient department and hospital wards.

Admission quick check

On admission, a quick check is done to ensure early life saving interventions.

An **ABCDE Acronym (Airway, Breathing, Circulation, Drugs and Equipment**) also can be used for the quick assessment.

TABLE: 1.32: Critical care scoring

<table>
<tr><th>Revised trauma score</th><th>GCS</th><th>CRAMS Scale</th><th>APACHE</th></tr>
<tr>
<td>
<table>
<tr><th>GCS</th><th>Sy BP</th><th>RR</th><th>Code</th></tr>
<tr><td>13–15</td><td>>89</td><td>10–29</td><td>4</td></tr>
<tr><td>9–12</td><td>76–89</td><td>>29</td><td>3</td></tr>
<tr><td>6–8</td><td>50–75</td><td>6–9</td><td>2</td></tr>
<tr><td>4–5</td><td>1–49</td><td>1–5</td><td>1</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Coded value of three or less should be treated as emergency and directed to trauma Center
</td>
<td>• Assess the extent of coma.
• The total score is sum of 3 responses (eye opening, motor response verbal response) and varies from 3 to 15.
• The lower the score the greater the severity of head injury.</td>
<td>The circulation respiration, abdomen, motor, speech (CRAMS) is another trauma triage score. Score less than 8 indicates major trauma and more than 9 indicates minor injury.</td>
<td>• Few parameters such as acute physiology, age, chronic health evaluation score are used.
• The maximum APACHE score is 71.
• The increasing score correlates with mortality. Many variants of APACHE II are devised.
• The APACHE II scoring system is widely used.</td>
</tr>
<tr>
<td colspan="4">The parameters used for scoring are:
1. Temperature
2. Mean Arterial Pressure
3. HR
4. RR
5. Alveolar arterial
6. Oxygen gradient
7. Arterial pH
8. Serum sodium
9. Serum potassium
10. Leukocytes count
11. Glasgow coma
12. Score</td>
</tr>
</table>

Summary of Pre-arrival Assessment

Pre-arrival Assessment

- Abbreviated report on patient (age, gender, chief complaint, diagnosis, pertinent history, physiologic status, invasive devices, equipment and status of laboratory and diagnostic tests.
- Complete room set up, including verification of equipment functioning

Admission Quick Check Assessment

- General appearance (consciousness)
- Airway (patency, position of artificial airway)
- Breathing (quantity and quality of respiration, rate depth, pattern, use accessory muscles) breath sounds, presence of spontaneous breathing
- Circulation and cerebral perfusion, ECG, rate, rhythm and presence of ectopy

Blood Pressure

- Peripheral pulses and capillary refill, skin color, temperature, moisture, presence of bleeding,
- Level of consciousness, responsiveness

Chief Complaints

- Primary body system
- Associated symptoms
- Drugs and diagnostic tests
- Drugs prior to admission
- Current usage of drugs
- Diagnostic test results
- Equipment

Pre-arrival Assessment—Case Scenario

The charge nurse notifies the SN on duty that she will be receiving a 26-year-old man from ER who was involved in a serious car accident. The ER nurse caring for the patient has called ICU to give a report. The patient suffered closed head injury and severe chest trauma with a left lung collapse. The patient is intubated and placed on mechanical ventilator. IV access has been obtained and a chest tube placed. After obtaining a CT scan of the head, the patient will be shifted to ICU. The SN questions ER nurse whether the patient is agitated and a foleys catheter is being introduced and whether the family had been notified of the accident.

The SN goes to check the unit in which the patient will be admitted and begins to do a mental check of what will be needed. The patient is intubated; hence, she keeps an Ambu bag connected to the oxygen source, checks for suction catheters and makes sure the suction system is working. The pulse oximetry and the ECG monitor are ready to go. Keeps an additional suction gauge, in case required for the chest drainage. The ECG monitor is turned on and the electrodes are ready to be applied. The arterial line flush system and the

transducer are ready to be connected. The IV infusion devices are set up. The patient has an altered LOC, therefore, a neuro check and potential insertion ICP monitoring, hand light is ready. Once again she checks if she has all the equipment ready for insertion of ICP catheter if Physician decides to perform after the CT.

She says to her "I think I am ready".

Along with assessment of the patient it is necessary to complete a family need assessment.

Evidence-Based Practice: Family Needs Assessment

Assessment of critically ill with different systems using correct map is given in Figure 1.23.

Assessment of respiratory system is shown in Table 1.33.
Assessment of cardiovascular system is given in Table 1.34.

Quick Assessment

a. Offer realistic hope
b. Give honest answers and information
c. Give reassurance

Comprehensive Assessment

a. Use Open ended questions and assess the communication style
b. Assess of level of anxiety
c. Assess perception of the situation
d. Assess family roles and dynamics
e. Assess coping mechanisms and resources

Compiled from Leske (2002) Raleigh et al. (1990) Roman et al. (1995) Sabo et al. (1989)

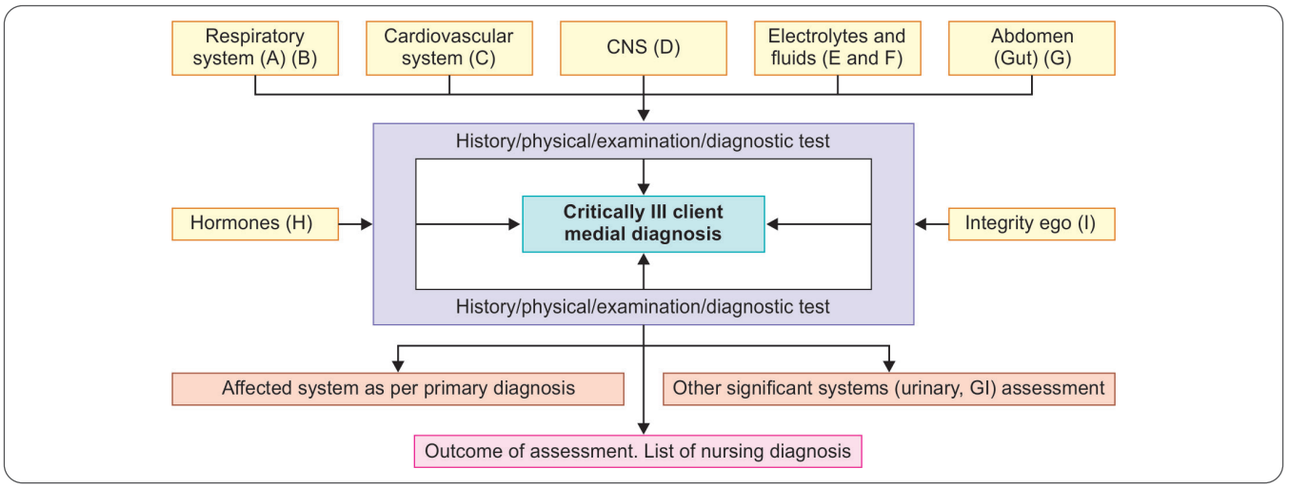


Fig. 1.23: Assessment of critically Ill—different systems using concept map

TABLE 1.33: Assessment of respiratory system

History	
• Presenting complaints • Environmental exposure • Risk factors	• Smoking • Past significant medical history • Family history, e.g., cystic fibrosis
Airway	**Breathing**
Patency obstruction partial or complete. Is airway protected? **Air entry:** Equal bilateral (MV patient) **Assessment** • Use of accessory muscles. • Complete airway obstruction results in paradoxical chest and abdominal movements. • Noisy breathing is indicative of partial airway obstruction. • Expiratory wheeze indicates lower airway dysfunction as it results from airways collapsing during expiration. • **Gurgling:** Presence of secretions • **Inspiratory:** Stridor indicates obstruction above larynx • By placing the back of your hand in front of patient's mouth you can detect presence of air flow.	• **RR:** Be concerned if >30 or <8 chest expansion equal, cyanosis yes/no • Pulse oximetry SpO_2 >90%? • Once air way management is completed, focus on life-threatening causes of respiratory deterioration. **E.g.**, Tension pneumothorax, massive hemothorax, pulmonary edema, acute severe asthma • Does the patient look distressed? Use of accessory muscles? Sternomastoid and scalene. • Can they talk? • **RR:** Important (often neglected) central and or peripheral cyanosis. • Abdominal distension.

Contd...

Breathing
Auscultation • Audible wheeze or rattling indicates presence of secretions • Breath sounds **Normal** • **Bronchial:** Pitch high—intensity loud on expiration. • A sound like air blown through a hollow tube heard over suprasternal area, lower trachea and mainstream bronchus. **Abnormal:** If heard over peripheral lung –atelectasis, consolidation. • Bronchovesicular • **Pitch moderate:** Intensity moderate • **Normal:** Blowing sound heard over airways on either side of the sternum between scapulae. • **Abnormal:** If heard over peripheral lung. **Vesicular:** Pitch high in inspiration low in expiration • **Normal:** Quiet rustling sounds over periphery • **Abnormal:** Decreased over periphery as in pneumonia, emphysema. • Pleural effusion. • **Adventitious sounds:** Crackles over lung fields and airways heard in lung base in pulmonary edema. • **Gurgles:** Over large airway • Course rattling louder low pitched described as musical. • **Condition:** Bronchospasm, secretion. • Wheezes over lung field, cause narrowed air way. • Crackling, whistling, high pitched. • Pleural friction rub. • Front and side of lung field. • **Cause:** Inflamed parietal and visceral pleura rubbing.

Diagnostic evaluation	
• Chest X-ray • Blood studies • Enzymes and ISO enzymes • Pulse oximetry • Pulmonary artery pressure	• Central venous pressure • Bronchoscopy • Pulmonary function studies. • Arterial blood gas studies • Pulmonary Angiography

TABLE 1.34: Assessment of cardiovascular system

Essential to the management of any hemodynamically unstable patient is rapid assessment of the determinants of cardiovascular insufficiency	
History	
• Presenting complaints • Past health history/family history • Current health status • Risk factors-Modifiable and nonmodifiable • Social and personal history.	
Circulation	
• Initial Quick assessment • **Patient looks** — distressed? • **Feet** — cold and clammy? • Capillary refill >2 seconds • Feel peripheral pulse • **Pulse rate** — Weak–regular • Obvious loss of blood/Fluid • Is there reason to suspect cardiac dysfunction • Chest pain	• **Inspection:** Pale, cyanosed, collapsed peripheral veins, external hemorrhage. • Decreased cardiac output resulting in reduced cerebral circulation and loss of consciousness and oliguria <0.5 mL/kg/hour of urine • **BP:** Compromised BP occurs only after compensatory mechanisms fail • Pulse Pressure (difference between systolic and diastolic blood pressure)

Contd...

Decreased diastolic pressure → Vaso dilatation as in sepsis	
• Diastolic Blood pressure <35–45 mm Hg is suggestive of arterial vasoconstriction as in cardiogenic and hypovolemic shock. • Palpation – Peripheral pulse, irregular, volume	• Bounding pulse -sepsis • Weak and thready pulse. Poor cardiac output • Capillary refill -< in 2 seconds.
Unless there is obvious evidence of carcinogenic shock, hypovolemia is considered as cause of circulatory collapse.	

Apical Pulse

- At the point of maximum impulse normally found in the 5th intercostal space at mid clavicular line.
- Left ventricular enlargement will increase the size and is shifted toward axilla.
- In right ventricular hypertrophy, sternum lifts with each contraction. Louder murmurs will be heard at upper sternum.

Auscultation

Traditional and revised auscultation are shown in Figure 1.24.
Assessment of CNC other systems and ongoing assessment are given in Tables 1.35 to 1.37.

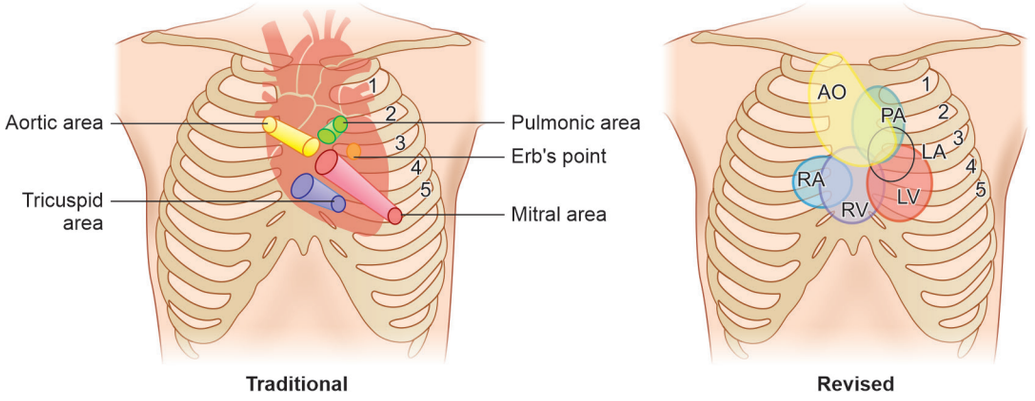


Fig. 1.24: Auscultation

Sites	
Aortic	Second right intercostal space
Pulmonic	Second left intercostal space
Tricuspid	Lower left sternal border
Mitral	5th intercostal line
Heart sound	
S1	Sound caused by closure of mitral and tricuspid valve heard at the onset of systole.
Soft	Decreased cardiac output Increased BP
Loud	Increased HR as in fever, hyperthyroidism
S2	Closure of aortic and pulmonic valves. Split is increased with inspiration heard at 2nd and 3rd intercostal space along left sternal border during deep inspiration Soft in valvular stenosis. Loud in hypertension embolism and circulatory collapse.

Contd...

Extra heart sound	
Gallops	Extra heart sounds heard best with bell of a stethoscope (They are S3 and S4)
S3	(Ventricular) gallop caused by sudden change in volume, flow and noncompliant ventricle. Lower in frequency and heard at the apex and in early diastole Present in CCF, Ventricular aneurysms, (normal in children)
S4	Atrial Gallop caused by atrial click as in systemic overload and increased resistance in filling due to decreased ventricular compliance. Lower in frequency heard at the apex. Present in CHF, CAD, HT, Aortic stenosis.
Murmurs	Are swishing sounds that can be auscultated in the area of valve due to turbulence caused by a change in flow rate, volume and resistant. It is found in Aortic stenosis, pulmonary stenosis, mitral and tricuspid insufficiency, regurgitation and stenosis.

Diagnostic tests	
• Chest X-ray • ECG • Holter monitoring • Echo Cardiography • Phonocardiography • Radio Nuclear Imaging (PET)	• Hemodynamic monitoring (with the use of monitors) • CVP, Arterial pressure, pulmonary artery wedge pressure • Cardiac catheterization.

TABLE 1.35: **Assessment of central nervous system**

History	
Recent trauma, Infection, headache, Problems with concentration, Memory, difficulty in ADL, job, Social life, alteration in LOC	• Dizziness weakness/difficulty in walking • Sensory distortion • Impotence or difficulty in urination • Substance abuse • Use/abuse medication

Assessment	
Glasgow coma scale • **Movement, strength, coordination** • **Reflexes** • **Pupillary changes:** ▪ Bilateral dilated—drug overdose ▪ Bilateral pinpoint—drug overdose Unilateral dilated—pupils • **Ocular sign** • **Sensory changes** • **Level of consciousness (LOC)**	**AVPU** **A** : Alert **V** : Response to verbal Stimuli **P** : Response to painful Stimuli **U** : Unresponsive

Diagnostic tests	
• EEG • CT scans, MRI, • PET, • Cerebral blood flow studies	• Myelography • Lumber puncture and CSF analysis • Transcranial Doppler studies

TABLE 1.36: **Assessment of other systems**

Other systems	
• (Urinary system) (E and F = Electrolytes and fluids)) • Electrolyte (Electrolytes and fluid) • Urine output—good indicator of kidney function	• Catheterization and hourly urine output measurement are required in critical care settings. • Kidney function tests are very valuable

Contd...

Diagnostic tests	
• Computed tomography • Electroencephalogram (EEG) • Magnetic resonance imaging (MRI). • Electro diagnostic tests, such as electromyography (EMG) and nerve conduction velocity (NCV). • Positron emission tomography (PET).	• Arteriogram (also called an angiogram). • Spinal tap (also called a lumbar puncture). • Evoked potentials. • Myelogram. • Neuro sonography. • Ultrasound (also called sonography).
Abdomen (Gut) (G)	
• Inspection requires good indirect lighting. • Assess the following: • Contour–Symmetry • Visible peristalsis–Indicates obstruction.	• Auscultation for bowel sounds before touching the abdomen. Normal bowel sounds 5–12/min. Rate increased in postprandial, diarrhea, early obstruction. • Sounds are hypo active in paralytic ileus and absent in late obstruction peritonitis, pneumonia, Spinal cord injuries. • Liver is percussed at 5^{th} intercostal space and spleen at 10^{th} intercostal space
Diagnostic tests	
• Abdominal radiography • Computed tomography • Upper gastrointestinal fluoroscopy with small bowel	• Antibiotics can protect against bacterial translocation • Clinically stable patients can be treated conservatively with bowel rest
Integrity-Ego(I)	
• Psychosocial assessment of the patient if conscious and of the family for all patients is mandatory. Nurse is usually confined by physical assessment planning. Holistic care is possible only by completing psychosocial assessment. Problems of ego integrity such as anxiety, fear, powerlessness, hopelessness, coping ineffective individual, coping ineffective-family, etc. can be identified if accurate assessment is done. • Ongoing assessment to identify changes in the patient's clinical condition is utmost important to decide on the treatment and nursing management. A brief outline is given below to carry out the ongoing assessment.	

TABLE 1.37: Ongoing assessment

Body system	Assessment parameters	
Nervous system	• LOC • Pupil • Motor strength of extremities	
Cardiovascular system	• Blood Pressure • Heart rate and rhythm • Heart Sound	• Capillary refill • Peripheral Pulses • Patency of IV
Respiratory system	• Respiratory rate and rhythm • Breath Sound • Color and amount of Secretions	• Pulse oximetry and end tidal CO_2 • Mechanical ventilatory parameters • Arterial and venous blood gases
Renal	• Intake and output • Color and amount of urinary output • BUN/Creatinine values	
Gastrointestinal	• Bowel sound contour of abdomen • Position of drainage tubes	• Color and amount of secretions • Bilirubin and albumin values
Endocrine, Hematologic, Immunologic	• Fluid balance, electrolyte and glucose value • CBC and coagulation value	• Treatment • WBC and differential counts
Integumentary	• Color and temperature of skin • Intactness of skin and Areas of redness	
Pain/discomfort	• In each system • Response to interventions	
Psycho social	• Mental status and behavioral response • Reaction and critical response • Presence of cognitive impairment such as dementia, delirium, depression.	• Family functioning and needs • Communication pattern • Sleep pattern

Nursing Diagnosis

It is arrived at the end of assessment. The assessment component of nursing process serves as the basis for identifying nursing diagnoses and collaborative problems. Nursing diagnosis is the first taxonomy created in nursing that has fostered autonomy and accountability.

Nursing diagnosis is a clinical judgment about an individual, family or community's response to actual or potential health problems. It provides basis for selection of nursing interventions to achieve outcome for which the nurse is accountable.

NANDA International is the official organization responsible for developing taxonomy of Nursing Diagnosis.

Planning

It is the second step in the nursing process. This includes setting priorities, goals and nursing interventions. As soon as the patient's problems are identified, the nurse must establish priorities by determining which problems are most urgent and, goals acceptable by the patient are set. Specific objectives in behavioral terms are stated. The nursing actions are directed toward accomplishments of the objectives. It should be individualized realistic and measurable. The entire planning phase of nursing process ends in the formation of patient's nursing care plan by the professional nurse.

Mayers (1983) defined patient care planning as **"systematic assessment and identification of problems, the setting up of objectives, and the establishment of methods and strategies for accomplishing them."** It is a systematic approach to planning patient care, which will meet individual needs of the patient. Nursing care plan is the visible and written record of the implementation of care planning. It documents the use of this approach. The components of nursing care plan are nursing assessment of patient, the goals of nursing intervention, the nursing interventions expressed in the form of nursing orders and the evaluation in terms of expected outcome.

Care planning and nursing process is closely linked. The nursing care plan takes into account the patient's background and environment, his likes and dislikes, his response to illness and his ability to cope with his illness and daily life. Because it is a written plan, it is available to all those involved in the care of the patient. It also becomes the basis for reporting sessions.

The information in the nursing care plan should be written in a concise, systematic, simple manner that facilitates use by all the nursing personnel. Care plan is subjected to change as patient's problems change, as priorities change and as problems resolve. Additional information about patient's health is added and care plan may be changed accordingly. A well-developed, continuously updated nursing care plan is the patient's greatest assurance that his problems are resolved and the basic needs will be met. Nursing care plan is to be kept as current and flexible to meet the patient's changing needs. While planning, patients and significant others are involved in all aspects of planning. There are many formats that can be used. What we plan to use is the format which is based on Maslow's hierarchy of needs and Roy's Adaptation model.

Implementation

It is the actual care giving to the patient. Care is personalized to be appropriate for a specific patient. Implementation of a care plan also contributes to continuity of care and coordination of care. Without planning and adequate communication about the plan, patient could experience gaps and duplications of care. Plan guides even flow of nursing care throughout the different stages of illness and coordinates scheduling of diagnostic tests and therapies from other health personnel into an adequate sequence of events. Completed nursing action end the implementation phase.

Evaluation

The final but continuous phase of nursing process is the evaluation or appraisal of the care given. Evaluation of the patient's progress is based on a comparison of the outcome of care given with outcome to be achieved by the nurse/patient/family as stated in the objection. Evaluation of nursing care is the feedback mechanism of judging quality and is designed to improve nursing care.

Sample documentation	
A	Patient, protected
B	• RR-28 breaths/min; moderate, thick secretions. SpO_2 93% on 8% O_2. • Decreased air entry and crepitation at Right base.
C	Cool peripheries
P	100/min regular, BP 100/60 mm of Hg capillary refill 4 seconds
D	AVPU – A
E	• Temperature 37°–40°C. • Nothing else of note on examination.

Contd...

Plan	
• Increase O_2 to 40% and add humidification • Chest physiotherapy • Sample sputum to microbiology • CXR	• Start broad Spectrum antibiotics • IV fluids—1 L NaCl 0.9% over next four hours and review. • Hourly observations for next 4 hours
Reassessment	
Patient improved with increase and humidification of oxygen and IV fluids RR 20 breaths/min; SpO_2 97% • P — 80/min, BP 120/70 Continue current O_2 therapy, IV fluids 1L over 8 hours, 4 hourly observations and inform if: • RR >28 breaths/min • SpO_2 <94% on current oxygen therapy • Pulse >100/min and BP <100 mm Hg systolic	
Documentation	
Most CCU's adopt flow sheets suitable to the needs which incorporate different parameters. Nurse in the unit documents relevant data in the flow sheet.	
Conclusion	
Assessment of the critical ill patient is the prime responsibility of the nurse working in critical care. Prompt assessment helps to identify the change in clinical condition of the patient and current life-threatening complications.	

ADULT ASSESSMENT FORMAT

Information:

Name: _____Occupation: _____

IP No: _____ Age: _____ Sex: _____

Reason for Admission: _____

Admission Date: _____ Time: _____ Diagnosis: _____

Other illness/Operation: _____

General appearance: Well built/thin/obese and other: _____ Weight: _____

Habits: Smoking/alcohol/drug abuse/other:_____

Behavior: Anxious/distressed/depressed/withdrawn/relaxed: _____

Level of consciousness: Conscious/confused/semiconscious/unconscious: _____

Hygiene (Skin, Hair, Nail) clean/dirty/any other:_____

Assessments of daily activities are given in Table 1.38.

TABLE 1.38: Assessments of daily activities

ADL	Subjective data (client) (report)	Objective data (client) (nurse (exhibits) observe/examine	Nursing diagnosis	
			Yes	No
Activity Mobility	Usual activities	Uses aids		
	Limitation	Immobile/partial ambulatory/ambulatory		
	Sleep	Insomnia		
	Pain	Facial grimacing/guarding		
Communication Senses	Eye—vision loss	Wears glasses/aid		
	Ear—hearing loss	Verbal/nonverbal		
	Speech problems	Communication		
	Skin	Temperature		

Contd...

ADL	Subjective data (client) (report)	Objective data (client) (nurse (exhibits) observe/examine	Nursing diagnosis	
			Yes	No
Nutrition	Usual diet	Weight		
	Eating	Recent changes		
	Drinking	Skin		
	Likes/dislikes	Teeth/gum		
	Anorexia	Therapeutic diet		
	Nausea/vomiting	• IV infusion • NGT • Vomiting		
Elimination	Usual bowel Pattern	Bowel sounds		
	Bleeding/constipation diarrhea.	Fees		
	Uses laxative			
	Urine amount	Urine		
	Frequency	Drainage		
	Difficulty	• On CBD/condom • I and O chart		
	Menstruation (female)	Bleeding excess LMP		
Respiration	Cough	Rate of respiration, dyspnea		
	Dyspnea	Breath sounds		
	Sputum	Sputum, cyanosis, cough		
	Smoking	Auscultation use of anesthetics		
Circulation	Chest pain, numbness, tingling	Edema Bleeding Wound Peripheral pulse BP Hb		
	Extremities	Color-temperature Nail beds		
Hygiene	Skin-color/temperature/wound mouth, mouth ulcer/dirty odor, teeth	• ADI independent, dependent partially dependent • Dentures/swallowing		
Ego Integrity	• Stress • Anxiety • Fear	• Calm • Anxious • Sighs deeply		

Nursing Care Plan: Therapeutic management (NPO status)

Nursing diagnosis: Nutrition alteration less than body requirement related to anorexia, critical illness.
Objective: Maintains adequate nutritional status
Expected outcomes: Improves nutritional status

Assessment

- On NPO
- Expresses inability to eat

Contd...

Nursing intervention

- Monitor food intake and observe the type of food patient can have
- Weigh and note the weight change, loss/gain
- Encourage fluid intake
- Maintain favorable eating environment
- If the patient is not able to eat solid, encourage fluid and nutrients
- Administer enteral feeds/intravenous fluid/parenteral feeds as ordered
- Maintain intake and output chart

Nursing diagnosis: Sleep pattern disturbance related to anxiety, confusion, and activity, rest imbalance.
Objective: Improves sleep pattern
Expected outcome: Sleeps a minimum of 6–7 hours.

Assessment

- Does not sleep
- Shows fatigue
- Many procedures are done.

Nursing intervention

- Reduce distractions, identify and reduce discomforts such as noise and anxiety
- Avoid disturbing patients
- Take measure to increase safety
- Provide night lights, provide identification bracelet
- Put up side rails
- Enhance comfort
- Avoid the use of restraints as far as possible
- Design a balanced schedule
- Administer medication as ordered.

Nursing diagnosis: Disturbance in self-concept, self-esteem, body image, role performance.
Goal: Gains self-confidence.
Expected outcome: Maintains self-esteem and accepts body image

Assessment

Loss of body part
Threat to life role change due to admission to ICU.

Nursing intervention

- Increase self-esteem give positive feedback
- Help patient identify strength and potentials.
- Encourage effort toward successfully altering lifestyle
- Encourage adherence to therapeutic regimen
- Provide instructions
- Provide explanations.

Nursing diagnosis: Activity intolerance—fatigue related to disease process.
Goal: Improves activity level.
Expected outcome: Improves activity

Assessment

Lethargic, not able to carry out activity due to the critical nature of illness.

Nursing intervention

- Provide rest periods during the day
- Increase the time of night sleep
- Rearrange routine activities
- Encourage use of relaxation techniques
- Mental imagery
- Administer blood products as ordered if there is blood loss or reduced
- Hemoglobin.

Nursing diagnosis: Risk for impaired skin integrity related to bedridden status
Goal: Maintains intact skin
Expected outcome: No pressure ulcer

Assessment

- Look for signs of pressure ulcer such as reddening of skin
- Identify existing risk factors such as bedridden status
- Continence status both urine and feces
- Immobile, on support measures
- Observe different pressure points

Contd...

Nursing intervention	
• Keep the skin clean, dry and free of pressure, irritant • Turn patient frequently	• Lubricate skin with lotion • Inspect pressure area for evidence of skin redness and breakdown.
Nursing diagnosis: Grieving related to anticipatory loss **Goal:** Grieves in healthy manner and maintains functional support systems. **Expected outcome:** Is able to verbalize	
Assessment	
• Critical nature of illness • Loss of job	• Loss of status • Financial burden
Nursing intervention	
• Encourage verbalization of fears/concerns/questions regarding disease, treatment and future • Encourage active participation of patient and/or family and visit family frequently to establish/maintain relationship and physical closeness • Allow for ventilation of negative feelings • Allow for periods of crying and expression of sadness • Encourage spiritual support	
Nursing diagnosis: Alteration in comfort-pain related to disease process, procedures **Goal:** Increases level of comfort. Reduces pain	
Expected outcome	
• Verbalizes lack of pain	
Assessment	
• Facial grimacing • Verbalizes pain, its severity, location, aggravating and relieving factors • Measures severity of pain in pain scale	
Nursing intervention	
• Assess pain, its location, quality, frequency, duration. • Reassure that pain is real and care will be taken • Assess other factors contributing to pain • Administer analgesics to promote optimum pain relief within the order	• Assess patient's behavioral responses to pain and pain experience • Collaborate with patient, physician and other health care members • Teach new strategies for pain relief such as distraction, imagery, relaxation

SUMMARY

Brief discussion of the nursing process concept is done with emphasis for the two models that are used as a basis for data collection in CCU. Due to the complexity of the critical care unit environment, at certain occasions, the nurse may not be able to carry out the formal assessment immediately after admission. Priority is given for preservation of life and life saving measures and an assessment and care planning can be carried out after the condition is made stable.

NANDA NURSING DIAGNOSIS LIST (2021–2023)

List of Domains

- **Domain 1:** Health Promotion
- **Domain 2:** Nutrition
- **Domain 3:** Elimination and Exchange
- **Domain 4:** Activity/Rest
- **Domain 5:** Perception/Cognition
- **Domain 6:** Self-Perception
- **Domain 7:** Role Relationships
- **Domain 8:** Sexuality
- **Domain 9:** Coping/Stress Tolerance
- **Domain 10:** Life Principles
- **Domain 11:** Safety/Protection
- **Domain 12:** Comfort
- **Domain 13:** Growth/Development

Domain 1: Health Promotion

Class 1: Health Awareness

- Decreased diversional activity engagement
- Readiness for enhanced health literacy
- Sedentary lifestyle

Class 2: Health Management

- Risk for elopement attempt
- Frail elderly syndrome
- Risk for frail elderly syndrome
- Readiness for enhanced exercise engagement
- Deficient community health
- Risk-prone health behavior
- Ineffective health maintenance behaviors
- Ineffective health self-management
- Readiness for enhanced health self-management
- Ineffective family health self-management
- Ineffective home maintenance behaviors
- Risk for ineffective home maintenance behaviors
- Readiness for enhanced home maintenance behaviors ineffective protection

Domain 2: Nutrition

Class 1: Ingestion

- Imbalanced nutrition: less than body requirements
- Readiness for enhanced nutrition
- Insufficient breast milk production
- Ineffective breastfeeding
- Interrupted breastfeeding
- Readiness for enhanced breastfeeding
- Ineffective infant feeding dynamics
- Ineffective adolescent eating dynamics
- Ineffective child eating dynamics
- Obesity
- Overweight
- Risk for overweight
- Ineffective infant suck-swallow response
- Impaired swallowing

Class 2: Digestion

None at present time

Class 3: Absorption

None at present time

Class 4: Metabolism

- Risk for unstable blood glucose level
- Neonatal hyperbilirubinemia
- Risk for neonatal hyperbilirubinemia
- Risk for impaired liver function
- Risk for metabolic syndrome

Class 5: Hydration

- Risk for electrolyte imbalance
- Readiness for imbalanced fluid balance
- Deficient fluid volume
- Risk for deficient fluid volume
- Excess fluid volume

Domain 3: Elimination and Exchange

Class 1: Urinary Function

- Disability associated urinary incontinence
- Impaired urinary elimination
- Mixed urinary incontinence
- Stress urinary incontinence
- Urge urinary incontinence
- Risk for urge urinary incontinence
- Urinary retention
- Risk for urinary retention

Class 2: Gastrointestinal Function

- Constipation
- Risk for constipation
- Perceived constipation
- Chronic functional constipation
- Risk for chronic functional constipation
- Diarrhea
- Dysfunctional gastrointestinal motility
- Risk for dysfunctional gastrointestinal motility

Class 3: Integumentary Function

None at this time

Class 4: Respiratory Function

Impaired gas exchange

Domain 4: Activity/Rest

Class 1: Sleep/Rest

- Insomnia
- Sleep deprivation
- Readiness for enhanced sleep
- Disturbed sleep pattern

Class 2: Activity/Exercise

- Decreased activity tolerance
- Risk for decreased activity tolerance
- Risk for disuse syndrome
- Impaired bed mobility
- Impaired physical mobility
- Impaired wheelchair mobility
- Impaired sitting
- Impaired standing

- Impaired transfer ability
- Impaired walking

Class 3: Energy Balance

- Imbalanced energy field
- Fatigue
- Wandering

Class 4: Cardiovascular/Pulmonary Responses

- Ineffective breathing pattern
- Decreased cardiac output
- Risk for decreased cardiac output
- Risk for impaired cardiovascular function
- Ineffective lymphedema self-management
- Risk for ineffective lymphedema self-management
- Impaired spontaneous ventilation
- Risk for unstable blood pressure
- Risk for thrombosis
- Risk for decreased cardiac tissue perfusion
- Risk for ineffective cerebral tissue perfusion
- Ineffective peripheral tissue perfusion
- Risk for ineffective peripheral tissue perfusion
- Dysfunctional ventilatory weaning response
- Dysfunctional adult ventilatory weaning response

Class 5: Self-Care

- Impaired home maintenance
- Bathing self-care deficit
- Dressing self-care deficit
- Feeding self-care deficit
- Toileting self-care deficit
- Readiness for enhanced self-care
- Self-neglect

Domain 5: Perception/Cognition

Class 1: Attention

Unilateral neglect

Class 2: Orientation

None at this time

Class 3: Sensation/Perception

None at this time

Class 4: Cognition

- Acute confusion
- Risk for acute confusion
- Chronic confusion
- Labile emotional control
- Ineffective impulse control
- Deficient knowledge
- Readiness for enhanced knowledge
- Impaired memory
- Disturbed thought process

Class 5: Communication

- Readiness for enhanced communication
- Impaired verbal communication

Domain 6: Self-Perception

Class 1: Self-Concept

- Hopelessness
- Readiness for enhanced hope
- Risk for compromised human dignity
- Disturbed personal identity
- Risk for disturbed personal identity
- Readiness for enhanced self-concept

Class 2: Self-Esteem

- Chronic low self-esteem
- Risk for chronic low self-esteem
- Situational low self-esteem
- Risk for situational low self-esteem

Class 3: Body Image

Disturbed body image

Domain 7: Role Relationships

Class 1: Caregiving Roles

- Impaired parenting
- Risk for impaired parenting
- Readiness for enhanced parenting
- Caregiver role strain
- Risk for caregiver role strain

Class 2: Family Relationships

- Risk for impaired attachment
- Disturbed family identity syndrome
- Risk for disturbed family identity syndrome
- Dysfunctional family processes
- Interrupted family processes
- Readiness for enhanced family processes

Class 3: Role Performance

- Ineffective relationship
- Risk for ineffective relationship
- Readiness for enhanced relationship
- Parental role conflict
- Ineffective role performance
- Impaired social interaction

Domain 8: Sexuality

Class 1: Sexual identity

None at present time

Class 2: Sexual Function

- Sexual dysfunction
- Ineffective sexuality pattern

Class 3: Reproduction

- Ineffective childbearing process
- Risk for ineffective childbearing process
- Readiness for enhanced childbearing process
- Risk for disturbed maternal–fetal dyad

Domain 9: Coping/Stress Tolerance

Class 1: Post-trauma Responses

- Risk for complicated immigration transition
- Post-trauma syndrome
- Risk for post-trauma syndrome
- Rape-trauma syndrome
- Relocation stress syndrome
- Risk for relocation stress syndrome

Class 2: Coping Responses

- Ineffective activity planning
- Risk for ineffective activity planning
- Anxiety
- Defensive coping
- Ineffective coping
- Readiness for enhanced coping
- Compromised community coping
- Readiness for enhanced compromised community coping
- Compromised family coping
- Disabled family coping
- Readiness for enhance compromised family coping
- Death anxiety
- Ineffective denial
- Fear
- Maladaptive grieving
- Risk for maladaptive grieving
- Readiness for enhanced maladaptive grieving
- Impaired mood regulation
- Powerlessness
- Risk for powerlessness
- Readiness for enhanced power
- Impaired resilience
- Risk for impaired resilience
- Readiness for enhanced resilience
- Chronic sorrow
- Stress overload

Class 3: Neurobehavioral Stress

- Acute substance withdrawal syndrome
- Risk for acute substance withdrawal syndrome
- Autonomic dysreflexia
- Risk for autonomic dysreflexia
- Neonatal abstinence syndrome
- Disorganized infant behavior
- Risk for disorganized infant behavior
- Readiness for enhanced organized infant behavior

Domain 10: Life Principles

Class 1: Values

None at this time

Class 2: Beliefs

Readiness for enhanced spiritual well-being

Class 3: Value/Belief/Action Congruence

- Readiness for enhanced decision-making
- Decisional conflict
- Impaired emancipated decision-making
- Risk for impaired emancipated decision-making
- Readiness for enhanced emancipated decision-making
- Moral distress
- Impaired religiosity
- Risk for impaired religiosity
- Readiness for enhanced religiosity
- Spiritual distress
- Risk for spiritual distress

Domain 11: Safety/Protection

Class 1: Infection

- Risk for infection
- Risk for surgical site infection

Class 2: Physical Injury

- Ineffective airway clearance
- Risk for aspiration
- Risk for bleeding
- Impaired dentition
- Risk for dry eye
- Ineffective dry eye self-management
- Risk for dry mouth
- Risk for adult falls
- Risk for child falls
- Risk for injury
- Risk for corneal injury
- Risk for nipple-areolar complex injury
- Risk for urinary tract injury

- Risk for perioperative positioning injury
- Risk for thermal injury
- Impaired oral mucous membrane integrity
- Risk for impaired oral mucous membrane integrity
- Risk for peripheral neurovascular dysfunction
- Risk for physical trauma
- Risk for vascular trauma
- Adult pressure injury
- Risk for adult pressure injury
- Child pressure injury
- Risk for child pressure injury
- Neonatal pressure injury
- Risk for neonatal pressure injury
- Risk for shock
- Impaired skin integrity
- Risk for impaired skin integrity
- Risk for sudden infant death
- Risk for suffocation
- Delayed surgical recovery
- Risk for delayed surgical recovery
- Impaired tissue integrity
- Risk for impaired tissue integrity

Class 3: Violence

- Risk for female genital mutilation
- Risk for other-directed violence
- Risk for self-directed violence
- Self-mutilation
- Risk for self-mutilation
- Risk for suicidal behavior

Class 4: Environmental Hazards

- Contamination
- Risk for contamination
- Risk for occupational injury
- Risk for poisoning

Class 5: Defensive Processes

- Risk for adverse reaction to iodinated contrast media
- Risk for allergy reaction
- Risk for latex allergy reaction

Class 6: Thermoregulation

- Hyperthermia
- Hypothermia
- Risk for hypothermia
- Neonatal hypothermia
- Risk for neonatal hypothermia
- Risk for perioperative hypothermia
- Ineffective thermoregulation
- Risk for ineffective thermoregulation

Domain 12: Comfort

Class 1: Physical Comfort

- Impaired comfort
- Readiness for enhanced comfort
- Nausea
- Acute pain
- Chronic pain
- Chronic pain syndrome
- Labor pain

Class 2: Environmental Comfort

- Impaired comfort
- Readiness for enhanced comfort

Class 3: Social Comfort

- Impaired comfort
- Readiness for enhanced comfort
- Risk for loneliness
- Social isolation

Domain 13: Growth/Development

Class 1: Growth

None at this time

Class 2: Development

- Delayed child development
- Risk for delayed child development
- Delayed infant motor development
- Risk for delayed infant motor development
- Critical care flow chart is given in Figure 1.25.

MUST KNOW

- Nursing process is a deliberate problem solving approach to the health care need and specific patient problems.
- According to ANA, it is the diagnosis and treatment of human responses to actual or potential health problems.
- Maslow's hierarchy of needs and Roy's adaptation model are used as the basis for care planning.
- Different steps of Nursing Process such as assessment, nursing diagnosis, planning, implementation and evaluation are discussed in detail, while assessment is depicted in a conceptual model.
- Sample assessment format, and patient data with care plan are also incorporated.

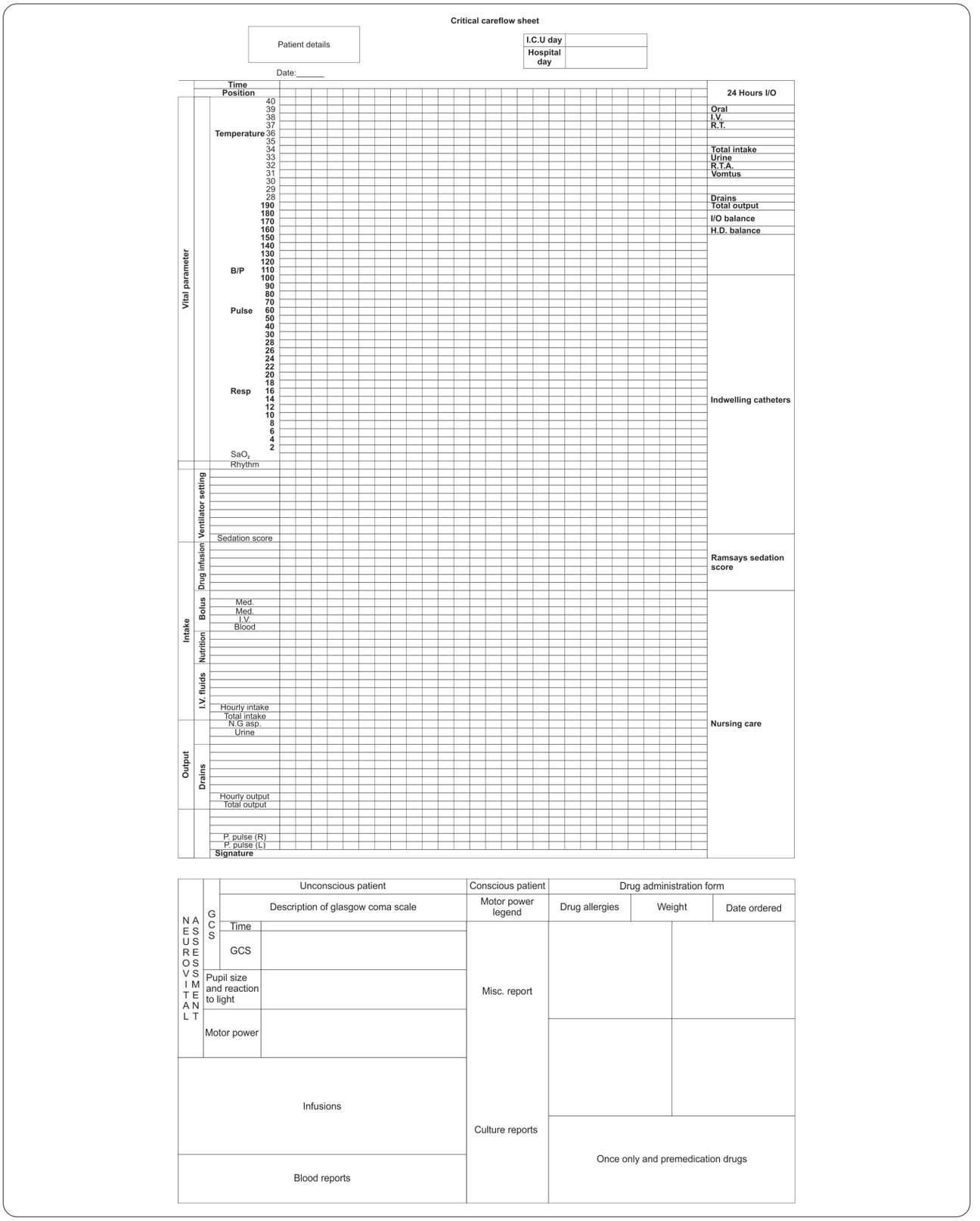


Fig. 1.25: Critical care flow chart

ASSESS YOURSELF

1. Describe Nursing process as applied in Critical Care Unit.
2. Write short notes on:
   - Assessment of critically ill patient
   - Hemodynamic monitoring
   - Assessment in a concept map

CRITICAL THINKING SKILLS

Identify priorities, approach and nursing diagnosis for a 50-year-old woman with metastatic liver cancer. She lives alone and no one accompanied her to hospital. She exhibits already the impending signs of hepatic failure. Prepare a care plan based on the identified nursing diagnosis.

COMMUNICATION IN CRITICAL CARE NURSING

INTRODUCTION

Most vital issue in this field of critical care nursing is that of communication. This takes many forms of communication between patient and nurse, between nurse and doctor, between patient and relatives. Communication can be of two types, verbal and nonverbal. This chapter explores the issues related to communication in critical care nursing. The advancement in medicine and the growth in monitoring and regulating body systems in the critical care unit brought about significant changes in the role of the critical care nurse.

It has extended and expanded to incorporate technical aspects of care, thereby the nurse is forced to focus skills on physiological problems even at the expense of meeting the psychosocial needs of the patient and family. The quality of a critical care nurse depends on the extent to which she has developed whole range of skills which enables her to provide total care to her clients. The patient in critical care unit experiences physiological crisis, a threat to his survival. Uncertainty and threat to life poses a series of real, imagined or potential threats to family members whose main concern is the safety and survival of the patient. The anxiety and distress experienced under these circumstances will have an impact on the excessive demands upon their abilities to cope. (Millar, 1989).

The abnormal patterns of sensory information are received from the patient's internal and external environments. Then patient has to make sense or to interpret these signals, when their cognitive abilities have been affected by the pathophysiology of the illness, the drug therapy. Hence, it leads of inability to communicating easily. Both verbal and nonverbal communication are affected. (Ashworth, 1980, Hudak et al. 1986). The patient has to cope with and deal with his thoughts, feelings of dependency, social isolation, powerlessness, fear, anxiety, insomnia and sensory perceptual alterations characterized by disorientation, restlessness, body image alterations, paranoia and depression. These experiences reduce the motivation to survive.

Communication is fundamental to any human relationship. It involves exchange of information through verbal and nonverbal behavior. To families in critical care, the interpersonal skills of the caregiver make significant change in their overall experience of critical illness. The patients rely on them for information, support, reassurance, comfort, empathy and security. Behaviors, which express this commitment, are motivated by values, which cannot be replaced by technology (Julie. P, 1994).

The nurse is involved in the total care of the patients and their families. The dependency of the patient, complexity of critical illness and modalities of life support add to the complexity of the assessment, data gathering, observation, decision making and coordination of the activities of other members of the multidisciplinary team toward providing high quality care. The nurse plays a key role in coordinating the care and communicating on behalf of the team and ensures continuity of care.

EFFECTIVE COMMUNICATION

Effective communication and good interpersonal relational skills of the caregivers can modify the patient's sensory perceptual alteration. Effective communication has a valuable contribution toward the well-being of the patient, the family and it positively affects the outcome of the illness. Thus it is a challenge for every critical care nurse to develop the effective skills of communication and to incorporate them into her daily routine in spite of the great demands on her time to meet the physiological needs.

Competent communication includes both cognitive and behavioral abilities; the knowledge about the communication process and the skills to enact the knowledge (Wiemann, 1977). It summarizes the process of selecting interaction choices, accomplishing interpersonal goals and recognizing the interpersonal and contextual constraints of communication situations.

In a typical critical care unit, patients are admitted or transferred from other units on an emergency basis. The initial emphasis of nursing care must be to meet the patient's physical and physiological needs working along with the multidisciplinary team to achieve homeostasis. The nurses face the challenge of utilizing their skills in, accurately assessing the patient's problems through the continuous cycle of assessment, planning, implementation and evaluation of the care provided. Once this is achieved, her attention turns to the family who is experiencing major situational crisis caused by the unexpected and unpredictable events. The challenge for the nurse is to enable the patients and the family members to utilize the available resources within themselves to cope with the situation. The ability of the nurse to meet the needs for open and honest information about the patient with the family determines the outcome of the crisis. The nature of distress is complex due to the threat to life, outcome of illness and its long-term effect, the alteration in the family role, degree of trust in the caregivers, comprehension of the information received and the ability to cope with physical, physiological, emotional and environmental stimuli.

The interpersonal goals for the nurses involved in critical care are to:

- Develop open, trusting relationship with patients and their relatives so that they feel free to ask question and doubts.
- Assess the family's ability to grasp the information.
- Repeat and reinforce the information.
- Interpret the medical and technical language.
- Prepare the family for visiting and demonstrating their care and concern to the patient through verbal and nonverbal communication
- Assess the ability of the family to deal with crisis and in assisting with plan of care.

Nurse may have to spend enormous time in getting the patient to cooperate and participate in the activities of care that are planned. Letter boards and nonverbal signs and signals and closed questions which enable the patient to nod or shake the head will assist in maintaining communication with the patient who has impaired communication related to disease process or therapeutic management.

Another event in the critical care unit where communication plays an important role in getting the patient prepared for a transfer from the unit to the dependency developed over the time. It is important to maintain continuity of care between the units and ward areas.

FUNDAMENTALS OF COMMUNICATION THEORY

Communication is a social skill and is learnt through socialization. The environment is where interaction takes place. Exploration is the knowledge derived from both information and transaction theories that offer a framework from which an understanding of the interrelationship between the components of the communication process may be realized. (French,1987; Pegano and Ragan,1992; Wilmort, 1987).

Information Theory

The four elements of communication are the sender, the message, the transmission channel and the receiver. These elements are linked and may be represented by the communication model given below.

The receiver decodes or converts messages into meaning and requires knowledge of the symbols and signals used and the sender and receiver must share the same encoding and decoding processes, for example, same language. The meaning derived may not be the accurate interpretation of what the sender intended to communicate.

Transactional Nature of Communication

In the communication model, communication process is in a unidirectional fashion. But in many occasions, communication is a transactional process in which both participate, play the role of a speaker, listener, observer, encoder, decoder, sender and receiver at the same time and participants affect each other in behavior. The transactional model of communication enables us to focus on the important function of listening, interpreting and giving feedback of checking out accuracy of the interpretations of the message received (Fig. 1.26).

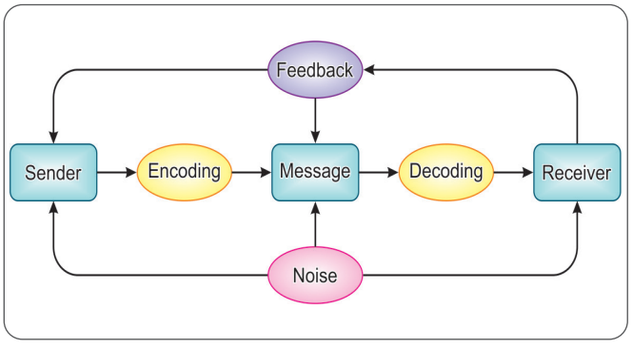


Fig. 1.26: Communication model

Interpretation and Feedback

The skilled communicator checks the accuracy of the messages given and received through feedback mechanism. This is particularly important for a nurse when communicating with a person who has difficulty in encoding messages due to impairment of brain function and memory loss. A person who is anxious or have high emotional state may have difficulty in expressing it.

There may be difficulty in choosing the correct transmission channel or the same due to inability to vocalize which may be caused by intubation or dyspnea. As a result of pathological changes of illness, mechanical constrains of the invasive monitoring or chemical constraints of sedative drugs, the patient may not be able to use appropriate nonverbal gestures. The nurse needs to use feedback techniques to check interpretations of the message through questioning, reflecting and summarizing.

Interference

Interference is anything that will distort or prevent the message from being sent or being received. These include the degree of skill of communicator, noise, use of jargon, attitudes, values socialization, physical, mental limitations, degree of experience and knowledge relating the message.

Barriers to Effective Communication

- **Encoding failure:** Problems arise in thought process due to impaired brain function, delirium, and memory impairment, brain damage as in hemorrhage or brain injury and emotional factors.
- **Transmission failure:** The patient in critical care unit may be intubated or sedated or restricted in movement, for invasive and noninvasive procedures and may be experiencing muscle weakness due to pathophysiology or use of drugs. These will impair the person's ability to speak or communicate.
- **Channel interference:** Channel interference is due to channel overload or attention overload, i.e., is when two people are speaking at one time or when one is speaking too rapidly.

  Attention overload involves competition for the receiver's attention, which can occur frequently within the critical care setting. The nurse may receive a message from the patient while being disturbed by the alarm sound, telephone rings and other information from others. Patient may also experience attention overload from abnormal sensory output such as noise from people, machines, artificial lighting and intensity of interactions with others.
- **Perceptual failure:** Impairment of person's ability to receive sensory stimuli may be limited by reduced visual field resulting in lack of eye contact and facial expression. Patient may have functional loss of sight, hearing and loss of touch. Certain drugs may cause perceptual failure such as blurred vision. The extreme sensory impairment is unconsciousness. Auditory sensation returns before motor ability and that is why a critical care nurse communicates verbally and non-verbally with unconscious patient even when he does not show signs of receiving.
- **Decoding failure:** Receiver may have difficulty in making sense of the message received. It may be difficulty with language or medical technical language that is used. Confusional states, pain, exhaustion and drug therapy may interfere with a person's ability to derive meaning from the message received.
- **Attitude among health care workers:** There are reasons for health care workers to distance themselves from the patients who need emotional help because many believe that emotional exhaustion can occur which can interfere with rational thinking and appropriate decision making. They also fear difficult questions and in certain occasion the inability to answer such questions. They also think it can affect their own emotional health and the whole process can be time consuming. The result of lack of training in communication skills among health caregivers is emotional exhaustion, depersonalization, detachment, burnout and lack of job satisfaction.

Remedial Action

The skill and ability of the nurse to identify and act on the causes of communication failure will enable communication problems to be minimized.

The remedial measures are:-

- Simplify the message
- Strengthen the stimuli
- Change the channel
- Give feedback.
- Give support, encouragement and reinforcement.
- Active listening. This occurs because of the disparity in the speed of talking and listening. Empathetic and active listening is recommended. The right questions facilitate communication.
- Appropriate questioning.

Verbal Communication

Speech is a unique characteristic of human communication. Complex task of communication is carried out without being aware of what is being done. Words have recognized meaning but meaning of a word may change depending on the context of communication. Confrontation and challenging should be part of effective communication, but after having established rapport with patients.

Nonverbal Communication

Nonverbal communication carries major part of the message around 80-90%. It is used subconsciously to express feeling, beliefs, attitudes and emotions. They have the potentials of conveying more than what is being said. Facial movements, gaze, eye contact, gestures, body movements, body posture, touch and body contact are usual modes of nonverbal communication.

Distance

Distance is proximity between people who give important signal.

- Intimate distance 18 inches—nurse and patient
- Personal distance 18 inches—4 ft. between family and friends
- Social distance 4–12 ft—professional
- Public distance 12 ft—public speaking

ISBAR IN CLINICAL HANDOVER

Clinical handover is one of the important step of the patient journey in the hospital and a core skill that need to be taught to all the health care professionals. It ensure that the lapse in continuity of patient care, errors and harm to patient are reduced. The key function of clinical handover is to improve the effectiveness of the actions taken by the recipient/s Evidence suggests the use of structured, standardized frameworks for handover improves information transfer and patient outcomes. The ISBAR (Introduction, Situation, Background, Assessment, Recommendation) framework, endorsed by the World Health Organization (WHO) is a standardized approach to communication which can be used in any situation. ISBAR is based on 'SBAR'—a system developed by the US Navy to ensure clear, precise communications between nuclear submarines.

ISBAR consists of five elements that to be focused during Communication:

1. **Introduction:** Who you are, what is your role and why you are communicating?
2. **Situation:** What is happening at that moment?
3. **Background:** What are the issues that lead to the situation?
4. **Assessment:** What do you believe the problem is?
5. **Recommendations:** What should be done to correct the Problem?

BREAKING BAD NEWS

Breaking bad news in CCU is basically the responsibility of the physician. However, it is very much necessary for the nurse to be aware of the dynamics of the same. Bad news is any information that drastically and negatively alters a person's view of his/her future.

No one likes to be a messenger of bad news. The ancient Greeks killed such messengers! In many health care scenarios, the responsibility usually descends to the most junior member of the team. Health professionals do not generally like their role as a messenger with bad news because their role is perceived as being one in which they are supposed to "make things better".

The reluctance to break bad news is due to combination of factors. It can upset and distress those receiving the news and is perceived as an acknowledgement of the failure to heal. However, it is essential for all health professionals to have this skill so that patients and families can be well informed and make realistic choices. It should be emphasized that although information should be given to all families, not everyone wants active involvement in choosing treatment options, many prefer to be aware of the options but leave the final choice to the doctor. The family must not be forced into making uncomfortable decisions. Also it should not be assumed that they do not want to be involved.

The key to breaking bad news is that it should be done in a way that facilitates realistic understanding and acceptance while minimizing overwhelming distress and negative coping mechanisms such as denial, ambivalence, collusion and unrealistic expectations.

Reaction to Bad News

The reaction of a person to bad news may be:

- **Acceptance:** It occurs if there has been sufficient time between the onset of illness and the diagnosis. It is less likely to occur in an acute situation. However, an apparent acceptance can occur if the news has not **'sunk in'** —these people may need help later.
- **Overwhelming distress:** It occurs if the news is suddenly broken without preparation or support. Using the appropriate skills to break bad news will reduce this distress.
- Denial is a legitimate coping mechanism in the early stages of receiving bad news and is a necessary defense against intolerable emotional pain. Forcing the person to be face to face that this stage is not helpful. They should not be confronted aggressively in a bid to eradicate denial. However, if denial persists, two strategies may be useful:
  1. Firstly, reflect back to the person inconsistencies between their beliefs and the reality.
  2. Secondly, there are times when reality breaks through to those in denial and ask them gently about these periods of doubt. It is an opportunity for them to get back into touch with reality by taking about these doubts.
- **Ambivalence:** An ambivalent response is an initial appearance of accepting the bad news but the person behaves later as if he/she were unaware of the given information.
- **Collusion:** This refers to the request by patient or family members to keep the bad news from others. The desire to collude is driven by love and by the perception that loved

ones need to be protected from painful truths. However, it ultimately leads to loss of mutual support when it is most needed.

- **Unrealistic expectations:** These are related to denial and the propaganda available in the media and the internet.

Framework Breaking Bad News

The following is a suggested framework for breaking bad news:

- **The setting:** Have adequate, complete and relevant information and take the case notes and imaging pictures with you. Have a private area available. All family members who request to be present should be allowed. Sit down comfortably. Initially, ascertain their current understanding of the situation. Start with a short sentence: "I am afraid I have some bad news for you"

  Proceed:
- **Time:** Give the news at a pace the family can understand. Allow pauses to allow for responses and questions, stop if the family has enough to handle in one sitting and get back later.
- **Space:** Give space to the family to absorb the news and interact between themselves.
- **Content:**
  - Don't give more information than can be absorbed. The information must be honest and sensitive. Use plain language, diagrams and imaging pictures to explain. Don't be afraid of saying 'I don't know'. Avoid criticizing colleagues, arguing or defending perceived shortcomings. Say 'Sorry' and acknowledge any genuine mistake. Prioritize the information given and tailor it to the person's needs.
  - Legitimize their feelings and show understanding without being defensive. Use repetition to ensure that the correct message is through. Use humor sparingly and cautiously.
- **Feedback:** Allow expression of feelings and be prepared to handle difficult emotions. Watch the nonverbal language. Check back on their understanding. Encourage questions and allow as many as needed. Address their concerns specifically. Be alert to your own feelings and your ability to cope. Incorporate help from support groups such as counselors, spiritual leaders, social workers as the case may be.

Conclusion

As you conclude, leave the door open for future meetings. Try to leave with some hope—if not for life, at least of having a pain free and comfortable death with dignity. If denial is the predominant response, it will be necessary to talk to them again at a time when they are more in touch with reality. If expectations are unrealistic, it is necessary to explore the basis on which these expectations are held. This dialogue will help them to see their expectations in the light of reality. On the other hand, if you are defensive or challenge these expectations directly, the shift to a realistic mode of thinking will be delayed.

A useful mnemonic for the whole process is:

SPIKES
S – Setting up: The environment privacy, adequate time.
P – Perception: Patient's or relatives' perceptions to be assessed before proceeding
I – Invitation: To break bad news: The 'Warning shot' referred to before
K – Knowledge: Regarding illness and prognosis to be given, in language understandable to the person
E – Emotional: Support to be provided by identifying the emotion and responding to It.

SUMMARY

Summarizing the plan, being available for future doubts and concluding with realistic hope is necessary. Communication is an important aspect of care in critical care units. Critical care nurse has to develop wide range of skills to carry out effective communication in critical care units. She needs to be aware of the modes of communication and barriers to effective communication so that she can carry out effective communication with patients, family and the other members of the team.

MUST KNOW

- Communication is an essential skill which has to be acquired by every critical care nurse.
- Communication is a social skill and it is fundamental to any relationship
- The patients and significant others rely on the nurse for information, support, reassurance, comfort, empathy, and security.
- Effective communication and good inter-personal relationships can modify patient's sensory perceptual alteration.
- The four elements of communication are sender, message transmission, channel and receiver. Interference in communication can occur when there is interference in any of the elements.
- Barriers to effective communication. Nonverbal communication plays a major part in the overall communication

ASSESS YOURSELF

1. Describe the importance of communication in CCU with adequate examples.
2. Differentiate between Verbal and Nonverbal communication.

CRITICAL THINKING SKILLS

A 65-year-old man is admitted to ICU with intracranial bleed. He has previous history of stroke and pneumonia. He develops hypotension and on inotropes for therapy. His son is informed of patient's condition. But every opportunity he gets to meet the doctors and nurses, he keeps on asking about fathers condition.

Q. 1. How will you manage the communication with the relative of this patient?

COUNSELING

Critical care demands dealing with those patients and family who are more often in a state of shock or agony. It is essential to convey honest information and reassurance than the normal way of consoling. The situation is all the more difficult when the illness is sudden and unexpected. The relatives go through guilt, anger, depression and many other negative feelings. It is essential to provide an understanding and accepting atmosphere for them. Nurse is placed at a strategically important and first line contact both with patient and the relatives.

Nurse working in ICU needs to have basic counseling skills to deal with such complex situations.

Counseling is a professional relationship between the counselor and a counselee. Counselor is a person who helps a person in need to deal better with the problem at hand.

Counselor is an expert with specific set of technical skills which are used to help a person to cope with a problem. All those who deal with people in need require counseling skills.

Counseling is a helping relationship. It is not meant to be manipulative relationship in order to be effective in making the counselors' point of view clear.

The most effective counselor is one who can be flexible and can choose the most appropriate method in a given situation.

Counseling skills are useful only in so far as they facilitate the expression of helping human qualities. A person who has learned the techniques of communication skill but lacks the core quality will not be an effective counselor. There are many counseling theories which can be applied. Counselors use different approaches to deal with different situations.

All those who deal with people need to develop counseling skills as there are not enough professional counselors available. Soft skills have an important role in making a significant impact in nurse-patient relationship.

Theory on Counseling

An underlying theory to explain what happens in the process of counseling will depend on one's understanding of the process. Just as the concept of atomic structure facilitates understanding of the physical universe, a theory of 'personhood' will facilitate understanding the complexity and richness of human experience and relationships. A theory is a 'Map' useful in unfamiliar territory when interpersonal interactions swerve into unexpected turbulences and helps not only to understand these interactions but also to avoid unhelpful lapses into one's own insecurities. There are many such theoretical constructs and a useful one is based on the "Person Centered Theory" of Carl R Rogers.

The self-structure consists of the beliefs and values relating to the self and the world which gives meaning to life. Beliefs may be based on one's own experiences or be handed down from parents and the society one lives in. Experience alone cannot usually change the self-structure (Fig. 1.27).

Experience consists of all that is sensed from the outside world through the five senses as well as from the internal visceral sense(s). A person always tries to integrate one's experiences with his or her self-structure. This drive to accept and integrate important experiences into one's self structure is

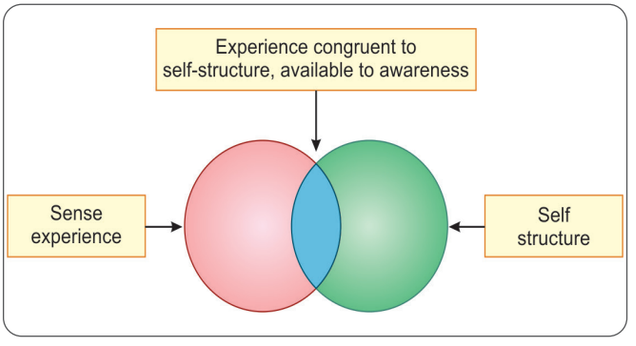


Fig. 1.27: Self-structure based on experience

shown as the actualizing tendency. The actualizing tendency constantly tries to achieve harmony between experiences and self-structure.

When any experience is at odds with the self-structure, emotional discomfort and pain occur. The more rigid one's self-structure is, the more is the emotional discomfort.

According to the Rogerian model, there are six conditions for relaxation of self-structure and acceptance of experience which can lead to a positive change in the personality.

For constructive personality change to occur, it is necessary that these conditions exist and continue over a period of time:

1. Two persons are in psychological contact.
2. The first, whom we shall term the client, is in a state of incongruence, being vulnerable or anxious.
3. The second person, whom we shall term the therapist, is congruent or integrated in the relationship.
4. The therapist experiences unconditional positive regard for the client.
5. The therapist experiences an empathic understanding of the client's internal frame of reference and endeavors to communicate this experience to the client.
6. The communication to the client of the therapist's empathic understanding and unconditional positive regard is to a minimal degree achieved.

No other conditions are necessary. If these six conditions exist, and continue over a period of time, this is sufficient. The process of constructive personality change will follow.

Core Qualities

The core qualities needed for counseling are GEL

- **G-Genuineness:** It is the ability to be honest and open about one's needs feelings and ideas. It has three components, self-awareness, self-acceptance and expression.
- **E-Empathy:** Empathy is a helping attitude and experiencing the feeling of others. It is rather feeling with others without losing one's own identity. Empathy helps to listen to the other side of the story as the other person chooses to narrate and to note the special significance while listening. Empathy dissolves into sympathy which should be avoided at all times.
- **The components of empathy are:**
  - Understand the situation
  - Understanding others feeling without drowning into theirs.
  - Communicating one's empathetic understanding to the other.
- **L-Love:** In the counseling relationship, it means that one seeks the highest possible good for the other person. In this context, love is an attitude not an emotion. It is non-possessive and empowers the other person and it also accepts other person's point of view.

Skills of a Counselor

There are additional skills that are required of a counselor:

- **Listening:** Ears hear and we listen with our whole self
- **Appropriate questioning:** The right question can facilitate good communication

SUMMARY

Effective skill in communication is a fundamental skill required for all health care workers to make them effective counselors as well. It helps nurse deal with patient's conflict and her own conflicts if she develops the counseling skills.

MUST KNOW

- Nurses, as they deal with patients undergoing problems and emotional turmoil, have to develop skills in counseling. We also lack professional counselors in our hospitals which is another reason nurses have to develop this skill. Nurses at senior level have to deal with conflicts that may arise in the critical care units.
- Core qualities of a counselor are genuineness, empathy, and love.
- Active and empathetic listening and appropriate questioning skills are required for a good counselor.

The whole process of counseling can be summarized as the synonym of SPIKES. They are:

- Setting up of conducive environment
- Perception–assessment
- Invitation
- Knowledge regarding Illness
- Emotional support
- Strategy and summary

ASSESS YOURSELF

1. Discuss the role of nurse in counseling in CCU.
2. Write short notes on:
   - Core qualities of a counselor
   - Listening and questioning
   - Theory of counseling

CRITICAL THINKING SKILLS

Mr A who is paraplegic for years is admitted with pneumonia and his ABG levels are deteriorating rapidly. He doesn't want intubation and any other life supporting devices. However relatives insist that everything possible should be done to him till the natural end. How would you counsel the patient and the relatives?

PRESSURE SORE PREVENTION AND MANAGEMENT IN CRITICAL CARE UNITS

PRESSURE ULCER

- A Pressure ulcer is an area of localized damage to the skin and underlying tissue caused by pressure, shear, friction and/or a combination of these.
- European Pressure Ulcer Advisory Panel EPUAP (2003) has developed the prevention strategies.
- Commonly referred to as bed sores, pressure damage, pressure injuries and decubitus ulcers

Why are pressure ulcers important?

- An estimated 4–10% of patients admitted to an acute care hospital develop a pressure ulcer
- Major cause are sickness, reduced quality of life and morbidity
- Associated with a 2–4-fold increase in risk of death in older people in intensive care units
- Substantial financial costs are related to pressure ulcer management.

Classification

Category/Stage I: Nonblanchable Erythema

- Intact skin with nonblanchable redness of a localized area usually over a bony prominence.
- Darkly pigmented skin may not have visible blanching; its color may differ from the surrounding area.
- The area may be painful, firm, soft, warmer or cooler as compared to adjacent tissue.
- Category I may be difficult to detect in individuals with dark skin tones.
- May indicate **'at risk'** persons.

Category/Stage II: Partial Thickness

- Loss of dermis presenting as a shallow open ulcer with a red pink wound bed, without slough.
- May also present as an intact or open/ruptured serum-filled or sero-sanginous filled blister.
- Presents as a shiny or dry shallow ulcer without slough or bruising*.
- This category should not be used to describe skin tears, tape burns, incontinence associated dermatitis, maceration or excoriation.

**Bruising indicates deep tissue injury.*

Category Stage III: Full Thickness Skin Loss

- Subcutaneous fat may be visible but bone, tendon or muscles are not exposed.
- Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling.
- The depth of a Category/Stage III pressure ulcer varies by anatomical location.
- The bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue and Category/Stage III ulcers can be shallow.
- In contrast, areas of significant adiposity can develop extremely deep Category/Stage III pressure ulcers.
- Bone/tendon is not visible or directly palpable.

Category/Stage IV: Full Thickness Tissue Loss

- Full thickness tissue loss with exposed bone, tendon or muscle.
- Slough or Escher may be present.
- Often includes undermining and tunneling.
- The depth of a Category/Stage IV pressure ulcer varies by anatomical location.

- The bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue and these ulcers can be shallow.
- Category/Stage IV ulcers can extend into muscle and/or supporting structures (e.g., fascia, tendon or joint capsule) making osteomyelitis or osteitis likely to occur.
- Exposed bone/muscle is visible or directly palpable.

Additional Categories/Stages

- Unstageable/Unclassified: Full thickness skin or tissue loss—depth unknown.
- Full thickness tissue loss in which actual depth of the ulcer is completely obscured by slough (yellow, tan, gray, green or brown) and/or Escher (tan, brown or black) in the wound bed.
- Until enough slough and/or Escher are removed to expose the base of the wound, the true depth cannot be determined; but it will be either a Category/Stage III or IV. Stable (dry, adherent, intact without erythema or fluctuance) eschar on the heels serves as "the body's natural (biological) cover" and should not be removed.
- Suspected deep tissue injury—depth unknown
- Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear.
- The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent tissue.
- Deep tissue injury may be difficult to detect in individuals with dark skin tones.
- Evolution may include a thin blister over a dark wound bed.
- The wound may further evolve and become covered by thin eschar.
- Evolution may be rapid exposing additional layers of tissue even with optimal treatment.

Risk Factors for Pressure Sores

- Age above 70 years
- Malnutrition-poor diet, deficient in protein, zinc and vitamin C
- Immobility
- Smoking: Nicotine impairs circulation and reduces the amount of oxygen reaching the skin
- Neurologic status: Decreased sensorium, lack of pain perception
- Urinary or fecal incontinence
- Other medical conditions
- Those which impair tissue oxygenation—anemia, diabetes mellitus, vascular disease
- Those which affect wound healing-Use of steroids, diabetes mellitus
- Those which cause repeated trauma from pressure, friction and shear forces, muscle spasms and contracture

Causes

- **Pressure-Shear force:** Parallel in opposite directions, sliding down in bed or chair, raising the head of the bed more than 30 degrees are likely to cause shearing force, which tears cell walls and tiny blood vessels.
- **Friction:** Two surfaces rubbing against each other when skin moves in one direction and underlying bone moves in another direction.
- **Moisture:** The moisture builds up due to incontinence, perspiration, inadequate drying after sponge bath can result in bacterial growth.

Prevention and Treatment of Pressure Ulcers

Assessment

- Risk factors and Risk assessment tools
- It is necessary to identify at risk individual who need preventive measures and to find out specific factors causing them to be at risk
- Risk assessment should be used as adjunct to clinical judgment
- Full assessment in patients to include general Medical Conditions:
  - Mobility
  - Moisture
  - Incontinence
  - Nutrition
  - Pain

Risk Assessment Tools
- Norton scale
- Braden Scale

Assessment of risk should be more than just the use of an appropriate risk tool. Assessment should be ongoing and frequency of reassessment should depend on patient's condition and environment. It is also necessary to maintain and improve tissue tolerance to pressure in order to prevent tissue injury. Skin condition should be documented daily and any changes should be recorded as soon as they are observed. Initial skin assessment should take into account the pressure points and identify early skin damage and also to identify the condition of the skin such as dryness, cracking, erythema, maceration, fragility, heat and induration. Every effort is made to optimize the skin of the patient. Avoid excessive rubbing over bony prominences as this does not prevent pressure damage and may cause additional damage. Find the source of excess moisture due to incontinence, perspiration, wound drainage and eliminate them wherever possible. When moisture cannot be avoided, interventions that can assist in preventing skin damage should be used.

Skin injury due to friction and shearing forces can be minimized through correct positioning, transferring and, re-positioning techniques. Nutritional compromised patients should receive adequate nutritional support and or supplementation. Maintaining activity level, mobility and range of movement is an appropriate goal for most individuals. Braden scale is given Tables 1.39 and 1.40.

TABLE 1.39: Braden scale

Sensory perception	Unresponsive	Very limited	Slightly limited	No impairment
Ability to respond meaningfully to pressure-related discomfort	(Does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation OR Limited ability to feel pain over most of body	Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness OR Has sensory impairment which limits the ability to feel pain or discomfort over half of body	Responds to verbal commands, but cannot always communicate discomfort or the need to be turned. OR Has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities	Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.
Moisture	**Constantly moist**	**Very limited**	**Occasionally moist**	**Rarely moist**
Degree to which skin is exposed to moisture	• Skin is kept moist constantly by perspiration, urine, etc. • Dampness is detected every time patient is moved or turned	• Skin is often, but not always moist. • Linen must be changed at least once a shift.	• Skin is occasionally moist, requiring an extra linen change approximately once a day	• Skin is usually dry, linen only requires changing at routine intervals.
Activity	**Bedfast**	**Chair fast**	**Walks occasionally**	**Walks frequently**
Degree of physical activity	Confined to bed	• Ability to walk severely limited or nonexistent. • Cannot bear own weight and/or must be assisted into chair or wheelchair	• Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.	Walks outside room at least twice a day and inside room atleast once every two hours during walking hours.
Mobility	**Completely immobile**	**Very limited**	**Slightly limited**	**No limitation**
Ability to change and control body position	Does not make even slight changes in body or extremity position without assistance.	Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently	Makes frequent though slight changes in body or extremity position independently	Makes major and frequent changes in position without assistance.
Nutrition	**1. Very poor**	**2. Probably**	**3. Adequate**	**4. Excellent**
Usual food intake pattern	Never eat a complete meal. Rarely eats more than half or any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement. OR Is NPO and/or maintained on clear liquids or IV for more than 5 days	Inadequate Rarely eats a complete meal and generally eats only about half of any food offered. Protein intake includes only 3 servings of meat or dairy products per day Occasionally will take a dietary supplement OR Receives less than optimum amount of liquid diet or tube feeding	Eats over half of most meals. Eats a total of 4 servings of protein (meat, dairy products per day. Occasionally will refuse a meal, but will usually take a supplement when offered. OR Is on a tube feeding or TPN regimen which probably meets most of nutritional needs.	Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation

Sensory perception	Unresponsive	Very limited	Slightly limited	No impairment
Friction and Shear	**1. Problem**	**2. Potential problem**	**3. No apparent problem:**	
	• Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. • Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. • Spasticity, contractures or agitation leads to almost constant friction.	• Moves feebly or requires minimum assistance. • During a move skin probably slides to some extent against sheets, chair, restrains or other devices. • Maintains relatively good position in chair or bed most of the time but occasionally slides down	• Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. • Maintains good position in bed or chair.	

TABLE 1.40: **Braden scale score for predicting risk of pressure sore**

Braden skin assessment score	Nursing actions
At risk** Score 15–18 **If other major risk factors are present (advanced age, fever, poor dietary intake of protein, diastolic pressure below 60, hemodynamic instability) Advance to the next level of risk	• Frequent turning • Maximal remobilization • Protect heels Pressure reduction support surface if bed or chair bound • Manager moisture, nutrition and friction and shear
Moderate risk** Score 13–14	• Implement turning schedule • Use foam wedges for 30 degree lateral positioning • Pressure-reduction support surface • Maximal remobilization • Protect heels • Manage moisture, nutrition and friction and shear
High risk Score 10–12	• Increase frequency of turning; supplement with small shifts • Pressure reduction support surface • Use foam wedges for 30 degree lateral positioning • Maximal remobilization • Protect heels • Manage moisture, nutrition and friction and shear
Very high risk Score 9 or below	• Implement all the above • Use pressure –relieving surface if patient has intractable pain or severe pain exacerbated by turning on has additional risk factors

Points at Risk of Developing Pressure Ulcers

Risk Factors

- Pressure
- Shearing/friction
- Level of mobility
- Sensory impairment
- Continence
- Level of consciousness
- Acute, chronic and terminal illness
- Comorbidity
- Posture
- Cognition, psychological status
- Previous pressure da mage
- Extremes of age
- Nutrition and hydration status
- Moisture to the skin

Risk Assessment Policy

- Establish a risk assessment policy in all health care settings.
- Educate health care professionals on how to achieve an accurate and reliable risk assessment.
- Document all risk assessments.
- Risk assessment tools should only be used as an aide memoire and should not replace clinical judgment.
- If use of a risk assessment tool is preferred, it is recommended that a scale that has been tested for use is chosen.

Risk Assessment Practice

- Use a structured approach to risk assessment to identify individuals at risk of developing pressure ulcers.
- This includes assessment of activity and mobility. Consider individuals who are bedfast and/or chair-fast to be at risk of pressure ulcer development.
- This also includes a comprehensive skin assessment to evaluate any alterations to intact skin. Consider individuals with alterations to intact skin to be at risk of pressure ulcer development.

Skin Assessment

- Persistent erythema
- Non-blanching hyperemia
- Blisters
- Localized heat
- Localized edema
- Localized pain
- Localized induration
- Purplish/bluish localized areas
- Localized coolness if tissue death occurs

Pressure Ulcer Development

Consider the impact of the following factors on an individual's risk of pressure ulcer development:

- Nutritional indicators
- Factors affecting perfusion and oxygenation
- Skin moisture
- Advanced age

Conduct a structured risk assessment on admission, and repeat as regularly and as frequently as required by the individual's condition. Reassessment should also be undertaken if there is any change in patient condition. Develop and implement a prevention plan when individuals have been identified as being at risk of developing pressure ulcers.

Pressure Ulcer Prevention

Skin Care

- Whenever possible, do not turn the individual onto a body surface that is still reddened from a previous episode of pressure loading.
- Do not use massage for pressure ulcer prevention
- Do not vigorously rub skin that is at risk for pressure ulceration.
- Use skin emollients to hydrate dry skin in order to reduce risk of skin damage.
- Protect the skin from exposure to excessive moisture with a barrier product in order to reduce the risk of pressure damage.

Nutrition for Pressure Ulcer Prevention

Provide nutritional support to each individual with nutritional risk and pressure ulcer risk, following the nutritional cycle. This should include:

- Initial Nutritional assessment
- Estimation of nutritional requirements
- Comparison of nutrient intake with estimated requirements
- Provide appropriate nutrition intervention, based on appropriate feeding route
- Monitoring and evaluation of nutritional outcome, with reassessment of nutritional status at frequent intervals while an individual is at risk.

Repositioning for the Prevention of Pressure Ulcers

- Repositioning should be undertaken to reduce the duration and magnitude of pressure over vulnerable areas of the body.
- Repositioning frequency will be determined by the individual's tissue tolerance, his/her level of activity and mobility, his/her general medical condition, the overall treatment objectives, and assessments of the individual's skin condition.
- Repositioning frequency should be influenced by the support surface used.
- Record repositioning regimes, specifying frequency and position adopted, and include an evaluation of the outcome of the repositioning regime.

Gaps in Prevention Programs

One example of a gap in many pressure ulcer prevention programs is the common practice in hospitals to provide pressure ulcer prevention education only to nurses and nursing assistants. Prevention strategies typically are not taught to other members of the health care team such as physicians, interns, and ancillary staff even though they spend

a significant amount of time with patients. Education for patients, families, and other caregivers and communication with them also often is missed.

What should we do when the ulcer has already occurred?

- Assessment of the individual with a pressure ulcer
- Complete an initial assessment of the individual with a pressure ulcer, that includes a complete health/medical and social history.

A focused physical examination includes:

- Factors that may affect healing (e.g., impaired perfusion, impaired sensation, systemic infection)
- Vascular assessment in the case of extremity ulcers (e.g., physical examination, history of claudication, and ankle-brachial index or toe pressure)
- Laboratory tests and X-rays as needed
- Nutritional assessment.
- Pain related to pressure ulcers.
- Risk for developing additional pressure ulcers.
- Psychological health, behavior and cognition.
- Functional capacity, particularly in regard to positioning, posture, and the need for assistive equipment and personnel.
- The employment of pressure-relieving maneuvers.
- Adherence to pressure-relieving maneuvers.
- Integrity of seating and bed surfaces (wear and tear).
- The individual's/family member's knowledge and belief about developing and healing pressure ulcers.

Reassess the individual if the ulcer does not show signs of healing as expected despite adequate local wound care, pressure redistribution, and nutrition—expect some signs of healing within two weeks.

Assessment of Pressure Ulcer

Assess

- Cause
- Site/location
- Dimensions
- Stage or grade
- Exudate amount and type
- Local signs of infection
- Pain
- Wound appearance
- Surrounding skin
- Undermining/tracking, sinus or fistula
- Odor
- Record
- Document
- Depth
- Estimated surface area
- Grade using EPUAP scoring
- Support with photography and/or tracings
- Document all pressure ulcers graded 2 and above as a clinical incident

Nutrition for Pressure Ulcer Healing

- Screen and assess nutritional status
- Provide sufficient calories
- Provide adequate protein for positive nitrogen balance
- Provide and encourage adequate daily fluid intake for hydration
- Provide adequate vitamins and minerals
- Offer each individual with nutrition of a minimum of 30–35 kcal/kg body weight per day with 1.5 kg/day protein and 1 mL of fluid per kcal per day.

Pain Assessment and Management

- Assess for pain
- Prevent pain
- Manage general pain
- Reduce debridement pain
- Manage chronic pain
- Educate individuals, family and health care providers

Support Surfaces for Treatment of Pressure Ulcers

- Prevention in individuals at risk should be provided on a continuous basis during the time that they are at risk (strength of evidence-c)
- Do not base the selection of support surfaces solely on the perceived level of risk for pressure ulcer development or the category/stage of any existing pressure ulcer (S of evidence-c).
- Selection of an appropriate support surface should be taken into consideration the factors such as individual's level of mobility within the bed, the need for micro climate control, and the place and circumstances of care provision.
- Choose a support system that is compatible with the care setting (S of E-c).
- Not all support surfaces are compatible with every care setting. In the home setting, other factors also to be considered.

Mattress and Bed Use in Pressure Ulcer Prevention

- Use higher specification mattresses rather than standard hospital foam mattresses for all individuals assessed as being at risk for pressure ulcer development (S of E- A)
- There is no evidence of superiority of one higher specification foam mattress over alternative higher specification foam mattress (S of E-A)
- Use an active support surface (overlay or mattress for patients at higher risk of pressure ulcer development

where frequent manual repositioning is not possible (S of E-B). When high risk patients cannot be repositioned manually, active support surfaces are needed as they can change their load distribution properties. Do not use small cell alternating pressure air mattresses or overlays because alternating pressure air mattress with small air cells diameter less than 10 cm cannot be sufficiently inflated to ensure pressure relief over the deflated air cells.

- Continue to turn and reposition where possible, all individuals at risk of developing pressure ulcers.

Repositioning for the Prevention of Pressure Ulcers

- The use of repositioning should be considered for all patients at risk.
- Repositioning should be undertaken to reduce the duration and magnitude of pressure over vulnerable areas of body (S of E- A)
- High pressure over bony prominences for short time and low pressure over bony prominences are equally damaging. It is important to reduce the duration and the amount of pressure the patient is exposed to. The use of repositioning as a prevention strategy must take into consideration the condition of the patient and the support surface in use.

Frequency of Repositioning

- It should be influenced by variables concerning the individual strength and the support surface in use.
- Repositioning frequency is determined by the individual's tissue tolerance, the level of activity and mobility, general medical condition, the overall treatment objectives and assessment of the individual skin condition. If the patient is not responding to present regime, reconsider the frequency and method of repositioning.
- Repositioning frequency should be influenced by the support surface used. (S of EA)
- A patient on non-pressure redistributing mattress should be repositioned with greater frequency than on visco elastic foam mattress. The repositioning frequency depends on the pressure redistributing qualities of support surface.

Repositioning Technique

Repositioning improves the patient's comfort, dignity and functional ability.

Use 30° tilted side lying position alternately right side, back and left side or prone position if not contra indicated.

Reposition the patient in such a way that the pressure is relieved or redistributed. It is necessary to avoid subjecting the skin to pressure and shear forces while repositioning. Use transfer aids to reduce friction and shear. Do lift the patient rather than dragging the patient on bed while repositioning. Avoid positioning the patient directly onto medical devices such as tubes and drainage systems and avoid positioning the patient on bony prominences with non-blanchable erythema. Avoid postures that increase pressure such as 90° side lying position or semi-recumbent position.

Documentation

Record repositioning regimes, specifying frequency and position adopted and include an evaluation of the outcome of repositioning technique.

Heel Pressure Ulcers

Use appropriate support surfaces to prevent heel pressure ulcers. Ensure that the heels are free of the surface of the bed. Heel protection devices should elevate the heel completely in such a way as to distribute the weight of the leg along the calf without putting pressure on the Achilles tendon. The knee is to be kept in slight flexion as hyper extension of the knee may cause obstruction of the popliteal vein and it predisposes the patient to Deep Vein thrombosis. Use a pillow under the calves so that the heels are elevated and inspect the skin of heel regularly.

Cleansing

- Cleanse the pressure ulcer and surrounding skin at the time of each dressing change.
- Cleanse the pressure ulcer using an irrigation solution, and apply sufficient pressure to cleanse the wound without damaging tissue or driving bacteria into the wound.
- Collect and properly dispose of used irrigation solution to reduce cross-contamination.

Debridement

- Debride devitalized tissue within the wound bed or edge of pressure ulcers when appropriate to the individual's condition and consistent with overall goals of care.
- Select the debridement method(s) most appropriate to the individual's condition; goals of care; ulcer/peri-ulcer status; type, quantity, and location of necrotic tissue; care setting; and professional accessibility/capability.

Surgical debridement may be performed in the presence of advancing cellulitis, crepitus, and/or sepsis secondary to ulcer-related infection.

Dressings

Wound dressings are a central component of pressure ulcer care. The selection of the dressing should be based on the tissue in the ulcer bed, the condition of the skin around the

ulcer bed, and the goals of the person with the ulcer. Generally maintaining a moist ulcer bed is the ideal when the ulcer bed is clean and granulating to promote healing or closure. Several moisture-retentive dressings are available. However, the type of dressing may change over time as the ulcer heals or deteriorates.

General Recommendations

- Assess pressure ulcers at every dressing change and confirm the appropriateness of the current dressing regimen.
- The plan of care should guide usual dressing wear times and contain provisionary plans for dressing changes as needed (for family, the individual, and staff) due to soiling, loosening, etc.
- Choose a dressing to keep the wound bed moist.
- Choose a dressing that remains in contact with the wound bed or skin barrier product to keep the peri-wound dry and prevent maceration.

Transparent Dressings

Transparent dressing is shown in Figure 1.28.

Assessment and Treatment of Infection

- Infection may spread beyond the pressure ulcer, resulting in serious systemic infections such as cellulitis, fasciitis, osteomyelitis, systemic inflammatory response syndrome (SIRS), or sepsis.

Fig. 1.28: Transparent Dressings

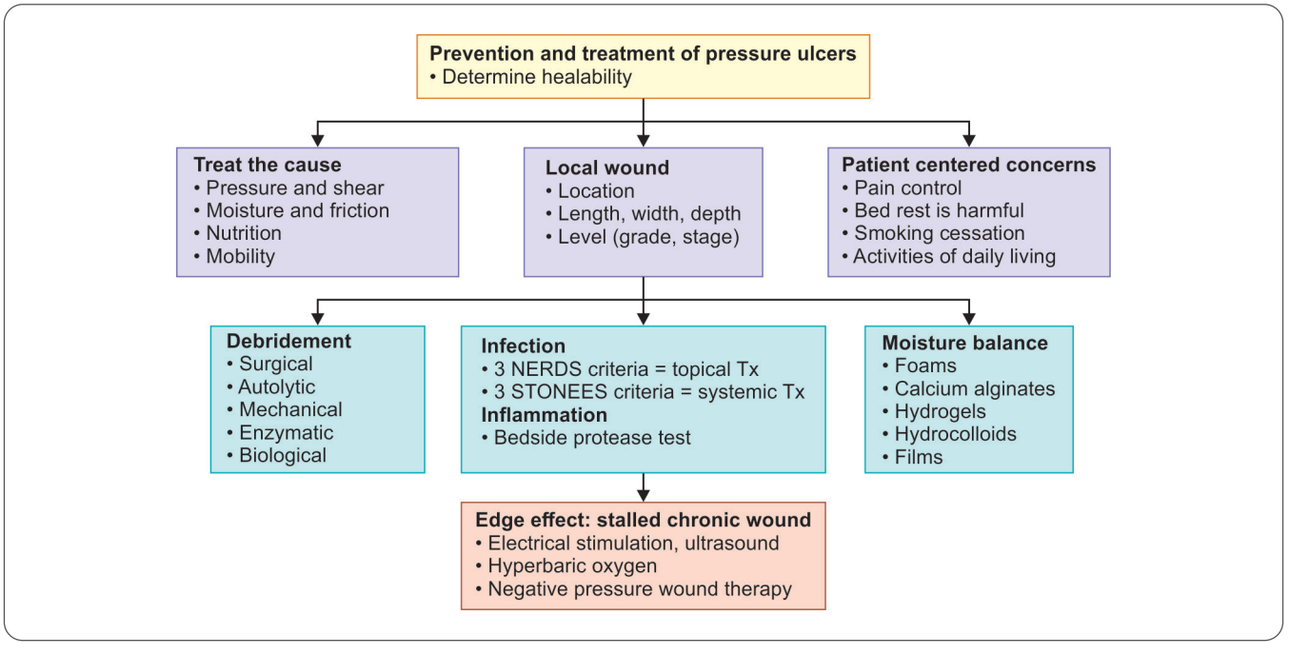
- To avoid these serious consequences, the professional should focus on identification of high-risk individuals, prevention, early detection, and prompt, effective treatment of pressure ulcer infection.

Biophysical Agents in Pressure Ulcer Management

- Electrical stimulation
- Electromagnetic agents
- Phototherapy (laser, infrared, ultraviolet)
- Acoustic energy (ultrasound)
- Negative pressure wound therapy
- Hydrotherapy: Whirlpool and pulsatile lavage with suction.

Wound bed preparation paradigm for holistic patient are is given in Flowchart 1.3 and quality indicators are shown in Figure 1.29.

Flowchart 1.3: Wound bed preparation paradigm for holistic patient care



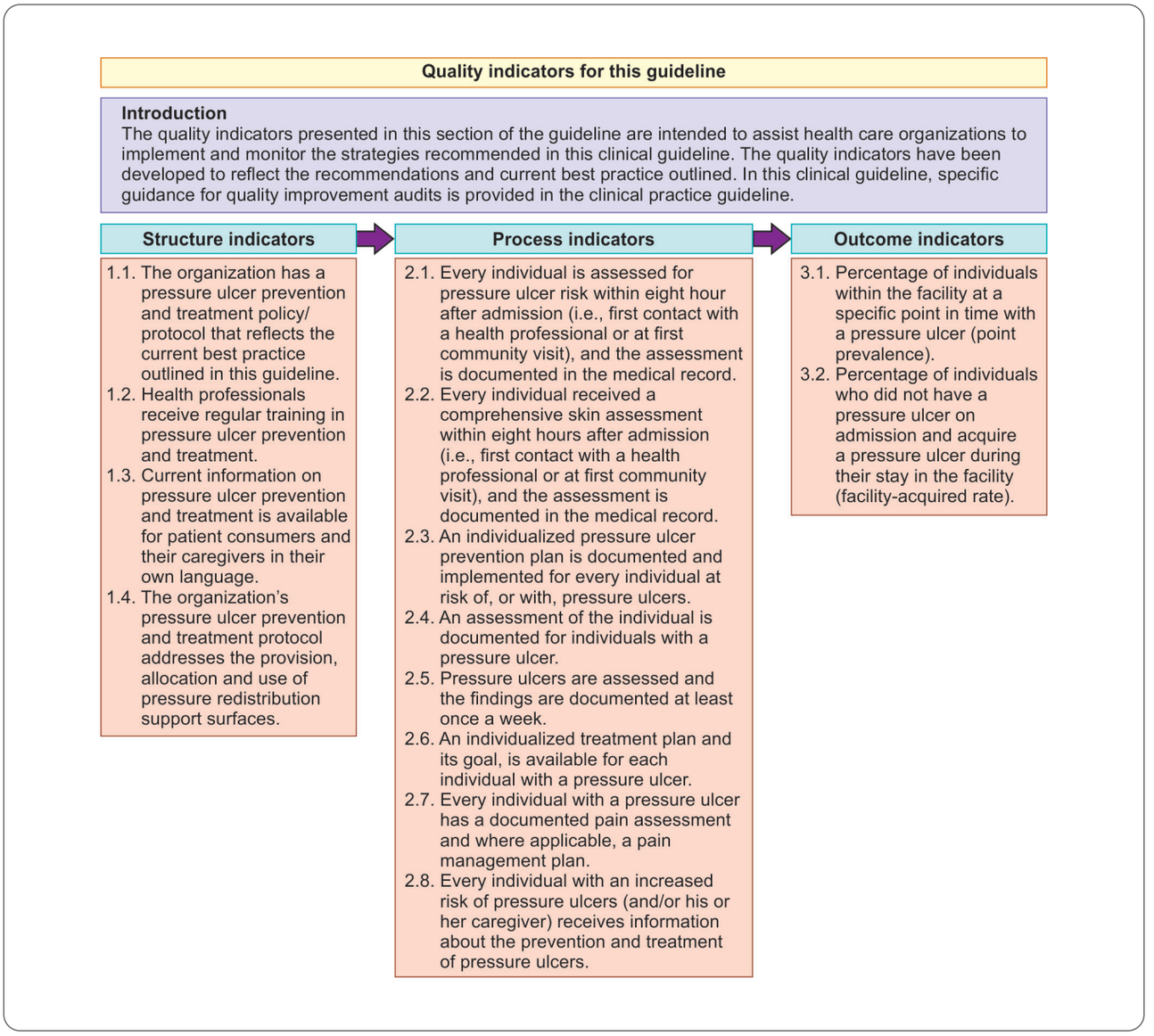


Fig. 1.29: Quality Indicators

Remember: Treat the WHOLE patient and not just the HOLE in the patient...!!!

A Quick Reference Guide summarizes evidence-based guidelines on pressure ulcer prevention and treatment in 2009. It was developed as a 4-year collaborative effort between the European Pressure Ulcer Advisory Panel (EPUAP) and American National Pressure Ulcer Advisory Panel (NPUAP).

Quality Indicators Guideline for Pressure Ulcer

MUST KNOW

- Prevention and management of pressure ulcers are independent nursing functions.
- Therefore, nurse has to be equipped to assess and identify the risk for developing pressure sores and initiating pressure sore prevention strategies at the earliest.

ASSESS YOURSELF

1. Discuss the various pressure sore prevention strategies in critical care units.
2. Write short notes on:
   - Risk factors of pressure ulcer
   - Risk assessment
   - Scales used in assessment of pressure ulcers
   - Dressing used in management of pressure ulcers
   - Repositioning
   - Biophysical management of pressure ulcer

CRITICAL THINKING SKILLS

While repositioning patients, the nurse should avoid dragging the patient across the surface. What is the justification for this statement?

DELIRIUM, AGITATION, SEDATION, ANALGESIA

DELIRIUM

Delirium is an abnormal 6th vital sign. It is the state of altered mood with cognitive impairment characterized by an insidious onset, with disorganized thinking, altered level of consciousness and a fluctuating course. It is an acute and potentially reversible organic dysfunction. About 11–83% of occurrence is reported. 80% mechanically ventilated patients are in delirium. Delirium may predispose to other complications such as pressure ulcer

It is defined as a disturbance of consciousness with inattention accompanied by a change in cognition or perceptual disturbance that develops over a short period of time and fluctuates over time. Risk factors for delirium are given in Table 1.41

Mnemonic for ICU Delirium

I watch DM

- **I**nfection
- **W**ithdrawal of alcohol and drugs
- **A**-Alcohol induced
- **T**-Trauma,
- **C**-Primary CNS pathology
- **H**-Hypoxia, Hypertension,
- **D**-Deficiencies,
- **M**-Metabolic encephalopathy

Types of Delirium

There are three types of delirium

1. Hyperactive (ICU psychosis)
2. Hyperactive (quite delirium)
3. Mixed (fluctuation between hypo/hyper

TABLE 1.41: Risk factors for delirium

Co-existing patient factors	Factors relating to critical illness	Iatrogenic factors
Old age • Alcoholism/substance abuse • Drug withdrawal especially alcohol and benzodiazepines • Hypertension: Hypertensive encephalopathy, stroke, arrhythmias	**Acidosis** **Hypoxemia:** • Anemia, pulmonary or cardiac failure • Sepsis/fever • Hypotension • Metabolic and electrolyte disturbances.	**Medication:** • Most commonly sedative, anesthetic and analgesic agents, but also psychotropic drugs • Sleep disturbance • Immobilization
Vitamin deficiencies: Vitamin B_{12}, folate, niacin, thiamine.	**Hepatic and renal failure** **Poisons:** Carbon monoxide, metabolic blockade, pesticides, solvents, mercury, lead	
Endocrine disorders: • Hyper/hypoadrenocortism, hyper/hypoglycemia, myxedema, hyperparathyroidism, depression, smoking, vision/hearing impairment • Cognitive impairment	**CNS pathology:** Abscess, hemorrhage, hydrocephalus, subdural hematoma, infections, seizures, stroke, tumors, metastasis, Vasculitis encephalitis, meningitis	

Assessment of Delirium

The most valid and reliable delirium monitoring tools in adult ICU patients as recommended by the American College of Critical Care Medicine (ACCM) are:

- The Confusion Assessment Method for ICU (CAM-ICU) (Fig. 1.30)
- Intensive Care Delirium Screening Checklist (ICDSC) (Fig. 1.31)

Clinical Outcomes of Delirium in ICU

Many studies have shown many negative outcomes such as:

- Increased time on ventilator
- Longer lengths of ICU and Hospital stay.
- Increased costs
- Higher mortality both in hospital and after discharge
- Greater long-term cognitive dysfunction
- Difficulty in weaning off ventilator

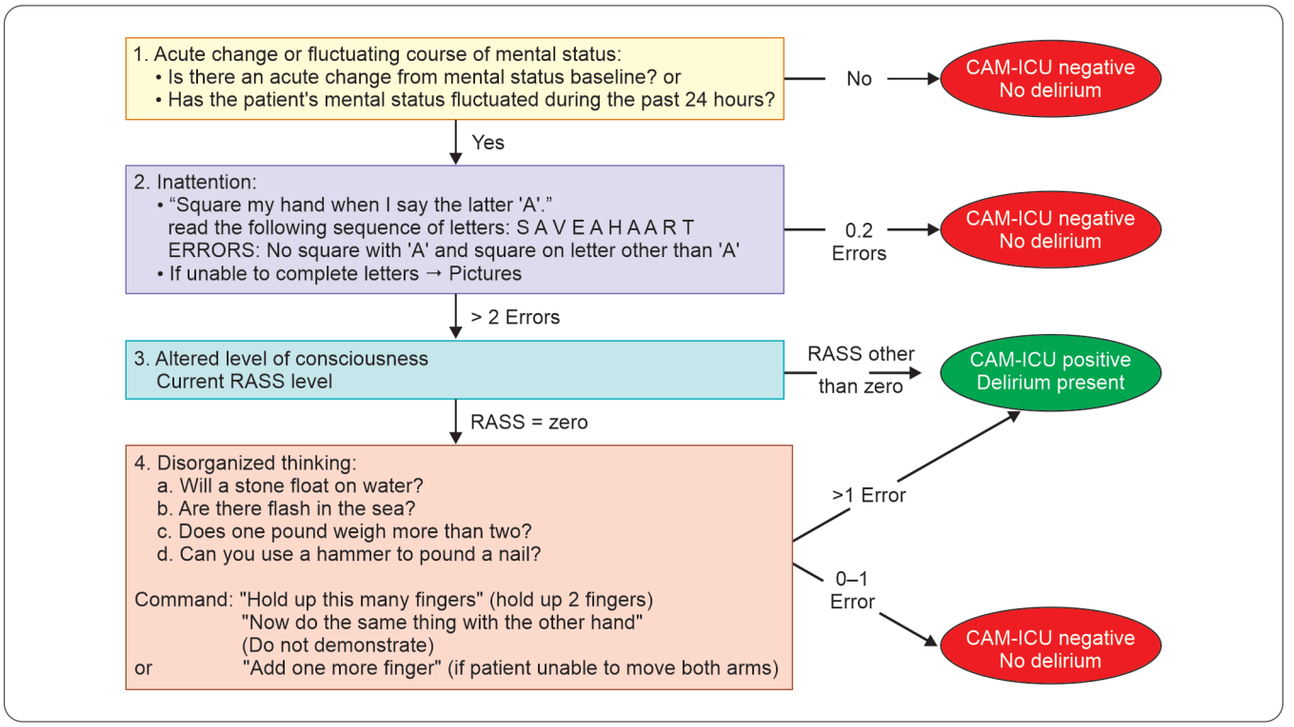


Fig. 1.30: The confusion assessment method for ICU

Patient evaluation	Day 1	Day 2	Day 3	Day 4	Day 5
Altered level of consciousness* (A–E)					
		If A or B do not complete patient evaluation for the period			
Inattention					
Disorientation					
Hallucination—delusion—psychosis					
Psychomotor agitation or retardation					
Inapproriate speech or mood					
Sleep/wake cycle disturbance					
Symptom fluctuation					
Total score (0–8)					

Fig. 1.31: Intensive care delirium screening checklist (ICDSC)

Treatment of Delirium

Treatment should start with:

- Early recognition of delirium
- Identifying any new underlying etiology
- Minimizing/eliminating predisposing and precipitating factors.

Treatment of delirium is done at three levels.

1. Providing the patient with orientation
2. Keeping a comfortable environment
3. Treating the actual condition

Orientation

- Provide visual and hearing aids
- Encourage communication and re-orient the patient repetitively
- Have the same nurse caring for the patient where possible
- Display familiar objects from patient's home, in the room
- Allow television during the day, with daily news
- Nonverbal music

Environment

- Sleep aids; lights on during the day, off at night
- Control excess noise at night
- Ambulate and mobilize patient early and often

Clinical Parameters

- Maintain systolic pressure >90 mm Hg
- Maintain oxygen saturations >92%
- Treat underlying metabolic derangements and infections

AGITATION

It is a violent physical activity and tumultuous emotion. The non-sedated patient who is paralyzed as well as the comatose patient with significant patient ventilation synchrony can be considered as agitation. Delirium, untreated pain and severe anxiety cause agitation (Fig. 1.32).

Critically ill patients treated in the intensive care setting are subject to number of unpleasant experiences. The pain and

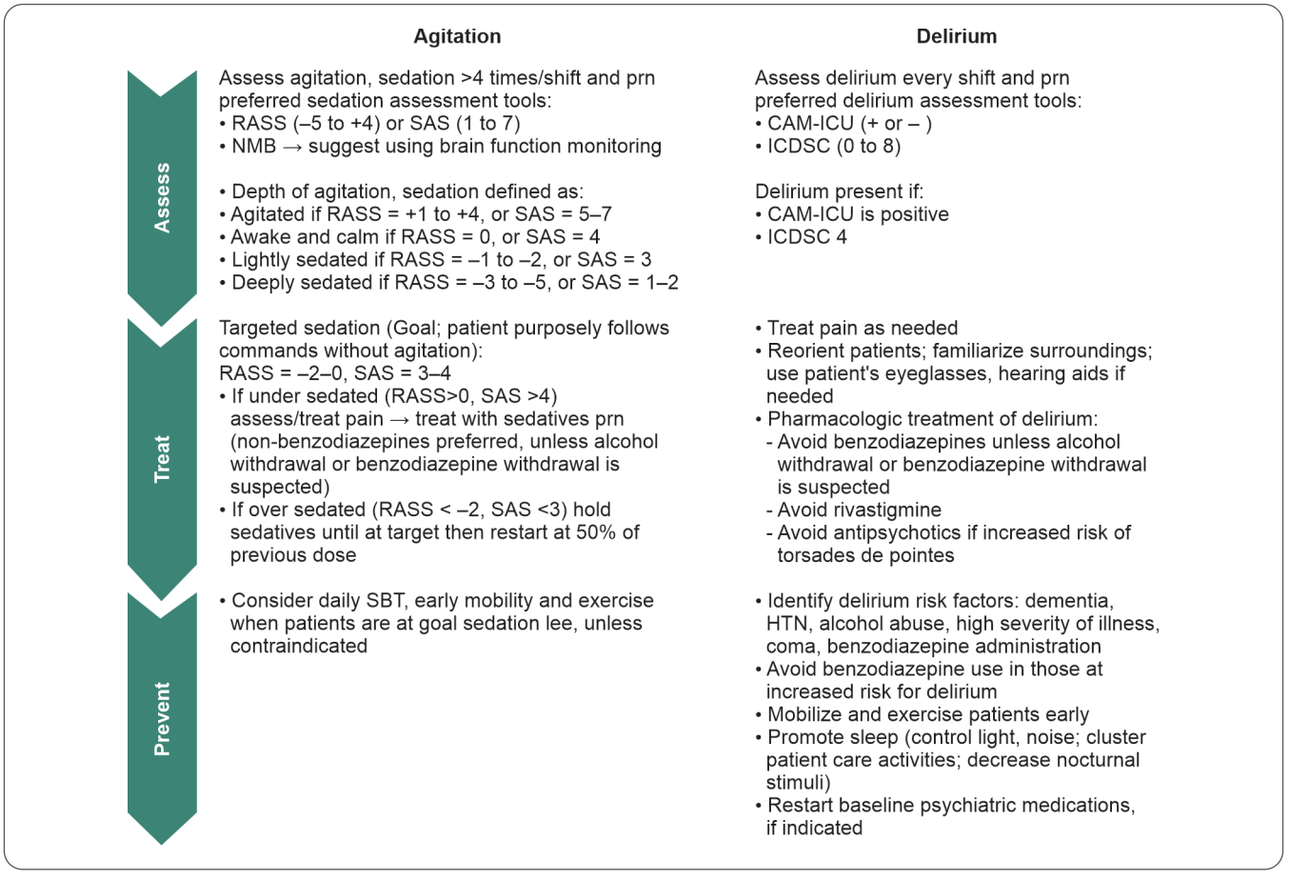


Fig. 1.32: Assessment of agitation and delirium

anxiety caused by mechanical ventilation, IV. Lines, continuous noise and disruption, and sleep deprivation, coupled with the stress of their illness, can cause agitation and distress.

Manifestations

- Continuous motor activity
- Disorientation
- Abnormal vital signs such a s BP/pulse rate

Assessment

Comparison between RAS and SAS scale is given in Table 1.42. Levels of agitation are shown in Figure 1.33.

Richmond Agitation Scale (RAS):

Causes

The causes of Anxiety/Agitation and pain are frequently multi-factorial. Causes of agitation in ICU are (Table 1.43):

- Pain
- Delirium
- Anxiety

Management in the ICU incorporating outputs is given in Figure 1.34 and the role of delirium and anxiety in agitation is given in Figure 1.35.

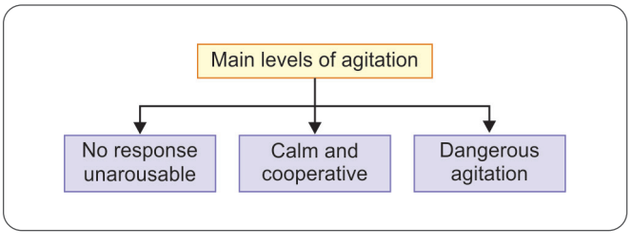


Fig. 1.33: Levels of agitation

TABLE 1.43: The causes of agitation in the ICU

• Anxiety from being in an unfamiliar environment, being on a ventilator or being aware of critical illness. • Excessive stimulation (e.g., continuous light and noise, suctioning, turning, investigations, observations) • Sleep deprivation • Difficulty or inability to communicate • A feeling of lack of control • Medical cause (e.g., hypoxia, hypoglycemia, hypotension, delirium)	• Drug • Prolonged immobility • Routine nursing care (e.g., washing, dressing changes, suctioning) • Monitoring devices (e.g., central lines, arterial lines, urinary catheters) • Therapeutic procedures and in-situ devices (e.g., endotracheal tubes, filtration lines, chest/ abdominal drains)

TABLE 1.42: Comparison between RAS and SAS

Riker Agitation Scale (RAS)

Level	Description	Explanation
1.	Unarousable	Minimal to no response to noxious stimuli
2.	Very sedated	Arouses to physical stimuli. Does not communicate or follow commands. May move spontaneously.
3.	Sedated	Difficult to arouse. Awakens to verbal stimuli or gentle shaking, but drifts off again. Follows simple commands.
4.	Calm/ cooperative	Calm, awakens easily, follows commands
5.	Agitated	Anxious or mildly agitated. Attempted to sit up. Calms with verbal instructions.
6.	Very agitated	Does not calm despite frequent verbal reminding of limits. Requires physical restraints. Bites ET tube.
7.	Dangerous agitation	Pulling at ET tube. Tries to remove catheters, climb over bedrail, strike at staff, and/or thrashing side-to-side.

Sedation-Agitation Scale (SAS)

Score	State	Behaviors
7.	Dangerous agitation	Pulling at ET tube, climbing over bedrail, striking at staff, thrashing side-to-side
6.	Very agitated	Does not calm despite frequent verbal reminding, requires physical restraints
5.	Agitated	Anxious or mildly agitated, attempting to sit up, calms down to verbal instructions
4.	Calm and cooperative	Calm, awakens easily, follows commands
3.	Sedated	Difficult to arouse, awakens to verbal stimuli or gentle shaking but drifts off
2.	Very sedated	Arouses to physical stimuli but does not communicate or follow commands
1.	Unarousable	Minimal or no response to noxious stimuli, does not communicate or follow commands

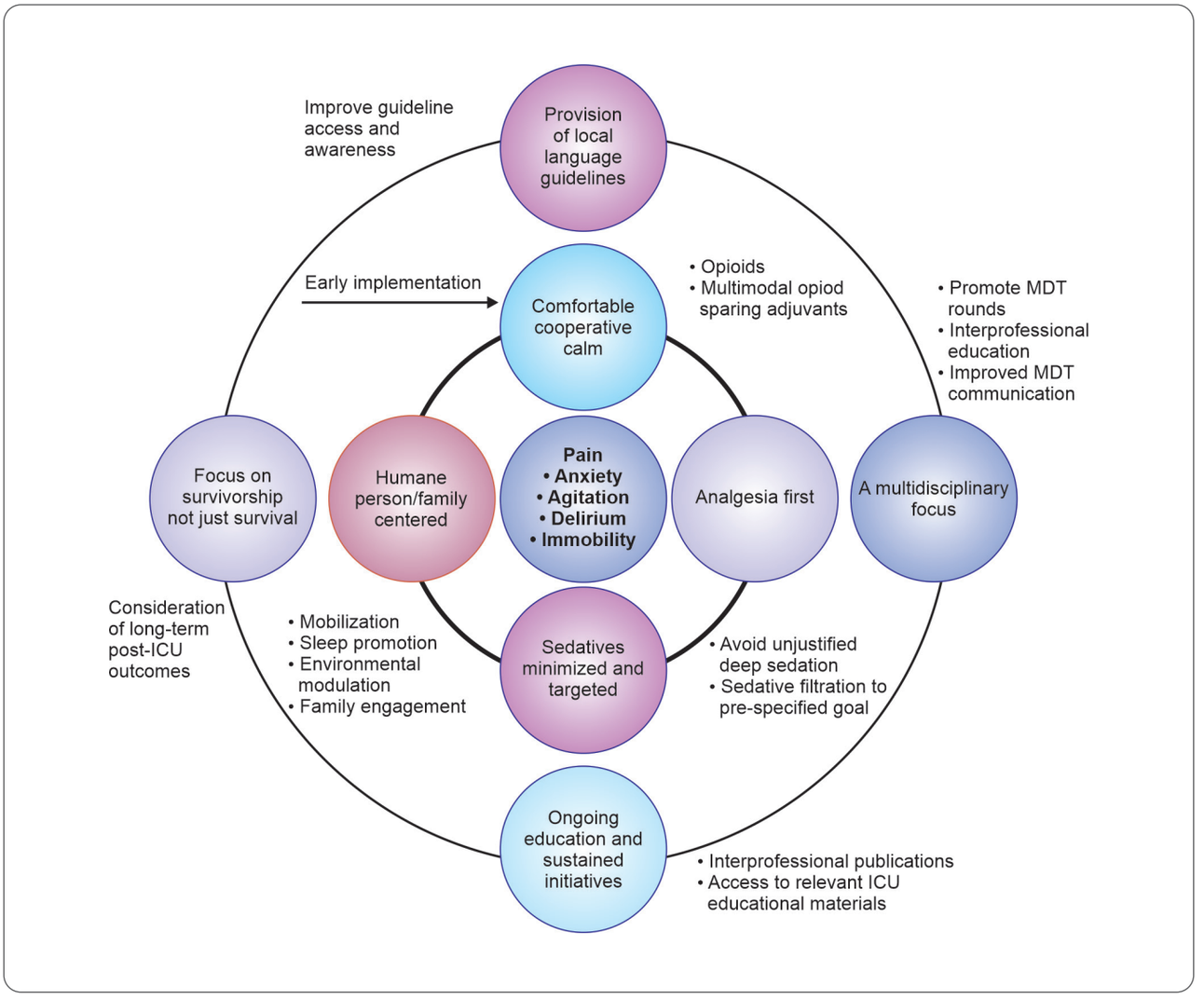


Fig. 1.34: Management in the ICU incorporating outputs

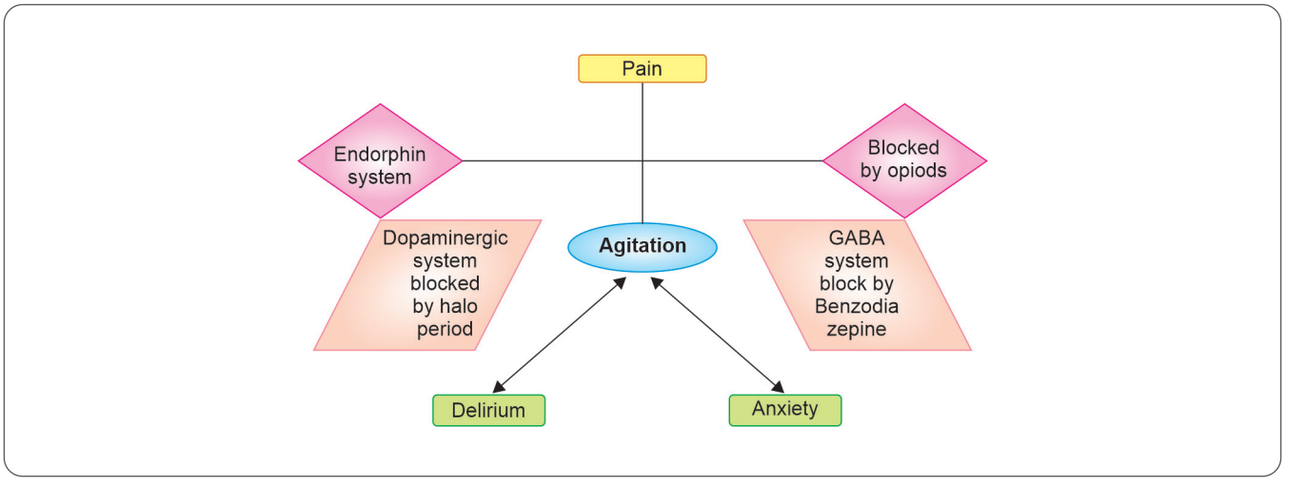


Fig. 1.35: Delirium and anxiety role in agitation

SEDATION IN ICU

According to the Academy of Medical Royal Colleges, Sedation is a drug induced depression of consciousness (Tables 1.44 and 1.45).

TABLE 1.44: Sedation in ICU

Minimal sedation	Moderate sedation	Deep sedation
Is a drug-induced state during which the patient: • Responds normally to commands • Cognitive function and physical co-ordination may be impaired. • Airway (reflexes, ventilator and cardiovascular functions are unaffected.	**Describes a state where:** • A purposeful response to verbal commands either alone (conscious sedation), or accompanied by light tactile stimulation, is maintained. • The airway is normally unaffected and spontaneous ventilation adequate.	**Describes a state where:** • The patient cannot easily be aroused but responds purposefully to repeated or painful stimulation. • It may be accompanied by clinically significant ventilatory depression. • The patient may require assistance in maintaining a patent airway, and positive pressure ventilation.

TABLE 1.45: Depth of sedation

	Minimal sedation/anxiolysis	Moderate sedation/analgesia	Deep sedation/analgesia
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or tactile stimulation	Purposeful response following repeated or painful stimulation
Airway	Unaffected	No intervention required	Intervention may be required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained

Complications

Complications of excessive sedation and analgesia include:

- Difficulty with adequately assessing neurological function.
- Increased duration of mechanical ventilation
- Greater cardiovascular depression and/or inotropic/vasopressor requirements.
- Paradoxical agitation resulting from a disorientated patient being unable to remember where they are or why they are in ICU
- Delusional memories and subsequent PTSD, resulting from patients being unable to recall actual events.
- Increased length of ICU stay
- Increased length of hospital stay
- Increased cost of ICU care.

Clinical Outcomes

Poor clinical outcomes with increased risk of delirium, cognitive dysfunction and mortality.
It is, therefore, important that the patient is neither over sedated nor under sedated (Fig. 1.36).

Sedation Assessment Scales

Use of sedation scales in the intensive care and acute care settings help in achieving the desired level of sedation. Nurses play an essential role in monitoring the level of sedation and a variety of subjective sedation scoring systems are available to help with this task.

The most valid and reliable sedation scales in the assessment of depth and quality of sedation in mechanically ventilated adult ICU patients include Richmond agitation-sedation (RASS) is shown in Tables 1.46 and 1.47. Sedation-agitation scale is shown in (SASS) Table 1.48.

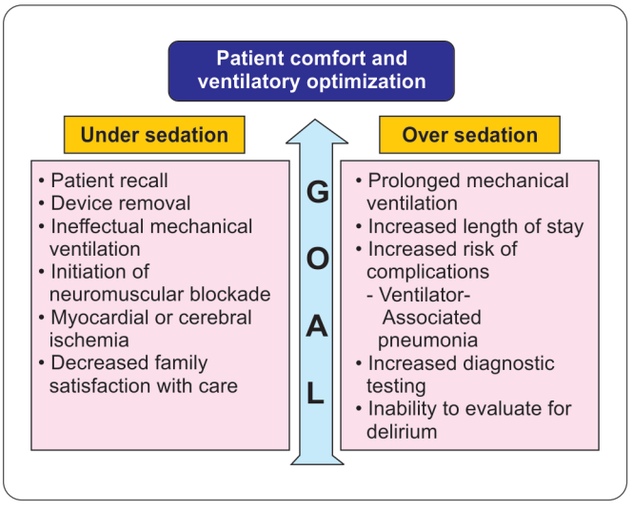


Fig. 1.36: ICU sedation: The balancing act

TABLE 1.46: The richmond agitation-sedation scale (RASS)

Score	Term	Description	
+4	Combative	Overly combative, violent, immediate danger to staff	
+3	Very agitated	Pulls or removes tube(s) or catheter(s) aggressive	
+2	Agitated	Frequent non-purposeful movement, flights ventilator	
+1	Restless	Anxious but movements not aggressive vigorous	
0	Alert and calm		
–1	Drowsy	Not fully alert, but has sustained awakening (eye-opening or eye contact) to voice (≥10 seconds)	Verbal Stimulation
–2	Light sedation	Briefly awakens with eye contact to voice (<10 seconds)	
–3	Moderate sedation	Movement or eye opening to voice (but no eye contact)	
–4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation	Physical Stimulation
–5	Unarousable	No response to voice or physical stimulation	

TABLE 1.47: Procedure for RASS assessment

• **Observe patient** ▪ Patient is alert, restless, or agitated	(Score 0 to +4)
• **If not, alert state patient's name and say to open eyes and look at speaker.** ▪ Patients awakens with sustained eye opening and eye contact ▪ Patient awakens with eye opening and eye contact, but not sustained ▪ Patient has any movement in response to voice but no eye contact.	 (Score –1) (Score –2) (Score –3)
• **When no response to verbal communication, physically stimulate patient by shaking shoulder and/or rubbing sternum** ▪ Patient has any movement to physical stimulation ▪ Patient has no response to any stimulation	 (Score –4) (Score –5)
If RASS is –4 or –5, then Stop and Reassess patient at later time **If RASS is above –4 (–3 through +4) then Proceed to Delirium Assessment.**	

TABLE 1.48: Sedation-agitation scale (SAS)

Level	Description	Explanation
1.	Unarousable	Minimal to no response to noxious stimuli
2.	Very sedated	Arouses to physical stimuli. Doesn't communicate or follow commands. May move spontaneously
3.	Sedated	Difficult to arouse. Awakens to verbal stimuli or gentle shaking, but drifts off again. Follows simple commands.
4.	Calm/cooperative	Calm, awakens easily, follows commands
5.	Agitated	Anxious or mildly agitated. Attempts to sit up. Calms with verbal instructions.
6.	Very agitated	Doesn't calm despite frequent verbal reminding of limits. Requires physical restraints. Bites ET tube.
7.	Dangerous agitation	Pulling at ET tube. Tries to remove catheters climb over bedrail, strike at staff, and/or thrashing side to side.

Goals of Sedation

The primary goals of sedation for the ICU patient are:

- To provide as pleasant an experience for the patient as possible through ameliorating anxiety, agitation and minimizing patient discomfort.
- To ensure patient safety
- To facilitate patient participation in their care
- To improve patient outcome.

Nonpharmacological Methods of Aiding Sedation

Ensuring patient comfort requires a multidisciplinary approach in addition to pharmacotherapy.

- This includes frequent communication and explanation to the patient by all staff directly involved in their care, both nursing and medical, and relatives.
- Physiotherapy plays an important role as prolonged immobility may be painful and this can be reduced by daily assessment and treatment.
- Basic needs such as feeding and hydration require addressing regularly to prevent the symptoms of hunger and thirst.

Agents Used for Sedation in ICU

Nurses, in their role of monitoring patients, are in a position to provide valuable input in the selection of the most desirable sedative agent. It is important for nurses to be familiar with the dosing, actions, and side effects of the major sedatives, and to understand the clinically pertinent information regarding the use of these agents.

Characteristics of an Ideal Sedative

- Rapid onset of action allows rapid recovery after discontinuation.
- Effective at providing adequate sedation with predictable dose response
- Easy to administer
- Lack of drug accumulation
- Few adverse effects
- Minimal adverse interactions with other drugs
- Cost effective
- Promotes natural sleep

The most commonly used agents include:

Propofol
Benzodiazepines
Antidopaminergics
Centrally acting alpha-adrenoreceptor agonists
Other agents

Some General Points

- All sedative drugs should be titrated (both up and down) to a target sedation score.
- When increasing the rate of a sedative infusion, a bolus dose should be given to achieve a more rapid attainment of an adequate, steady state effect site (brain) concentration.

Sedative medications in ICU are shown in Table 1.49.

TABLE 1.49: Sedative medications in ICU

Drug	Elimination	Onset duration	Dosing (IV)	Advantages	Limitations
Lorazepam	Hepatic conjugation to inactive metabolite	5–20 minutes 6–8 hours	BD: 2–4 mg MD: 1–10	Inexpensive long half-life	Propylene glycol toxicity at high doses
Midazolam	Cytochrome P450 Active metabolite excreted renally	5–10 minutes 1–4 hours	BD: 1–5 mg MD: 1–10	Shorter acting fast onset	Many drug interactions. Active metabolite accumulates in renal failure
Propofol	Conjugation	30–50 seconds 3–10 minutes	BD: 1–3 mg MD: 5–150 mcg/kg/min	Short acting	Lowers BP, increases serum triglyceride, pancreatitis, propofol infusion syndrome
Dexmedetomidine	Hepatic Cyto chrome P450 and glucuronidation	Immediate 5–10 minutes	BD: 0.5 mcg/kg MD: 0.2–0.7 mcg/kg/h	Very short duration. No respiratory depression. Has analgesic properties	Lowers BP/HR Not approved for use more than 24 hours.

Contd...

Drug	Elimination	Onset duration	Dosing (IV)	Advantages	Limitations
Morphine	Conjugation; active metabolite	5–10 minutes 2–6 hours	BD: 2–4 mg MD: 2–30 mg/hr for ventilated patients	Cheap Good analgesic Euphoria	Decreases BP, respiratory depression, active metabolite, accumulation in hepatic/ renal failure
Hydromorphone	Hepatic	5–10 minutes 2–4 hours	BD: 0.2–0.6 mg MD: 0.5–3 mg/hr	May work if patients are tolerant to morphine fentanyl	Respiratory depression, caution in non-ventilated patient; highly addictive
Fentanyl	Cytochrome P4503A4	30–60 seconds 30–60 minutes	BD: 25–50 mcg MD: 1–10 mcg/kg/hr for ventilated patients	Less hypotension than morphine	Muscle rigidity, euphoria, miosis, bradycardia and bronchoconstriction, respiratory depression
Alfentanil	Hepatic, active Metabolites excreted by kidney	1 minute 30–60 minutes	BD: 50–75 mcg/ kg MD: 0.5–3 mcg/ kg/min	Very short acting	Hypotension, chest wall rigidity, bradycardia, and tachycardia, respiratory depression
Sufentanil	Hepatic	1–3 minutes	BD: 1–2 mcg/kg MD: 8–50 mcg as needed		HR decreases BP Increases
Remifentanil	Tissue esterases	1–3 minutes 10–20 minutes	BD: 1 mcg/kg IV MD: 0.5–3 mcg/ kg/min	BD: 1 mcg/kg IV, MD: 0.5–3 mcg/kg/min	Decreases HR, Lowers, BP, increases ICP,

Abbreviations: BD, bolus dose; MD, maintenance dose; HR, heart rate; BP, blood pressure. All are for adult patients, boluses need to be given slowly and may have to be decreased in patients with hepatic/liver failure

Sedation Breaks

- Involve the daily stopping of continuous sedative and analgesic infusions.
- Once the patient awakens or is uncomfortable, sedation/ analgesia is recommended at a lower rate (e.g., half) with further titration of sedatives/analgesics to a targeted sedation score.
- It is performed safely as long as patients are appropriately monitored by nursing and medical staff for awakening and there is timely resumption of sedation/analgesia where appropriate.
- It is contraindicated in patients under neuromuscular blockade and where fluctuations in blood pressure and oxygen consumption may be detrimental, e.g., Neuro-ICU, traumatic brain injuries and heart failure with critical ventricular function.
- It has been found to reduce the duration of mechanical ventilation, ICU stay and the number of investigations performed to explain prolonged coma following withdrawal of sedation.
- However, withdrawal syndromes can occur with most sedatives and all opioids. Patients at risk include:
- Those who have been in ICU for more
- Those on high sedative/analgesic doses
- The gradual tapering of doses and consideration of conversion to longer acting agents lower risk of withdrawal symptoms.

Indicators for Sedation

Indicators for sedation are shown in Figure 1.37.

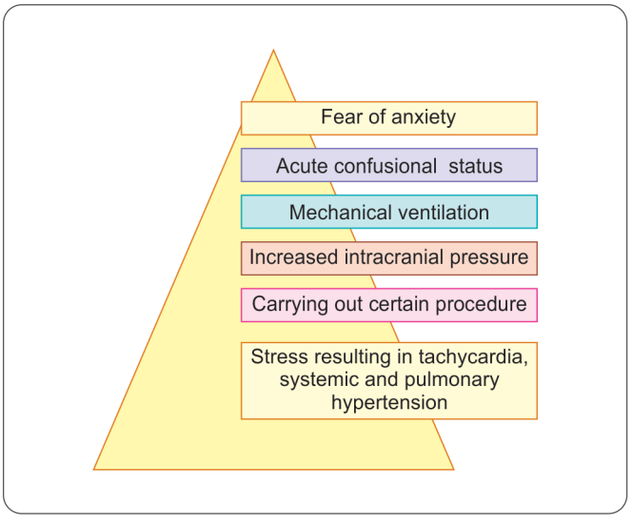


Fig. 1.37: Indicators for sedation

MUST KNOW

- Delirium is the 6th vital sign which has to be assessed in every patient admitted to ICU. It is a cognitive impairment characterized by an insidious onset with disorganized altered level of consciousness. There are many risk factors for delirium. Mnemonic for ICU delirium is **I WATCH DM** which is explained in the text.
- There are many scales which are used for assessing delirium. CAM ICU and ICDSC are few of them.
- Agitation is another state of delirium caused by untreated pain and severe anxiety. RASS and SAS are the scales used for assessing agitation.
- For maintaining optimal sedation in ICU, one has to balance the use of drugs to achieve therapeutic level.

ASSESS YOURSELF

1. Differentiate between delirium and agitation.
2. Discuss the different scales used for assessing delirium and agitation.
3. List the risk factors of delirium.
4. Briefly explain sedation in ICU.

CRITICAL THINKING SKILLS

A patient is admitted to ICU with ARDS and connected to ventilator. Oxygen saturation level is 84%. Patient is intubated and connected to ventilator. On assessment, there is visible sign of patient ventilator synchrony. Patient is agitated with violent physical activity.

Q. 1. What are the possible reasons for the patient's behavior?

Q. 2. How would you assess this patient?

Q. 3. What are the medications which may be administered to this patient?

COMA AND BRAIN DEATH

Coma

The cerebral cortex lacks an intrinsic mechanism to promote awakening and depends on subcortical structures to initiate and maintain arousal. Arousal is the process of waking and becoming vigilant. It can occur in response to internal and external stimuli. It requires intact subcortical and brainstem functions. Awareness requires intact cortical function.

CONSCIOUSNESS

It encompasses both arousal and awareness. Coma is defined as a state of complete unresponsiveness to external and internal stimuli. It is characterized by a failure of arousal. The result is that there is lack of awareness of the self and the environment, a lack of response to stimuli. The failure of arousal results from damage to the brainstem, thalamus or both cerebral hemisphere. A comatose person cannot be awakened, fails to respond normally to pain or light, does not have sleep wake cycles and does not take voluntary actions.

Delirium is an acute change or fluctuation in mental status comprising of inattention, disorganized thinking or an altered level of consciousness.

In a comatose patient consider the acronym **MIST** to summarize the causes:

Metabolic:

- **Exogenous:** Poisoning, Alcohol
- **Endogenous: Endocrine:** Hypoglycemia, hyperglycemia, hypothyroidism
- **Non-endocrine:** Hypoxia, hypercarbia, uremia, hyperammonemia

Infections: Meningitis, encephalitis, cerebral malaria, enteric fever

Immune: Demyelination (ADEM)

Stroke/Seizure/SOL

Trauma

HYPERAMMONEMIA

This can be a rare but potentially reversible cause. Ammonia is a normal constituent of all body fluids. At physiologic pH, it exists mainly as ammonium ion. Reference serum levels are less than 35 μmol/L. Excess ammonia is excreted as urea, which is synthesized in the liver through the

urea cycle. Sources of ammonia include bacterial hydrolysis of urea and other nitrogenous compounds in the intestine, the purine-nucleotide cycle and amino acid transamination in skeletal muscle, and other metabolic process in the kidneys and liver. Increased entry of Ammonia to the brain can be the primary cause of many neurological disorders associated with hyperammonemia (Table 1.50).

Inborn Errors of Metabolism

These include enzyme defects in urea cycle, organic acidemia and others. In the absence of acidosis or ketosis, possibilities are urea cycle defect or an amino acid transport defect may occur. They occur mainly in children but can occur in adults also. There are several case reports of late onset manifestations of omithine trans carbamylase deficiency (OTCD) mostly in heterozygous female patient over a wide age range.

Valproate

Hyperammonemia may occur after acute overdose or chronic use of valproic acid, and may also occur with normal liver function tests. Increases in plasma ammonia occur in nearly 50 percent of patients treated with valproic acid, and are asymptomatic in almost one half of cases. Hyperammonemia is believed to be due to propionic acid, a metabolite of valproic acid, which inhibits mitochondrial carbamoyl phosphate synthetase, an enzyme necessary for ammonia elimination via the urea cycle. If the action of this enzyme is sufficiently impaired, ammonia levels will accumulate, producing encephalopathy. Valproic acid also may raise serum ammonia levels through interaction with carmitine, a cofactor necessary for mitochondrial long-chain fatty acid metabolism: Serum ammonia concentrations directly correlate with the dose and serum concentrations of valproic acid, and inversely with serum concentrations of carmitine.

VEGETATIVE STATE

Patients with vegetative state (VS) are in coma except that they seem to have a cyclical arousal pattern (limited to an eye open, awake appearance alternating with an eyes closed "sleep-like" state). A vegetative state that lasts more than a month is after a hypoxic injury or 1 year after traumatic injury has a chance of further recovery of less than one in 1000. This is defined as permanent VS. Damage to the upper brainstem—mesencephalic component of the reticular activating arousal in response to external stimuli but over components of consciousness is absent. It results from extensive bilateral cortical, subcortical matter or thalamic injuries with relative sparing of the brainstem—thus accounting for the preservation of arousal. Thus, behavioral arousal in Permanent Vegetative State (PVS) indicates preservation of brainstem systems.

In permanent vegetative stage, following is found:

- Sleep related EEG changes (REM, sleep spindles and vertex waves) are absent
- Decrease in glucose utilization globally in the brain
- Absence of activation of the sensory association regions

TABLE 1.50: Causes of hyperammonemia

• **Infections with urease producing organisms:** Proteus, Klebsiella, urinary infection	• **Hepatic failure: Acute/chronic:** Reye's Portosystemic shunt syndrome.
• **Increased protein load and catabolism:** Trauma, burns, chemotherapy, GI bleed • **Neoplasm**: Multiple myeloma	• **Drugs:** Valproate, carbamazepine, rifabutin, inborn errors of metabolism

MINIMALLY CONSCIOUS STATE (MCS)

This is a state of altered consciousness with minimal but definite behavioral evidence of awareness of self of the environment. It differs from PVS by the presence of inconsistent but clearly discernable behavioral evidence of consciousness which may suggest that awareness may be present. The prognosis is more favorable than for PVS. When patients exhibit consistent, reliable functional communication, (more than the ability to follow simple commands), they have emerged from MCS.

LOCKED IN STATE/SYNDROME

Unlike PVS, in which the upper portions of the brain are damaged and the lower portions are spared, locked-in syndrome is caused by damage to specific portions of the lower brainstem with no damage to the upper brain. In the locked in state, the person is aware and awake, but cannot move or communicate due to complete paralysis of nearly all voluntary muscles in the body. It is the result of a ventral pontine damage. It is also called pseudo-coma, differentiated state or the ventral pontine syndrome.

Locked in syndrome results in quadriplegia with an inability to speak in those persons who have intact cognition. Patients who have locked in syndrome are conscious and aware with no loss of cognitive function. They can sometimes retain proprioception and sensation throughout their body. Some patients may have the ability to move certain facial muscles, most often some or all of the extra ocular muscles. Those with locked in syndrome may be able to communicate with others by coding messages by blinking or moving their eyes, which may not be affected by the paralysis.

BRAIN DEATH

Death is defined as the irreversible cessation of biological function. Although death for a unicellular organism may be considered as an event at a definite point in time, death for multicellular organism is a process occurring over a period of time. Applied to humans, it does not imply cessation of the biological functions of all cells in the body but refers to the irreversible loss of consciousness. Devoid of consciousness, there is no personality and hence, no recognizable person. Historically, death was defined as coma with apnea and absence of pulse. The period of transition between these components did not matter as, in the absence of effective intervention, failure of one resulted in failure of although the different systems stopped functioning at different times. As death was a process, each of these constituted a point of no return in the process of dying. Permanent cessation of spontaneous cardiac action (asystole) was a point of no return and resulted in permanent loss of consciousness; permanent cessation of respiration (apnea) also resulted in permanent loss of consciousness and was, therefore, another point of no return.

The present day clinical criteria to diagnose brain death are a means to diagnose irreversible coma. The term 'reversible' implies persistent cessation of function during an appropriate period of observation and/or trial of therapy. This period may vary from hours to days depending on the clinical situation. The testing has been defined as the "point of no return" for no patient has ever recovered consciousness after satisfying the present criteria for brain death through viable areas of localized brain activity can persist for variable periods of time (e.g., osmolar regulation, anterior pituitary endocrine regulation, vasopressor response to pain and transiently preserved EEG and evoked potentials). Further, though irreversible apnea is a component of the current criteria, asystole is not. However, asystole does follow brain death in a period of days. If cardiac action is sustained with adrenaline alone following brain death, asystole has been shown to occur in a mean (SD) of 24.1 (17–2) hours; if arginine-vasopressin is added to adrenaline, cardiac rhythm ceased in mean (SD) 23.1 (19.1) days. If present criteria are applied accurately, the positive predictive value is 100% (no patient with a temporary loss of consciousness will be diagnosed as brain dead). However, the sensitivity (the criteria fail to diagnose brain death in some who have irreversible loss of consciousness) and negative predictive value (even if the criteria are not met the person may be irreversibly unconscious) are less than 100%. It is useful to understand in this context that the present criteria diagnose death of the "brain as a whole" (loss of integrated functioning of the brain and not "death of the whole brain". The brainstem is the core component which allows the whole brain to function as an integrated unit.

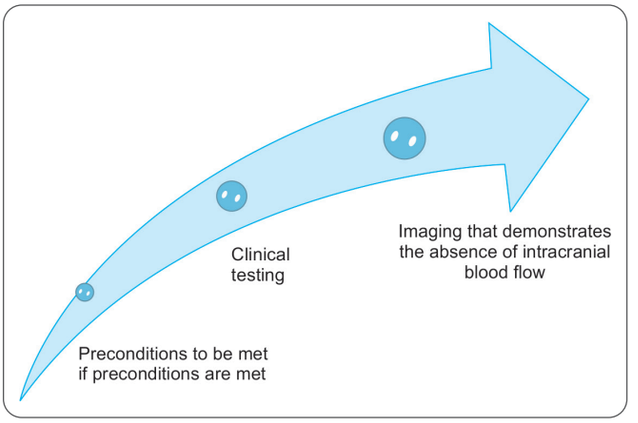


Fig. 1.38: Brain death

Criteria for Brain Death (Brainstem Death)

Brain death occurs in the setting of a severe brain injury associated with marked elevation of intracranial pressure. Inadequate perfusion pressure results in a cycle of cerebral ischemia and edema and further increases in intracranial pressure reaches or exceeds systemic blood pressure, intracranial blood flow ceases and the whole brain, including the brainstem, dies.

The clinical testing for brain death essentially checks brainstem function and is valid only if the preconditions are satisfied. The relevant brain functions which are checked for diagnosing Brain Death are those that are clinically testable (Fig. 1.38).

Brain death is determined by:

Preconditions (Inclusion Criteria)

- **Patient is in apneic coma:** The patient is in a state of sleep-like unresponsiveness. It should be obvious that the patient will be on a ventilator with a respiratory rate equal to that set on the ventilator.
- **Evidence of sufficient intracranial pathway:** Definite clinical or neuro-imaging evidence of acute brain pathology (e.g., traumatic brain injury, intracranial hemorrhage, hypoxic encephalopathy) consistent with the irreversible loss of neurological function. Proof of sufficient cause for irreversible, structural brain damage due to a disorder or loss of neurologic function. Proof of sufficient cause of irreversible, structural brain damage due to a disorder which can lead to brain death. If a primary diagnosis cannot be established, this condition cannot be satisfied. Proof of pathology from CT scan, MRI or angiography is adequate. However, in some situations (e.g., hypoxic brain injury following a witnessed event likely to cause anoxia) the fact that the patients are comatose in spite of adequate cardiopulmonary resuscitation and maintenance of optimum oxygenation

and hemodynamic status will allow a diagnosis of hypoxic—ischemic damage to be made, provided that there are no reversible factors;

- **Normothermia** (temperature >35°C)
- **Normotension:** As a guide, systolic BP >90 mm Hg, mean arterial pressure (MAP) >70 mm Hg in an Adult);
- **Exclusion of effects of sedative drugs (self-administered or otherwise):** The time taken for plasma concentrations of sedative drugs to fall below levels with clinically significant effects depends on the dose and pharmacokinetics of drugs used, and on hepatic and renal function. If there is any doubt about the persisting effects of opioids or benzodiazepines, an appropriate drug antagonist should be administered.
- **Absence of severe electrolyte, metabolic or endocrine disturbances:** Marked derangements in plasma concentrations of glucose, sodium, phosphate or magnesium; liver and renal dysfunction; and severe endocrine dysfunction.
- **Intact neuromuscular function:** If neuromuscular-blocking drugs have been administered, a peripheral nerve stimulator or other recognized method (e.g., electromyography) should always be used to confirm that neuromuscular condition is normal.
- **Ability to adequately examine the brainstem reflexes:** It must be possible to examine at least one ear and one eye.
- **Ability to perform apnea testing:** This may be precluded by severe hypoxic respiratory failure or a high cervical spinal cord injury.

Confirmation of Cessation of Brainstem Function

- **No abnormal motor movements**
  - Trismus
  - Seizure
  - Decortication
  - Decerebration

Presence of any of the above implies that there are viable neurons in the brainstem allowing transmission of these impulses.

- **Absent brainstem reflexes**
  - **Light reflex:** A history of surgery to the eye (e.g., iridectomy) preexisting abnormalities (Holmes-Adie pupil with delayed or absent response to light) or ocular drugs (atropine, pilocarpine) must be sought for. Artificial eyes should obviously not be tested. In brain death patients, the pupils may be of variable size and widely dilated pupils are not a necessary criterion for brain death as it may be in mid position. Dilated pupils may occur due to systemic adrenaline given as an inotrope. The essentials criteria are fixed pupils with no response to light.
  - **Corneal reflex:** Contact lenses are to be removed prior to testing for this response. Repeated corneal stimuli are to be avoided as it is unnecessary and corneal abrasions are not desirable. Corneal stimulation usually causes a bilateral blink response but when the response is reduced, blinking may occur only on the side stimulated. The test should be done on the other side if absent on one side.
- **Ocular reflexes:**
  - Vestibulo ocular (caloric)
  - Oculocephalic (dolling)

These tests are not possible in the presence of significant ocular injury.

Apneic Oxygenation Testing

Normal apnea breathing pattern is shown in Figure 1.39 and obstructive sleep apnea is shown in Figure 1.40.

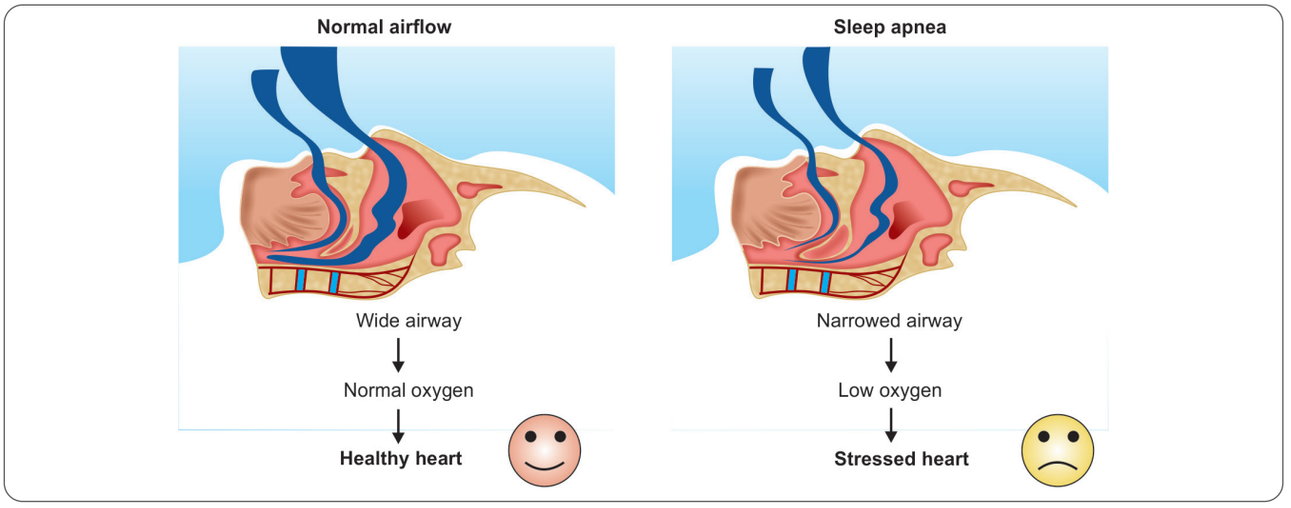


Fig. 1.39: Normal/Apnea breathing pattern

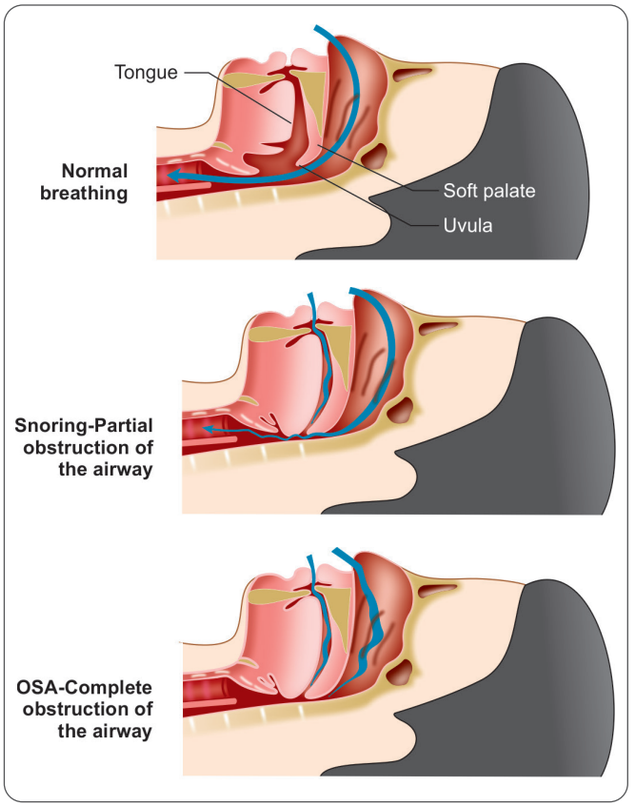


Fig. 1.40: Obstructive sleep apnea

Apneic oxygenation is used to demonstrate that lack of any ventilator drive. This involves the supply of 100% oxygen to the trachea, without providing ventilatory assistance. Through mass-movement, oxygen reaches the alveoli, allowing for transfer to the blood. In the absence of ventilation, $PaCO_2$ rises and stimulates the brain-stem respiratory centers, causing spontaneous breathing. Usually $PaCO_2$ rises by –3 mm Hg (0.4 KPA) for every minute of apnea. As the $PaCO_2$ rises, the ventilator center is maximally stimulated by a $PaCO_2$, of –60 mm Hg. This is a key test for brainstem function enough to ensure that the $PaCO_2$ rises to a level capable of stimulating any visible respiratory centers neurons.

This test should be done only as the last test (after all other tests for brainstem function). It is not possible to do this test if there is a high cervical cord injury and abolished phrenic nerve function.

The three components of this test are:

1. Prevents hypoxemia
2. Ensure an adequate $PaCO_2$
3. Observation that spontaneous respiratory effort is absent.

The method to prevent hypoxemia is by apneic oxygenation which includes:

- Preoxygenate with 100% oxygen for 10 minutes which ensures washout of body nitrogen, saturation of tissues with oxygen and buildup of a high PaO_2
- Maintain diffusion oxygenation by one of two methods
- Deliver oxygen at 4–6 L/min via a soft catheter inserted into the trachea (at higher flow rates partial clearance of CO_2 may occur). Care is necessary to ensure that the catheter is not endobronchial by taping it after inserting at a distance equal to the length of the ET tube. The bore of the catheter should be small enough to ensure that there is room for expiratory gas flow around it.
- Deliver oxygen at 6 L/min by a T piece attached to the ET Tube.

Observations that are Compatible with Brain Death

The following do not preclude determination of brain death:

Spinal reflexes can be either spontaneous or elicited by stimulation, including a painful stimulus applied to limbs or sternum, tactile stimulation applied to palmar or plantar areas, neck flexion, limb elevation or hypoxia (such as during ventilation disconnection). Spinal reflexes are not to be confused with a pathological flexion or extension response.

Spinal movements may include:

- Extension-pronation movements of the upper limbs
- Undulating toe reflex (plantar flexion of great toe, followed by brief plantar flexion sequentially of second to fifth toes)

Physiological and Metabolic Changes during Brain Death

Cardiovascular

Brainstem compression may be accompanied by an intense sympathetic storm with marked hypertension, tachycardia and/or arrhythmias. This is usually of short duration but can result in cardiac ischemia, ECG changes, cardiac dysfunction and myocyte necrosis. Following the autonomic storm, there is usually loss of sympathetic outflow, resulting in vasodilation and hypotension. This may be exacerbated by pre-existing hypovolemia, cardiac dysfunction and polyuria from DI.

Hypothermia

There is loss of hypothalamic thermoregulation; reduced whole body heat production (loss of brain metabolism and resting muscle tone), inability to generate it by shivering; inability to conserve heat by vasoconstriction. Loss of heat occurs by exposure or via the urine and by the administration of (cold) fluids. Adverse effects include cardiac dysfunction, arrhythmias, coagulopathy and a leftward shift of the oxy-hemoglobin dissociation curve, with reduced oxygen delivery to tissues. Temperatures of <35°C preclude the clinical testing for diagnosis of brain death.

Pituitary Dysfunction and Hormonal Resuscitation

- **Posterior pituitary hormones:** Diabetes insipidus occurs in approximately 80–90% of brain dead potential donors and is due to the loss of posterior pituitary function resulting in deficiency of anti-diuretic hormone (ADH, vasopressin). This results in polyuria, hypernatremia and hypovolemia. Hypernatremia in the donor has been associated with worse outcomes for renal loss through the administration of large volumes of fluid may result in further derangements, such as hyperglycemia and hypothermia.
- **Anterior pituitary hormones:** There is conflicting evidence on the occurrence and clinical significance of hypothalamic-pituitary adrenal/thyroid dysfunction in brain death. Human studies suggest that anterior pituitary function is partially preserved, with normal levels of cortisol and thyroid hormone, or low thyroid hormone in the setting of normal or elevated levels of thyroid stimulating hormone (TSH) consistent with the sick euthyroid syndrome.

Anemia, Coagulopathy and Immunological Changes

Anemia is commonly due to bleeding which may be exacerbated by coagulopathy. Coagulopathy may occur secondary to substances related from necrotic brain inducing fibrinolysis (especially in traumatic brain injury), or dilatation from bleeding and fluid administration, and it may be worsened by hypothermia. Significant changes in cytokine profiles, including elevation of pro-inflammatory cytokines are seen.

MUST KNOW

Prerequisite for Apnea test in brain death:

- Core Temperature 36.5°C or 97°F.
- Systolic blood pressure 90 mm Hg.
- Corrected diabetes insipidus (positive fluid balance).
- Normal PCO_2 (arterial PCO_2 of 35-45 mm Hg).

ASSESS YOURSELF

1. What are the factors leading to coma?
2. What tests are likely to be conducted for a patient diagnosed with coma?
3. How would one ascertain brain death/what is the role of the nurse while handling a patient who is brain dead?

CRITICAL THINKING SKILLS

A young girl, 18-year-old admitted with history of having consumed pesticide, thus suspected of organophosphorus poisoning. She is ventilated and on medications for 72 hours. Her GCS is 3, has fixed and dilated pupil with no brainstem reflexes. The prognosis is explained to the relatives by the treating physician. What would be the priority of care for this patient and anxious family member?

DEATH AND DYING

DEATH

Death is an everyday occurrence in a critical care unit. The dying frequently happens in critical care units. Life supporting interventions have not helped to reduce the suffering rather have added the agony and burden of a prolonged dying process. Death, which everyone wishes to be peaceful and to occur in the presence of loved ones have become artificial, away from the family surrounded by the gadgets of modern critical care. Prolonged and futile life support had undoubtedly imposed economic strain on patients and families.

Potentially salvageable patients can be denied ICU care when scarce beds and resources are consumed in a futile search for cure when death is imminent. Setting goals appropriate to clinical situations of poor prognosis are an integral part of critical care. Quality critical care requires that the practice be well grounded in ethical principles and that the ICU staffs are trained in the skills of end of life care. In many occasions, the patient himself may not know that he is dying. In certain other occasions, the truth is hidden from the patient and the spouse and rest of the family members are aware of it. This is what happens in many situations in an Indian scenario unlike in western countries where the patient has the right to know about his condition.

A consensus regarding the practices relating to EOL care in an Indian ICU should eventually lead to the evolution of appropriate legislation in keeping with the changing needs of critical care practice. Recent Mumbai high court order with regard to end of life issues is a beginning to consider such issues in the light of legal aspect. At the same time it is important to ensure no life is ended due to lack of facilities or willingness in taking care of such a person. Aruna Shanbaugh's case is a typical example of not ending the life because the co-professionals, the

nurses of KEM hospital are not willing to let her die and they were willing to look after her till her natural death.

Determination of Death

Death is determined by neurologic criteria when it is followed by cardiopulmonary arrest not revived by basic and advanced life support. Death by neurologic criteria is otherwise brain death which indicates irreversible loss of both cortical and brainstem activity. The procedure used by physicians in determining this is guided by the institutional rules and regulations. Conditions that must be ruled out as causes of coma prior to testing for death by neurologic criteria include the effects of neurologic depressants, hypothermia, and severe metabolic and endocrine disturbances. In addition, the cause of the patient's condition should be ensured and be consistent with irreversible brain injury.

EUTHANASIA

The word means gentle or easy death derived from the two Greek words **eu** and **Thanatos**. In the true sense of medical profession, it is not permitted to end anyone's life. But many arguments have cropped up regarding the issue. There are two terms to be understood:

1. **Active euthanasia:** The physician takes an active role in administering a drug which shortens life. This is illegal in most countries and ethically indefensible and it is not the duty of the physician.
2. **Passive euthanasia:** Has been used to imply the act of removing care in order to let the patient die due to disease process. In other words, it implies that disease is allowed its natural course. Therefore, active euthanasia refers to putting an end to life whereas passive euthanasia refers to not fighting the death. However, more appropriate terms which are used in the critical care environment are Withdrawing/withholding futile therapy which should not be equated with passive euthanasia. On practical point of view, withdrawing is more difficult than withholding.

Even if it is found legally and socially acceptable and is decided both by caregivers and family to implement, abrupt cessation of therapy is medically unacceptable and it may result in increased distress. It can be done gradually first by reducing the inotropes, then reducing oxygen concentration and then reduce the ventilation. The distressing symptoms should be anticipated and should be taken care. It is recommended to plan the whole process with a minimum of 6 hours. Opioids, Benzodiazepine and Butylscopolamine and Hyoscine must be used as indicated to reduce the distressing symptoms of the patients during the terminal stage.

Checklist for Initiating EOL Discussions

- Advanced age coupled with a poor premorbid state due to chronic debilitating diseases, e.g., advanced COPD requiring home oxygen and severe impairment of quality of life.
- Advanced interstitial disease not responding to medical treatment.
- Chronic Renal failure requiring long-term dialysis, chronic liver disease, advanced congestive cardiac failure.
- Catastrophic illnesses with organ dysfunction unresponsive to reasonable period of aggressive treatment
- Prolonged coma in the absence of brain death due to acute nonreversible causes or chronic vegetative state.
- Incurable chronic severe neurological states rendering meaningful life unlikely, e.g., progressive dementia, quadriplegia with ventilator dependency.
- Progressive metastatic cancer where treatment has failed or patient refuses treatment
- Post cardio respiratory arrest, non-restoration of comprehension after a few days.
- Comparable clinical situations coupled with physician prediction of low probability of survival
- Patient/family preference to limit life support or refusal to accept life support

Recommendations

According to Indian society of critical care medicine, following are the guidelines for physicians to handle such situations.

- The physician has a duty to inform the capable patient and the relatives regarding the patient's poor prognosis with honesty and clarity when further aggressive therapy is going to be non-beneficial. The physician should initiate discussion on treatment options available including the options of no specific treatment.
- When the fully informed capable patient or family desires to consider palliative care, the physician should offer the available treatment modalities of limiting life prolonging interventions.
- The physician must discuss the implications of forgoing aggressive interventions through formal discussions with capable patient or family and work toward shared decision making process.
- Pending consensus decisions or in the event of conflict between physician's recommendations and family wishes, all supporting treatment should continue. No new therapy should be instituted during this time of decision making process.
- The decision leading to withhold lifesaving therapy should be clearly documented in the case records to ensure transparency and avoid misunderstanding.
- The overall responsibility rests with the physician who must ensure that all members of the team including medical and nursing staff are also in consensus with the decision and also follow the same approach to the care of the patient.

- If the capable patient or family consistently desires that life support be withdrawn, in situations in which the physician considers the aggressive treatment non beneficial, the treating team is ethically bound to consider withdrawal within legal permits.
- In the event of withdrawal or withholding of support, it is the physician's obligation to provide compassionate and effective palliative care of the patient as well as to attend to the emotional needs of the family.

PALLIATIVE CARE

Palliative care is an approach that improves the quality of life of patients and their families facing the problem associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual.

Palliative care, which can be used in all types of health care settings, is focused on the relief of physical, mental, and spiritual distress for individuals who have an incurable illness. The goal of palliative care is to prevent and relieve suffering by early assessment and treatment of pain and other physical, psychosocial, and spiritual needs to improve the patient's quality of life.

Characteristics

- Provides relief from pain and other distressing symptoms
- Affirms life and regards dying as a normal process
- Intends neither to hasten or postpone death
- Integrates the psychological and spiritual aspects of patient care
- Offers a support system to help patient's life as actively as possible until death
- Offers a support system to help the family cope during patient's illness and in their own bereavement
- Uses a team approach to address the needs of the patients and their families, including bereavement counseling, if indicated.
- Enhances quality of life and may also positively influences the course of illness

Palliative care is applicable early in the illness and conjunction with other therapy that is intended to prolong life such as chemotherapy, radiotherapy and includes those investigations needed to better understand and manage distressing clinical complications.

Bereavement

Bereavement is a universal human experience and potentially dangerous to health. It is associated with a high mortality and up to a third of bereaved people develop a depressive illness. The help targeted at those at risk has been shown to be effective and to make the most efficient use of scarce resources. When a death is anticipated, preparation for bereavement can be made and this can also improve the outcome. In many occasions, we take things for granted and assume that the help is not required especially when the relatives are educated. It is the truth that every individual requires adequate explanation and emotional support during the process.

Grieving

Grief is a natural response to loss. It is the emotional suffering you feel when something or someone you love is taken away. The more significant the loss, the more intense the grief will be.

Any loss can cause grief, including:

- Divorce or relationship breakup
- Loss of health
- Losing a job
- Loss of financial stability
- A miscarriage
- Retirement
- Death of a pet
- Loss of a cherished dream
- A loved one's serious illness
- Loss of a friendship
- Loss of safety after a trauma
- Selling the family home

Stages of Grief

- **Denial:** "This can't be happening to me."
- **Anger:** "*Why* is this happening? Who is to blame?"
- **Bargaining:** "Make this not happen, and in return I will ____."
- **Depression:** "I'm too sad to do anything."
- **Acceptance:** "I'm at peace with what happened."

Nurses' Role in Bereavement and Grieving

- **Good bereavement care follows the nursing process approach:**
  - Assessment
  - Analysis
  - Planning (goal setting)
  - Intervention/implementation
  - Evaluation.

It acknowledges these five dimensions of optimal health, and incorporates them into the nursing process.

- The occupational health nurse, as clinician and advisor, can provide care to the bereaved individual and guidance to the manager and coworkers about the grief process and how to interact with the grieving employee.
- Grief work is necessary for healing. The occupational health nurse can play a valuable role in facilitating the work by offering clinical support, a 'safe' place for the grieving employee to talk about the death, referrals to the Employee Assistance Program or other professional support, and education about the process.

MUST KNOW

- Death is inevitable in certain patients inspite of the best of care.
- Dying is more commonly witnessed in CCU more than other parts of the hospital.
- Nurses working in CCU need to be equipped to deal with death, dying, bereavement and grieving.
- Euthanasia is not legalized in India.
- However, nurse may come across controversial end of life issues.

ASSESS YOURSELF

1. Long question:
   - Discuss the role of nurse in the process of death and dying.
2. Write short notes on:
   - Bereavement
   - Palliative care
   - Euthanasia
   - Stages of grieving

CRITICAL THINKING SKILLS

The patient who is dying may feel hot at one moment and cold the next moment.
Q. 1. What is the reason for the same?
Q. 2. What can you do for this patient?

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