

**Critical-care Training**  
**Module**  
**for**  
**Nursing staff**



**An ISO 9001: 2008 Certified Institution**

**State Institute of Health & Family Welfare,  
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## **Chapter 1: Introduction to critical care**

### **1.1 Introduction:**

This module is designed to assist nursing staff in developing expertise and in- depth knowledge in the field of Critical Care Nursing. Nursing staff are able to develop advanced skills in caring for critically ill patients using nursing process. It enables them to function as critical care nurse practitioner/ specialist. It further enables them to function as critical care nurse practitioner, educator, and manager in the field of Critical Care Nursing.

At the end of the course students shall be able to –

- Elicit trends and issues related to Critical Care Nursing.
- Describe the epidemiology, etiology, patho-physiology and diagnostic assessment of critically ill patients.
- Describe the various drugs used in critical care and the nurse's responsibility.
- Demonstrate advance skills/ competence in managing critically ill patients including Advance Cardiac Life Support.
- Demonstrate skills in handling various equipments/ gadgets used for critical care.
- Apply nursing process in the care of critically ill patients.
- Enhance team work and coordinate activities related to patient care.
- Practice infection control measures.
- Access and manage pain.
- Discuss the legal and ethical issues in critical care nursing.
- Assist in various diagnostic, therapeutic and surgical procedures.
- Incorporate evidence based nursing practice and identify the areas of research in the field of critical care nursing.
- Teach and supervise nurses and allied health workers.
- Identify complications and take appropriate measures.

### **1.2 What is Critical Care?**

Critical care (Intensive Care) is a healthcare specialty that cares for patients with acute, life-threatening illness or injury and involves multiple skills and specialties. Most of us will experience a critical illness or injury, either as the patient, family member or friend of a patient. Critical care provides support for patients whose conditions are potentially life-threatening.



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Critical care establishments are known as intensive care units (ICU), Critical Care Unit (CCU), Intensive Therapy Unit (ITU), and/ or Coronary Care Unit (CCU).

Professionals involved in Critical care physicians, nurses, respiratory care technicians, pharmacists and other allied health professionals who use their unique expertise, ability to interpret important therapeutic information, access to highly sophisticated equipment and the services of support personnel to provide care that leads to the best outcome for the patient.

### 1.3 Why Critical care?

- Poor infrastructure, human resource development, protocol, guidelines formation and research.
- Need for quality health care delivery to the critically sick.
- The ICU is highly specified and sophisticated discipline specifically designed, staffed, located, furnished and equipped, dedicated to management of critically ill patients, injuries or complications.
- Need for defined policies; protocols and procedures, having its own quality control, education, training and research programs.
- Critical care is a specialty and can no longer be regarded purely as part of anesthesia, Medicine, surgery or any other specialty.

### 1.4 Critical Illness:

Critical illness is a condition where life cannot be sustained without invasive therapeutic interventions. A wide variety of diseases may lead to critical illness; however the number of interventions required is limited. A high ratio of nurses to patients is characteristic of critical/ intensive care units.

### 1.5 Issues in critical care:

- **Nursing Issues in CCU:**

These are divided into four components.

- |                     |              |
|---------------------|--------------|
| ➤ Clinical practice | ➤ Research   |
| ➤ Education         | ➤ Management |

- **Ethical Issues in Critical unit:**

#### **Informed Consent:**

Prior to initiating any procedure in the ICU, physicians must secure informed consent (permission) from the patient. Except in emergency situations, physicians obtain consent directly from patients. If a patient cannot give consent, the physician seeks permission from an individual with durable power of attorney for health care. Durable power of attorney is a legal document that grants authority to an



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individual for another's health care decisions when that person is unable to make those decisions. If this is not available, a close family member can grant consent.

### 1.6 Who needs critical care?

- Myocardial infarction
- Patients with serious arrhythmias even when not associated with acute myocardial infarction
- Pulmonary insufficiency
- Coma
- Sepsis
- Gastrointestinal bleeding
- Acute renal failure
- Trauma, accidental emergencies and
- Severe diseases or when a patient not manageable at basic care units

### 1.7 Critical Care Unit:

“An critical care unit (CCU) is defined as a specially staffed, specialty equipped, separate section of a hospital dedicated to the observation, care, and treatment of patients with life threatening illnesses, injuries, or complications from which recovery is possible. It provides special expertise and facilities for the support of vital function and utilizes the skill of medical nursing and other staff experienced in the management of these problems.”

Overall, there are few critical care units in the country that are well equipped and have the expertise to use modern, sophisticated technology to the patient's advantage. Many units are poorly equipped for economic reasons, and a few units are reasonably well equipped but lack the comprehensive equipment and/or the expertise to use it with efficiency and discretion. The scenario is slowly changing for the better in terms of technology and expertise.

### 1.8 IPHS standards for Critical/Intensive Care Unit & High Dependency Wards:

#### General (Sub-District/Sub-Divisional Hospitals):

Principle: 2 to 5 percent total medical and surgical beds in a hospital should be Critical Care beds.

Minimum 4, maximum 12 bed per Critical Care unit.

Number of beds -5% of the total hospital bed strength.

For example, in a 500-bedded hospital-

Total of 25 beds (5%) will be for Critical Care

13 may be ICU beds

12 will be allocated for High Dependency Wards

ICUs having <6 beds are not cost effective and also do not provide enough clinical experience and exposure to skilled HR of the ICU. At the same time, ICU with bed strength of >24 are difficult to manage.



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**Location:**

- Close to operation theatre department and other essential departments, such as, X-ray and pathology.
- Easy and convenient access from emergency and accident department is also essential.
- Equipped with central suction and medical gases, uninterrupted electric supply, heating, ventilation, central air conditioning and efficient life services.

**Facilities:**

- Nursing Station
- Clean Utility Area
- Equipment Room

**Critical Care Area (Emergency Services):**

- Entry independent of OPD main entry (for minimum time loss in giving immediate treatment).
- Easy ambulance approach with adequate space for free passage of vehicles and covered area for alighting patients.

**1.9 Basic requirements of critical care units:**

**a. Infrastructure:**

**Location/entry/exit points of critical care unit in Hospital:**

- In close proximity of ER, Operating rooms, trauma ward, diagnostic facilities, blood bank, pharmacy etc. (for Safe, easy, fast transport of a critically sick patient).
- Corridors, lifts & ramps spacious enough to provide easy movement of bed/ trolley.
- There should be single entry/exit point to ICU, which should be manned.  
However, it is required to have emergency exit points in case of emergencies and disaster.

**ICU Bed Designing and Space Issues**

**Space:**

- **125 to 150 sq ft area per bed in the patient care area** or the room of the patient. In addition there should be **100 to 150% extra space** to accommodate nursing station, storage, patient movement area, equipment area, doctors and nurses rooms and toilet.
- One or two bigger rooms or area which may be utilized for patients to undergo bedside procedures like ECMO, RRT etc with support Gadgets attached to them.
- 10 % (one to two) rooms may be designated isolation rooms where immune compromised patients may be kept. These rooms may have 20% extra space than other rooms.

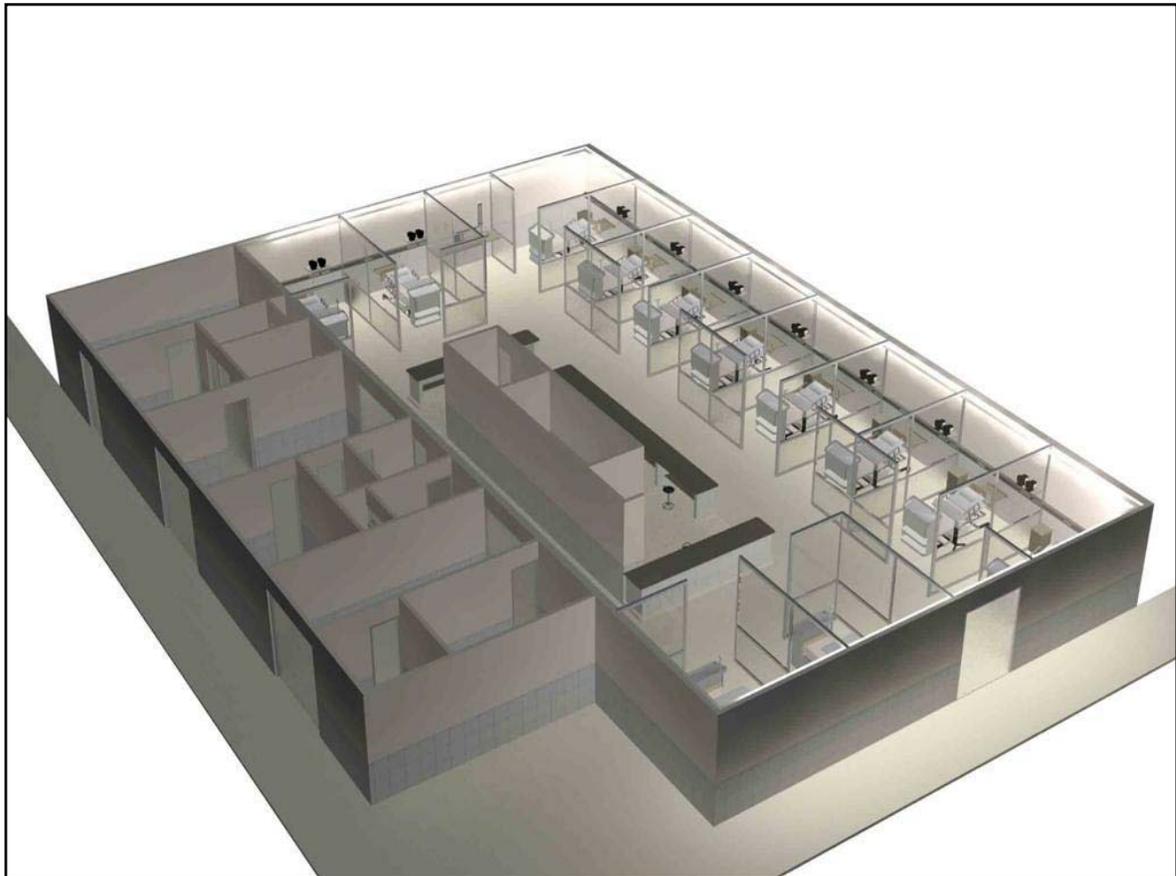


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### Isolation Rooms

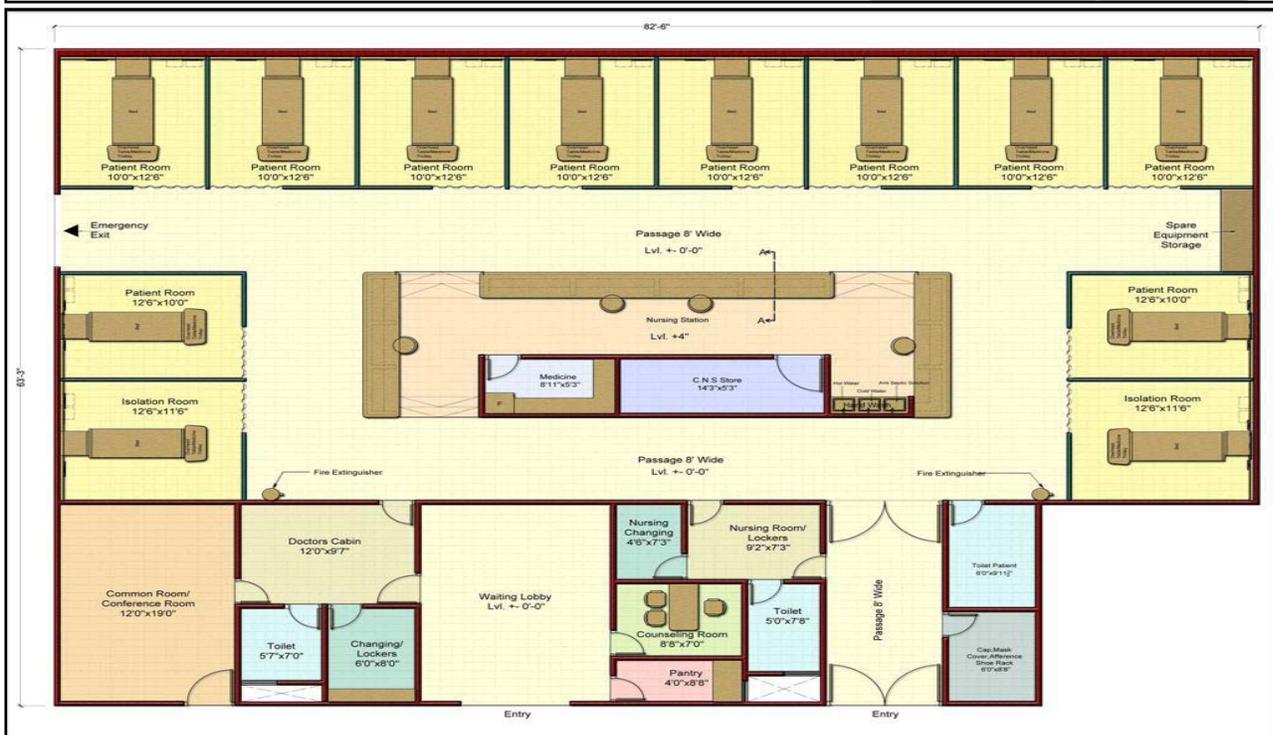
10% of beds (1 or 2) rooms may be used exclusively as isolation area for cases like for burns, severely infected patients or immune suppressed patients.

### Ideal critical Care unit design:





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#### **b. Human Resource required in Critical Care:**

- Nurses
  - Nurse ICU Coordinator who should preferably be trained in intensive care or has five years experience in intensive care.
  - ICU nurse-patient ratio -1:1 for ventilated cases and 1:2 for other cases.
  - 1/2 to 1/3 nurse patient ratio is acceptable for less seriously sick patients.
- Doctors
- Respiratory Therapists
- Physiotherapist
- Technicians, Computer programmer
- Biomedical Engineer
- Nutritionist
- Clinical Pharmacist
- Support staff-Cleaning staff, guards and Class IV

#### **1.10 Basic Equipments and supplies for Critical Care Unit:**

##### **a. Monitors in the CCU:**

**Some of the monitoring equipment seen in the ICU includes the following:**

- **Cardiac or heart monitors:** to monitor the electrical activity of the heart.
- **Pulse Oximeter:** to monitor the saturation of oxygen in the blood.
- **Swan-Ganz catheter:** or pulmonary artery catheter is used to measure the amount of fluid filling the heart as well as to determine how the heart is functioning.
- **Arterial Line:** A very thin tube (catheter) is inserted into one of the patient's arteries (usually in the arm) to allow direct measurement of the blood pressure and to measure the concentration of oxygen and carbon dioxide in the blood. The arterial line is attached to a monitor.

##### **b. Tubes & Catheters in the CCU:**

- **Central venous catheter (CVC):** is a soft, pliable tube that is inserted into a large vessel (vein) in the neck (internal jugular vein), in the upper chest (subclavian vein), or in the groin area (femoral vein).
- **Intravenous set (IV):** is a plastic catheter (tube) that is inserted into the veins (peripheral IV) or a larger size catheter inserted into the larger veins of the neck for fluids, medications, nutrition preparations, and blood products.
- **Chest tubes:** Chest tubes to drain fluid or air that has accumulated.



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- **GI Tube:** used to introduce liquids, food, or medication into the stomach.
- **Nasogastric Tube (NG Tube):** for direct "tube feeding" to maintain the nutritional status.
- **Shunt:** A procedure to draw off excessive fluid in the brain.
- **Urinary catheter:** Urinary catheters, often referred to as Foley catheters, are inserted through the urethra into the bladder. Urinary catheters continuously drain the bladder and allow for accurate measurement of urinary output, which is extremely important in fluid management and in assessing kidney function.
- **Endotracheal tubes:** Endotracheal tubes are used when mechanical ventilation is necessary.

**c. Life Supportive Devices in the CCU**

- **Ventilator:** The ventilator, or respirator, is a breathing machine that helps patients breathe. The patient is connected to the ventilator by an **endotracheal tube**. Patient on the ventilator need sedation, for patient comfort and for the ventilator to be able to work effectively. If ventilator is needed for long, a **tracheostomy** (making a small hole in the neck, just below the vocal cord) is often performed and a small tube is inserted into the hole and connected to the ventilator.
- **Central venous catheters:** for Nutritional solutions administered through feeding tubes.

**d. Some common items used in Critical care unit:**

Bed pad, Bedpan, Gloves, Hand-washing Foam, Hospital Beds and Mattresses, Hospital Clothing, Intravenous (IV) Feeding, Intravenous (IV) Fluids, Liquid Tube Feeding, Oxygen Supply, Drug supply etc.

**What kinds of illness and injury usually require critical care?**

- Heart Attack
- Poisoning
- Pneumonia
- Surgical Complications
- Premature Birth
- Stroke
- Severely Injured

**What is the difference between critical care and emergency medicine?**

Critical care refers exclusively to the treatment of patients who suffer from life-threatening conditions. Emergency room physicians and nurses treat patients who suffer from relatively minor emergencies (sprained ankles, broken arms) to those with major problems including heart attack, knife or gunshot wounds or drug overdoses. In the Emergency Department, physicians and nurses stabilize patients and transport them to the ICU or other area of the hospital for further treatment. The long-term management of critically ill and injured patients is provided by critical care professionals, often in the ICU



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### 1.11 What is Critical Care Nursing?

Critical care nursing is the field of nursing with a focus on the utmost care of the critically ill or unstable patients. Critical care nurses can be found working in a wide variety of environments and specialties, such as emergency departments and the intensive care units.

#### What are the Roles and functions of Nurses in CCU?

- Care provider
- Educator
- Manager
- Advocate

Critical-care nurse will perform actions listed below:

- Assesses and implements treatment for patient responses to life-threatening health problems
- Provides direct measures to resuscitate, if necessary
- Uses independent, dependent, and interdependent interventions to restore stability, prevent complications, and achieve and maintain optimal patient responses
- Provides health education to the patient and family
- Supervises patient care and ancillary personnel
- Supports patient adaptation, restores health, and preserves the patient's rights, including the right to refuse treatment

#### What are the Skill set required for Critical Care Nursing?

- Bedside Safety
- Admission, Transfer and Discharge of patient
- Bedside and Patient Care Planning
- Patient Care Issues –
  - Essential patient care
  - Skin Care
  - Safe Moving and handling
  - Monitoring of vital signs
- Documentation
  - Observation chart,
  - Fluid balance chart,
  - Care plan
- Respiratory Care (Airway and Breathing)
  - Airway management,
  - Manual Ventilation,
  - Care of Endotracheal/ Tracheostomy Tube
- Respiratory Support,  
➢ Ventilation / Extubation)
- Cardiovascular Care (Circulation)
  - Arterial lines
  - Central lines
  - Fluid management
  - Emergency clinical situations (shock, cardiac arrest))
- Neurological Care (Disability)
  - Level of consciousness (AVPU / GCS)
  - Sedation and analgesia
- Nutritional Care
  - Enteral nutrition
  - Glycaemic control
  - Psychosocial / Spiritual Care
  - Infection Control
  - Laboratory Investigations



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### 1.12 What are the types of Critical Care Unit?

- Neonatal intensive-care unit (**NICU**)
- Coronary intensive care unit (**CICU**) for heart disease
- Cardiac Surgery intensive-care unit (**CSICU**)
- Cardiovascular intensive-care unit (**CVICU**)
- Medical intensive-care unit (**MICU**)
- Medical Surgical intensive-care unit (**MSICU**)
- Surgical intensive-care unit (**SICU**)
- Overnight intensive recovery (**OIR**)
- Psychiatric intensive-care unit (**PICU**)
- Neuroscience/Neurotrauma intensive-care unit (**NICU**)
- Neurointensive-care unit (**NICU**)
- Burn intensive-care unit (**BWICU**)
- Trauma Intensive care Unit (**TICU**)
- Surgical Trauma intensive-care unit (**STICU**)
- Trauma-Neuro Critical Care intensive-care unit (**TNCC**)
- Respiratory intensive-care unit (**RICU**)
- Geriatric intensive-care unit (**GICU**)
- Mobile Intensive Care Unit (**MICU**)

### Qualifications for Critical care Nurses:

- Should be a registered nurse (RN)
- Should preferably have critical-care training course or orientation that includes essential information on the care of the critically ill patient.

### 1.13 Common terminology used in critical care:

- **Aplasia** – incomplete development of tissue, absence of growth
- **Aplastic** – incapable of growing new tissue
- **APRV** - airway pressure release ventilation
- **ARF** - acute respiratory failure
- **Aspiration**
- **Atelectasis** – no air in the alveoli, lung solid.
- **Bronchography {bronchographic (adj.)}** – preparation of an X-ray after introduction of radio-opaque substance into the bronchial tree.
- **Bronchopleural fistula (BPF)** – bronchopleural fistulas are large air leaks which develop secondary to collapsed lungs.
- **Bronchopulmonary** – pertaining to the bronchi and the lungs.
- **Bronchorrhoea** – an excessive discharge of mucous from the bronchial mucous membrane.



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- **Carbon dioxide partial pressure (PaCO<sub>2</sub>)** – the partial pressure of carbon dioxide in the arterial blood.
- **Cardiac Index (CI)** - an adjustment of the *cardiac output* based on the size of the person's body. It is the most and individualized cardiac parameter that the nurse can use. It is based on body surface area (BSA). The formula for calculating cardiac index is  $CI = CO/BSA$ . The normal value for this parameter is 2.5 to 4L/min/m<sup>2</sup>
- **Cardiac Output (CO)** - can be calculated if we know the heart rate and the stroke volume.  
 $CO = HR * SV$  dynes/Cm<sup>2</sup> Normal 4-8 L/min
- **Central Venous Pressure (CVP)** - A measurement of the pressure in the right atrium. This reflects the right ventricular diastolic pressure, or the ability of the right side of the heart to pump blood. This is a valuable tool for assessing the relationship between cardiac action, vascularity, and blood volume.
- **Hypoxemia** – diminished amount (reduced saturation) of oxygen in arterial blood (PaO<sub>2</sub>/FiO<sub>2</sub> ratio less than 200 mm Hg); hypoxic hypoxemia–interference with pulmonary oxygenation; stagnant hypoxia–a reduction in blood flow, as seen in the finger nails in surgical shock or in cold weather.
- **Pneumothorax** – leakage of air in the pleural cavity from the lungs.

#### 1.14 What are the nursing protocols for Critical Care?

- No critical care patient will be left without a nurse in attendance.
- Each nurse will be responsible for the entire care of his/her patient, and acts to coordinate care with other health team professionals.
- Breaks will be arranged according to unit need/safe coverage by mutual agreement between each nurse and his/her coworkers. The nurse must give a full report to another staff nurse prior to leaving for a break.
- The staff nurse will report any changes in his/her patient's condition directly to the physician.
- All critical care patients will have continual ECG monitoring.
- Alarms must be left on the ECG and arterial lines at all times. Appropriate limits will be selected at the nurse's discretion according to institutional policy.
- For a stable, non-acute patient without invasive monitoring equipment, vital signs are measured at least every hour.
- For neurological problems will have hourly neurological assessments performed.
- The turning of all critically ill patients every two hours around the clock is done unless contraindicated, with skin assessment recorded as part of the every four-hour assessment.



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- All Critical Care patients will have mouth care done every four hours with inspection for oral skin sores.
- The Critical Care nurse may restrain patients at his/her discretion. Provided documentation done according to hospital policies and procedures.
- All dressings unless otherwise indicated will be changed daily.
- Nursing care will be spaced out to allow periods of rest.
- Procedures will be explained to patients; person, place and time being repeatedly stated to the patient.
- Information and emotional support needs for the family and patient will be provided by the nurse/physician/social work/palliative care, as required.
- The environment will be maintained in a mechanically safe condition through: dry floors, good repair of furniture, proper placement of machines and equipment, cleanliness, freedom from clutter, and good repair of equipment.
- Isolation technique will be followed as per infection control manual.
- Any containers of body fluids (i.e. suction canisters or chest drainage sets) must be disposed in the appropriate biohazard bag or box.
- All medications will be reviewed by the Critical Care physicians (upon admission to Unit.) and either reordered or stopped. Nursing staff will ensure this has been done prior to carrying out any medication, treatment or investigative orders. Each treatment/medication must be listed.
- Respiratory orders may only be carried out when written by the patient's physician. Ventilatory changes will only be done upon receipt of written order.
- All orders written other than by the Critical Care physicians will be brought to the attention of the Critical Care physician by the nurse prior to being carried out.
- Narcotics **MAY NOT** be kept at the bedside. If use is not immediate after withdrawal from the narcotic cabinet, wastage as per narcotic protocol will be carried out.
- Visiting is negotiated between the nurse and family, with consideration given to unit activity and institutional policy.
- The nurse/physician will notify families of significant deteriorations in the patient's condition.
- All staff working at a bedside where an acute trauma or actively bleeding patient is being managed will wear protective goggles, masks and gloves. Protective gear is also required anytime risk of splash from body fluids exists e.g. suctioning.



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### 1.15 What are the Quality Indicators for Critical care nursing?

#### 1. Mortality:

##### **Standardized mortality rate (SMR):**

The SMR is a very useful parameter to compare outcomes in two or more groups under study and provides opportunity to individual ICU for improving the processes and techniques

##### **Formula for calculation -**

Risk-adjusted Mortality = Observed Rate/Risk-adjusted expected Rate (X100),

Observed rate = Actual death in ICU/ institution.

Risk adjusted expected rate = Predicted death rate by predictive model

Interpretation-

- Equal to 100 — hospital's mortality rate and the expected average rate are the same
- >100 — hospitals mortality rate is higher than the expected average mortality rate
- <100 — hospitals mortality rate is lower than the expected average mortality rate.

Higher SMR does not necessarily mean that hospital is unsafe as this is a snapshot method and Simultaneous assessment of other quality indicators must be done to draw a logical conclusion.

Single Parameter based judgment on performance level is not advocated

Patient population- All patients admitted to critical care units of different type

Source of data- Hospital record for the observed mortality (numerator)

Type of parameter- Outcome

#### 2. Iatrogenic Pneumothorax:

It is procedure related Pneumothorax, associated mortality and morbidity, prolonged stay, cost Implications.

**Formula for calculation:** (Number of Pneumothorax / Number of cases) X 1000

Patient population-All patients admitted to Intensive care Unit

Source of data-Hospital record

Benchmark-83 per 1000 cases

5% (Interstitial emphysema/pneumothorax/pneumomediastinum/subcutaneous emphysema)

#### 3. Incidence of Acute Renal Failure in non coronary ICU:

Acute renal failure requiring renal replacement therapy or when urine output is < 200 mL in 12 h and/or marked azotemia defined as a BUN level > 84 mg/dL) during patient's ICU stay.

Rationality - Renal failure increases possibility of death (60.3%) notwithstanding whether renal replacement therapy has been initiated. Even a modest increase in the serum creatinine level (0.3 to



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0.4 mg per deciliter [26.5 to 35.4 mol per liter]) increases risk of death by 70% when compared to normal.

Formula for calculation:  $\text{Number developed severe renal failure} / \text{Number managed in ICU} \times 100$

Patient population - Numerator: Severe renal failure (GFR < 10 ml/min.) developing in ICU (excluding chronic renal failure patient)

Denominator - Patient managed in ICU in a given time frame

Source of data - ICU record

Type of parameter - Outcome parameter

Benchmark - Severe ARF 5.7%, 10% patients develop ARF (including Severe ARF)

#### 4. Decubitus (Pressure) ulcer:

Description - Decubitus ulcer and pressure sore are synonyms. Decubitus is derived from Latin word Decumbere means "to lie down. Since pressure sore can develop from other positions, it is called Pressure sore. Prolonged uninterrupted pressure over bony prominences causes necrosis and ulceration.

Depending upon tissue damage ulcers are classified in 4 stages

- Stage 1 indicates superficial colour change
- Stage 2 represents partial thickness skin loss
- Stage 3 full thickness skin loss
- Stage 4 denotes deep and extensive tissue damage involving muscle, tendon or bone. Hip and buttock sores represent 67% of all pressure sores.

Rationality - Annual cost of treatment in US exceeds \$1 billion

Formula for calculation:  $\text{Number of pressure ulcers} / \text{Number of cases} \times 1000$

Patient population - Critically ill

Source of data- Hospital record

Type of parameter - Morbidity, Safety of patients

Benchmark - 3 – 11%, 22.71 / 1000 cases

#### 5. Operational or Process Parameters:

##### a) Length of Stay:

Description - Total hours and days patients managed in the unit with midnight bed occupancy are more accurate than the number of calendar days a patient spends in the ICU. Arithmetic means overestimate LOS. LOS is also influenced by factors such as the availability of an intermediary care, discharge practices and mortality rates.



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Rationality -ICU beds are limited in any hospital. Rationalized use for needy patients therefore is necessary. LOS is therefore used to assess quality of care and resource utilization.

Formula for calculation: Total occupied bed days / number of patients in a given time Frame weekly, monthly /yearly.)

Patient population -All admitted patients in the unit

Source of data - ICU data

Type of parameter-Outcome measure

Benchmark - Average LOS in year 2001 Norfolk General Hospital,4.36 days in general ICU, 2.43 days in vascular ICU

**b) Compliance to protocol:**

Description - Selected guidelines, protocols, treatment bundles in the unit to improve patient care, resource utilization, and reduce iatrogenic complications.

Rationality- Compliance to protocols, guidelines and treatment bundles are expected to improve patient care. Compliance to protocol could be absolute non compliance, partial or full (correct).

Formula for calculation -Number of time followed/ Number of time expected to follow X 100

Patient population-All ICU patients

Source of data -Audit report

Type of parameter - Process parameter

Benchmark - 90%

**c) ICU readmission rate:**

Description -Readmission to the ICU within 24 hrs of transfer during a single hospital stay. This is an indicator of post ICU care.

Rationality -A zero readmission rate reflects more defensive approach by ICU team which increases LOS in ICU causing risk of Nosocomial infection, iatrogenic complications, and non availability of bed for the deserving patients Higher mortality rate of 1.5 to 10 times that of controls and higher length of stay at least twice that of control patients had been documented .A higher readmission rate indicates premature decision to shift out.

Formula for calculation - (Number of readmitted patients/ Total patients managed in ICU) X 100

Patient population - All patients discharged from ICU in a time frame.(exclusion : death in CCU)

Source of data -Hospital record

Type of parameter -Process, Safety of patients

Benchmark -ICU readmission rates are around 5–6%



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**d) Error and patient Safety:**

Error is defined as the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim“.

- Culture of safety is important considering in the high number of preventable deaths (44000 to 98000/ annum medical error related deaths had been reported in USA).
- Brochure released by society of Critical Care Medicine, USA in 2004 had quoted very high incidence of medication errors which caused more than 770,000 injuries and deaths per year.
- Both patient safety and staff safety are important.

**e) Patients' fall rate:**

Definition- An untoward event which results in the patient coming to rest unintentionally on the ground or on other lower surface

Rationality- Fall could be accidental, anticipated physiological or unanticipated physiological .This is a safety issue for a patient in ICU. Accidental fall could lead to morbidity, prolonged stay and customer dissatisfaction

Formula for calculation, Fall rate = (No. of Falls/No. of Bed Days) x 1000

Patient population - All patients

Source of data - ICU record

Type of parameter - Safety and morbidity

Benchmark -8.46 falls per thousand bed days with an injury rate of 12.85% in 2000-012

**f) Medication error:**

Description -Medication error could be due to wrong prescription, dosing, and due to communication gap (verbal or written)

Rationality -Medication errors occur on an average in 19% of hospitalized adults. 78% of the serious medical errors that occurred in the ICU were attributed to medications. At least 2% of these errors caused significant patient harm (eg, injury requiring treatment, prolonged hospital stay, and death.)

Formula for calculation - Medication error rate = (no. of error /no. of bed days) x 1000

Patient population- All patients in ICU

Source of data- ICU record

Type of parameter- Patient safety

Benchmarks -Medication errors range from 1.2 to 947 per 1000 patient-days (median of 105.9 per 1000 patient-days) in adult ICUs and Median of 24.1 per 1000 patient days in neonatal/pediatric ICUs, Wrong dose: 105.9 errors per 1000 patient-days in ICU.



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**g) Adverse events /error rate:**

Description -Common ICU errors are related to treatment, procedure, ordering carrying out medication orders, reporting or communication, and failures to take precautions or follow protocols.

Rationality -Critically ill patients are at high risk for complications due to the severity of medical conditions, complexity of treatments, poly pharmacy, and technology based interventions. Nearly all ICU patients suffer from potentially harmful events. Nearly half (45%) of the adverse events are preventable.

Formula for calculation- Adverse events/ error rate = (no. of error /no. of bed days) x 1000

Patient population- All ICU patients

Source of data -Medical record

Type of parameter -Safety (patient)

Benchmark – The rates per 1000 patient-days for all adverse events, preventable adverse events, and serious errors were 80.5, 36.2, and 149.7, respectively. Among adverse events, 13% (16/120) were life-threatening or fatal; and among serious errors, 11% (24/223) were potentially life-threatening.

**h) Needle stick injury rate:**

Description -A penetrating stab wound from a needle (or other sharp objects) that may or may not be associated with exposure to blood or other body fluids

Rationality:-Needle stick injuries can cause transmission of blood borne pathogens. Needle stick injury can occur due to faulty handling of needle syringe with needle, suture needle, recapping of needle, and faulty disposal. Annual incidence ranges from 600,000 to 800,000 at global level. According to CDC estimate 385,000 needle stick injuries occur annually in U.S. hospital settings. Approximately half of those go unreported.

Formula for calculation- Incidence per 10,000 vene-punctures

Patient population - All health care workers

Source of data - ICU record

Type of parameter - Safety (Healthcare worker)

Benchmark -0.94 per 10,000 vene-punctures in the USA national rate.

**i) Reintubation rate:**

Description -Reintubation within 48 hours of extubation.

Rationality -Accidental extubation and subsequent reintubation can lead to prolonged stay, longer ventilation and higher Nosocomial pneumonia and mortality.

Formula for calculation - (Number reintubated/ Number extubated) X 100



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Patient population -ICU patients with end tracheal tube had undergone planned extubation.

Source of data -ICU record

Type of parameter -Morbidity, safety

Bench mark -12.2%, 12%.

### 1.16 What are Nosocomial / Hospital Acquired Infections?

“Any clinically recognizable disease that affects, the patients as a consequence of hospital admission, or hospital staff as a consequence of their work whether or not the symptoms appear during hospital stay.”

Ten to 30 per cent of patients admitted to hospitals and nursing homes in India, acquire Nosocomial infection as against an impressive five per cent in the West.

#### Incidence Pattern:

- Average Incidence - 5% to 10%, but maybe up to 28% in ICU
- Urinary Tract Infection - usually catheter related -28%
- Blood Stream infection - 7% to 16%
- Surgical Site Infection or wound infection -19%
- Pneumonia -17%

#### Types of HAI:

- Cross infection
- Environmental and
- Self commensal - to-opportunistic

#### Factors associated with HAI:

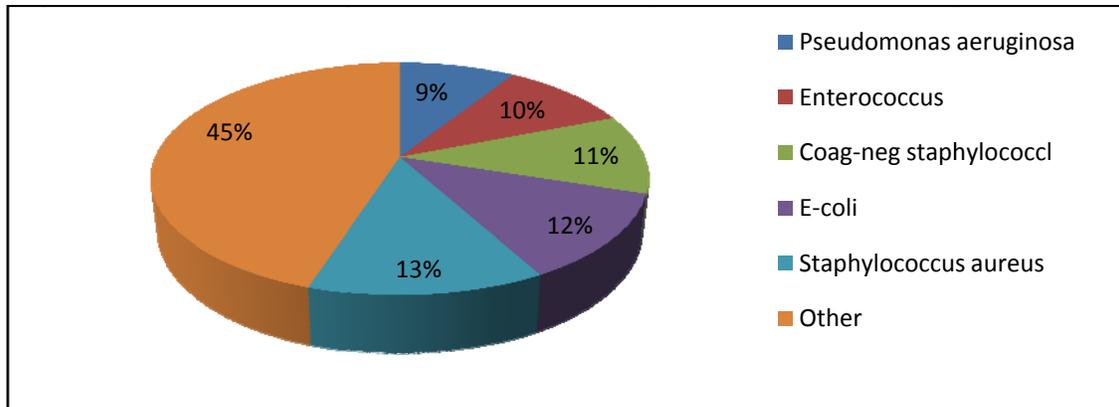
- Low resistance to infection
- Contact with infectious person
- Drug resistance among endemic microbes
- Contaminated environmental sites

#### Consequences:

- Prolongation of hospital stay: Varies by site, greatest with pneumonias and wound infections
- Additional morbidity
- Mortality increases - in order - LRI, BSI, and UTI
- Long-term physical & neurological consequences
- Direct patient costs increased- Escalation of the cost of care



### Common bacterial agent:



Source: HIS, 2005

### 1.17 Main routes of transmission:

#### 1. Contact Transmission:

- Direct-contact transmission- Involves a direct body surface-to-body surface contact and physical transfer of microorganisms between a susceptible host and an infected or colonized person.
- Indirect- contact transmission- It Involves contact of a susceptible host with a contaminated intermediate object. Such as contaminated instruments, needles, or dressings, or contaminated gloves that are not changed between patients.

2. **Droplet transmissions:** occurs when droplets are generated from the source person mainly during coughing, sneezing, and talking, and during the performance of certain procedures such as bronchoscopy.

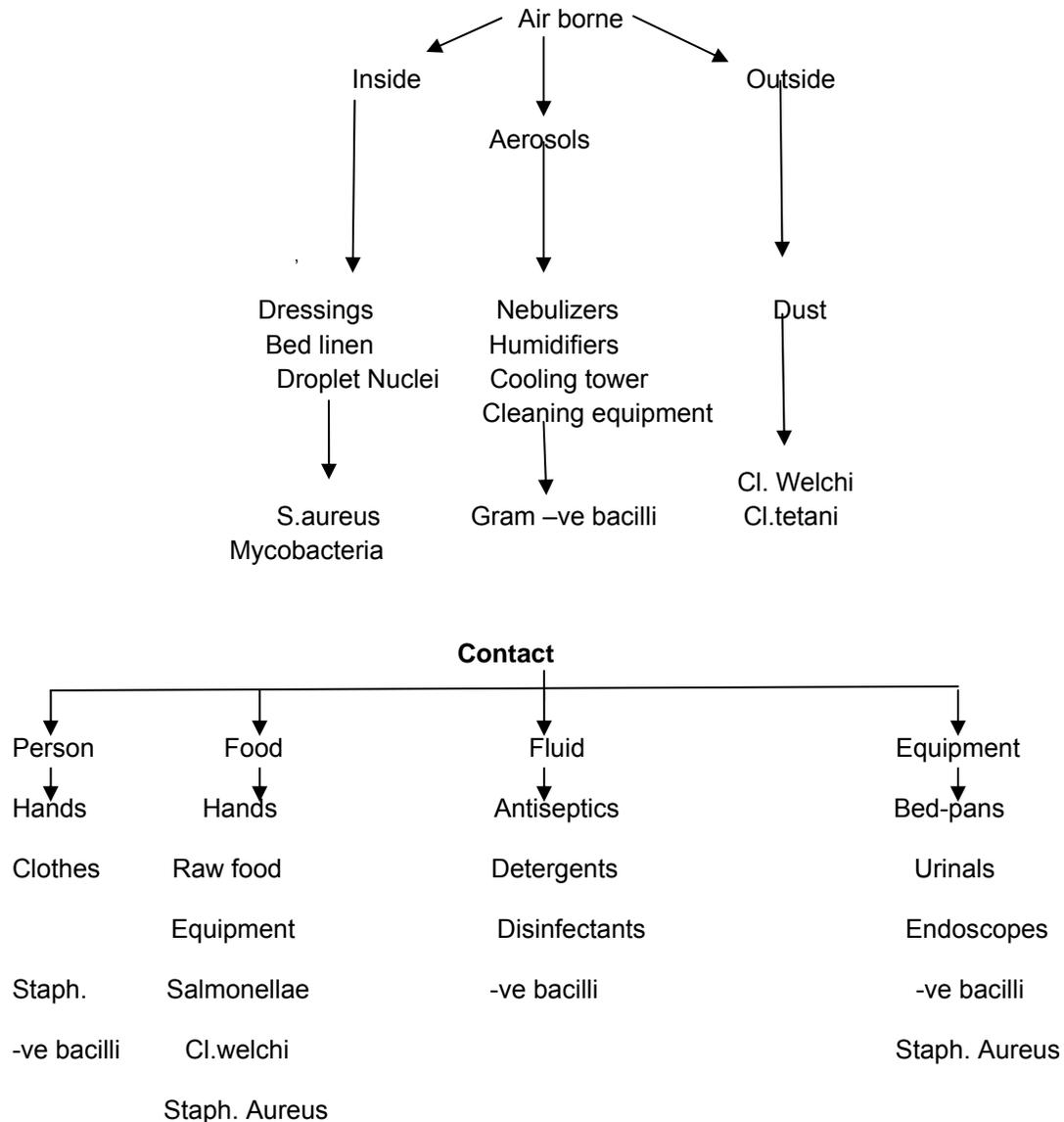
3. **Airborne transmission:** occurs by dissemination of either airborne droplet nuclei (small-particle residue 5  $\mu$ m or smaller in size. Microorganisms carried in this manner can be dispersed widely by air currents and may become inhaled by a susceptible host.

4. **Common vehicle transmission:** applies to microorganisms transmitted to the host by contaminated items such as food, water, medications, devices, and equipment.

5. **Vector borne transmission:** occurs when vectors such as mosquitoes, flies, rats, and other vermin transmit microorganisms.



### 1.18 How infections travel in Hospitals?



### 1.19 Infection control and universal precautions in critical care:

#### 1. General Measures:

- Frequent Hand Washing
- Physical Barriers(Gloves, Aprons, Mask, cap)

#### 2. Consultation with infection control team:



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### 3. Invasive Procedures:

- Aseptic techniques
- Use of sterile gloves
- Frequent change of catheters or intravenous lines

### 4. Vascular Cannulation:

- Hands must be washed
- Protective gloves should be worn
- Appropriate skin disinfection

### 5. Apparatus / equipment:

- Sterilization, disinfection
- decontamination

### 6. Disposable Items:

- Disinfected and discarded
- Not be reused or recycled

### 7. Reusable Items:

- Decontaminated and disinfect/ sterilize before each use

### 8. Ventilator circuits:

- Ventilator/breathing circuit must be regularly sterilized, or decontaminated and disinfected
- Disposable circuits may be necessary for patients with infectious diseases

### 9. Supplies:

- Storage Area
  - Clean and sterile items should not be stored in the same area where decontamination procedures take place
- Sterile Items
  - All sterilized items must be stored in a clean, dry area. Stock supply must

be rotated so that the oldest is used first

- Linen
  - Linen is stored in a clean, dry area and kept covered to prevent airborne contamination. It is recommended that clean linen that has been removed but not used must not be returned to the storage area

### 10. Isolation of patient with contagious disease/ infection:

#### 11. Hygiene:

- Patients Hygiene, bath, hand washing, change of dressing.

#### 12. Personnel:

- A clean uniform
- Avoid wearing Jewelry (a potential breeding area for colonization of bacteria)
- Exposure to a communicable disease must be reported to his/her immediate supervisor

#### 13. Housekeeping:

- Frequent Cleaning of the patient care area.
- No brooming
- Only wet mopping/ vacuum cleaning

#### 14. Visitors:

- Limit number
- Limit visit hours
- Do not allow flowers, eatables from outside



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**15. Limited Access:**

- Only authorized personnel are allowed access

**16. Waste disposal:**

- Disinfection and disposal of sharps
- Avoid re-sheathing of needles.
- Segregation

- Storage in color coded containers as per nature of waste

**17. Education:**

- On infection control and safety
- Orientation regarding infection control
- Practicing universal precautions within the critical care area

**1.20 Role of nurses in infection control:**

- Participating in the Infection Control Committee
- Promoting the development and improvement of nursing techniques, and ongoing review of aseptic nursing policies, with approval by the infection Control Committee
- Developing training programmes for members of the nursing staff
- Supervising the implementation of techniques for the prevention of infections in specialized areas such as the operating suite, the intensive care unit, the maternity unit and newborns
- Monitoring of nursing adherence to policies
- Identifying Nosocomial infections
- Investigation of the type of infection and infecting organism.
- Participating in training of personnel
- Surveillance of hospital infections
- Participating in outbreak investigation
- Development of infection control policy and review and approval of patient care policies relevant of infection control.
- Ensuring compliance with local and national regulations
- Liaison with public health and with other facilities where appropriate
- Providing expert consultative advice to staff health and other appropriate hospital programmes in matters relating to transmission of infection

A central sterilization department serves all hospital areas, including the operating suite. An appropriately qualified individual must be responsible for management of the programme. The responsibility for day-to-day management may be delegated to a nurse or other individual with appropriate qualifications, experience, and knowledge of medical devices. The responsibility is to clean, decontaminate, test, prepare for use, sterilize, and store aseptically all sterile hospital equipment. It works in collaboration with the infection control committee and other hospital programmes to develop and monitor policies on cleaning and decontamination of:



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- Reusable items
- Contaminated equipments including:
  - Wrapping procedures, according to the type equipment
  - Sterilization conditions ( eg temperature,duration,pressure,humidity)

## 1.21 Prevention of Nosocomial Infections:

### 1. Commonly used Terms:

- **Sterilization:**  
Complete elimination or destruction of all forms of microbial life and is accomplished in the hospital by either physical or chemical processes.
- **Disinfection:**  
A process that eliminates many or all pathogenic microorganisms on inanimate objects, with the exception of the bacterial endospore.
- **Cleaning:**  
The removal of all foreign material (e.g. soil, organic material) from objects, and it is normally accomplished using water with detergents or enzymatic products.
- **Decontamination:**  
Procedure that removes pathogenic microorganisms from objects, so they are safe to handle.
- **Germicide:**  
Agent that destroys microorganisms, particularly pathogenic microorganisms (germs).
- **Chemical sterilants**  
Disinfectants which kills spores with prolonged exposure times (6-10 hours).

### 2. Reducing Person To Person Transmission:

#### A) Hand decontamination:

The importance of hands in the transmission of hospital infections has been well demonstrated and can be minimized with appropriate hand hygiene.

#### **Procedure:**

Here must be written policy or procedures for hand washing. Jewellery must be removed before washing. Simple hygiene procedures may be limited to hands and wrists: surgical procedures included the hand and forearm. Procedures will vary with the patient risk assessment

#### **Routine care:**

- Hand washing with non-aseptic soap
- Quick hygienic hand disinfection ( by rubbing with alcoholic solution



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**Antiseptic hand cleaning (moderate) - aseptic care of infected patient:**

- Hygienic hand washing with antiseptic soap following manufactures instructions ( eg one minute )
- Quick hygienic hand disinfection : as previously

**Surgical scrub (Surgical care):**

- Surgical hand and forearm washing with antiseptic soap and sufficient time and duration of contact ( 3-5 minutes)
- Surgical hand and forearm disinfection: simple hand washing and drying followed by two applications of hand disinfectant, then rub to dry for the duration of contact defined by the product.

**B) Personal Hygiene:**

All staff should maintain good personal hygiene. Nails must be clean and kept short. False nails should not be worn. Hair must be worn short or pinned up. Beard and moustaches must be kept trimmed short and clean.

**C) Clothing:**

**Working clothes:**

Staff can normally wear a personal uniform or street clothes covered by white coat. In specific area such as ICU, uniform trousers and a short sleeved gown are required for men and women. The working outfit made of material easy to wash and decontaminate .I f possible a clean out fit should be worn each day. An outfit must be changed after exposure to blood or if it becomes wet through excessive sweating or other fluid exposure.

**Shoes:**

In aseptic unit staff must wear dedicated shoes, which must be easy to clean.

**Caps:**

In aseptic unit staff must wear caps or hoods which completely cover the hair.

**Masks :**

Masks of cotton wool, gauze, or paper are ineffective.

**Gloves :**

Staff should wear sterile gloves for surgery, care for immune-compromised patients, invasive procedures. And non sterile gloves should be worn for all patient contacts were hands are likely to be contaminated



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#### **D) Safe injection practices:**

To prevent transmission of infections between patients with injections:

- Eliminate unnecessary injections
- Use sterile needle and syringe
- Use disposable needle and syringes, if possible
- Prevent contamination of medications
- Follow safe sharps disposal practices

#### **E) Preventing transmission from the environment:**

To minimize the transmission of microorganisms from equipment and the environment, adequate methods for cleaning, disinfecting and sterilizing must be in place. Written policies and procedures which are updated on a regular basis must be developed for each facility.

#### **Cleaning of the hospital environment:**

- Routine cleaning is necessary to ensure a hospital environment which is visibly clean, and free from dust and soil.
- Ninety per cent of microorganisms are present within “visible dirt”, and the purpose of routine cleaning is to eliminate this dirt. Neither soap nor detergents have antimicrobial activity, and the cleaning process depends essentially on mechanical action.
- There must be policies specifying the frequency of cleaning and cleaning agents used for walls, floors, windows, beds, curtains, screens, fixtures, furniture, baths and toilets, and all reused medical devices.
- Methods must be appropriate for the likelihood of contamination, and necessary level of asepsis. This may be achieved by classifying areas into one of four hospital zones

#### **Use of hot/superheated water:**

An alternative to disinfection for environmental cleaning for some objects is hot water

#### **Disinfection of patient equipment:**

Disinfection removes microorganisms without complete sterilization to prevent transmission of organisms between patients. Disinfection procedures must

- Meet criteria for killing of organisms
- Have a detergent effect
- Act independently of the number of bacteria

Present the degree of hardness of the water, or the presence of soap and proteins (that inhibit some disinfectants).



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To be acceptable in the hospital environment, they must also be:

- Easy to use
- Non-volatile
- Not harmful to equipment, staff or patients
- Free from unpleasant smells
- Effective within a relatively short time.

**High-level disinfection** (critical) — this will destroy all microorganisms, with the exception of heavy contamination by bacterial spores.

**Intermediate disinfection** (semi-critical) — this inactivates *Mycobacterium tuberculosis*, vegetative bacteria, most viruses and most fungi, but does not necessarily kill bacterial spores.

**Low-level disinfection** (non-critical) — this can kill most bacteria, some viruses and some fungi, but cannot be relied on for killing more resistant bacteria such as *M. tuberculosis* or bacterial spores. These levels of disinfection are attained by using the appropriate chemical product in the manner appropriate for the desired level of disinfection.

**Sterilization:**

Sterilization is the destruction of all microorganisms. Operationally this is defined as a decrease in the **Spectrum of activity achieved of the main disinfectants:**

Level of disinfection required	Spectrum of activity of disinfectant	Active ingredients potentially capable of satisfying these spectra of activity	Factors affecting the efficacy of a disinfectant
High	<ul style="list-style-type: none"> <li>• Sporicidal</li> <li>• Mycobactericidal</li> <li>• Virucidal</li> <li>• Fungicidal</li> <li>• Bactericidal</li> </ul>	<ul style="list-style-type: none"> <li>• Peracetic acid</li> <li>• Chlorine dioxide</li> <li>• Formaldehyde</li> <li>• Glutaraldehyde</li> <li>• Sodium hypochlorite</li> <li>• Stabilized hydrogen Peroxide</li> <li>• Succinaldehyde (succinic aldehyde)</li> </ul>	<ul style="list-style-type: none"> <li>• Concentration</li> <li>• Contact time</li> <li>• Temperature</li> <li>• Presence of organic matter</li> <li>• pH</li> <li>• Presence of calcium or magnesium ions (for example, hardness of the water used for dilution)</li> </ul>
Intermediate	<ul style="list-style-type: none"> <li>• Tuberculocidal</li> </ul>	<ul style="list-style-type: none"> <li>• Virucidal</li> </ul>	<ul style="list-style-type: none"> <li>• Formulation of the</li> </ul>



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	<ul style="list-style-type: none"> <li>• Phenol derivatives</li> <li>• Fungicidal</li> <li>• Bactericidal</li> </ul>	<ul style="list-style-type: none"> <li>• Ethyl and isopropyl alcohols</li> </ul>	disinfectant used
Low	<ul style="list-style-type: none"> <li>• Bactericidal</li> </ul>	<ul style="list-style-type: none"> <li>• Quaternary ammonium</li> <li>• Amphiprotic</li> <li>• Amino acids</li> </ul>	

**Level of disinfection for patient equipment in relation with type of care:**

Devices use	Class	Level of risk	Level of disinfection
Into vascular system, into sterile cavity into sterile tissues: Surgical instrumentation, e.g. arthroscopes, biopsies, instrumentation, etc.	• Critical	• High	• sterilization or high-level disinfection
Mucous membrane contact non-intact skin: e.g. gastroscopy, etc	• Semi-critical	• Medium	• disinfection of median level
Intact skin or without contact with patient: E.g. beds sink, etc.	• Non-critical	• Low	• disinfection of low level

Sterilization can be achieved by either physical or chemical means.

- Sterilization is required for medical devices penetrating sterile body sites, as well as all parenteral fluids and medications.
- For reprocessed equipment, sterilization must be preceded by cleaning to remove visible soil.
- The object must be wrapped for sterilization. Only a wrapped sterilized object should be described as sterile:



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Materials for packaging include:

- Paper which prevents contamination if intact, maintains sterility for a long period, can act as a sterile field, and can also be used to wrap dirty devices after the procedure

### **Principal sterilization methods:**

#### **Thermal sterilization:**

- Wet sterilization: exposure to steam saturated with water at 121 °C for 30 minutes, or 134 °C for 13 minutes in an autoclave; (134 °C for 18 minutes for prions).
- Dry sterilization: exposure to 160 °C for 120 minutes, or 170 °C for 60 minutes; this sterilization process is often considered less reliable than the wet process, particularly for hollow medical devices.

#### **Chemical sterilization:**

- Ethylene oxide and formaldehyde for sterilization are being phased out in many countries because of safety and greenhouse gas emission concerns.
- Peracetic acid is widely used in the United States and some other countries in automatic processing systems.

## **1.22 Surveillance of Nosocomial infections:**

### **What is surveillance?**

“Ongoing, systematic collection, analysis and interpretation of health data essential to planning, implementation and evaluation of public health services; closely integrated with timely dissemination of the data to those who need to know about it”.

### **Types:**

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• Sentinel- event based<ul style="list-style-type: none"><li>➢ Indicates Failure of Hospital's efforts</li><li>➢ Requires individual investigation</li><li>➢ Denominator not required</li></ul></li></ul> | <ul style="list-style-type: none"><li>• Population based<ul style="list-style-type: none"><li>➢ Surveillance of patients with similar risks</li><li>➢ Requires both Numerator &amp; Denominator</li></ul></li></ul> |
|---|---|

### **Purpose of surveillance:**

- |  |  |
|--|--|
| <ul style="list-style-type: none"><li>• Reducing infection rate within hospital</li><li>• Establishing endemic baseline rates</li><li>• Identifying outbreaks</li><li>• Convincing medical staff</li><li>• Evaluating control measures</li></ul> | <ul style="list-style-type: none"><li>• Convincing Planners, Media &amp; People</li><li>• Defending Hospital procedures- legal aspects</li><li>• Comparing rates between hospitals</li></ul> |
|--|--|



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#### **Nosocomial infections-Surveillance methods:**

- Case finding issues
- Incidence v / s Prevalence in hospital wide surveillance
- Targeted surveillance
- Objective/Priority directed surveillance
- Limited periodic surveillance
- Post discharge surveillance

#### **Surveillance of Nosocomial infections Data Collection:**

- Numerator
  - who to collect data
  - What data to collect
  - Sources of data
  - How to collect data
- Denominator
  - What data to collect
  - Data source and collection techniques

#### **Surveillance of Nosocomial infections Essential Data:**

- Demographic
  - Name
  - Age
  - Sex
  - Hospital Reg. number
  - Service
  - Diagnosis
  - Ward/unit
- Admission date
- Infection
  - Onset
  - Site
- Laboratory
  - Pathogens
  - Anti- biogram

#### **Surveillance of Nosocomial infections Data analysis:**

- Comparing rates amongst patient groups
- Comparing rates over time
- Comparing infection rates
- Identifying outbreaks
- Assessing appropriateness of medical care

#### **Nosocomial infections-Hospital Infection Control:**

##### **Steps**

- Isolation of patients with communicable disease
- Hand washing & Hand disinfection
- Infection control policies and procedures
- Education of Medical staff
- Ensuring employee health
- Medical waste management



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## Neonatal Intensive Care Unit





## Neonatal Intensive Care Unit

### 2.1 What is NICU?

Newborn intensive care is defined as care for medically unstable or critically ill newborns requiring constant nursing, complicated surgical procedures, continual respiratory support, or other intensive interventions. The NICU combines advanced technology and trained healthcare professionals to provide specialized care for the tiniest patients. NICUs may also have intermediate or continuing care areas for babies who are not as sick but do need specialized nursing care. Some hospitals do not have the personnel or a NICU and babies must be transferred to another hospital.



### 2.2 Infrastructure for NICU:

- **Location within the Hospital:**

The NICU shall be located within space designed for that purpose. It shall provide good visibility of infants and circulation of staff, family, and equipment. Traffic to other services shall not pass through the unit. The NICU shall be in close proximity to the area of the hospital where births occur. Units receiving babies from other facilities shall have ready access to the hospital's transport receiving area.

- **Minimum Area, Clearance and Privacy Requirements for the Infant Care Space:**

Each infant care space shall contain a minimum of 120 square feet (11.2 square meters), excluding sinks and aisles. Additionally, there shall be an aisle adjacent to each infant care space with a minimum width of 3 feet (0.9 meters). Each infant care space shall be designed to allow privacy for the baby and family.

- **Staff Support:**

Space shall be provided within the NICU to meet the professional, personal, and administrative needs of the staff. Rooms shall be sized to provide privacy and to satisfy their intended function. Locker, lounge, private toilet facilities and on-call rooms are required at a minimum.

- **Parent-Infant Room(s):**

Parent-infant room(s) shall be provided within or immediately adjacent to the NICU that allow(s) parents and infants extended private time together. The room(s) shall have direct, private access to sink and toilet facilities, telephone or intercom linkage with the NICU staff, sleeping facilities for at least one parent, and sufficient space for the infant's bed and equipment. The room(s) can be used for other family educational, counseling, or demonstration purposes when unoccupied.



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- **Ancillary Accommodation:**

Distinct support space shall be provided for respiratory therapy, laboratory, pharmacy, radiology, and other ancillary services when these activities are routinely performed on the unit.

- **Floor Surfaces:**

Floor surfaces shall be easily cleanable and shall minimize the growth of microorganisms. Floors shall be highly durable to withstand frequent cleaning and heavy traffic.

- **Wall Surfaces:**

Wall surfaces shall be easily cleanable and provide protection at points where contact with movable equipment is likely to occur.

- **Safety/ Security of Infant:**

The NICU shall be designed as part of an overall security program to protect the physical safety of infants, families and staff in the NICU. The NICU shall be designed to minimize the risk of infant abduction.

### 2.3 Who can provide NICU Care?

- NICU Nurse
- Attending Doctor (Neonatologist)
- Pediatric Surgeon
- Pharmacist
- Residents
- Supporting Staff

### 2.4 What are the high-risk factors?

- **Maternal factors:**
  - Age younger than 16 or older than 40 years
  - Drug or alcohol exposure
  - Diabetes
  - Hypertension (high blood pressure)
  - Bleeding
  - Sexually transmitted diseases
  - Multiple pregnancy (twins, triplets, or more)
  - Too little or too much amniotic fluid
  - Premature rupture of membranes (also called the amniotic sac or bag of waters)
- **Delivery factors:**
  - Fetal distress/birth asphyxia (changes in organ systems due to lack of oxygen)
  - Breech delivery presentation (buttocks delivered first) or other abnormal presentation
  - Meconium (the baby's first stool passed during pregnancy into the amniotic fluid)
  - Nuchal cord (cord around the baby's neck)
  - Forceps or cesarean delivery
- **Baby factors:**
  - Birth at gestational age less than 37 weeks or more than 42 weeks



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- Birth weight less than 2,500 grams (5 pounds, 8 ounces) or over 4,000 grams (8 pounds, 13 ounces)
- Small for gestational age
- Medication or resuscitation in the delivery room
- Birth defects
  - Respiratory distress including rapid breathing
- Grunting, or apnea (stopping breathing)
- Infection such as herpes, streptococcus, chlamydia
- Seizures
- Hypoglycemia (low blood sugar)
- Need for extra oxygen or monitoring, intravenous (iv) therapy, or medications
- Need for special treatment or procedures such as a blood transfusion

### **High-Risk newborn babies:**

- In some cases, unexpected difficulties and challenges occur along the way.
- Some newborns are considered high risk. This means that a newborn has a greater chance of complications because of conditions that occur during fetal development, pregnancy conditions of the mother, or problems that may occur during labor and birth.
- Some complications are unexpected and may occur without warning. Other times, there are certain risk factors that make problems more likely.
- Fortunately, advances in technology have helped improve the care of sick newborns. Under the care of specialized physicians and other healthcare providers, babies have much greater chances for surviving and getting better today than ever before.

### **2.5 What are the Assessment criteria for newborn babies?**

Each newborn baby is carefully checked at birth for signs of problems or complications. A complete physical assessment will be performed that includes every body system.

#### **Apgar-Scoring:**

The Apgar score is one of the first checks of newborn health. The Apgar score is assigned in the first few minutes after birth to help identify babies that have difficulty breathing or have a problem that needs further care. The baby is checked at one minute and five minutes after birth for heart and respiratory rates, muscle tone, reflexes, and color.



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Sign	0 Points	1 Point	2 Points
<b>A</b> Activity (Muscle Tone)	Absent	Arms and Legs Flexed	Active Movement
<b>P</b> Pulse/Heart rate	Absent	Below 100 bpm	Above 100 bpm
<b>G</b> Grimace (Reflex Irritability)	No Response	Grimace	Sneeze, cough, pulls away
<b>A</b> Appearance (Skin Color)	Blue-gray, pale all over	Normal, except for extremities	Normal over entire body
<b>R</b> Respiration	Absent	Slow, irregular	Good, crying

➤ **Birth weight and measurements:**

The average weight for term babies (born between 37 and 41 weeks gestation) is about 7 lbs. (3.2 kg). In general, small babies and very large babies are at greater risk for problems. Babies are weighed daily in the nursery to assess growth, fluid, and nutrition needs. Newborn babies may lose as much as 10 percent of their birth weight. This means that a baby weighing 7 pounds 3 ounces at birth might lose as much as 10 ounces in the first few days. Premature and sick babies may not begin to gain weight right away. Most hospitals use the metric system for weighing babies. This chart will help you convert grams to pounds.

Measurements:

Other measurements are also taken of each baby. These include the following:

- Head circumference (the distance around the baby's head) - is normally about one-half the baby's body length plus 10 cm.
- Abdominal circumference - the distance around the abdomen.
- Length - the measurement from crown of head to the heel.
- Physical examination.

Physical examination of a newborn often includes the assessment of the following:

Vital signs:

- Temperature - able to maintain stable body temperature 98.6° F (37° C) in normal room environment.
- Pulse - normally 120 to 160 beats per minute.
- Breathing rate - normally 30 to 60 breaths per minute.
- General appearance - physical activity, tone, posture, and level of consciousness.



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- Skin - color, texture, nails, presence of rashes.
- Head and neck.

Appearance, shape, presence of molding (shaping of the head from passage through the birth canal) fontanelles (the open "soft spots" between the bones of the baby's skull).

- Clavicles (bones across the upper chest).
- Face - eyes, ears, nose, cheeks
- Mouth - palate, tongue, throat
- Lungs - breathing sounds, breathing pattern
- Heart sounds and femoral (in the groin) pulses
- Abdomen - presence of masses or hernia
- Genitals and anus - for open passage of urine and stool
- Arms and legs - movement and development

## 2.6 What are the types of Newborn Reflexes?

- **Rooting reflex:**

This is considered a basic instinct as it helps baby feed. Rooting reflex helps the newborn to find the breast or bottle and suck it. When the baby's mouth or cheek is stroked, it responds by 'rooting' or turning and opening its mouth in the direction of the finger. This reflex continues for a few months until baby is able to turn voluntarily.



- **Grasp reflex:**

Baby grasps anything that is placed into her fist. The grasp is more firm in premature babies; it usually disappears within few weeks.



- **Sucking reflex:**

When you touch the roof of baby's mouth, its natural instinct will be to suck. Sucking reflex is not fully developed in premature babies and that is why the problems with feeding. This reflex too becomes voluntary after a few months.



- **Startle reflex (Moro reflex):**

It is baby's response to noise and sudden movements. Baby will react by throwing back its head, extending its legs and arms with fingers outstretched, and cry to basically prevent him from falling. The baby will then pull back its arms and legs.





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- **Tonic neck reflex:**

When we turn baby's head to the side, the arm on that side extends out and the arm opposite bends at the elbow. Also called the fencing reflex, it disappears when baby is about 7 months of age.



- **Step reflex:**

If we hold baby upright and let baby's feet touch a firm surface newborn will mimic a stepping action. This has nothing to do with actual walking. This reflex is also aptly called the 'dance or walking' reflex. It disappears in about a month.



- **Crawling:**

When placed on the stomach, baby will automatically assume the crawling position with its pelvis high and knees pulled up under the abdomen. When he kicks his legs, it may appear like vague crawling.



## 2.7 Usual Conditions and Complications for NICU:

### 2.7.1 Low Birth Weight:

Low birth weight is a term used to describe babies who are born weighing less than 2,500 grams pounds.

Problems associated with low birth weight babies:

- Low oxygen levels at birth
- Inability to maintain body temperature
- Difficulty feeding and gaining weight
- Infection
- Breathing problems such as respiratory distress syndrome (a respiratory disease of prematurity caused by immature lungs)
- Neurologic problems such as intra-ventricular hemorrhage (bleeding inside the brain)
- Gastrointestinal problems such as necrotizing enterocolitis (a serious disease of the intestine common in premature babies)
- Sudden infant death syndrome (SIDS)

Nearly all low birth weight babies need specialized care in the Neonatal Intensive Care Unit (NICU) until they gain weight and are well enough to go home.



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### 2.7.2 Post-maturity (post-term):

Post-maturity refers to any baby born after 42 weeks gestation or 294 days past the first day of the mother's last menstrual period.

Care given to post-mature babies:

- Checking for respiratory problems related to meconium (baby's first bowel movement) aspiration.
- Blood tests for hypoglycemia (low blood sugar).

### 2.7.3 Prematurity (Preterm):

A baby born before 37 weeks of pregnancy is considered premature, that is, born before complete maturity.

#### Problems associated with Premature Babies:

- Temperature instability - inability to stay warm due to low body fat.
- Respiratory problems:
  - Hyaline membrane disease/ respiratory distress syndrome
  - Chronic lung disease/bronchopulmonary dysplasia
  - Air leaking out of the normal lung spaces into other tissues
  - Incomplete lung development
  - Apnea (stopping breathing)
- Cardiovascular problems:
  - Patent ductus-arteriosus (PDA)
  - Too low or too high blood pressure
  - Low heart rate - often occurs with apnea
- Blood and Metabolic related problems:
  - Anemia - may require blood transfusion
  - Jaundice
- Too low or too high levels of minerals and other substances in the blood such as calcium and glucose (sugar)
- Immature kidney function
- Gastrointestinal problems:
  - Difficulty feeding
  - Poor digestion
  - Necrotizing enterocolitis (NEC)
- Neurological problems:
  - Intra-ventricular hemorrhage
  - Peri-ventricular leukomalacia
  - Poor muscle tone
  - Seizures - may be due to bleeding in the brain
  - Retinopathy of prematurity
- Infections

#### Characteristics of prematurity:

- small baby, often weighing less than 2,500 grams (5 pounds 8 ounces)
- thin, shiny, pink or red skin, able to see veins



- little body fat
- little scalp hair, but may have lots of lanugo (soft body hair)

#### Care given to premature babies:

- temperature-controlled beds
- monitoring of temperature, blood pressure, heart and breathing rates, and oxygen levels
- giving extra oxygen by a mask or with a breathing machine
- mechanical ventilators (breathing machines) to do the work of breathing for the baby
- intravenous (IV) fluids - when feedings cannot be given, or for medications
- placement of catheters (small tube) into the umbilical cord to give fluids and medications and to draw blood
- x-rays (for diagnosing problems and checking tube placement)

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- weak cry and body tone
- genitals may be small and underdeveloped

- Special feedings of breast milk or formula, sometimes with a tube into the stomach if a baby cannot suck. Breast milk has many advantages for premature babies as it contains immunities from the mother and many important nutrients
- medications and other treatments for complications, such as antibiotics
- Kangaroo Care - a method of caring for premature babies using skin-to-skin contact with the parent to provide contact and aid parent-infant attachment. Studies have found that babies who "kangaroo" may have shorter stays in the NICU

#### 2.7.4 Respiratory Disorders:

There are many respiratory disorders that place a newborn at higher risk and require clinical care by a physician or other healthcare professional.

##### 1. Apnea of Prematurity:

Apnea is a term for the absence of breathing for more than 20 seconds. It can occur in full-term babies, but is more common in premature babies.

##### Symptoms of Apnea of prematurity:

- longer periods of absent breathing
- severe decrease in heart rate (bradycardia)
- apnea beginning right after birth or after the second week
- blue coloring

##### 2. Chronic Lung Diseases:

Chronic lung disease (CLD) is a general term for long-term respiratory problems in premature babies. It is also known as Bronchopulmonary dysplasia (BPD).



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Symptoms associated with Chronic Lung Diseases

- respiratory distress (rapid breathing, flaring of the nostrils, chest retractions)
- continued need for mechanical ventilation or oxygen after a premature baby reaches 36 weeks gestation

### 3. Hyaline Membrane Disease / Respiratory Distress Syndrome:

Hyaline membrane disease (HMD), also called respiratory distress syndrome (RDS), is one of the most common problems of premature babies. It can cause babies to need extra oxygen and help breathing.

Symptoms of HMD

- Respiratory difficulty at birth that gets progressively worse
- Cyanosis (blue coloring)
- Flaring of the nostrils
- Tachypnea (rapid breathing)
- Grunting sounds with breathing
- Chest retractions (pulling in at the ribs and sternum during breathing)

The symptoms of HMD usually peak by the third day, and may resolve quickly when the baby begins to diurese (excrete excess water in urine) and begins to need less oxygen and mechanical help to breathe.

Complications associated with HMD:

- Pneumomediastinum - air leaks into the mediastinum.
- Pneumothorax - air leaks into the space between the chest wall and the outer tissues of the lungs.
- Pneumopericardium - air leaks into the sac surrounding the heart.
- Pulmonary interstitial emphysema (PIE) - air leaks and becomes trapped between the alveoli, the tiny air sacs of the lungs.
- Chronic Lung Diseases, sometimes called Bronchopulmonary Dysplasia

### 4. Meconium Aspiration:

Meconium aspiration occurs when a baby breathes in amniotic fluid containing meconium (the baby's first stools).

**Symptoms of Meconium Aspiration:**

- Rapid breathing
- Retractions (pulling in of the chest wall)
- Grunting sounds with breathing
- Cyanosis (blue coloring)
- Over distended chest



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### **Treatment for Meconium Aspiration:**

Specific treatment for Meconium aspiration will be determined by your child's physician based on the following:

- The amount and thickness of the Meconium
- The length of time the baby was exposed
- The degree of respiratory distress

At delivery, treatment may include:

- Suctioning of the upper airways (nose, mouth, and throat)
- Suctioning of the lower airways through an Endotracheal tube (ET) placed in the windpipe
- Supplemental oxygen given by face mask or mechanical ventilator

### **5. Persistent Pulmonary Hypertension (PPHN):**

Persistent pulmonary hypertension (PPHN) is also known as Persistent Fetal Circulation. In this condition, a newborn baby's circulation changes back to the circulation of a fetus, where much of the bloods flow bypasses the lungs.

Symptoms associated with Persistent Pulmonary Hypertension

- Baby appears ill at delivery or in first hours after birth
- Cyanosis (blue coloring)
- Rapid breathing
- Rapid heart rate
- Low blood oxygen levels while receiving 100 percent oxygen

Treatment for Persistent Pulmonary Hypertension:

- Supplemental oxygen (giving 100 percent oxygen by a mask or plastic hood)
- Placing an endotracheal tube into the baby's windpipe (ET TUBE)
- Mechanical breathing machine (to do the work of breathing for the baby)
- Medications
- Inhalation of nitric oxide (to help dilate the blood vessels in the lungs)
- Extracorporeal membrane oxygenation (ECMO) - a special technique that may be used when a baby does not respond to maximum medical care. With ECMO blood from the baby's veins is pumped through an artificial lung where oxygen is added and carbon dioxide is removed. The blood is then returned back to the baby. ECMO is only used in specialized NICUS



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### **2.7.5 Small for Gestational Age:**

This term is used to describe a baby who is smaller than the usual amount for the number of weeks of pregnancy. SGA babies usually have birth weights below the 10th percentile for babies of the same gestational age. SGA babies may appear physically and neurologically mature but are smaller than other babies of the same gestational age. SGA babies may be proportionately small (equally small all over) or they may be of normal length and size but have lower weight and body mass. SGA babies may be premature (born before 37 weeks of pregnancy), full term (37 to 41 weeks), or post term (after 42 weeks of pregnancy).

#### **Complications associated with SGA:**

- Decreased oxygen levels
- Low Apgar scores
- Meconium aspiration
- Hypoglycemia
- Difficulty maintaining normal body temperature
- Polycythemia

#### **Treatment for SGA:**

- Temperature controlled beds or incubators
- Tube feedings (if the baby does not have a strong suck)
- Checking for hypoglycemia (low blood sugar) through blood tests
- Monitoring of oxygen levels

Babies who are SGA and are also premature may have additional needs including oxygen and mechanical help to breathe.

### **2.7.6 Very Low Birth weight:**

Very Low Birth weight is a term used to describe babies who are born weighing less than 1,500 grams (3 pounds, 4 ounces). Babies with very low birth weight look much smaller than other babies of normal birth weight.

#### **Causes for Very Low Birth weight:**

- Premature birth (born before 37 weeks gestation )
- Intrauterine growth restriction
- Mother's exposed to drugs, alcohol and cigarettes health
- Mothers of lower socioeconomic status



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**Risk factors associated with very Low Birth weight:**

- Race
- Age (Teen mothers)
- Multiple Birth Babies

**Complications associated with VLBW:**

- Low oxygen levels at birth
- Inability to maintain body temperature
- Difficulty feeding and gaining weight
- Infection
- Breathing problems such as respiratory distress syndrome (a respiratory disease of prematurity caused by immature lungs)
- Neurological problems such as intra-ventricular hemorrhage (bleeding inside the brain), cerebral palsy, blindness  
Deafness, mental retardation
- Gastrointestinal problems such as necrotizing enterocolitis (NEC)
- Sudden infant death syndrome (SIDS)

**Diagnosis for very low birth weight:**

- The height of the fundus (the top of a mother's uterus) can be measured from the pubic bone. after the 20th week
- Ultrasound
- Babies are weighed within the first few hours after birth. A birth weight less than 2,500 grams (5 pounds, 8 ounces) are diagnosed as low birth weight. Babies weighing less than 1,500 grams (3 pounds, 5 ounces) at birth are considered very low birth weight

**Treatment for babies who have Very Low Birth weight:**

- Care in the NICU
- Temperature controlled beds
- Special feedings, sometimes with a tube into the stomach if a baby cannot suck
- Other treatments for complications.

**Steps taken for the prevention of Very Low Birth Weight babies:**

- Prenatal care
- Healthy diet and gaining the proper amount of weight in pregnancy are essential
- Mothers should also avoid alcohol, cigarettes, and illicit drugs



## 2.8 Care of babies in NICU

- **Intravenous Line and Tubes:**

- Intravenous line (IV):

Babies may have an IV placed in a hand, foot, or scalp, where veins are easily accessed. Tubing connects the IV to a bag containing fluids that are carefully delivered with a pump.

- Umbilical catheter:

After the umbilical cord is cut at birth; newborn babies have the short stumps of the cord remaining. Because the umbilical cord stump is still connected to their blood and circulatory system, a catheter (small flexible tube) can be inserted into one of the two arteries or the vein of the umbilical cord. Medications, fluids, and blood can be given through this catheter. After placement of the umbilical catheter, x-rays are taken to check the location in the baby's body.

- Percutaneous line:

A catheter is placed in a deep vein or artery in the baby's arm and is used for meeting a baby's longer-term needs than an IV in the hand or scalp.

- **Nutrition:**

Feeding babies in the NICU is quite different from feeding healthy babies. When babies are sick or premature, they are often not well enough to breastfeed or take a bottle. Premature babies may not be able to suck effectively, or their gastrointestinal tracts may not be mature enough to digest feedings. Babies who are medically unstable are often unable to take regular feedings. Babies with umbilical catheters and those on mechanical ventilators may not be able to be fed because of the risk of aspiration (breathing food into the lungs).

- **Fluids:**

Many babies in the NICU receive essential fluids and electrolytes through a tube in a vein called an IV. Some babies may need a special preparation called parenteral hyperalimentation, which contains nutrients they need until they are able to take milk feedings. The contents of IV fluids and hyperalimentation are carefully calculated for each baby. Calories, protein, fats, and electrolytes including sodium, potassium, chloride, magnesium, and calcium are all important components.

- **Monitoring baby's electrolyte and blood levels:**

Some babies have too much or too little of certain electrolytes or other components in the blood. As a result, some of the common problems include the following:

- Hyponatremia - high amounts of sodium (salt) in the blood.

- Hyperkalemia - high amounts of potassium in the blood; can be diagnosed by blood test, or by



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changes in the baby's heart rate pattern.

- Hyperglycemia - high amounts of glucose (sugar) in the blood; diagnosed by blood tests, often done by heel stick; some babies may need insulin to control high glucose levels.

- Hypoglycemia - low blood sugar; usually treated with IV fluids containing dextrose (another form of sugar).

- Hypocalcaemia - low calcium levels in the blood; usually treated with calcium in IV fluids.

- **Determining baby's condition for milk feedings:**

- Signs of sucking.
- Active bowel sounds.
- Have passed meconium stools (baby's first bowel movements).

- Have no signs of abdominal distention or infection.

Most babies older than 28 weeks gestation have digestive tracts mature enough for milk feedings. Once baby is taking milk feedings well and is gaining weight, intravenous (IV) fluids and hyperalimentation can be decreased.

Sick babies may not be strong enough to suck effectively. Premature babies may not be physically mature enough to coordinate sucking; swallowing, and breathing, or they may be too weak to suck for long periods of time. Special pacifiers designed for premature babies are sometimes used to teach them how to suck properly before they begin to breastfeed or bottle feed.

- **Feeding of babies in NICU:**

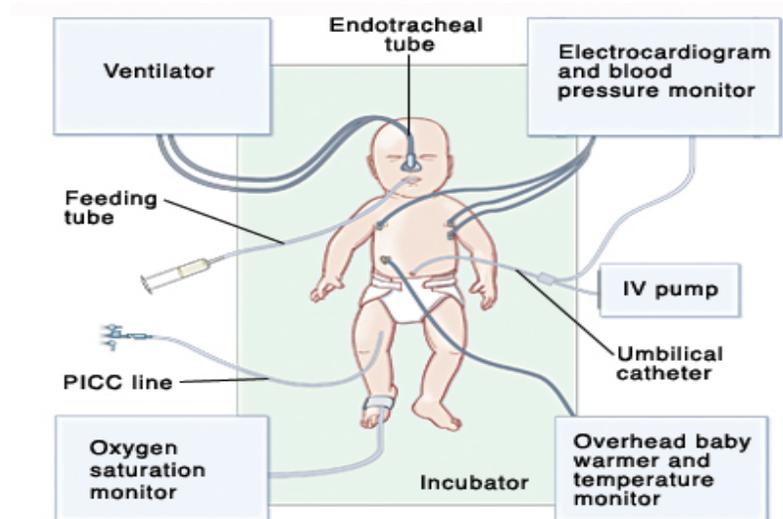
- Gavage or tube feedings:

Gavage or tube feedings may be needed until the baby learns to suck effectively. For gavage feedings, a small flexible tube is placed into a baby's nostril or mouth and passed down into the stomach. The tube is sometimes removed, but may be left in place if feedings are frequent. Before each tube feeding, a baby is checked for residual, the amount of milk in the stomach left over from the last feeding. If the amount of residual is too high, it may mean the baby is not digesting food well.

- Nipple feedings:

Feeding from breast or bottle can begin as soon as babies are stable and are able to suck effectively. Baby may begin nipple feedings while still being tube fed. Even if a baby is able to nipple feed, it can be tiring.

## 2.9 Equipments used in NICU:



- **Radiant warmers:** Radiant warmers are used when a baby is very unstable or extremely premature. Small babies have a large surface area compared to their volume, and little body fat, and cannot maintain their own temperature.
- **Incubator:** The incubator keeps the baby warm with moistened air in a clean environment, and helps to protect the baby from noise, drafts, infection, and excess handling.
- **Weighing scale:** Every feeding, IV solution, and medication is calculated and based on the baby's weight, and it's critically important that the weight be accurate, up-to-date, and readily available at all times. The weight is carefully corrected for the weight of the diaper and any equipment that is attached to the baby, as well as the clean piece of paper that the baby lies on during the weighing. It is typically recorded in grams and is accurate to within 5 grams. (Note that one pound = 454 grams).
- **Physiologic monitor/ Cardiorespiratory monitor:** It is attached to sensors on the baby and provides a constant read-out of the baby's heart rate and rhythm, breathing rate, arterial or central venous pressure, and other useful information. Alarms can be configured to provide an alert when any of the vital signs being monitored goes above or below a certain limit.





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- **Pulse oximeter:** It monitors the oxygen saturation of the baby's blood.
- **Dinamap:** It takes the baby's blood pressure at programmed intervals. It inflates a plastic cuff around the baby's arm or leg.
- **Infant ventilators (respirators):** Infant ventilators (respirators) breath for the baby when the baby is too sick or too weak to breath for itself.
- **Phototherapy lights:** These are used when babies are suffering from jaundice.
- **Defibrillator:** It is used to "shock" the heart from an abnormal rhythm pattern back into a normal rhythm.
- **Endotracheal tube (ET):** This tube is placed through the baby's mouth or nose into the trachea (windpipe).



#### 2.10 Common Medications used in NICU:

**Antibiotics:** Ampicillin, Gentamicin, Cefotaxime, Amoxicillin, Erythromycin

**Antifungals:** Amphotericin, Caspofungin, Fluconazole

**Cardiovascular:** Dopamine, Dobutamine, Prostaglandin, Indomethacin

**Diuretics:** Lasix, Hydrochlorothiazide, Spironolactone

**Pain/sedation:** Morphine, Fentanyl, Lorazepam, Phenobarbital, Tylenol

**Gastrointestinal:** Zantac, Reglan, Prevacid,

**Nutrition:** Multi-vitamins, Ferrous Sulfate,



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Prednisolone

Calcitriol

**Respiratory:** Caffeine Citrate, Albuteral,  
Flovent, Racemic, Epinephrine

**Steroids:** Dexamethasone, Hydrocortisone,

**Miscellaneous:** Albumin, Lovenox, Surfactant,  
Heparin, Sucrose, Aquafor

## 2.11 Special Care is provided in NICU:

### 1. Developmental care:

It includes:

- The overall physical environment - changing the physical surroundings to provide normal day/night cycles and decrease noise and stress.
- The baby's immediate environment - providing cushions for supporting the baby's position and keeping the baby's arms and legs in proper arrangement to help with development and comfort.
- The way care is provided - using signals from the baby to plan care at times when the baby is awake and least stressed rather than interrupting sleep patterns or performing procedures when the baby is at a high stress level.

This leads shorter hospital stays, fewer complications, improved weight gain, better feeding, and enhanced parent/infant bonding.

### 2. Kangaroo Care:

Kangaroo Care means holding an NICU baby skin-to-skin (against the parent's chest) for varying lengths of time.



Benefits associated with Kangaroo care

- Higher blood oxygen levels
- Improved sleep
- Improved weight gain
- Improved breastfeeding

Kangaroo Care also helps parents feel close to their baby, and gives them confidence in their ability to meet their baby's needs. Mothers who act as "kangaroo" also show improved breast milk production.

### 3. Co-bedding of multiple birth babies:

Co-bedding is putting multiple birth babies to sleep in the same bed. It is based on the idea that babies who grows and develop together in the mother's womb become used to having each other nearby. When these multiple babies are born and placed in separate beds, they may be find difficulty to get comfort and settle without the presence of the other baby or babies. Co-bedding gives the babies back the comfort of the other multiples and may help them develop similar sleep and wake patterns.



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**Lab Procedures performed in NICU:**

- Blood typing - to check the blood group (A, B, O) and the Rh factor (positive or negative)
- Testing for anemia (too few red blood cells) or polycythemia (too many red blood cells)
- Testing for infection in the blood, urine, or spinal fluid
- Blood gases to measure oxygen levels and carbon dioxide
- Blood sugar
- Electrolyte levels
- X-rays (to check placement of tubes or view the condition of the lungs, heart, or abdomen)

**4. Warmth and temperature regulation:**

Premature and low birth weight babies usually have little body fat and may be too immature to regulate their own temperature, even in a warm environment. By keeping babies at optimal temperatures, neither too hot nor cold, they can conserve energy and build up reserves. This is especially important when babies are sick or premature.

Different ways to keep babies warm:

- Immediate drying and warming after delivery
- Open bed with radiant warmer
- Incubator/isolette



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## Coronary (Cardiac) Intensive Care Unit (CICU)





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## **Coronary (Cardiac) Intensive Care Unit (CICU)**

### **3.1 What is coronary intensive care unit (CICU)?**

A coronary intensive care unit (CICU) is a hospital ward specialized in the care of patients with heart attacks, unstable angina, Cardiac dysrhythmia and various other cardiac conditions that require continuous monitoring and treatment. Close monitoring by specially trained staff, cardiopulmonary resuscitation and medical measures could reduce the mortality from complications of cardiovascular disease. Doctors and nurses will also give the patient drugs or medication to improve their condition. This could include:

- Medication to support the heart's function
- Manipulation of the lungs to improving breathing
- Giving antibiotics and additional fluid
- The administration of drugs to improve their general condition
- Providing adequate nutrition, often through a feeding tube
- Infection control, which may include moving the patient to a secure side room
- Pain control, including giving sedatives or painkillers

The length of stay in the CCU varies, depending on:

- Whether or not the diagnosis of a heart attack is confirmed
- The severity of the heart attack
- The presence and severity of associated complications

A patient with a heart attack without complications spends about two to three days in a CCU before being transferred to a step-down unit. A step-down unit offers less intensive care than the CCU but still permits continuous ECG monitoring to screen for abnormal heart rhythms or other complications.

### **3.2 What kind of care is given in CICU?**

- Relief of chest pain and anxiety
- Further assessment (diagnostic tests) to confirm a diagnosis
- Limiting the size of the heart attack and the area of heart muscle infarct
- Reducing the work of the heart
- Identifying, preventing, and treating complications from the heart attack
- Doctors determine if a patient needs an angioplasty
- The patient's level of activity and diet is restricted



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### 3.3 What are the duties of a Cardiac Care Nurse?

- Capable of performing nursing evaluations in order to gather information and recognize the needs of the patient.
- Organizes and converses the needs of patients about the discharging.
- Develop and execute his/her own nursing care plan that he/she can use with the patient so that the needs and concerns can be addressed effectively.
- Work together with physicians and the like in directing caring plans and patient outcome facilitating.
- Put into practice and assess patients' response to care
- Offer care that is based on ascertains standards of methods, policies as well as protocols.
- Guarantees admission, transfer and discharge of patients efficiently.
- With great leadership in terms of resources, thinking skills and in anticipation of patients needs.
- Documents the evaluation, care delivery and response of patients to care using medical record.
- Takes parts in enhancement of performance for an improved outcome and processes.
- Accountable for the current learning needs and education for competencies.
- Mold and strengthen the services and operations of the unit every time and be the resource person for others.
- Model of the institutes mission, vision and values every day.
- If there are other duties assigned, he/she must be flexible for it.

### 3.4 Physical setup of CICU:

- The cardiac intensive care unit/intermediate unit/cardiac ward should be constructed as an independent ward in the hospital.
- The desired intensive care unit standard is a separate room for each patient and up to two to three patients per one room in the intermediate unit.
- There should be at least one single bedroom with the possibility to isolate patients with contagious infection.
- The architecture of the unit should be designed to make it possible to observe the patients from the nurses' monitoring station and to have easy and fast access.
- The station should be in a central position and well equipped, and the surrounding area will be spacious so as to afford optimal working conditions.



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- The separate intensive care procedure room should be spacious enough so that it can contain all the physicians (cardiologists, anaesthesiologists, nurses, technicians) and multitude of bulky equipment (X-ray machine, heavy monitoring, and intra-aortic balloon pump) necessary to initiate treatment for a complicated acute case. The minimal area should be 25 m<sup>2</sup>. The room must have washable walls for 2 m in height. Construction should fit requirement for the use of X-ray fluoroscopy.
- The electrical equipment should have an emergency feeding and a continuity apparatus.
- Windows in the intensive care ward are desirable, but not a pre-requisite.
- The lighting should be good, but not dazzling; lightning should be indirect.
- A dialysis facility (source of water and sewage) should be established in a few rooms as necessary.
- The cardiac intensive care unit should be situated as close as possible to the emergency room, the catheterization lab, general intensive care unit, and operating theatres (if available in the institution).
- It is also desirable that the intensive care ambulance may have a direct access to the unit, so that in appropriate cases, a patient may be directly admitted, bypassing the emergency department.

**Other areas to be included:**

- Staff rooms
- Family waiting room
- Office
- Store room (a lot of electronic equipment that requires constant electricity recharge)
- Computer communications

**Number of beds in the CICU:**

The number of beds in the CICU must suit the size of the reference population and the relative specific workload of the hospital. The hospital's specific workload can be evaluated in a number of ways: the simplest measure of the relative workload is the number of visits to the hospital's internal emergency room.

Recommended formula for calculation:

1. For each 100000 inhabitants, four to five ICCU beds
2. For every 100000 visits per year in the internal emergency room, 10 ICCU beds

The number of beds will be determined according to the higher of the two.

**Number of beds in the intermediate cardiac care unit:**

The desired ratio of beds between ICCU and the intermediate CCU is 1:3



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### 3.5 CICU staff:

- Physicians: cardiologists/residents in cardiology/cardiology fellows
- Department head: a certified cardiologist.
- On call physician.
- Nurses
- Secretary and nurse assistant full time.
- Dietician, computer expert (hardware and software), ventilation technician, social worker, physiotherapist, porters, and cleaners—part time.

The CICU should be staffed by at least one physician for every three to four patients, including the Unit director. The director of the Unit should be a board certified cardiologist, specially trained and accredited as an acute cardiac care specialist.

The nursing staff should be at least 2.8 nurses per bed, to cover three shifts per day, so that the minimal number of nurses in a given time will be at least one nurse per two beds during day time and one per three beds during night shift.

### 3.6 Equipments used in CICU:

**a. Non-invasive cardiovascular monitor:** It is a method or tool that involves the penetration of the patient's body in order to repair or help the cardiovascular system. Surgeries such as angioplasty, cardiac catheterization, and vascular surgery are all examples of invasive cardiovascular procedures.



**b. Defibrillator:** A defibrillator is used to "shock" the heart from an abnormal rhythm pattern back into a normal rhythm.



**c. External pacemaker:** It is a device used to stimulate the heartbeat electrically by means of impulses conducted through the chest wall, as used in emergency care of significant bradyarrhythmias.



**d. Infusion pump:** An electronic device used to control the administration of intravenous fluids in very small amounts and at a carefully regulated rate over long periods.





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**e. Ventilator:** A medical ventilator may be defined as any machine designed to provide the mechanism of breathing for a patient who is physically unable to breathe



**f. Pulse oximeter:** A pulse oximeter is a medical device that indirectly monitors the oxygen saturation of a patient's blood



**g. Intra-aortic balloon pump (IABP):** It is a mechanical device that decreases myocardial oxygen demand while at the same time increasing cardiac output. These actions combine to decrease myocardial oxygen demand and increase myocardial oxygen supply



### 3.7 Common cardiac procedures in CICU:

**a. ECG:** A standard ECG is obtained by placing 12 small electrodes on the patient's body in a specific pattern. The ECG machine is then turned on, and the recording is made in just a few moments. The test is entirely painless.

**b. Percutaneous Transluminal Coronary Angioplasty (PTCTA):** This procedure is also known as a "Balloon Angioplasty" and is a treatment of a coronary artery disease condition that results when the coronary arteries are narrowed or partially blocked, this is commonly caused by atherosclerotic deposits of fibrous and fatty tissue. In a PTCA procedure a balloon-tipped catheter is inserted into a blood vessel and moved to the narrowed area of the artery. It is placed into the blockage and inflated, compressing the plaque against the arterial walls.

**c. Coronary Artery Bypass Graft (CABG):** It is an open-heart operation in which arteries or veins are taken from another part of the body to channel needed blood flow to the coronary arteries. During surgery these arteries or veins are connected directly to the coronary arteries on the surface of the heart beyond the blockages. This approach allows blood to flow through the grafted arteries or veins to bypass the narrowed or closed points.

**d. Valve Replacement:** Two kinds of prosthetic heart valves are available.

- Mechanical valves are created from manmade materials
- Biological (tissue) valves are taken from pig, cow, or human donors. Biological valves don't last as long as mechanical valves



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**e. Coronary Angioplasty:** Localized narrowing (“lesions”) in the coronary artery can be treated without resorting to surgery. This procedure known as coronary angioplasty

**f. Pacemaker Implantation (Single and Dual Chamber):** It is a procedure to put a small medical device which uses electrical impulses for the beating of the heart and this is inserted just under the skin of your chest, just below your collarbone, to help your heart beat regularly

**g. Catheterization:**

### 3.8 Common disease conditions:

#### 3.8.1 Coronary heart disease (CHD):

It is the most common disease which affects the heart and a 7 leading cause of premature death in India and in whole world. In this disease the walls of arteries can become furred up with fatty deposits. This process is known as atherosclerosis and the fatty deposits are called atheroma. The plaque often narrows the artery so that the heart does not get enough blood. This slowing of blood flow causes chest pain, or angina. If plaque completely blocks blood flow, it may cause a heart attack (myocardial infarction) or a fatal rhythm disturbance (sudden cardiac arrest).

#### Symptoms:

- Chest pain on exertion (angina pectoris)
- Shortness of breath on exertion
- Jaw pain, back pain, or arm pain, especially on left side
- Palpitations (a sensation of rapid or very strong heart beats in your chest)
- Dizziness, light-headedness, or fainting
- Weakness on exertion or at rest
- Irregular heart beat
- Silent Ischemia

#### Treatment:

- ACE (angiotensin-converting enzyme) inhibitors
- Angiotensin II receptor antagonists:
- Calcium channel blockers
- Thiazide diuretics
- Beta blockers
- Statins
- Low-dose aspirin
- Nitrates

#### Preventive Measures:

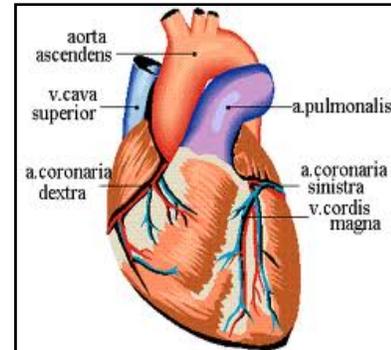
- Healthy eating, lose weight
- exercise and fitness
- stop smoking and use of alcohol



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### 3.8.2 Heart attack (Myocardial infarction):

A heart attack (also known as a myocardial infarction) is the death of heart muscle from the sudden blockage of a coronary artery by a blood clot.



#### Symptoms:

- Pain, fullness, and/or squeezing sensation of the chest
- Jaw pain, toothache, headache
- Shortness of breath
- Nausea, vomiting, and/or general epigastric (upper middle abdomen) discomfort
- Sweating
- Heartburn and/or indigestion
- Arm pain (more commonly the left arm, but may be either arm)
- Upper back pain
- General malaise (vague feeling of illness)

No symptoms (Approximately one quarter of all heart attacks are silent, without chest pain or new symptoms. Silent heart attacks are especially common among patients with diabetes mellitus.)

#### Complications:

- Heart failure
- Ventricular fibrillation

#### Risk factors:

- High Blood Cholesterol (Hyperlipidemia)
- High Blood Pressure (Hypertension)
- Tobacco Use (Smoking)
- Diabetes (Diabetes Mellitus)
- Male Gender
- Family History of Heart Disease

**Diagnosis:** (Prompt medical attention is required after diagnosis)

- Electrocardiogram
- Blood tests

#### Treatment:

- Anti-platelet medications
- Anti-coagulant medications
- Coronary angiography with either Percutaneous Transluminal Coronary Angioplasty (PTCA) with or without



stunting to open blocked coronary arteries

- Clot-dissolving medications
- oxygen Support

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- Medications to decrease the need for oxygen by the heart's muscle
- Medications to prevent abnormal heart rhythms

### **3.8.3 Angina pectoris:**

Angina pectoris (also referred to as angina) is chest pain or pressure that occurs when the blood and oxygen supply to the heart muscle cannot keep up with the needs of the muscle.

#### **Types of Angina:**

- Stable Angina
- Unstable Angina
- Nocturnal Angina
- Angina Decubitus

#### **Drug Therapy:**

- Antiplatelet aggregation therapy
- Nitrates – vasodilators
- Nitroglycerine
- b-adrenergic blockers
- Calcium Channel blockers

#### **Nursing Care of Angina pectoris:**

- Health Promotion and Education
- Acute Needs
  - Assessment: of pain, history, activity
  - Pain: deep or superficial? Diffuse or well located?
- Care during angina attack:
  - O2 therapy
  - Vitals, ECG
  - Pain relief with Nitrate (& narcotic analgesic if ordered)
  - Assessment of heart and breath sounds Assessment of patient response to therapy



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## Medical Intensive Care Unit (MICU)





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## Medical Intensive Care Unit (MICU)

### 4.1 What is MICU?

A Medical intensive care unit (MICU) is a specialized section of a hospital that provides comprehensive and continuous care for persons who are critically ill and those are not required care in special type of ICU.

### 4.2 MICU Layout Design:

- The Medical intensive care unit should be easily accessible by departments from which patients are admitted and close to departments which share engineering services.
- It is desirable that critically ill patients are separated from those requiring coronary care or high dependency care where a quieter environment is often needed.
- It is possible to provide intensive care and high dependency care in the same unit so long as patients can be separated within the unit.
- However, the differing requirements of these patients may limit such flexibility.
- The floor sizes given below represent a minimum guide.



MICU layout design

### Size:

- Intensive care bed requirements depend on the activity of the hospital with additional beds required for regional specialties such as cardiothoracic surgery or neurosurgery.



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- Small (<6 beds) or very large (>14 beds) units may be difficult to manage although larger units may be divided operationally and allow better concentration of resources.

**Reception Area:**

Each ICU or MICU cluster should have a receptionist area to control visitor access. Ideally, it should be located so that all visitors must pass by this area before entering. The receptionist should be linked with the ICU(s) by telephone and/or other intercommunication system, and if any visitor is allowed in emergency he/she should wear all the protective gears near reception.

**Special Procedures Room:**

If a special procedures room is desired, it should be located within, or immediately adjacent to, the ICU. One special procedures room may serve several ICUs in close proximity. Consideration should be given to ease of access for patients transported from areas outside the ICU.

**Equipment Storage:**

An area must be provided for the storage and securing of large patient care equipment items not in active use. Space should be adequate enough to provide easy access, easy location of desired equipment, and easy retrieval.

**Staff Lounge:**

A staff lounge must be available on or near each ICU or ICU cluster to provide a private, comfortable, and relaxing environment. Secured locker facilities, showers and toilets should be present.

**Patient Transportation Routes:**

Patients transported to and from an ICU should be transported through corridors separate from those used by the visiting public. Patient privacy should be preserved and patient transportation should be rapid and unobstructed. When elevator transport is required, an oversized keyed elevator, separate from public access, should be provided.

**Supply and Service Corridors:**

A perimeter corridor with easy entrance and exit should be provided for supplying and servicing each ICU. Removal of soiled items and waste should also be accomplished through this corridor. This helps to minimize any disruption of patient care activities and minimizes unnecessary noise.

**Oxygen, Compressed Air and Vacuum:**

Centrally supplied oxygen and compressed air must be provided at 50 to 55 psi from main and reserve tanks, and installation must follow NFPA standards. At least one oxygen outlets per patient are required.

**Satellite Laboratory:**

All ICUs must have available 24-hour clinical laboratory services. When this service cannot be provided by the central hospital laboratory, a satellite laboratory within or immediately adjacent to the ICU(s) must



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serve this function. Satellite facilities must be able to provide minimum chemistry and hematology testing, including arterial blood gas analysis.

#### **Physician On-Call Rooms:**

When in-house physician services are provided on a 24-hour basis, on-call rooms should be available close to the ICU(s). Toilet and shower facilities should be provided. On-call rooms must be linked to the ICU(s) by telephone and/or voice intercommunication system.

#### **Patient areas:**

- Patient areas must provide unobstructed passage around the bed with a floor space of 20m<sup>2</sup> per bed. Curtains or screens are required for privacy.
- Floors and ceilings must be constructed to support heavy equipment (some may weigh 1000 kg.)
- Doors must allow for passage of bulky equipment as well as wide beds.
- Every bed should have access to a wash basin.
- The specification should include at least 1 cubicle per 6 beds with 30m<sup>2</sup> floor area for isolation. Air conditioning should allow for positive and negative pressure control in cubicles, temperature and humidity control.
- The bed areas should have natural daylight and patients and staff should ideally have an outside view.
- Communications systems include an adequate number of telephones to avoid all telephones being in use at once, intercom systems to allow bed to bed communication and a system to control entry to the department.
- Computer networks should enable communication with central hospital administration and laboratory system.

#### **4.3 MICU Staffing (Medical):**

- Intensive care has evolved from the early success in simple mechanical ventilation of the lungs of polio victims to the present day where patients admitted to intensive care will usually have failure or dysfunction of one or more organs systems requiring mechanical support and monitoring.
- The intensive care unit should have dedicated consultant sessions allocated with additional allocation for management and audit activities.
- These sessions should be divided between several intensive care specialists.
- In addition, the intensive care specialist should be supported by junior doctors in training who can provide 24 hrs per day cover on a rotation which provides for adequate rest.



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### **MICU staffing (nursing):**

- Critically ill patients require close nursing supervision. Many will require 1:1 nursing throughout a 24h period while other are of a lower dependency and can share nurses.
- A few patients are so ill with the need for multiple interventions that their real nursing requirement is >1:1.
- In addition to the bedside nurses, the department needs additional staff to manage the day to day operation of the unit, to assist in lifting and handling of patients, to relieve bedside nurses for rest period and to collect drugs and equipment.
- These additional nurses can be termed the fixed nursing establishment and the nature of their duties is such that they will usually be higher grade nurses.
- The bedside nurses are a 'variable establishment' and their numbers are dependent on activity such that more patients require higher numbers.
- Most departments fix their variable establishment by assuming an average activity.

One of the difficulties in staffing an intensive care unit relates to the variable dependency and occupancy.

### **Medico-legal aspects:**

- The intensive care unit is a source of many medico-legal problems. Patients are often not competent to consent to treatment.
- They may be admitted following trauma, violence or poisoning, all of which may involve a legal process. Admission may also follow complications of treatment of medical mishaps occurring elsewhere in the hospital.

### **Consent:**

- Many procedures in intensive care are invasive or involve significant risk.
- The patient is often not competent to consent for such treatment such that the next of kin must be involved.

### **4.4 Common Problems needs care in a Medical Intensive Care Unit (MICU):**

**A. Shock:** In shock the organs of the body do not get enough oxygen and blood for them to function normally. Types of shock

- Hypovolemic Shock
- Cardiogenic Shock
- SIRS or Systemic Inflammatory Response Syndrome
- Septic Shock

**Treatment:** intravenous fluids (IV) and medications to maintain blood pressure.



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**B. Acute Respiratory Failure:** It occurs when the lungs do not work properly.

Causes:

- ARDS (acute respiratory distress syndrome)
- Pneumonia
- Aspiration (foreign liquid gets into the lungs)
- Trauma
- Severe infections
- Pancreatitis

**C. Chronic Respiratory Failure:** If patients remain critically ill for a long period, they become very weak. This weakness often prevents them from having the strength to breathe on their own.

**D. Infectious Conditions:**

- Pneumonia
- Bacteremia
- Urinary Tract Infections
- Diarrhea
- Sepsis

**E. Renal Failure:** The kidneys are very sensitive to any severe illness and many different illnesses can lead to renal failure. Two major problems occur with renal failure. First, the body is unable to remove extra water and wastes from the body. The skin is a common place the water is stored and results in swelling of the arms, legs, and face. The patient will often look puffy. That extra water also builds up in the organs of the body and can cause trouble breathing and problems with the function of other organs.

- Renal failure can be mild to severe.
- Severe renal failure can lead to the need for dialysis (a machine to take over the function of the kidneys and remove the toxins and the extra water).

**F. Neurological Conditions:**

- Traumatic brain injuries
- Strokes, infections
- Changes that occur when a patient is critically ill

**G. Bleeding and Clotting:**

- Stress ulcers.
- blood clots in their legs and lungs

**H. Multiple Organ Dysfunction Syndromes (MODS)-**Any type of critical illness that brings a patient to the ICU has the potential to affect the other organs in the body. These organs may not have been affected at first, but slowly one organ after another starts to fail. This is called Multiple Organ Dysfunction Syndrome or MODS. There is not specific treatment for MODS, only supportive care. The first and most commonly affected organs are the lungs and the kidneys, followed by the brain and the immune system (fights off infection). Other organs then begin to be involved: the heart, liver, blood,



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intestines, and any other organs of the body can be affected. Once a patient starts develop MODS, their prognosis is poor.

#### **4. 5 Common equipments used in MICU:**

##### **1. Patient monitoring equipment:**

###### **Patient monitoring equipment:**

Patient monitoring equipment includes the following:

- Acute care physiologic monitoring system— continuously measures and displays data on vital signs, such as heart rate, blood pressure, cardiac output, and blood oxygen levels.
- Pulse oximeter—Monitors the oxygen saturation in the blood.
- Intracranial pressure monitor—Measures the pressure of fluid in the brain in patients with head trauma or other conditions affecting the brain (such as tumors, edema, or hemorrhaging).
- Apnea monitor—continuously monitors breathing to detect cessation in infants and adults at risk of respiratory failure.

##### **2. Life support and emergency resuscitative equipment:**

ICU equipment for life support and emergency resuscitation include the following:

- Ventilator (also called a respirator)—Assists with or controls pulmonary ventilation in patients who cannot breathe on their own.
- Infusion pump—Device that delivers fluids intravenously or epidurally, including continuous anaesthesia, drugs, and blood infusions.
- Crash cart—Portable cart containing emergency resuscitation equipment for patients who are "coding" (that is, their vital signs are in a dangerous range), including a defibrillator, airway intubation devices, resuscitation bag/mask, and medication box.
- Intra-aortic balloon pump—A device that helps reduce the heart's workload and helps blood flow to the coronary arteries for patients with unstable angina, myocardial infarction, or patients awaiting transplants.

##### **3. Diagnostic equipment:**

The use of diagnostic equipment is also required in the ICU. Mobile x-ray units are used for bedside radiography, particularly of the chest. Portable clinical laboratory devices, called point-of-care analyzers, are used for blood analysis at the bedside to provide results much faster than if samples were sent to the central laboratory.

##### **4. Disposable ICU equipment:**

- Urinary (Foley) Catheters
- Swan-Ganz Catheters



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- Monitoring Electrodes

- Chest and Endo-tracheal Tubes
- Gastrointestinal and Nasogastric Feeding Tubes

### **Airway management in Critical care:**

It is the process of ensuring that:

1. There is an open pathway between a patient's lungs and the outside world
2. The lungs are safe from aspiration

#### **A. Manual methods:**

- **Head tilt/Chin lift:**

The simplest way of ensuring an open airway in an unconscious patient is to use a head tilt chin lift technique, thereby lifting the tongue from the back of the throat.

- **Jaw thrust:**

The jaw thrust is a technique used on patients with a suspected spinal injury and is used on a supine patient. The practitioner uses their thumbs to physically push the posterior (back) aspects of the mandible upwards - only possible on a patient with a GCS < 8 (although patients with a GCS higher than this should also be maintaining their own patent airway).

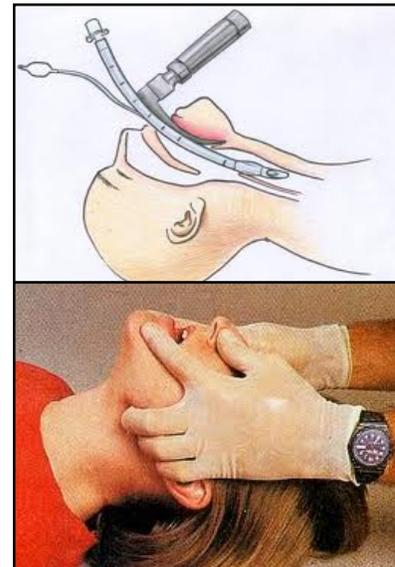
When the mandible is displaced forward, it pulls the tongue forward and prevents it from occluding (blocking) the entrance to the trachea, helping to ensure a patent (secure) airway.

- **Removal of vomit and regurgitation:**

In the case of a patient who vomits or has other secretions in the airway, these techniques will not be enough. Suitably trained clinicians may elect to use suction to clean out the airway, although this may not always be possible. An unconscious patient who is regurgitating stomach contents should be turned into the recovery position when there is no suction equipment available, as this allows (to a certain extent) the drainage of fluids out of the mouth instead of down the trachea.

- **Artificial airways :**

- Endotracheal tube
- Laryngeal Mask Airway (LMA)
- Laryngoscopy
- Bronchoscopy
- Oropharyngeal Airway or Nasopharyngeal Airway





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## Surgical Intensive-Care Unit (SICU)





## Surgical Intensive-Care Unit (SICU)

### 5.1 What is SICU?

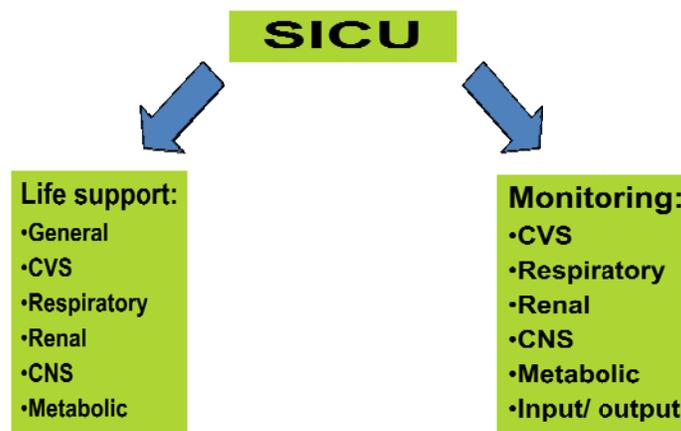
The Surgical Intensive Care Unit (SICU) is a critical care unit designed to provide comprehensive care for critically ill surgical patients. The Surgical Intensive Care Units work directly with patients suffering from multi system injuries.

### 5.2 Indications for SICU admission:

- Pre and post-operative patients undergoing major and ultra major surgeries
- Craniotomy patients
- Thoracotomy patients
- All Ultra Major Surgeries
- Patients with head or spine trauma requiring mechanical ventilation
- Unstable multiple trauma patients
- Open Heart Surgery Patient
- Thoracic patients
- Vascular patients
- Complex Orthopedic Patients,
- Patients With Oral, Throat And Neck Surgery
- Patients Include Complicated Abdominal

### Function of an SICU:

- Provide optimum life support and
- Provide adequate monitoring of vital functions



Major functional areas on nurse in SICU



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### 5.3 General Nursing Responsibilities in SICU:

- Documentation
- Communication
- Verify patient identification;
- Ensure surgical consent
- Prepare patient's chart
- Identify risk factors
- Document specific allergies

### Postoperative Care in SICU:

Postoperative care is the management of a patient after surgery. This includes care given during the immediate postoperative period, both in the operating room and post anesthesia care unit (PACU), as well as during the days following surgery.

#### Purpose

- Is to prevent complications such as infection, to promote healing of the surgical incision, and to return the patient to a state of health.
- It involves assessment, diagnosis, planning, intervention, and outcome evaluation. The extent of postoperative care required depends on the individual's pre-surgical health status, type of surgery, and whether the surgery was performed in a day-surgery setting or in the hospital. Patients with day-surgery usually require only a few hours of care by health care professionals before they are discharged to go home.
- If post anesthesia or postoperative complications occur within these hours, the patient must be admitted to the hospital. Patients who are admitted to the hospital may require days or weeks of postoperative care by hospital staff before they are discharged.
- It begins in the recovery room and continues throughout the recovery period. Critical concerns are airway clearance, pain control, mental status, and wound healing
- Surgeon should be notified immediately if anything wrong.

### 5.4 Common Surgical Emergencies:

#### 1. Acute Pancreatitis:

Acute pancreatitis or acute pancreatic necrosis is a sudden inflammation of the pancreas. Depending on its severity, it can have severe complications and high mortality despite treatment.

#### Signs and symptoms:

- Severe epigastric pain radiating to the back
- Nausea, vomiting, diarrhea and loss of appetite
- Fever/chills
- Hemodynamic instability, including shock



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**Causes:**

- Alcohol abuse
- Gallstones

**Diagnosis:**

- X-ray films/ct scan
- Ultrasound
- Endoscopic retrograde Cholangiopancreatography (ERCP)

**Treatment:**

- Those people who are having trouble breathing are given oxygen.
- An IV (intravenous) line is started, usually in the arm. If needed, medications for pain and nausea are prescribed.
- Antibiotics are given if the health care practitioner suspects an infection may be present.
- No food or liquid should be taken by mouth for a few days. This is called bowel rest.
- Nasogastric (NG) tube. The thin, flexible plastic tube is inserted through the nose and down into the stomach to suck out the stomach juices.
- Nutritional supplements are administered through an IV line.

**2. Small Bowel Obstruction:**

It is a mechanical or functional obstruction of the intestines, preventing the normal transit of the products of digestion. It can occur at any level distal to the duodenum and is a emergency. Although many cases are not treated surgically, though it is a surgical problem.

**Signs and Symptoms:**

- Abdominal pain
  - Abdominal distension
  - Vomiting
  - Fecal vomiting
  - Constipation
  - Bowel obstruction
  - Bowel Ischaemia
- In small bowel obstruction the pain tends to be colicky (cramping and intermittent) in nature, with spasms lasting a few minutes. The pain tends to be central and mid-abdominal. Vomiting occurs before constipation.
- In large bowel obstruction the pain is felt lower in the abdomen and the spasms last longer. Constipation occurs earlier and vomiting may be less prominent. Proximal obstruction of the large bowel may present as small bowel obstruction.



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**Causes:**

- Adhesions from previous abdominal surgery
- Hernias containing bowel
- Crohn's disease causing adhesions or inflammatory strictures
- Neoplasms, benign or malignant
- Intussusception in children
- Volvulus
- Superior mesenteric artery syndrome
- Ischaemic Strictures
- Foreign bodies (e.g. gallstones in gallstone ileus, swallowed objects)
- Intestinal atresia

**Diagnosis:**

- Blood tests
- X-rays of the abdomen
- CT scanning
- Ultrasound
- Biopsy

**Management of Small bowel obstruction:**

- Surgeries
- Intravenous therapy

**3. Diverticulitis:**

It is a common disease particularly found in the large intestine. Diverticulitis develops from diverticulosis, which involves the formation of pouches (diverticula) on the outside of the colon. Diverticulitis results if one of these diverticula becomes inflamed.

**Signs:**

- Classic triad of left lower quadrant pain
- Fever, and leukocytosis
- Nausea, diarrhea, constipation
- Abdominal pain
- Tenderness around the left side of the lower abdomen
- Nausea
- Vomiting
- Feeling hot while having no fever
- Cramping
- Constipation
- Raised intra luminal colonic pressures

**Diagnosis:** CT scans

**Treatment:**

- Bowel rest (i.e., nothing by mouth)
- IV fluid resuscitation
- Broad-spectrum antibiotics which cover anaerobic bacteria and gram-negative rods



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- Recurring acute attacks or complications, such as peritonitis, abscess, or fistula may require surgery, either immediately or on an elective basis.
- Discharge patients may be placed on a low residue diet. This low-fiber diet gives the colon adequate time to heal without needing to be overworked. Later, patients are placed on a high-fiber diet.
- In some cases surgery may be required to remove the area of the colon with the diverticula. Surgery.
- Emergency surgery is necessary for people whose intestine has ruptured; intestinal rupture always results in infection of the abdominal cavity. During a diverticulitis surgery, the ruptured section is removed and a colostomy is performed.



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### Trauma Intensive Care Unit (TICU)





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## Trauma Intensive Care Unit (TICU)

### 6.1 What is TICU?

Trauma Intensive Care Unit is designed specially for trauma patients who need nonstop care and continuous observation and that too in an environment that will boost the recovery process. The unit comprises of best-in-class multi-disciplinary Doctors, nurses and therapists who know how to handle injured patients. Latest technologies and monitoring equipments are in place to complement the efforts of the TICU team.

### 6.2 General Duties of TICU Nurse:

- Specialized in emergency care
- Focuses on identifying serious problems in incoming trauma cases
- Stabilizing patients
- They must make decisions quickly under stress to save patients

### 6.3 Required Training for nurses:

Prior to their trauma nurse training, a nursing candidate must have completed a specifically designed nursing program, whether in a traditional college setting or a hospital or nursing school environment, and have experience treating emergency patients.

### Desirable skills:

Medical/surgical, emergency, and/or critical-care experience (hands-on skills with IV therapy, ventilators, cardiac monitoring, defibrillator, pain management, pre- and postoperative care), flexibility, stress management, decision making, and assessment, assertiveness, communication skills, motivation, and interpersonal skills.

### 6.4 Staffing in trauma intensive care unit:

- Team Leader - Trauma Surgeon, Emergency Medicine Physician
- Anaesthetist
- Anaesthetic Assistant
- General Surgeon
- Orthopaedic Surgeon
- Emergency Physician
- Respiratory Therapist
- Trained and skilled Nurses. (Three if no anaesthetic assistant)
- Technicians
- Radiographer

Other specialties can be added depending on the nature of the injury, for example a neurosurgeon ,chest surgeon, etc



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### 6.5 What is Trauma/Injury?

**Trauma** or **injury** refers to "a body wound or shock produced by sudden physical injury, as from violence or accident." It can also be describes as "a physical wound or injury, such as a fracture or blow.

Deaths from trauma have classified as:

- **Immediate deaths:** these occur within seconds to minutes after injury and are due to heart or major vascular rupture, brain stem injury or massive head injury.
- **Early deaths:** these are the deaths which occur after few minutes to hours after injury. Usual causes are airway obstruction, tension pneumothorax, closed head injury or hypovolemic shock.
- **Late deaths:** these are deaths occurring days after injury, in the intensive care units and are due to septicemia, coagulopathy and multiorgan failure.

### 6.6 Triage:

The word *triage* comes from the French word *trier*, which means "to sort". This is a process of determining the priority of patients' treatments based on the severity of their condition. This patient treatment when resources are insufficient for all to be treated immediately.

#### Classification of patient under Triage:

- **Red Tag (Category 1)** – It can be used for the critical patients whose survival is depend on immediate stabilization of a life. This include causality suffering from severe bleeding from easily accessible sources, obstruction of respiratory tract, pneumothorax or hemothorax ( in which case must be established that the obstruction can be removed in the shortest possible time ), hypovolaemic shock, severe injuries to the extremities, facial burns or burns to the upper respiratory tract.
- **Yellow Tag (Category 2)** - It indicates a seriously injured patient who requires some medical stabilization in the field prior to transportation, but whose life is not immediately threatened. It considers 40 % of casualties. As their lives are no longer in danger, so that an operation can be performed within the next 6 to 8 hours. This category includes causality suffering from fracture and dislocations, injuries to the abdomen and the thorax, the urogenital tract, the skull or the brain, 2nd degree burns covering 20 to 30 % of the body or 3<sup>rd</sup> degree burns covering up to 20 % of the body.
- **Green tag (Category 3)** – It is applied to ambulatory or walking wounded patient who does not require any medical attention at the disaster site prior to transportation to a hospital. It required by about 40 % of casualties. For causality suffering from minor wounds, fractures of the small bones, sprains or second degree burns covering less than 20 % of the body, first aid measures



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suffice for the time being. They can be given further medical treatment if the situation improves and once casualties in Category 1 and 2 have been attended to.

- **Black Tag (Category 4)** – This category will include the dying, or the injured with no chance of survival. To operate on the latter would be so difficult and time consuming that, meanwhile, other casualty in Category-1 would die. Such injured require pain controlling drugs and nursing comfort. Beyond this constant watch must be kept on their condition in case it is necessary to assign them to another category

### 6.7 Basic life support:

Basic life support (BLS) is a level of medical care which is used for patients with life-threatening illness or injury until the patient can be given full medical care.

#### 6.7.1 CPR (Cardiopulmonary resuscitation):

Cardiopulmonary resuscitation (CPR) is an emergency procedure which is attempted in an effort to return life to a person in cardiac arrest. This is the technique of the manual inflation of the lungs with oxygen, and compression of the heart, therefore pumping oxygenated blood around the body, and keeping the vital organs supplied with oxygen. It is used in an attempt to revive a victim who has had a Cardiac Arrest.



**Indication-** CPR is indicated for any person who is unresponsive with no breathing or only gasps as breathing as it is most likely that they are in cardiac arrest. If a person still has a pulse, but is not breathing (respiratory arrest), artificial respirations are more appropriate.

#### ABC of CPR:

Airway — open the airway

Breathing — if still no breaths, attempt rescue breathing

Circulation — if no pulse, perform chest compressions

Compressions are performed on a casualty to pump blood around the body

- **Infant from (0-1year):** On an infant we use two fingers in the middle of the sternum between the nipples and compress to 1/3 chest depth (about 1-2cm).
- **Children & Adults:** On children and adults we use two hands in the middle of the chest and compress to 1/3 chest depth (max 4-5cm on an adult).



### Steps to Performing CPR:

Conventional CPR is performed by qualified medical practitioners. It involves clearing the airway, mouth-to-mouth rescue breathing along with chest compression. Before doing CPR, put the person on his/her back. Check whether the person is conscious or unconscious. If it is confirmed that he/she is in unconscious state, then only one can proceed for CPR. Recommended CPR for children and adults is different.

#### 1. CPR in adults:

The first step in performing CPR is to open the airway of the person. To achieve this, put your palm on the forehead and carefully tilt the head back. Gently lift the chin forward with your other hand and try to feel the person's breath. Also look if there is any chest movement. If the person is not breathing properly, nostrils should be pinch. In case, if the chest doesn't rise, repeat the step of clearing the airway (head-tilt, chin-rise) position and do mouth-to-mouth breathing. If the mouth is injured, one can give mouth-to-nose breathing now; proceed with chest compressions



in order to restore blood circulation of the person. For this, kneel at the side of the person and place the heel of your hand in the middle of the chest (between the nipples). You have to put your other hand on the top of the hand placed on the chest. Make sure your elbows are straight and the shoulders are directly above the hand.

Gently compress the chest of the victim to about 5 cm (2 inches). While giving chest compression, push hard and fast at a rate of about 2 per second. Repeat the compression for 30 times and after that, open the airway as mentioned in the first step. Give two rescue breaths and check if the chest rises. This is the completion of the first cycle.

Repeat the steps about five cycles of 30 compressions and two rescue breaths, i.e. for about 2 minutes and check if the person starts breathing or not. In case the person is not breathing, repeat the procedure again.

#### 2. CPR in Children:

Child CPR steps for victims 1 to 12 years old are nearly identical to adult CPR steps with the following key differences:

- Perform 5 cycles of CPR (about 2 minutes)
- Use one hand instead of two
- Depth of compressions is based on the size of the chest cavity
- Place the heel of one hand in the center of the chest. Press chest down 1/3 the depth of the chest at a rate of 100 per minute (16 in 10 seconds)



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### 6.7.2 Advanced Trauma Life Support:

It is a training program for doctors and paramedics in the management of acute trauma cases. It is designed for emergency situations where only one doctor and one nurse are present, ATLS is now widely accepted as the standard of care for initial assessment and treatment in Indian trauma centers.

#### 1) Primary Survey:

The first and key part of the assessment of patients presenting with trauma is called the primary survey. During this time, life-threatening injuries are identified and simultaneously resuscitation is begun. A simple mnemonic, ABCDE, is used as a memory aid for the order in which problems should be addressed.

**A** Airway

**B** Breathing

**C** Circulation

**D** Disabilities

**E** Expose/Environment

#### 2) Secondary Survey

When the primary survey is completed, resuscitation efforts are well established, and the vital signs are normalizing, the secondary survey can begin. The secondary survey is a head-to-toe evaluation of the trauma patient, including a complete history and physical examination, including the reassessment of all vital signs. Each region of the body must be fully examined. If at any time during the secondary survey the patient deteriorates, another primary survey is carried out as a potential life threat may be present.

#### Causes and risk factors:

- Blunt trauma
- Penetrating trauma
- Blast injury
- Ingestion of alcohol and illicit drugs
- Long-acting benzodiazepines increase the risk of trauma in elderly people

#### Diagnosis:

- X-rays of the chest and pelvis are commonly performed in major trauma
- Computed tomography (CT) scans are the gold standard in imaging in major trauma
- Surgical techniques- such as diagnostic peritoneal lavage, placement of a thoracostomy tube, or pericardiocentesis





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### **Management:**

Surgery and Blood transfusion. Outcomes are better if this occurs as quickly as possible thus the so called golden hour of trauma.

### **Stabilization and Transportation:**

- In the pre hospital setting the use of stabilization techniques improve the chances of a person surviving the transport to the nearest trauma-equipped hospital. After ensuring their own safety and taking isolation precautions, a primary survey is performed, consisting of checking and treating airway, breathing, and circulation (called the ABC's)
- To prevent further injury, unnecessary movement of the spine is minimized by securing the neck with a cervical collar, and the back with a long spine board with head supports, or other medical transport device such as a Kendrick extrication device, before moving the person. Unless the person is in imminent danger of death, first responders will typically "load and go," transporting immediately to the nearest appropriate facility
- Rapid transportation of those who are severely injured is associated with improved outcomes

### **Intravenous fluids:**

The current evidence however supports limiting the use of fluids for penetrating thorax and abdominal injuries allowing mild hypotension to persist. If blood products are needed a greater relative use of fresh frozen plasma and platelets to packed red blood cells has been found to result in improved survival and less overall blood product usage

### **Medications:**

- Tranexamic acid decreases mortality
- Factor VII

### **Surgery:**

Damage control surgery is employed in the management of trauma. This involves performing the least number of procedures to save life and limb. Less critical procedures are left until the person is in a more stable

### **6.7.3 Classification of trauma injuries:**

#### **a) Polytrauma:**

**Polytrauma** or **multiple traumas** is term describing the condition of a person who has been subjected to multiple traumatic injuries, such as a serious head injury in addition to a serious burn. It is defined via an Injury Severity Score ISS  $\geq 17$ . It is also associated with motor vehicle accidents. This is because vehicular accidents often occur at high velocities causing multiple injuries.



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### **b).Head injury:**

Head injury refers to trauma to the head. This may or may not include injury to the brain. Head injuries include both injuries to the brain and those to other parts of the head, such as the scalp and skull. Head injuries may be closed or open. A closed head injury is one in which the skull is not broken. A penetrating head injury occurs when an object pierces the skull and breaches the duramater.

#### **Specific problems after head injury can include:**

- Skull fracture
- Lacerations to the scalp and resulting hemorrhage of the skin
- Traumatic subdural hematoma, a bleeding below the dura mater which may develop slowly
- Traumatic extradural, or epidural hematoma
- Traumatic subarachnoid hemorrhage
- Cerebral contusion, a bruise of the brain
- Concussion, a temporary loss of function due to trauma
- Dementia pugilistica, or "punch-drunk syndrome", caused by repetitive head injuries, for example in boxing or other contact sports
- A severe injury may lead to a coma or death
- Shaken Baby Syndrome - a form of child abuse

#### **Types of Hemorrhage:**

##### **Intracranial hemorrhage:**

Types of intracranial hemorrhage are roughly grouped into intra-axial and extra-axial. The hemorrhage is considered a focal brain injury; that is, it occurs in a localized spot rather than causing diffuse damage over a wider area.

- **Intra-axial hemorrhage:**

Intra-axial hemorrhage is bleeding within the brain itself, or cerebral hemorrhage. Intra-axial hemorrhages are more dangerous and harder to treat than extra-axial bleeds.

- **Extra-axial hemorrhage:**

Extra-axial hemorrhage, bleeding that occurs within the skull but outside of the brain tissue.

#### **Symptoms of skull fracture can include:**

- leaking cerebrospinal fluid
- Wounds or bruises on the scalp or face
- Basilar skull fractures, those that occur at the base of the skull

#### **Causes:**

- motor vehicle traffic collisions
- Home and occupational accidents, falls, and assaults
- Bicycle accidents are also a cause of head injury-related death and disability especially among children.



**Diagnosis:**

Non-contrast CT of the head should be performed immediately in all those who have suffered a moderate or severe head injury.

**Management:**

- Controlling elevated intracranial pressure. This can include sedation, paralytics, cerebrospinal fluid diversion.
- Second line alternatives include decompressive craniotomy, barbiturate coma, hypertonic saline and hypothermia.

**Glasgow Coma Scale:**

It is a neurological scale that aims to give a reliable, objective way of recording the conscious state of a person for initial as well as subsequent assessment. A patient is assessed against the criteria of the scale, and the resulting points give a patient score between 3 (indicating deep scale unconsciousness) and either 14 (original scale) or 15 (the more widely used modified or revised scale). In hospitals it is also used in monitoring chronic patients in trauma intensive care. The scale comprises three tests: eye, verbal and motor responses. The three values separately as well as their sum are considered. The lowest possible GCS (the sum) is 3 (deep coma or death), while the highest is 15 (fully awake person).

Glasgow Coma Scale for Head Injury	
<b>Glasgow Coma Scale,</b>	
<b>Eye opening</b>	
Spontaneous	4
To loud voice	3
To pain	2
None	1
<b>Verbal response</b>	
Oriented	5
Confused, disoriented	4
Inappropriate words	3
Incomprehensible sounds	2
None	1
<b>Best motor response</b>	
Obeys	6
Localizes	5
Withdraws (flexion)	4
Abnormal flexion posturing	3
Extension posturing	2
None	1

Generally, brain injury is classified as:

- Severe, with GCS  $\leq$  8
- Moderate, GCS 9 - 12
- Minor, GCS  $\geq$  13

**c). Chest trauma:**

It is a serious injury of the chest. Thoracic trauma is a common cause of significant disability and mortality, the leading cause of death from physical trauma after head and spinal cord injury. Blunt thoracic injuries are the primary or a contributing cause of about a quarter of all trauma-related deaths.



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**Classification:**

- Injuries to the chest wall
- Chest wall contusions or hematomas
  - Rib fractures
  - Flail chest
  - Sternal fractures
  - Fractures of the shoulder girdle
- Pulmonary injury (injury to the lung) and injuries involving the pleural space
  - Pulmonary contusion
  - Pulmonary laceration
  - Pneumothorax
  - Hemothorax
  - Hemopneumothorax
- Injury to the airways
  - Tracheobronchial tear
- Cardiac injury
  - Pericardial tamponade
  - Myocardial contusion
- Blood vessel injuries
  - Traumatic aortic rupture, thoracic aorta injury
- And injuries to other structures within the torso
  - Esophageal injury (Boerhaave syndrome)
  - Diaphragm injury

**Diagnosis:**

- Tracheal intubation
- Mechanical ventilation
- Chest tube insertion
- Ct scanning

**d) Abdominal trauma:**

Abdominal trauma is an injury to the abdomen. It may be blunt or penetrating and may involve damage to the abdominal organs.

**Classification:**

- Blunt
- Penetrating

**Causes:**

- Vehicle accidents
- Bicycle accidents
- Falls and sports
- Gunshot wounds

**Signs and symptoms:**

- Nausea
- Vomiting
- Fever
- Abdominal pain
- Rigidity
- Bruising of the external abdomen
- Blood in the urine Tenderness



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### Diagnosis

- Ultrasonography
- Computed tomography
- Peritoneal lavage

### Treatment

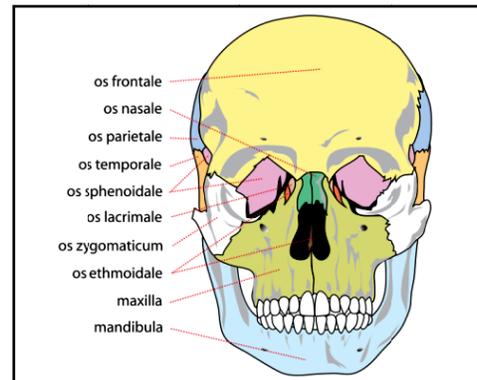
- Initial treatment involves stabilizing the patient enough to ensure adequate airway, breathing, and circulation, and identifying other injuries. Surgery may be needed to repair injured organs.
- Surgical exploration is necessary for people with penetrating injuries and signs of peritonitis or shock. Laparotomy is often performed in blunt abdominal trauma, and is urgently required if an abdominal injury causes a large, potentially deadly bleed.
- Intra-abdominal injuries are also frequently successfully treated nonoperatively.
- The use of CT scanning allows care providers to use less surgery because they can identify injuries that can be managed conservatively and rule out other injuries that would need surgery.

### e) Facial trauma:

Facial trauma can involve soft tissue injuries such as burns, lacerations and bruises, or fractures of the facial bones such as nasal fractures and fractures of the jaw, as well as trauma such as eye injuries.

### Symptoms

- pain
- swelling
- loss of function
- changes in the shape of facial structures
- blindness
- difficulty moving the jaw



Human face

### Classification

- Soft tissue injuries include abrasions, lacerations, avulsions, bruises, burns and cold injuries. Commonly injured facial bones include the nasal bone (the nose), the maxilla (the bone that forms the upper jaw), and the mandible (the lower jaw).
- Fractures may also occur in the bones of the palate and those that come together to form the orbit of the eye.

### f) Spinal cord injury:

It refers to an injury to the spinal cord. It can cause myelopathy or damage to nerve roots or myelinated fiber tracts that carry signals to and from the brain.



### Classification:

- **A** indicates a "complete" spinal cord injury where no motor or sensory function is preserved in the sacral segments S4-S5.
- **B** indicates an "incomplete" spinal cord injury where sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5. This is typically a transient phase and if the person recovers any motor function below the neurological level, that person essentially becomes a motor incomplete, i.e. ASIA C or D.
- **C** indicates an "incomplete" spinal cord injury where motor function is preserved below the neurological level and more than half of key muscles below the neurological level have a muscle grade of less than 3, which indicates active movement with full range of motion against gravity.
- **D** indicates an "incomplete" spinal cord injury where motor function is preserved below the neurological level and at least half of the key muscles below the neurological level have a muscle grade of 3 or more.
- **E** indicates "normal" where motor and sensory scores are normal. Note that it is possible to have spinal cord injury and neurological deficits with completely normal motor and sensory scores.

### Signs and symptoms

The effects of a spinal cord injury may vary depending on the type, level, and severity of injury, but can be classified into two general categories:

- In a **complete injury**, function below the "neurological" level is lost. Absence of motor and sensory function below a specific spinal level is considered a "complete injury". Recent evidence suggests that less than 5% of people with "complete" spinal cord injuries recover locomotion.
- In an **incomplete injury**, some sensation and/or movement below the level of the injury is retained. The ability to contract the anal sphincter voluntarily or to feel peri-anal pinprick or touch, the injury is considered to be "incomplete".

### g). Cervical injuries

It usually results in full or partial tetraplegia (Quadriplegia). However, depending on the specific location and severity of trauma, limited function may be retained.

- **C3 vertebrae and above:** Typically results in loss of diaphragm function, necessitating the use of a ventilator for breathing.
- **C4:** Results in significant loss of function at the biceps and shoulders.
- **C5:** Results in potential loss of function at the shoulders and biceps, and complete loss of function at the wrists and hands.
- **C6:** Results in limited wrist control, and complete loss of hand function.



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threshold level for retaining functional  
independence.

- **C7 and T1:** Results in lack of dexterity in the hands and fingers, but allows for limited use of arms. C7 is generally the

#### **h) Thoracic injuries**

Injuries at or below the thoracic spinal levels result in paraplegia. Function of the hands, arms, neck, and breathing is usually not affected.

- **T1 to T8:** Results in the inability to control the abdominal muscles. Accordingly, trunk stability is affected. The lower the level of injury, the less severe the effects.
- **T9 to T12:** Results in partial loss of trunk and abdominal muscle control.

#### **i) Lumbar and sacral injuries**

The effects of injuries to the lumbar or sacral regions of the spinal cord are decreased control of the legs and hips, urinary system, and anus.

#### **Causes**

- **Trauma** such as automobile crashes, falls, gunshots, diving accidents, war injuries, etc.
- **Tumor** such as meningiomas, ependymomas, astrocytomas, and metastatic cancer.
- **Ischemia** resulting from occlusion of spinal blood vessels, including dissecting aortic aneurysms, emboli, arteriosclerosis.
- **Developmental disorders**, such as spina bifida, meningomyelocoele, and others
- **Neurodegenerative diseases**, such as Friedreich's ataxia, spinocerebellar ataxia, etc.
- **Demyelinative diseases**, such as Multiple Sclerosis.
- **Transverse myelitis**, resulting from stroke, inflammation, or other causes.
- **Vascular malformations**, such as arteriovenous malformation (AVM), dural arteriovenous fistula (AVF), spinal hemangioma, cavernous angioma and aneurysm.

#### **j) Genitourinary system trauma:**

It is defined as injury resulting from physical force, either accidental or inflicted (intentional), to organs such as the kidney, ureter, bladder, urethra, internal reproductive organs or external genitalia. It is the leading cause of morbidity and mortality in the pediatric age group.

#### **Causes**

- Motor vehicle
- Falls injuries



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### **Symptoms of trauma to the genitourinary tract**

- History or evidence of physical injury.
- Blood in the urine
- Severe pain in the flank or lower back
- Nausea
- Vomiting or swelling of the abdomen
- Internal bleeding
- Fever and/or shock

### **Treatment**

- The more severe and less commonly occurring injuries of the kidney may require close observation in the hospital and, at times, surgical intervention.
- Bladder rupture is typically of an intraperitoneal nature, meaning that urine leaks from the bladder into the abdominal cavity. This typically results from a direct blow to the bladder at a time when it is full of urine. These injuries require immediate surgical repair.
- Injury to the external genitalia typically results from a blunt mechanism of trauma. Initial evaluation is critical for defining the presence and extent of injury. This may require evaluation with ultrasound and/or urethrogram and surgical repair of injuries.

### **k) Pelvic Trauma:**

Pelvis injuries range from the benign to life threatening. They include pelvic ring fractures, acetabular fractures, and avulsion injuries. The majority of pelvis injuries are due to high energy blunt trauma, although frail and elderly patients may sustain such injuries from a low energy mechanism.

### **Signs and symptoms**

- A broken pelvis is painful, often swollen and bruised. The individual may try to keep the hip or knee bent in a specific position to avoid aggravating the pain.
- If the fracture is due to a high-energy injury, there may also be injuries to the head, chest, abdomen, or legs. There is usually considerable bleeding, which can lead to shock.

### **Diagnosis**

- X-rays
- Computed tomography (CT)

### **Treatment**

- **Nonsurgical Treatment**
  - Stable fractures, such as the avulsion fracture experienced by an athlete, will normally heal without surgery. The patient will have to use crutches or a walker, and will not be able to put all of his or her weight on one or both legs for up to three months, or when the bones are healed
  - Medication



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- **Surgical Treatment**

- External fixator to stabilize the pelvic area.
- Traction
- Unstable fractures may require surgical insertion of plates or screws

### **I) Soft tissue injury (STI):**

It is the damage of muscles, ligaments and tendons throughout the body. Common soft tissue injuries usually occur from a sprain, strain, a one off blow resulting in a contusion or overuse of a particular part of the body. Soft tissue injuries can result in pain, swelling, bruising and loss of functions.

#### **Management**

Immediately after the injury occurs one should apply the PRICE principle to minimize the local tissue damage and reduce inflammation.

- 'PROTECTION' protect the individual from further injury by preventing them from moving and keep further hazards away from the individual.
- 'REST' Rest the individual from any activity that causes pain. If simple movements such as bending, straightening or walking are causing pain "rest" means immobilizing the injury by splinting or preventing weight bearing with crutches.
- 'ICE' During the first 72 hours following an injury ice can help minimize pain and control swelling caused by bleeding and fluid loss from the injured tissue. Icing is recommended for 15minutes every 4 hours to help control the swelling and pain.
- 'COMPRESSION' Compression is the application of pressure over the injured area with the use of a bandage, elastic wrap or compression tape. This is to control the initial bleeding of joint or limb tissues or to reduce residual swelling.
- 'ELEVATION' Used in combination with ice and compression, elevation can also minimize initial tissue bleeding and swelling. Elevate the injured part above the level of the heart as much as possible for the first 72 hours or longer of the swelling persists.

#### **Treatment**

- If severe pain persists after the first 24hours it is recommended that an individual consults with a professional who can make a diagnosis and implement a treatment plan so the patient can return to everyday activities. These are some of the tools that a professional can use to help make a full diagnosis.
- Electrodiagnosis also helps differentiate between myopathy and neuropathy. The best method of imaging soft tissue is magnetic resonance imaging (MRI).



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## Mobile Intensive Care Unit (MICU)





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## Mobile Intensive Care Unit (MICU)

### 7.1 What is MICU?

MICU are well-equipped ambulances staffed by highly trained paramedics dispatched to emergency situations where patients require a higher level of care than a regular ambulance can provide. It may be large vehicle, ambulance, or air ambulance; these units are all configured with medical equipment onboard.



### 7.2 Advanced life support service in MICU:

In MICU patient transfers and treatment on wheels provided to a seriously ill or injured patient requiring invasive medical intervention and continuous advanced life support medical care. If required intensive care management and transportation may also be offered by air from or to an intensive care unit of a critically ill or injured patient requiring continuous advanced life support medical care.

### 7.3 Specific requirement:

#### Vehicle type:

- The vehicle shall be modified, adapted and configured to resemble an ambulance enabling accommodation of at least one stretcher patient
- The vehicle shall be fitted with radio or telephonic communication so as to provide continuous communication with the ambulance's control room
- The vehicle must be fitted with a fire extinguisher

#### Essential Equipment and Drugs used in MICU:

- Adult oxygen masks providing at least 40% inhaled oxygen and tubing
- Ambulance stretcher with straps and mattresses with 'body elevation' facility with appropriate fixation device
- Antiseptic Solution - 100ml or equivalent



- 1 x Bag-Valve-Mask with Reservoir (Adult) with range of transparent masks
- 1 x Bag-Valve-Mask with Reservoir (paediatric) with range of transparent masks
- 2 x 100mm Bandages Elasticised
- Blood glucose monitoring strips
- Defibrillator gel or pads
- Defibrillator electrodes & paper (adult and paediatric)
- Dextrose 50% intravenous, 20ml ampoules
- ECG electrodes for adults and neonates
- ECG paper for monitor / defibrillator
- Endotracheal Intubation Equipment
- External Cardiac Pacer
- Fire Extinguisher
- Full set cervical collars
- Gauze swabs : packets of 10
- 1 x Glucometer and blood glucose monitoring strips
- 4 x Infusion flow regulators
- Intravenous fluids :
  - 2 x Normal Saline 200ml
  - 6 x 1000ml Ringers Lactate
- Laryngoscope set - adult and paediatric
- 1 x Long Spine Board or equivalent with straps
- 1 x Lower extremity traction splint (Trac 3, Thomas Tarangula, etc)
- 2 x Adult Oxygen nebuliser Masks
- 4 x Adult Oxygen masks providing 40% inhaled oxygen, with tubing
- 1 x Maternity Pack

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- 1 x ECG Monitor / defibrillator/ external pacer with leads
  - 2 x Nasal cannula for oxygen, with tubing
  - Nasogastric tubes - full range of sizes
  - Oxygen supply, providing 30 minutes of oxygen at 15 litres per minute minimum; i.e. 1 fixed 10 litre O<sub>2</sub> cylinder and gauge minimum; 1 portable 2 litre O<sub>2</sub> cylinder and gauge minimum
  - 2 x Paediatric oxygen masks providing at least 40% inhaled oxygen and tubing
  - 1 x Pair scissors
  - 1 x Pulse Oximeter
  - 1 x Pupil Torch
  - Range of hard and soft suction catheters
  - Range of intravenous catheters and administration sets
  - Range of syringes and needles
  - 2 x Rolls adhesive tape
  - 1 x Scoop stretcher
  - Sheets, pillow, pillow cases
  - 1 x Sphygmomanometer with adult cuff
  - 6 x Splints - long (leg) i.e. rigid support material e.g. cardboard, metal, vacuum, wood, plastic etc.
  - 4 x Splints - short (arm)
  - 1 x Stethoscope
  - 1 x Suction apparatus (hand, foot or battery operated)
  - 1 x Urine drainage bag
  - Waste Disposal Facility and Sharps Container
  - 1 x Water Bottle



- 5 x Wound dressing - 100mm x 200mm
- 1 x Wound dressing - extra large
- 1 x Emergency medication cooler bag - if drug medications/ blood need to be kept cool
- 1 x Ventilator

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- 1 x Infusion pump or syringe driver with appropriate administration sets
- 1 x Mechanical/ automatic vital signs monitor
- 1 x Thermometer - standard

#### 7.4 Role of Nurse in mobile intensive care unit:

- She responds quickly while work in MICU
- Nurse's works in MICU bears extensive travelling challenges according to their job specification
- Her/ his role starts just after the first information of an emergency occurs.
- She has responsibility of carrying the patient from the site of event to transferring them safely at nearest facilitated hospital
- She plays vital role while transporting patient from one hospital to another referral center
- Mobile intensive care nurses are capable of administering life-sustaining drugs
- She has skills of applying electrical defibrillation
- She establishes Intravenous Therapy
- She utilizes advanced airway skills at the scene of an emergency and while transporting the patient to the nearest medical care center

#### 7.5 Equipment used in MICU:

##### a) Portable Ventilator:

It is defined as any machine designed to mechanically move breathable air into and out of the lungs, to provide the mechanism of breathing for a patient who is physically unable to breathe, or breathing insufficiently.



##### Specifications:

**Power:** on/of, mode: control, assist control, SIMV, tidal volume: 100 to 2200 cc, rate: 2.0 to 40 BPM, peak flow: 20-120 LPM

##### Indicators:

Green light: power on, power status, mode, and sign on. Yellow light: silenced and unlocked



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**Alarms:**

Audible/Visual: high pressure, low pressure, apnea, low battery, power charge, ventilator inoperative.  
Audible: complete power failure.

**b) Portable cardiac monitor:**

Portable Cardiac Monitor is placed in MICU to ensure uninterrupted ECG monitoring and display Heart rate. A system and method for obtaining ECG signals from an ambulatory patient are disclosed herein.



**c) Portable Defibrillator:**

The portable defibrillator goes everywhere with color LCD monitor that allows ECG monitoring as required. This is built more compact and lightweight, thereby allowing the nursing staff to use it conveniently in MICU and all emergencies.



**d) Resuscitation kit:**

An essential first aid kit for providing effective resuscitation. This is an Essential Carrying Kit for providing Effective Resuscitation for all age group (Adult/Child/Infant)



**It includes:**

- Adult/Child Resuscitation
- Laryngoscope
- Foot suction

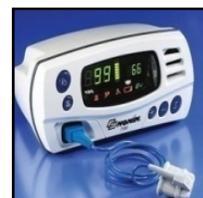
**e) Portable Oxygen cylinder:**

Fitted with Pressure Regulator valve, Safety Valve. Used as a source of oxygen in emergencies. Refill Adaptor for refilling the above cylinder from any big oxygen cylinder.



**f) Pulse Oximeter:**

A **pulse oximeter** is a medical device that indirectly monitors the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly through a blood sample) and changes in blood volume in the skin, producing a photoplethysmograph. It is often attached to a medical monitor so staff can see a patient's oxygenation at all times.



**g) Suction machine:**

Suction machine used to remove mucus and other bodily fluids from a patient. Takes out secretions (sputum) from the lungs





**h) E.C.G:**

Electrocardiography (ECG) is a transthoracic interpretation of the electrical activity of the heart over time captured and externally recorded by skin electrodes. It is a noninvasive recording produced by an electrocardiographic device. The ECG works mostly by detecting and amplifying the tiny electrical changes on the skin that are caused when the heart muscle "depolarizes" during each heart beat.



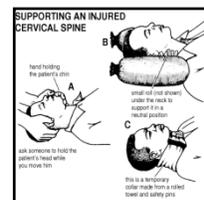
**i) Oxygen supply kit:**

Patients given mobile and stationary ventilation and inhalation treatment have to be assured of a safe and correct dosage of oxygen at all times when necessary in MICU.



**j) Spinal Collars:**

Spinal collars are used by paramedics to keep a patient's head, neck and spine still. This is done in cases where a patient is at risk of a spinal injury where movement could result in spinal cord damage, leading to paraplegia. While the patient moved through MICU the chances of movements in patient's body are more so the various type of collars are kept in MICU.



**Types of spinal collars:**

- Rigid- These are used to restrict movement. A rigid collar is stiff and this type of collar is used for more severe cases of spinal instability or injury and may be used for a longer period of time.
  - Used for fixing in head and neck traumas and spinal injuries
  - It is made of elastone material
  - Tough, shape keeping and easily handling
- Soft - These are used provide muscular support while allowing movement. These are flexible and wraps around the neck securely.

**Examination of a spinal injury:**

- Feel for any local bruising, swelling, and tenderness along his spine. Examine spinous processes systematically from patient's neck to his sacrum.
- Look for any break in the line.
- Feel for any soft 'doughy' areas between his spinous processes into which your fingers can sink. You may feel a palpable gap. These last two signs indicate an unstable fracture. Don't test the movements of the spine.



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### Immediate treatment of a fractured spine:

- This varies with the level of the lesion.
- Neck must be kept straight, and not flexed, extended, or rotated.

#### 1. Cervical spine:

Apply traction to all patients with:

- Any unstable fracture or any dislocation
- Any patient with incomplete paralysis or impending paralysis



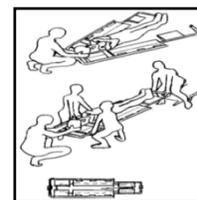
#### 2. Lumbar and sacral spine:

Lay the patient in his most comfortable position. Transporting a patient with a spinal injury is never easy, even by air. If the roads are bad, the journey long, patient will probably be safer in MICU when the skilled staff will take care the injured.



#### 3. Scoop stretcher:

- The scoop stretcher is a device used specifically for casualty lifting.
- A scoop stretcher is a tubular structure that can be split vertically into two parts; blades are fixed to the tubes. The two halves are put on each side of the casualty, and then clipped together; the blades go under the casualty and replace the hands of the first responders (as the blades are thinner than hands, they are less likely to worsen an unstable trauma).
- The scoop stretcher can be operated with only two team members: one is carrying the head side, the other one the feet side.
- The scoop stretcher can be used for patient transport, provided the patient is strapped. But for comfort reasons, it is recommended to put the patient on a vacuum mattress instead or at least on a long spine board: the scoop stretcher is put on the transport device and then opened.





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### Commonly Used Emergency Medicines/Life Saving Drugs:

1. Adenosine Injection
2. Adrenaline Bitartrate Injection
3. Aminophylline Injection
4. Amiodarone Injection
5. Antisnake venom inj polyvalent Injection
6. Antitetnus Human Immunoglobulin Injection
7. Atropine sulphate 0.6mg/ml Injection
8. Calcium chloride Injection
9. Chloroquine phosphate 64.5 mg/ml (5ml amp) Injection
10. Dextran-70 Injection
11. Diazepam 5mg/ml Injection
12. Dicyclomine hydrochloride 10mg/ml Injection
13. Diphenhydramine Injection
14. Diltizem Injection
15. Diptheria Antitoxin Injection
16. Dobutamine 50mg/ml (5 ml amp) Injection
17. Dopamine hydrochloride 40mg/ml (5ml amp) Injection
18. Epinephrine hydrochloride 1mg/ml Injection
19. Flumazenil Injection
20. Fresh Frozen Plasma Injection
21. Frusemide 10mg/ml Injection
22. Glucose with sodium chloride Injection
23. Glyceryl trinitrate 5mg/ml Injection
24. D50% Injection
25. Haloperidol Injection
26. Heparin sodium 5000IU/ml Injection
27. Hydrocortisonesodiumsuccinate 100mg/ml Injection
28. Insulin soluble (bovine + porcine or porcine) 40IU/ml Injection
29. Lignocaine IV 2% Injection
30. Lidocaine 2% Injection
31. Magnesium sulphate Injection
32. Mannitol 10%, 20% Injection
33. Metoclopramide 5mg/ml
34. Metoprolol 1mg/ml Injection
35. Morphine sulphate Injection
36. N/2 saline Injection
37. N/5 saline Injection
38. Naloxone 0.4mg/ml Injection
39. Neostigmine 0.5, 2.5mg/ml Injection
40. Oxygen Inhalation
41. Oxytocin Injection
42. Pancuronium 2mg/ml Injection
43. Phenobarbitone 200mg/ml Injection
44. Phenytoin 50mg/ml Injection
45. Potassium Chloride Injection
46. Pralidoxime chloride (2-PAM) 25mg/ml Injection
47. Protamine sulphate Injection
48. Rabies vaccine Injection
49. Ringer lactate Injection
50. Salbutamol sulphate Inhalation
51. Sodium bicarbonate Injection
52. Succinyl choline 50mg/ml Injection
53. Streptokinase Injection
54. Tetanus Toxoid Injection
55. Vitamin K10mg/mlInjecti



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