

# Equipment, devices and procedures in the Intensive Care Unit

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# Introduction

- ❑ Critical Care units or Intensive Care Unit ICU are designed to meet the special needs of acutely and critically ill patients.
  - ❑ In Intensive Care Unit (ICU), there are several medical devices. These devices are used for diagnosis, patient monitoring or therapies.
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# **Intensive Care Unit (ICU) :**

- Is a specialized facility in a hospital that provides intensive care medicine.
  - They are designed to meet the special needs of acutely and critically ill patients.
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# Critical Care:

- The medical care provided to people with an immediate life threatening illness or injury associated with single or multiple organ failure.
  - The interventions required to manage life-threatening illnesses generally include both intensive nursing care and cardio-pulmonary monitoring as well as supports focused on the patient's particular illness.
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## **Critically ill patient:**

- The patient who is at risk for actual or potential life-threatening health problems. The more critically ill patient is, the more likely to highly vulnerable , unstable and complex, thereby requiring intense and comprehensive nursing care.
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# Critical Care Nurse:

The American Association of Critical Care Nurse (AACN) define critical care nursing as specialty dealing with human responses to life-threatening problems.

➤ **critical care nursing was practiced wherever there were critically ill patient**

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## **Specialized types of ICUs include:**

- (Neonatal intensive care unit)NICU
  - (Pediatric Intensive Care Unit) PICU
  - (Psychiatric Intensive Care Unit) PICU
  - (Coronary Care Unit) CCU (for heart disease)
  - Cardiac Surgery Intensive Care Unit) CSICU
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## Cont.,.....

- (Medical Intensive Care Unit) MICU
  - (Surgical Intensive Care Unit) SICU
  - Neuro Intensive Care Unit) NICU
  - Burn Wounds Intensive Care Unit) BWICU
  - Trauma Intensive care Unit) TICU
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# ICU Equipment and devices

- ❖ Patient monitoring
  - ❖ Life support and resuscitation device
  - ❖ Diagnostic emergency devices
  - ❖ Diagnostic devices
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# 1- Patient monitoring equipment:

- ✓ ECG
  - ✓ Pulse oximeter
  - ✓ monitor
  - ✓ Capnography
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## **2- Life support and emergency resuscitation equipment:**

- ✓ Mechanical Ventilator
  - ✓ Infusion pump
  - ✓ Syringe pump
  - ✓ Crash cart
  - ✓ Intubation devices
  - ✓ Defibrillator
  - ✓ Intra-aortic balloon pump
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### **3- Diagnostic equipment:**

- ✓ Mobile X-Ray
  - ✓ Scans: CT and MRI
  - ✓ Ultrasound
  - ✓ Echocardiogram
  - ✓ Portable clinical laboratory device
  - ✓ Blood chemistry parameter
  - ✓ ABGs machine
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## 4- Other ICU equipment:

### ✓ Disposable equipment

- Oxygen mask
- Nasal cannula
- Nasogastric tube
- Urinary catheter

### ✓ Reusable equipment

### ✓ Laryngoscope

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# **Common Procedures and supplies In ICU**

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## Arterial line

An intra-arterial catheter (A-line) is a very small plastic tube (called catheter) placed in one of blood vessels (an artery) by highly trained personnel. This is usually done during or before certain types of surgery or in the Intensive Care Unit.

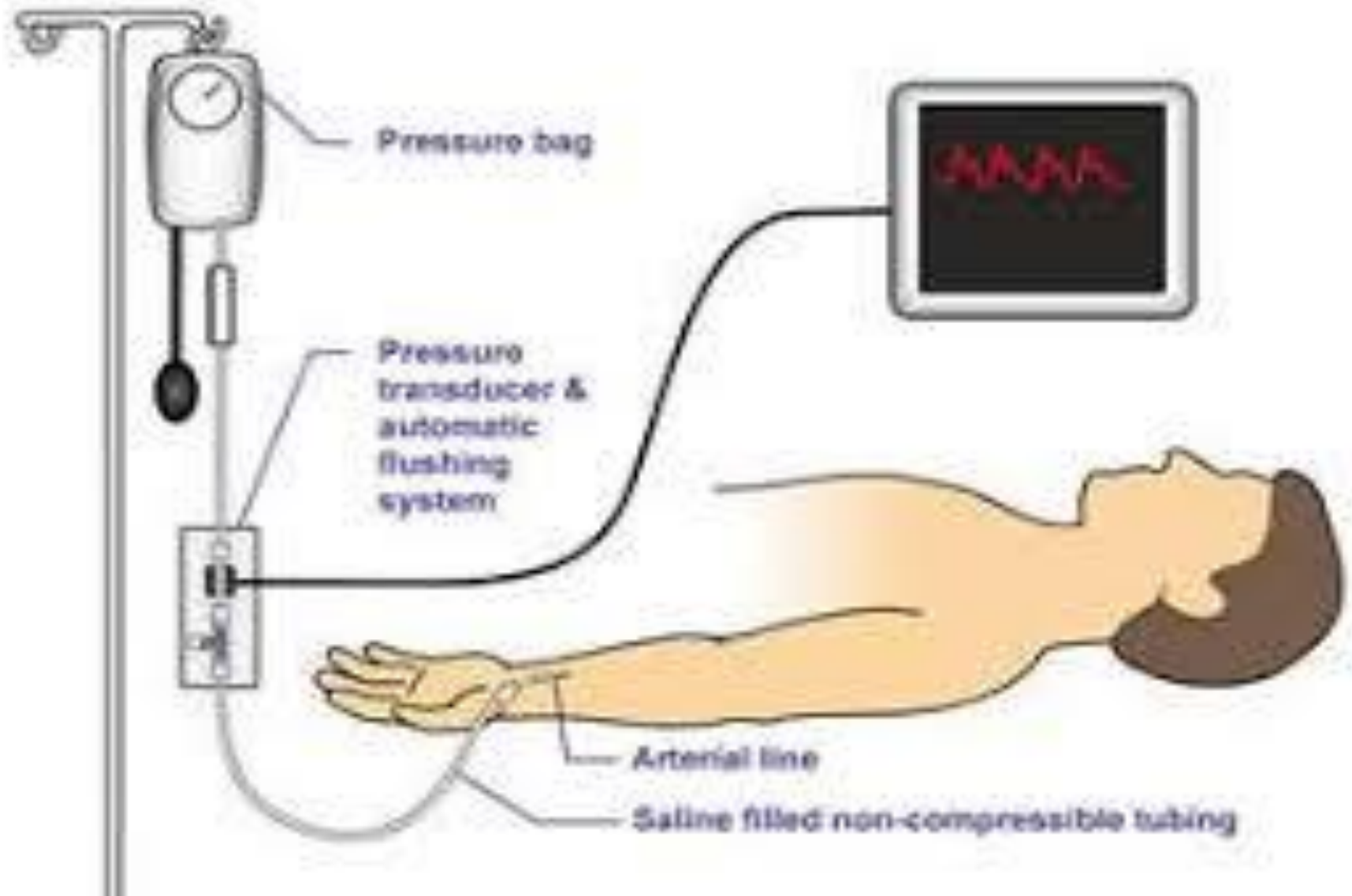
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## Purpose:

- ☐ To watch blood pressure very closely
  - ☐ To draw frequent blood samples for lab tests (ABGs)
  - ☐ To test for the oxygen saturation in the blood
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## Central venous catheter:

- CVC is a good choice because large volumes of fluid can easily be delivered.
  - Is a catheter placed into a large veins of the upper thorax—subclavian (SC) and internal jugular (IJ)—are most commonly used for percutaneous CVC line insertion. The femoral vein in the groin is used when the thoracic veins are not accessible.
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- this Catheter inserted by a physician when the patient needs frequent or intensive cardiovascular monitoring, hemo dynamic monitoring.
  - Central Venous Catheters A range of CVC options are available as single-, double-, triple-, and quad-lumen infusion catheters, depending on the specific needs of the patient.
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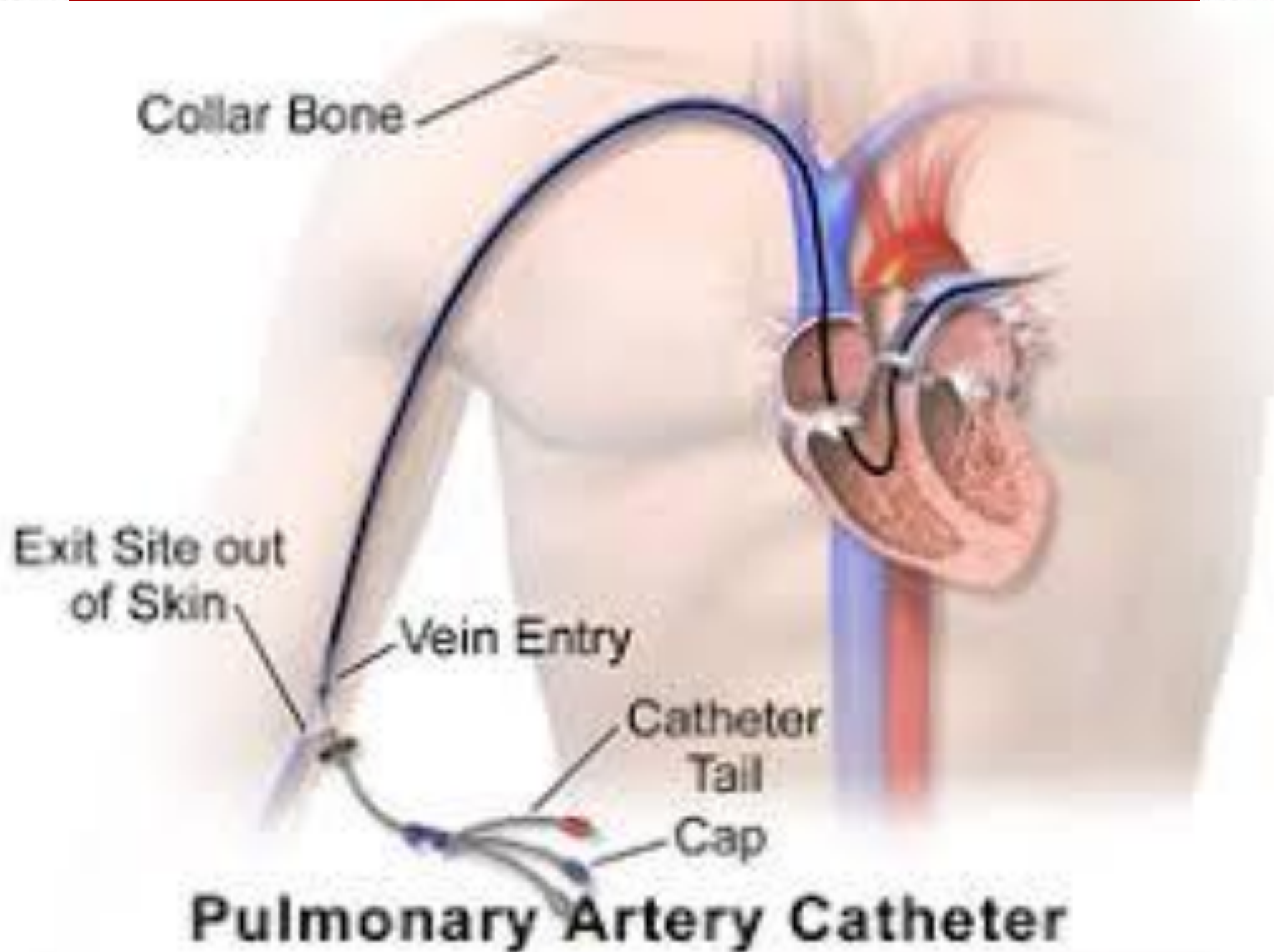




## Swan-Ganz Catheter:

- The pulmonary artery (PA) catheter is the most invasive of the critical care monitoring catheters. It is also known as a right heart catheter or Swan-Ganz catheter (named after the catheter's inventors).
  - PA catheter is a soft catheter with an expandable balloon tip that is used for measuring blood pressure in the pulmonary artery.
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# Indications

- Cardiogenic shock
  - Acute respiratory distress syndrome (ARDS) or noncardiogenic pulmonary edema
  - Septic shock
  - Hypovolemic shock
  - Acute heart failure
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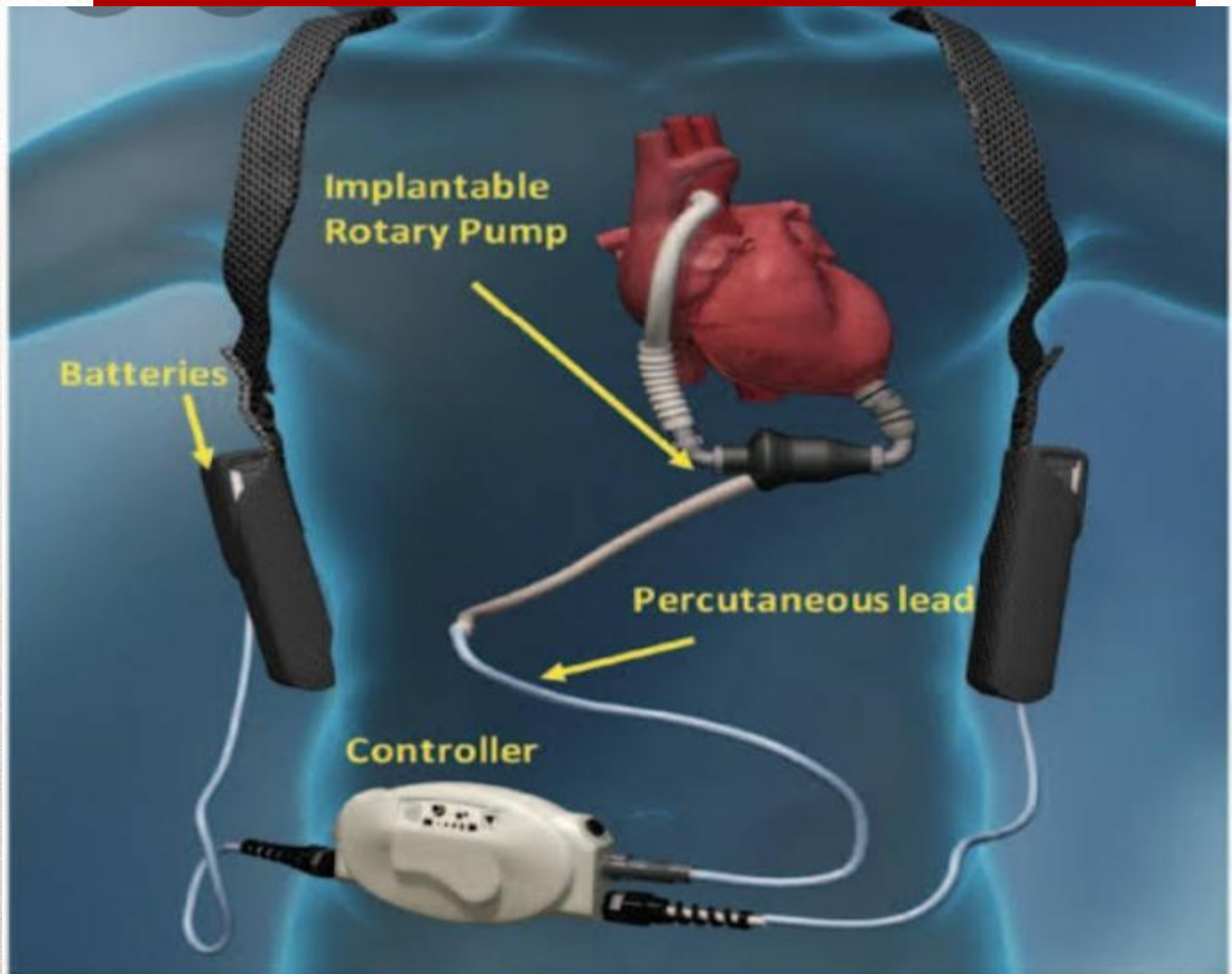
## Intraaortic Balloon Pump (IABP)

- ✓ The procedure requires placement of a catheter with an Intraaortic balloon attached.
  - ✓ The balloon is inserted into an artery, usually in the groin (the femoral artery) and then advanced into the largest artery in your body, the aorta.
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# Indications

1. During severe angina episodes
  2. Before, during, or after open-heart surgery (in certain patients only)
  3. During emergency situations, including heart attack and congestive heart failure
  4. During the waiting period for a donor heart for heart transplantation
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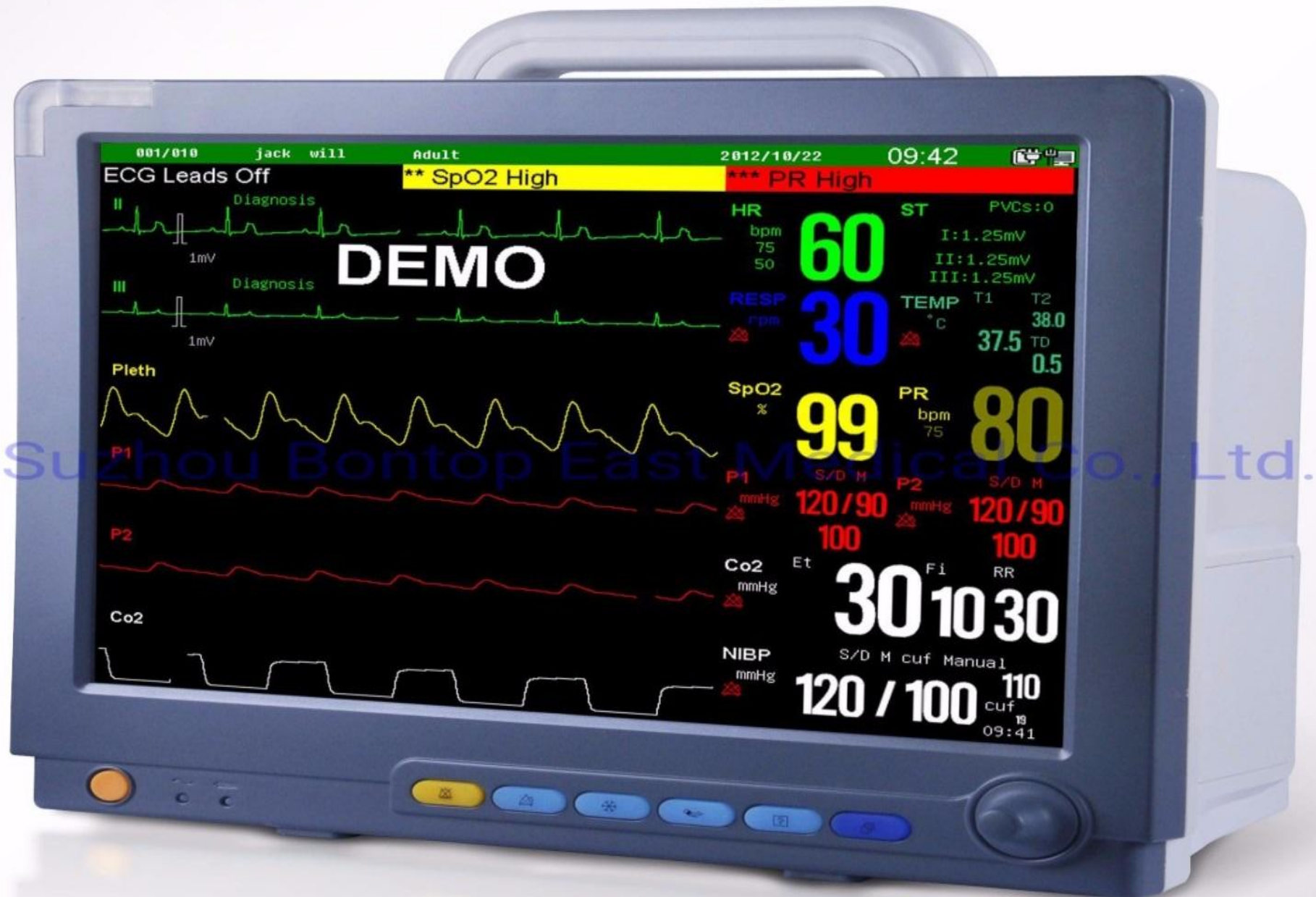




## Bedside Monitors

- All patients admitted to the ICU are connected to a bedside monitor during their stay.
  - The ICU monitor, which looks like a television or computer screen, provides ICU staff with real-time information on important vital functions such as heart rate and rhythm (ECG), blood pressure, body temperature, breathing rate and oxygen saturation.
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## Oxygen saturation monitoring (Pulse Oximeter)

- The pulse oximeter is primarily used to measure the blood oxygen saturation level in non-invasive fashion.
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# Purpose

- Measure the baseline SpO<sub>2</sub> as part of a comprehensive oxygenation assessment.
  - Provide a mechanism for early detection of changes in SpO<sub>2</sub> that may progress to a critical event.
  - Evaluate the patient's response to activities that positively or negatively affect oxygenation(i.e. suctioning, repositioning, changes in FiO<sub>2</sub>)
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## Resuscitator Bag

- A bag valve mask, sometimes known by the proprietary name Ambu bag or generically as a manual resuscitator or "self-inflating bag", is a hand-held device commonly used to provide positive pressure ventilation to patients who are not breathing or not breathing adequately.
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# EQUIPMENT & PARTS OF BMV



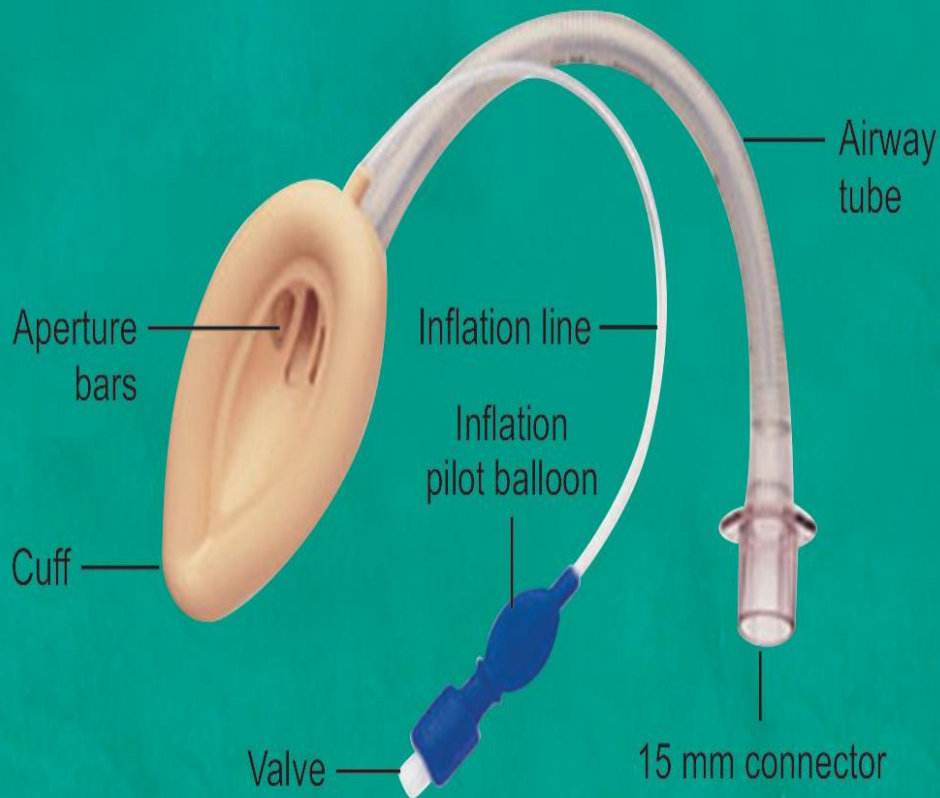
## The laryngeal mask airway(LMA)

- The laryngeal mask airway (LMA) is a novel device that is an intermediate between tracheal intubation and a facemask. It is blindly inserted into the pharynx, forming a low-pressure seal around the laryngeal inlet and permitting gentle positive-pressure ventilation.
  - It allows oxygenation and ventilation and also the administration of inhaled anesthetics, with minimal stimulation of the airway
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## ➤ It used most common in case of:

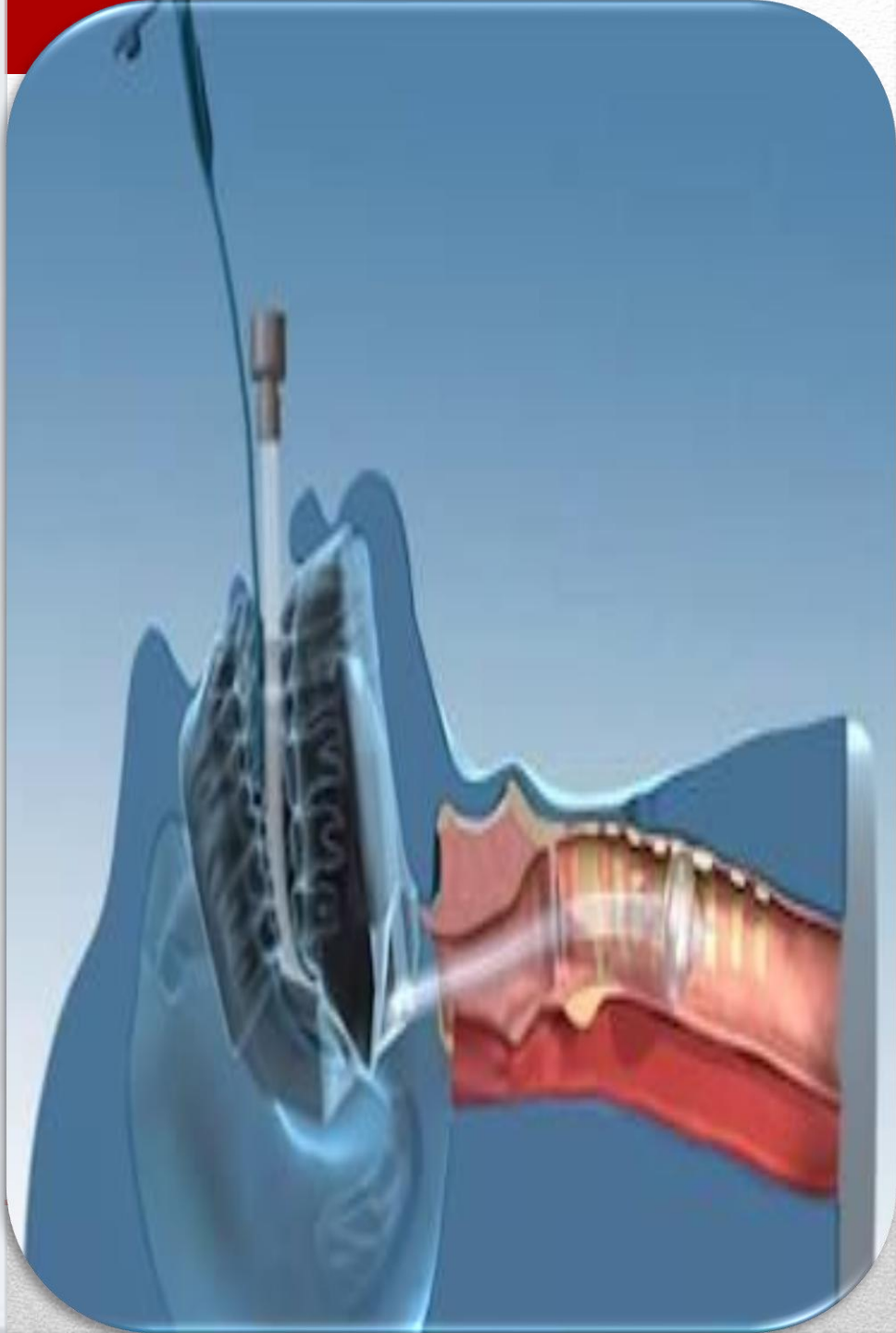
- Prehospital airway management
- Difficult intubation



## Endotracheal Intubation (ETI):

- Endotracheal intubation is a medical procedure in which a tube is placed into the trachea through the mouth or nose under sedation. In most emergency situations it is placed through the mouth.
  - Intubation provides a patent airway when the patient is arrested or having respiratory distress that cannot be treated with simpler methods.
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# Tracheostomy

- Surgical created stoma (opening) in the trachea to establish patent air way.





# Indication

- presence of an upper airway obstruction due to trauma, tumors, or swelling and the need to facilitate airway clearance due to spinal cord injury, neuromuscular disease, or severe debilitation or for prolonged mechanical ventilator.
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# Mechanical Ventilator

Mechanical ventilator is a positive- or negative-pressure breathing device that can maintain ventilation and oxygen delivery for a prolonged period.





# Indications of Mechanical Ventilator:

- **Inadequate gas exchange**

Pneumonia, pulmonary edema, acute respiratory distress syndrome

- **Obstructed breathing**

Upper airway obstruction e.g epiglottitis, edema, tumor.

Lower airway obstruction e.g bronchospasm.

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# Laryngoscopy

- It is a medical procedure that is used to obtain a view, for example, of the vocal folds and the glottis.
  - Laryngoscopy may be performed to facilitate tracheal intubation during general anaesthesia or cardiopulmonary resuscitation or for surgical procedures on the larynx or other parts of the upper tracheobronchial tree.
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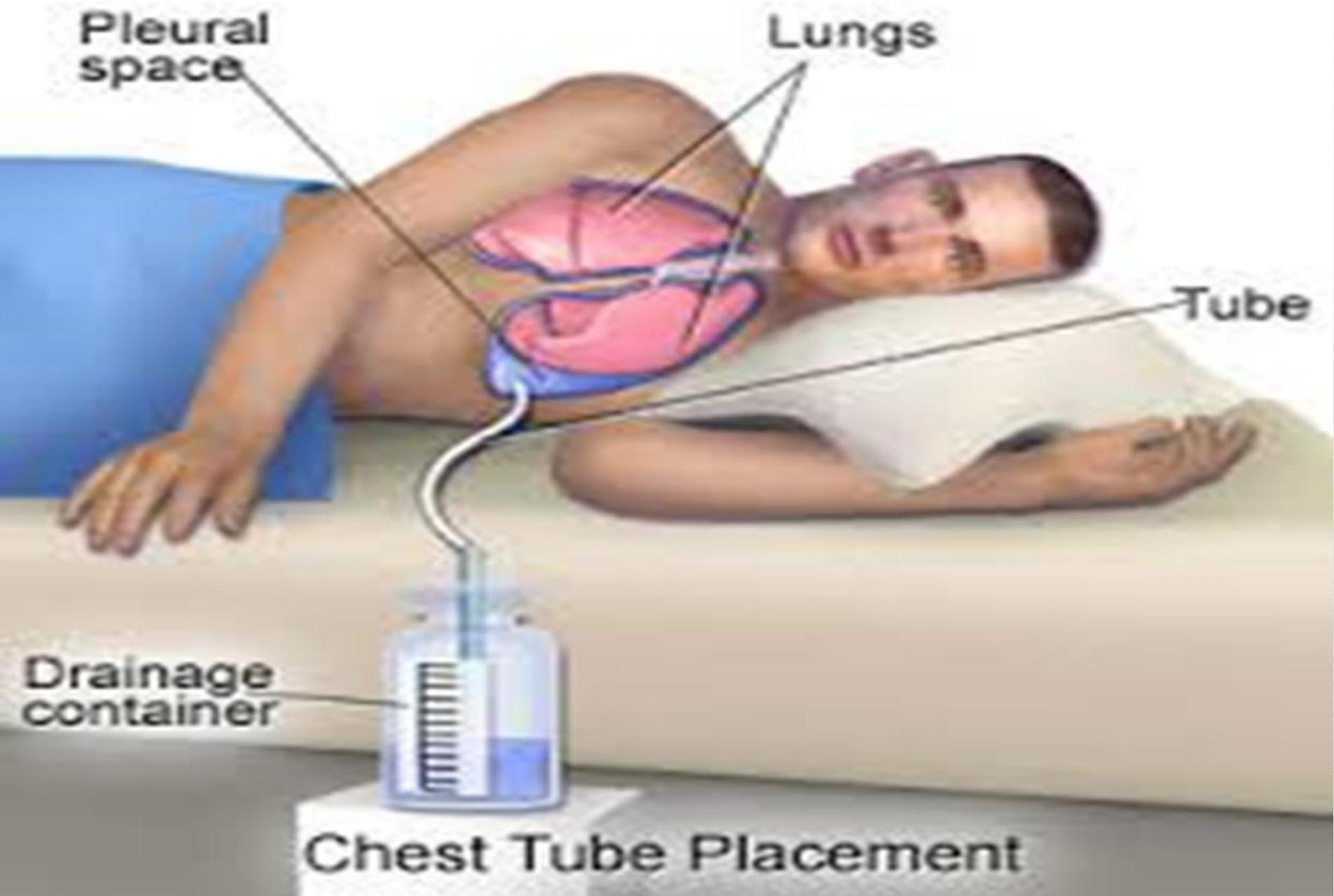
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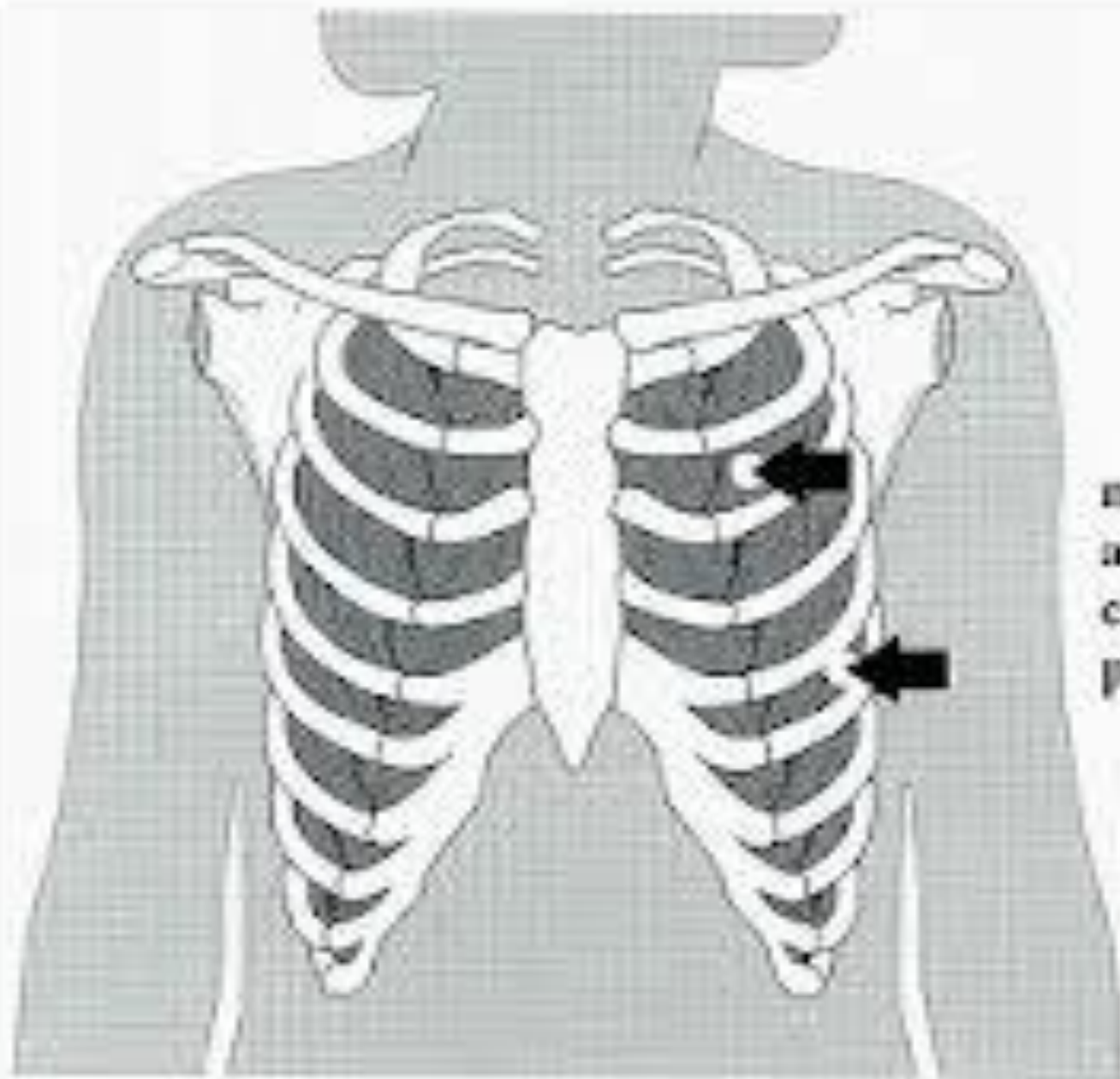
## chest tube

A tube that is inserted through a surgical cut in the chest after the skin has been anesthetized to drain the following fluid, blood, or air to maintain lung expansion and restore the normal negative pressure in the pleural cavity.

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most common  
areas for  
chest tube  
placement



## Urinary catheterization

A technique that involving the insertion of a sterile hallow tube from the external urethra to the bladder to drain urine in several medical conditions, and it is a closed system.

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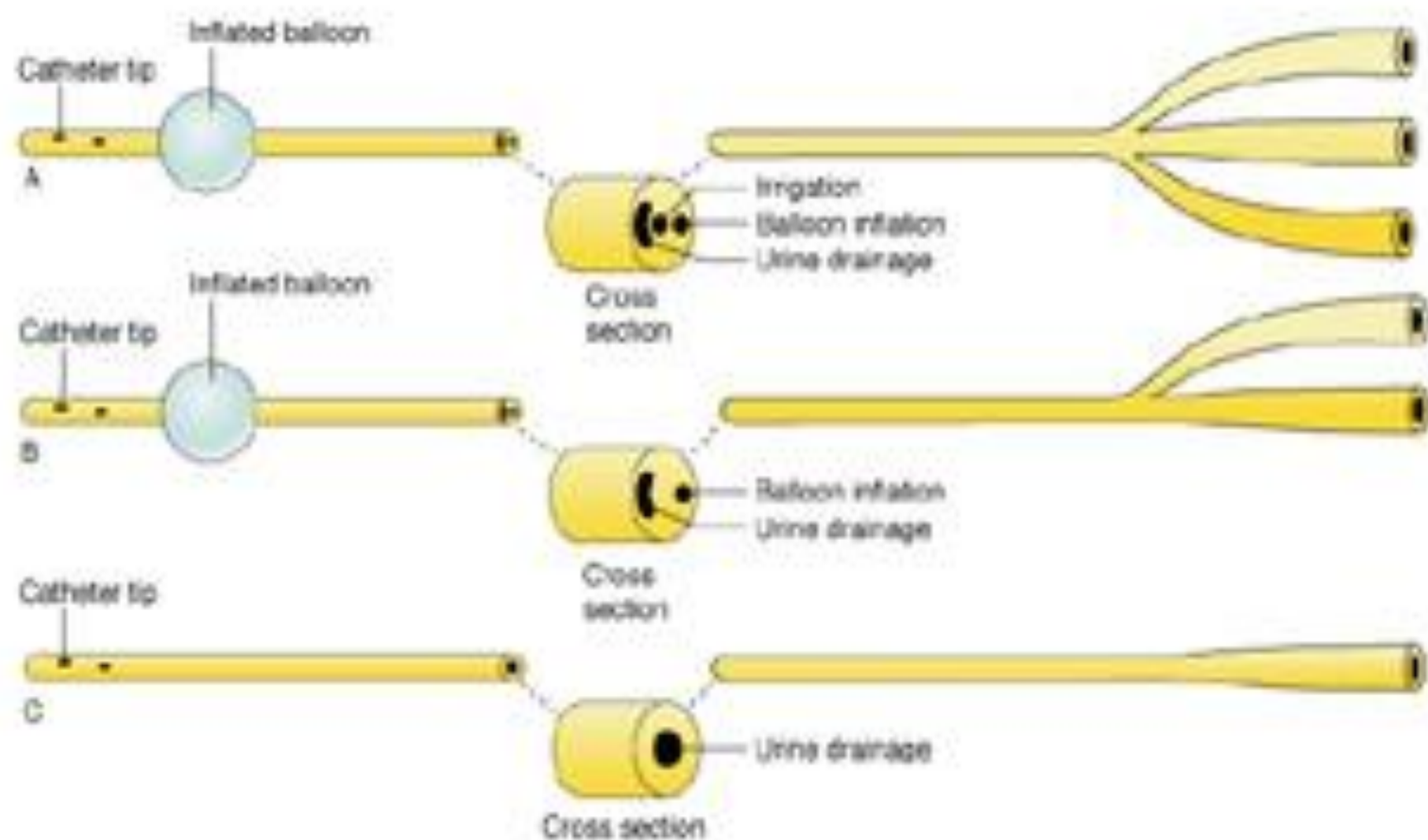


Figure 43-9 (A) Triple-lumen indwelling catheter (B) Double-lumen indwelling catheter (C) Straight catheter



## Nasogastric tube

Method of inserting a tube into the stomach through the nose, for instilling food and fluids or with drawing fluids and gas.

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## Suctioning:

Suctioning is a sterile procedure that is performed only when the patient needs it and not on a routine schedule.

### **Indications**

- secretions in the airway
  - respiratory distress
  - increased peak airway pressures on the ventilator.
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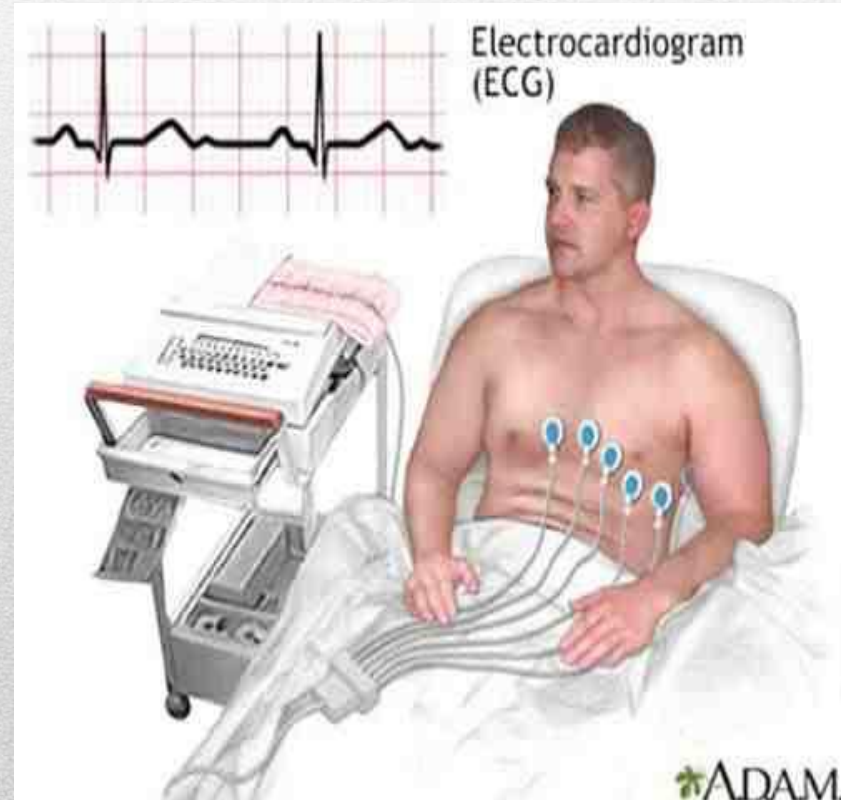
# ECG

- (ECG or EKG\*) is the process of recording the electrical activity of the heart over a period of time, Using electrodes placed on the skin.
  - These electrodes detect the tiny electrical changes on the skin that arise from the heartmuscle'selectrophysiologic pattern of depolarizing during each heartbeat. It is a very commonly performed cardiology test.
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## ➤ Types

- **Portable ECG:**

Portable, can be moved from one patient to another

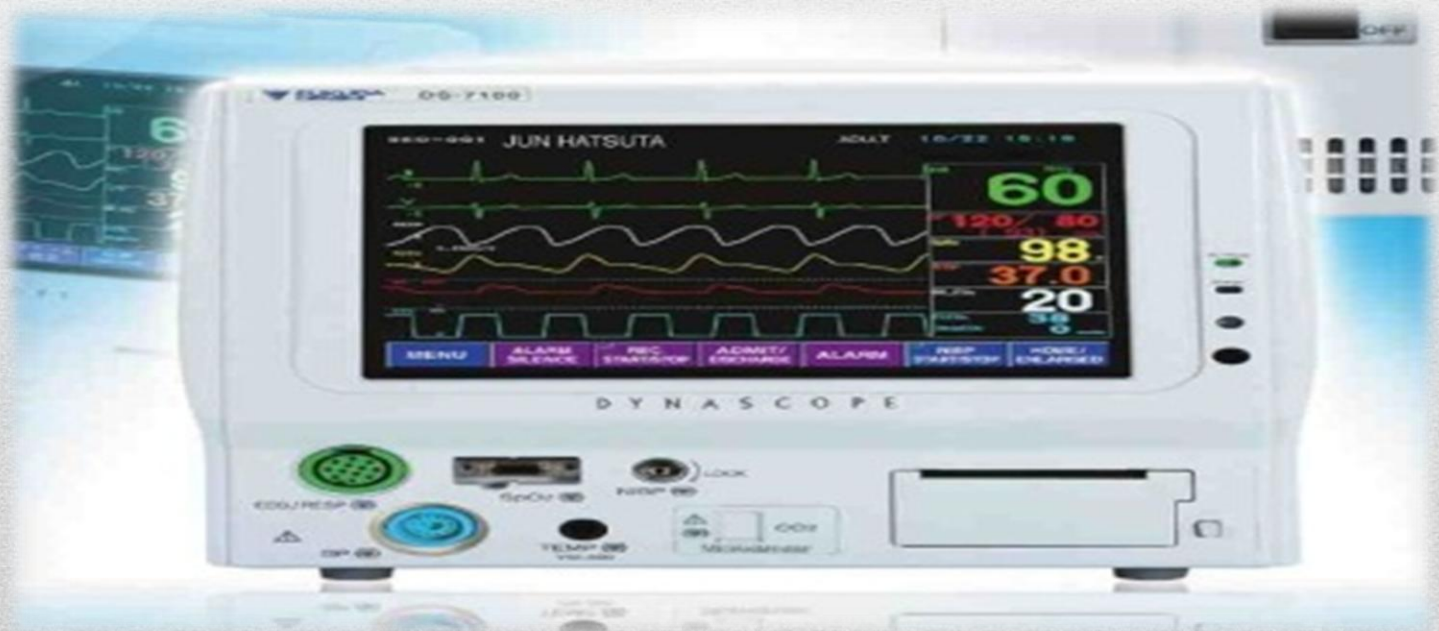




- **Non portable:**

- 1- Hardwire monitoring

Used for continuous monitoring for bed ridden patient



## 2-Telemetry

- Used for continuous monitoring of non-bed





# ECG is used to identify:

- Myocardial ischemia and infarction.
  - Conduction disturbances.
  - Chamber enlargement.
  - Electrolyte imbalances.
  - Effects of the drugs on the heart
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## Near infrared spectroscopy(sto2)

- continuous non invasive technology ,use light transmission to measure skeletal muscle oxygenation as an indicator of shock.
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- Probe is applied to the thenar muscle that located in the palm of hand near the thumb and it measure oxygen saturation of tissue by determine the amount of infrared light absorption
  - Low value of tissue oxygenation less than 80% indicate severity of shock ;the lower value ,more sever shock.
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## Crash cart

- A **crash cart** or **code cart** or "MAX cart" is a set of trays/drawers/shelves on wheels used in hospitals for transportation and dispensing of emergency medication/equipment at site of medical/surgical emergency for life support protocols to potentially save someone's life.
  - The cart carries instruments for cardiopulmonary resuscitation and other medical supplies while also functioning as a support litter for the patient.
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## **Maintenance of Crash Cart**

- The worst thing ever is to reach for a piece of emergency equipment or an emergency medication and find it inoperable or expired. It is important that the crash cart be checked regularly and maintained so that its contents are there when needed.
  - The following is a maintenance routine that should be completed at least monthly:
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- Expiration dates on medications should be checked on the first day of the month
  - Expired medications should be promptly removed and replaced
  - The defibrillation pads on the AED or the defibrillator should be checked for expiration date
  - The battery charge on the monitor and/or AED should be checked and documented
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# Defibrillator



- Is advice that gives a high energy electric to the heart of someone who is in cardiac arrest. This high energy shock is called defibrillation, and it's an essential part in trying to save the life of someone who's in cardiac arrest.
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# Types of defibrillators

## 1. Manual external defibrillator

- Deliver the shock through paddles or pads on the patient's chest.



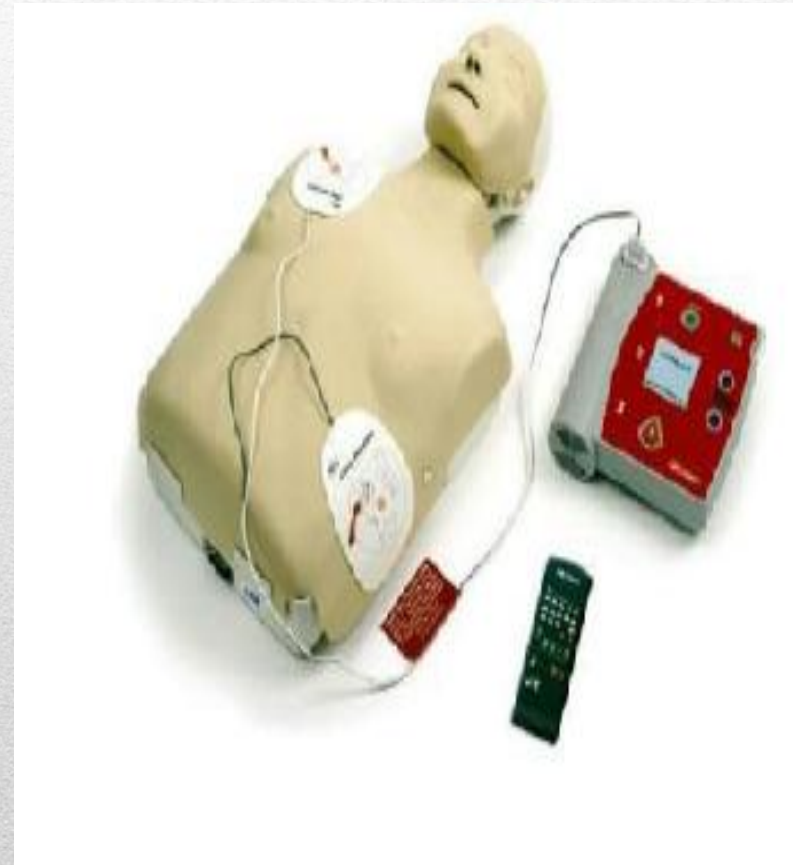
## 2. Manual internal defibrillator

- Identical to the external version except that the charge is delivered through internal paddles in direct contact with the heart.
  - These are almost exclusively found in operating theatres.
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### 3. Automated external defibrillator (AED)

- is a portable electronic device that automatically diagnoses the life-threatening cardiac arrhythmias of ventricular fibrillation and ventricular tachycardia in a patient, and is able to treat them through defibrillation,



## 4. Implantable cardio verter-defibrillator (ICD)

- Is a device implantable inside the body similar to pacemaker, able to perform cardio version, defibrillation, and (in modern versions) pacing of the heart. The device is therefore capable of correcting most life-threatening cardiac arrhythmias.
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Implantable Cardioverter Defibrillator





## 5. Wearable cardiac defibrillator

- is a portable external defibrillator that is worn like a vest. The unit monitors the patient 24 hours a day and will automatically deliver a biphasic shock if needed. This device is mainly indicated in patients awaiting an implantable defibrillator.



# Beds

The ICU bed is designed to be able:

- To transport critically ill, ventilated patients.
  - To support the patient comfortably
  - To provide room to carry portable oxygen cylinders, suction equipment, emergency resuscitation equipment, intravenous infusions and their pumps, as well as a transport monitor and ventilator.
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# Infection control and prevention in ICU

- **Cleaning and disinfection**


- High-quality cleaning and disinfection of all patient-care areas is important, especially surfaces close to the patient (e.g. bedrails, bedside tables, doorknobs and equipment)
  - Some pathogens can survive for long periods in the environment, particularly methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), *Acinetobacter* species, *Clostridium difficile* and norovirus
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- EPA-registered disinfectants or detergents that best meet the overall needs of the ICU should be used for routine cleaning and disinfection.
  - Frequency of cleaning should be as follows: Surface cleaning (walls) twice weekly, floor cleaning 2-3 times/day and terminal cleaning (patient bed area) after discharge or death.
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- The unit may be situated close to the operating theater and emergency department for easy accessibility, but should be away from the main ward areas .
  - Central air-conditioning systems are designed in such a way that recirculated air must pass through appropriate filters .
  - It is recommended that all air should be filtered to 99% efficiency down to 5  $\mu\text{m}$
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- Suitable and safe air quality must be maintained at all times. Air movement should always be from clean to dirty areas
  - It is recommended to have a minimum of six total air changes per room per hour, with two air changes per hour composed of outside air
  - Isolation facility should be with both negative- and positive-pressure ventilations
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- Clearly demarcated routes of traffic flow through the ICU are required .
  - Adequate space around beds is ideally 2.5-3 m .
  - Electricity, air, vacuum outlets/connections should not hamper access around the bed .
  - Adequate number of washbasins should be installed.
  - Alcohol gel dispensers are required at the ICU entry, exits, every bed space and every workstation .
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- There should be separate medication preparation area .
  - There should be separate areas for clean storage and soiled and waste storage and disposal .
  - Adequate toilet facilities should be provided .
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