2.0 OBJECTIVES

After completing this practical, you should be able to:

- describe the physical layout of neonatal care unit;
- identity the personnel required for providing optimal care to high risk neonate;
- operate various neonatal equipments efficiently; and
- provide nursing care to neonate being nursed with various devices.

2.1 INTRODUCTION

The organization of a good quality neonatal care unit is essential for reducing the neonatal mortality and improving the quality of life amongst survivals. The emphasis should be laid on developing a sound infrastructure to ensure delivery of safe nursing care, promote asepsis. Adequate space, availability of running water round the clock, centralized oxygen and suction facilities, maintenance of thermoneutral environment, ready availability of adequate linen and disposal and sophisticated electronic gudget is mandatory to provide care to high risk neonate.
2.2 PHYSICAL LAYOUT

In this section we shall focus on location floor plan, ventilation, lighting, environmental temperature and humidity, acoustic characteristic, communication system.

2.2.1 Space and Location

Each neonate should be provided with a minimum area of 100 square feet. Neonatal care unit should be located as close as possible to the labour room and obstetric operation theatre to facilitate prompt transfer of sick and high risk neonate.

2.2.2 Floor Plan

The neonatal care unit should be preferably in a square space so that abandoned open unencumbered space is available. The wall should be made of glazed tile and windows should have two layers of glass panes to ensure heat and sound insulations. Wash basins with elbow or foot operated tap having round the clock water supply should be provided. The door should be provided with automatic door closures. Built in wall wooden cabinet with foldable cover should be used for stocking purposes. There should be isolation room where affected neonate with neonatal sepsis should be nursed. There should be breast feeding room for promoting practice of exclusive breastfeeding and educating mothers.

2.2.3 Ventilation and Lighting

Effective air ventilation of nursery is essential to reduce nosocomial infection. The most satisfactory ventilation is achieved by laminated air flow system. Simple methods to achieve satisfactory ventilation consist of provision of exhaust fan in a reversed direction near the ceiling for input of fresh uncontaminated air and fixation of another exhaust fan in the conventional manner near the floor air exit. Constant positive air pressure should be maintained in the nursery so that contaminated air from the corridor does not gain access into the nursery.

The nursery must be well illuminated and painted with white or slight off-white to permit prompt and early detection of jaundice and cyanosis. It is best achieved by cool white fluorescent tubes to provide at least 100 foot candle, shadow free illumination at the infant level.

2.2.4 Environment Temperature and Humidity

The temperature of the nursery complex must be maintained around 28 ± 2 degree centigrade indoor to minimize effects of thermal stress on the babies. This is best achieved by centralized air conditioning having temperature control knobs in the nursery. Portable radiant heater, infrared lamp or bulb can be used to provide additional source of heat to an individual infant. Humidity is maintained around 50 per cent Neonatal care unit should be equipped with room thermometer and hygrometer.

2.2.5 Acoustic Characteristic and Communication System

Sound intensity in the nursery should not exceed 75db to protect hearing of nursery personnel and infants. Telephone rings and equipment’s alarms should be replaced by blinking light. Decibel meter should be installed to monitor sound level in the nursery. The beneficial and soothing effect of meaningful sound such as gentle music or recording of parent’s voice should be harnessed to provide physiological stability to the babies.

The nursery complex should be provided with an intercom system so that additional person can be called for help in case of emergency. A direct line
external telephone in mandatory so that parents have an easy access to enquire about welfare of their infants. Mobile phone should not be used near the vicinity of nursery because the electromagnetic waves are liable to interfere with the functioning of the electronic equipment.

### 2.3 PERSONNEL

It is important that while allocating nursing, medical and paramedical staffs, the needs of the neonatal unit should not be ignored. The highest priority in the organization of neonatal unit is the availability of sufficient number of adequate trained personnel especially the nurse. The high power committee has recommended one nurse is needed to offer special or intermediate nursing care to three babies or intensive care to one infant.

The National Neonatology Forum of India has recommended that at least one trained nurse should be allocated to provide coverage to four babies in the special care neonatal unit. The allowance should be kept for additional 25 per cent staffs to provide for the exigencies if day off and leave. The continuity of the service can be maintained if at least 5 per cent of the nurse are rather permanent and not transferred frequently as is the usual practice in general hospital.

Neonatologist should devote his full time to improve the existing standard of neonatal special care service. The unit must also have an independent senior resident doctor and one junior resident round the clock for every eight babies requiring special care.

A laboratory technician should be available to operate bilirubinometer, glucometer, micro centrifugation, CRP kits and blood gas analyzer. A biomedical technician or a link person is essential to maintain a liaison with supplies of equipment to ensure their smooth functioning and prevent breakdown. When ventilatory facility are established respiratory therapist is a useful member of neonatal team to monitor ventilatory settings.

### 2.4 EQUIPMENT

In neonatal care unit various equipments are used either for monitoring the physiological status of neonate for example pulse oximeter and apnea monior or for maintaining temperature and other therapeutic purposes for example phototherapy unit, radiant warmer and incubator.

#### 2.4.1 Incubator

The incubators are essential to provide an ideal microenvironment. The main functions are: isolation, maintenance of thermo neutral ambient temperature, desired humidity and administration of oxygen. It is essential that an incubator should not interfere with observation of an infant, should offer easy access to the baby and readily cleanable.

An incubator that can control temperature, humidity and oxygen concentration while providing a high degree of isolation through the slight positive pressure maintained by air circulation system.

These incubators are becoming less popular now days as increased risk of nosocomial infection (humidity chamber is potential source of infection).

A) Indicator lights — Two white lights on the control panel. One white light indicates that the power is on and the other indicates that the air circulation system is operating.
B) Temperature indicator meter — Provides continuous readings of the infant’s temperature when the probe is affixed to skin.

C) Thermo stat knob — To obtain thermostat control of incubator air temperature turn this knob to the position that will maintain the incubator temperature at the desired level.

D) Servo control probe — The probe is secured to the midline of the abdomen halfway between the umbilicus and the xiphoid.

E) Thermometer — The thermometer inside the incubator indicates the temperature of the incubator.

F) Control point adjust button — The temperature control point of the infant servo control unit is fixed at 97°F (36.1°C). A temperature control point of 98°F or 36.1°C. Skin temperature is correlated with a body temperature of 98.5°F or 36.9°C.

G) Red line adjust button — Provides a quick means of checking the temperature meter for proper calibration. Press redline adjust button. The meter needle should slowly swing up, stopping on the redline on the meter face.

H) Oxygen inlet — The tube attached to the source of oxygen flow should be connected at this oxygen inlet.

I) Humidity chamber — The humidity chamber should be filled with sterile distilled water. The water should be drained and replenished daily to the level indicated by a black line. To drain the humidity reservoir, turn the fill pipe counter clockwise. High humidity aids in relieving respiratory difficulty. Add 0.8 - 2.5 ml of 1:10,000 solution of silver nitrate per liter of water to inhibit the growth of microorganism. Humidity tank incubators are a potential source of infection. In some places incubators are used without adding water in the humidity chamber.

J) Port holes and plastic — For access to the infant the port hole is opened/closed by turning the metal ring that surrounds the plastic sleeve counter clockwise/clockwise.

The plexiglass port hole is a lined plexiglass door located at the foot end of incubator through which contaminated linen and other articles may be removed from incubator.

K) Weighing facility — The vent at top portion of the plexiglass hood is used to facilitate weighing of the infant.

L) Storage cabinet — The base of the incubator provides storage area for individual linen and supplies.

M) Heater output monitor — Built in heater output monitor provides information regarding the amount of heat generated by the incubator warmer to keep the infant homeothermic.

N) The front panel can be opened and bassinet can be pulled out for unhindered access to infant for examination procedure.
Weaning the Infant from the Incubator

When heater output reading is minimal or nil it suggest that infant is capable of generating enough metabolic heat to keep himself warm and can be nursed in an open cot.

Dress and wrap the infant warmly, switch off the incubator, open all the incubator port/holes, the incubator’s temperature come down to room temperature gradually, the infant may be removed and placed in a cot.

Specific instructions

Alcohol, ether or acetone should not be used to clean the plexiglass and plastic parts of the incubator.

Nurse’s Responsibilities

The incubator should be pre warmed to 34°-36.1°C for infants less than 1500 gms and 33.9°-35°C for infants more than 1500 gms.

After the infant is placed the incubator is set for maintenance of skin temperature between 36.0° C-36.5°C.

The infant need not be fully clothed, a diaper is only put.
Ensure that servo control probe is in place and properly secured to prevent hyperthermia. Reposition the probe when infant is turned, never place a probe under the infant.

The weaning of infant from incubator should be gradual process.

The unit should be thoroughly disinfected every day.

Record temperature and humidity of the incubator and the responses of infant.

Do not open the incubator during the routine care. Abrupt change in the temperature can cause untoward metabolic responses in the new born that may cause apnea.

Humidity chamber should be drained and replenished daily.

2.4.2 Radiant Warmer

A radiant warmer is a device used to maintain the body temperature of the newborn and thus play an essential role in influencing oxygen consumption, apnea and acid base balance.

The infrared heat is preferable because it directly warms the subject without affecting the temperature of intervening environment. Open care system is equipped; with an overhead radiant warmer and skin thermister with servo—control is becoming increasingly popular and preferred over an isolette incubator because of easy access to infant and less chances of nosocomial infection.

1) Hood — Hood contains the radiant heat panel. The radiant heat panel will automatically turn on and off to maintain the infants temperature as desired by temperature control and thermister attached to the infant.

2) Panels — There are four panels, two sides panels, head and foot panel.

3) Bassinet procedure table — The bassinet may be placed in varying levels of fowlers or trendelenburg position by squeezing the handle under the tabletop.

4) Storage area — Linen and equipment necessary for the individual care of infant may be stored here.

5) Control panel

   a) Off-on switch — Turn power on or off.

   b) Power light- Amber light illuminated when power is on.

   c) Set temperature — Set the temperature between 36° C- 36.5° C radiant energy is maintained at a level that will maintain the desired skin temperature.

Skin sensor probe — It is fixed to the abdominal skin midway between umbilicus and xiphisternum. The skin sensor feeds the information regarding temperature of the baby to thermostat, which automatically regulates the output of the heat to maintain desired skin temperature.

Heater output — Provides information regarding the amount of heat generated by the incubator/warmer to keep the infant normothermic.

Visible/Audible alarm speaker — Red light flashes/Emits audible alarm when temperature measured by thermister is ±1° C set temperature i.e. 36.0°-36.5°C.
2.4.3 Phototherapy Unit

Principle

Photoisomerisation and photo-oxidation changes indirect bilirubin into water soluble substance.

Operational Instruction

- Adjust the angle and height of the lamp housing to the desired position. It is recommended that the light be kept at 18" or 45 cm away from the infant to minimize any heating effect of the lamp. Intensity of light is 425-475 nm.

- Turn on the power switch located on extension arm.

- Rotate the aperture control for maximum field size.

- Rotate the intensity as determined by radiometer.
Nurse’s Responsibility

- Remove clothing to maintain proper skin exposure.
- Turn frequently to expose all skin areas.
- Monitor temperature and level of hydration.
- Close infant’s eyelids and cover with a light opaque eyeshield secured/ held in place by tape or bandage. It should be changed every eight hours and give eye care.
- Cover genitalia.
- Observe common side effects of phototherapy — loose greenish stools transient skin rash, bronze discolouration of the skin, hyper pigmentation, dehydration as phototherapy increases insensible water loss.

Local hyperthermia under the electrode can cause redness of the skin. Overheating of surface should be avoided. The nurse should be alert to the development of blisters and should record and report her findings. Change the site 2-3 hourly.

2.4.4 Pulse Oximeter

It is a non-invasive measure for continuously monitoring the blood oxygen tension levels i.e. PO₂ levels so that minute to minute changes can be observed.

Principle

Infra red rays are absorbed by oxygenated blood and deoxygenated blood differently.

The arterial blood oxygen saturation can be determined transcutaneously by measuring the absorption of two selected wave lengths of light. The light generated in the sensor probe passes through the body and tissues and is converted into electronic signals by a photodetector located in the sensor. The oxyhemoglobin and reduced haemoglobin allow different amounts of light at selected wavelengths to reach the photodetector. The monitor gives the digital display of arterial oxygen saturation, pulse rate and audible pulse tone.

Indication

Hypoxemia i.e. inadequate ventilation plus poor perfusion of tissues combine to cause low arterial oxygen tension.

Uses

To monitor pulse rate, oxygen saturation and apnea.

Types of probe

Flex probe/Multisensor probe:

Precautions

Do not place probe of pulse oximeter on the limb on which B.P. cuff is put for recording blood pressure.

Do not put on the TV set as this can cause altered reading.
Nursing care of infant with pulse oximeter:

Placement of probe: The skin is cleaned with alcohol to remove oil and allowed to dry. The probe can be fixed on the dorsum of the foot of baby.

Check for proper contact between electrode and skin to maintain accurate readings.

Blood pressure cuff should not be applied to the same limb to which transcutaneous probe is fixed.

Infants less than three days old have marked reduction of PO2 level during vigorous crying. More accurate PO2 levels are obtained when the infant is at rest. The rate of PO2 level should alert the nurse, to an imminent need for resuscitative measures.

Record PO2 level every half hour.

The nurse should use PO2 level as a guide to modify nursing care. Handling, special procedures, position and crying of an infant can significantly alter PO2 level. Suctioning, diapering etc. should be done in a gentle, organized, well spaced plan to maintain a constant PO2 level.
Do not use probe in neonate having severe oedema, skin diseases, barbiturate intoxication (due to high skin sensitivity), receiving nitrous oxide because the presence of 100 per cent Nitrous Oxide stimulates presence of approximately 2 per cent oxygen.

To safeguard the risk of hyperoxia and retrolental fibroplasia, upper limit of alarm for oxygen saturation should be set at 95 per cent.

**2.4.5 Mechanical Ventilator**

Continuous positive pressure breathing (CPPB) and synonymous term continuous positive pressure ventilation (CPPV); Positive end-expiratory pressure (PEEP) continuous residual airway pressure (CRAP) are designed to prevent atelectasis and to allow for greater oxygen and carbon dioxide exchange at the alveolar – capillary level.

Ventilators are sophisticated electronic mini air pumps. Assisted ventilation is required in some babies with respiratory failure (hyaline membrane disease, recurrent apneic attacks.)

Two types of ventilators (IPPV):

- Pressure generator
- Flow generator

On the basis of built in control principles for termination of inspiratory phase, the ventilator may be pressure cycled, volume cycled or time cycled. A suitable infant ventilator should be able to deliver adequate gas volume and compensate for any loss of gas volume due to compression, leaks and dead space.

Clinical Parameters indicating ventilatory support are as follows.

**Arterial blood gas:**

- \( \text{PaO}_2 < 50 \text{ mm Hg} \)
- \( \text{PcO}_2 > 60 \text{ mm Hg} \)

Parts of ventilator are:

**Oxygen blender:** Provides precise control of oxygen concentration from 21 per cent atmospheric air to 100 per cent.

**Compressor:** Centralised supply of oxygen and purified air alternatively air compressor of 50 PSI is mandatory for assisted ventilation. Percentage of F102 is regulated as per the requirement compressor compresses the air and deliver at 50 PSI. (It should be washed daily).

**Pressure manometer:** Provides constant monitoring of the pressure of air/oxygen mixture being delivered to the ventilator. A green wedge on the manometer dial indicates mandatory operational pressure range between 45 and 55 PSI.

**Humidifier module:** Fill jar with distilled water to the full mark.

**Thermometer:** Indicates the temperature in the tube system near the patient and so approximates the temperature of the inspired gas.
Endotracheal intubation may be needed in some infants.

- When the ventilator is put into operation record all gauge settings i.e. pressure, flow rate, oxygen concentration, temperature, tidal volume settings.
- Auscultate and assess the ventilation of both lungs. Observer for hyper expansion and degree and location of retractions. Detect early signs of pneumothorax.
- Observe the inspiratory/expiratory ratio (normal is 1:1.5 to 1:2).
- Observe for abdominal distension, which can cause undue pressure on the diaphragm preventing full lung expansion.
- Observe and record temperature of inspired gas, it should approximate body temperature.
- Check water volume of humidifying system.
- Strict aseptic techniques must be observed to prevent infection — periodic filter changes, culturing humidifying container for bacterial growth, use of sterile suctioning equipment.
- Suctioning to remove accumulated tracheobronchial secretion.
- Chest physiotherapy.
- Monitor arterial blood gas. A sudden fall in PaO2 and rise in PaCO2 indicates deterioration of the patient.
- Be sensitive to alarm.
- The position of the infant should be changed frequently. Vital signs, fluid intake and output should be monitored.

Complications: Atelectasis, Pneumothorax, oxygen toxicity, infection, Psychological trauma.

2.4.6 Infusion Pump

As you have learnt earlier, the amount of fluid to be administered to neonate is based on the neonate’s weight and physiological status. It is recommended that in a neonate the fluid should be given through infusion pump, because this devise allows for a more accurate setting of flow rates.

An infusion pump can be used to control the administration of small volumes of fluid, blood, medication and total parenteral nutrition. It is important to be familiar with the type of infusion pump, used at your institution. Be sure to set controls for both the amount of fluid to be infused and rate of infusion. Check the pump frequently to be certain it is programmed and working accurately.

2.5 DISINFECTION OF EQUIPMENT

Prevention of infection is more cost effective than treating infections in neonate. Thus every Hospital should establish its own detailed guidelines to prevent infection in neonatal care unit. Basic requirement for asepsis are running water supply, soap, elbow or foot operated taps, strict handwashing, adequate disposables, good housekeeping and asepsis routine.
**Guidelines**

- Name of the Nursery visited
- Number of beds

<table>
<thead>
<tr>
<th>Name of Equipment</th>
<th>Disinfection method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probes of radiant Warmer/incubator/pulse Oximeter</td>
<td>Clean with spirit swab</td>
<td>Daily</td>
</tr>
<tr>
<td>Laryngoscope</td>
<td>Clean with spirit swab Wrap in autoclave cloth Put date on cover</td>
<td>Daily and after each use</td>
</tr>
<tr>
<td>Infusion pumps</td>
<td>Clean with wet clean cloth if blood stained Use soap and water</td>
<td>Daily</td>
</tr>
<tr>
<td>Oxygen hood</td>
<td>Wash with soap and water and dry</td>
<td>Daily</td>
</tr>
<tr>
<td>Face mask</td>
<td>Clean with soap and water, immerse in cidex for 20 minutes, rinse in distilled/running water and then dry</td>
<td>Daily and after each use</td>
</tr>
<tr>
<td>Resuscitation bag, Reservior, oxygen tubing</td>
<td>Clean with soap and water after dismantling, immerse in cidex for 4 - 6 hours, rinse in distilled water, dry and wrap in autoclave linen</td>
<td>Weekly</td>
</tr>
<tr>
<td>Radiant warmer and incubator</td>
<td>Wet mop with clean water daily if occupied. If not occupied, clean with 2 per cent bacillocid</td>
<td>Daily</td>
</tr>
<tr>
<td>Pulse oximeter and Phototherapy unit</td>
<td>Wet mop with clean water</td>
<td>Daily</td>
</tr>
</tbody>
</table>

2.6 LET US SUM UP

In this practical you have learnt about organization of neonatal care unit and nurses role in maintenance of safe environment and promoting asepsis. You have also learnt operation of various equipment used in nursery and nurses responsibilities.