UNIT 7 USE OF EQUIPMENTS

Structure

7.0 INTRODUCTION

We have all seen oxygen being administered to a sick babies /adults in a hospital. But did you think what would be required if the oxygen in the cylinder finished and you were to replace it with another one? It would be tricky and unless you knew it well, you would not even attempt it, because wrong handling can spoil the flow meter or the pressure regulating valve. Equipment such as the oxygen delivery set, radiant warmer to provide warmth and safely to a newborn, phototherapy unit to provide light treatment for jaundice in newborns, a suction device to clear secretions from the mouth and throat of a baby or an Ambu bag with mask to provide artificial respiration in a baby, are commonly required for carrying out essential newborn care as well as to resuscitate any sick patients.

Health care providers must know the proper use of these equipments that the client derives optimal benefit and no harm is caused. Also the equipment is not spoilt due to misuse or mishandling. You should also know what to check if there are errors in its functioning and when to call for a maintenance person to check or rectify it.

In this unit you will learn about use, functioning operating procedure, cleaning and disinfection, maintenance and trouble shooting of various equipments used in newborn care.

7.1 OBJECTIVES

After completing this practical, you should be able to:

- follow basic principles in working of equipments while using them in a health facility;
- identify the various parts of equipments;
- apply the correct technique of setting up and using the various equipments for care of newborn;
- take precautions while using the equipment;
- use effective techniques of cleaning and disinfection; and
- manage minor problems with their operation, and ensure appropriate maintenance.

7.2 COMMONLY USED EQUIPMENTS FOR NEWBORN CARE

We shall begin with Radiant Warmer as given below.

7.2.1 Radiant Warmer

Newborn babies, in particular, the preterm and the low birth weight babies are extremely predisposed to hypothermia. Special care of newborn babies can be provided with radiant warmers.

Functioning of radiant warmer

- Radiant warmers provide intense source of radiant heat energy.
- They also reduce the conductive heat losses by providing a warm microenvironment surrounding the baby.
- The radiant warmer (also called open care system) was developed as an 'open incubator' that ensures ready access to the baby.
- The overhead quartz heating element produces heat which is reflected by the parabolic reflector on to the baby in the bassinet.
- The quantity of heat produced is displayed in the heater output display panel.
- Temperature selection knobs select the desired skin temperature. This information is processed by the microprocessor inside the control panel and matched against the actual temperature of the baby. If the temperature of the baby is lower than the set temperature, the microprocessor will send feedback to the quartz rod heater to increase the heat output till the baby's temperature reaches the set temperature. At this point the heater output will be reduced. This system in which the heater output is determined automatically based on skin temparature information is called **servo system.**
- Servo system is the preferred method of running the open care system.
- The heat output from the quartz heating rod could also be increased or decreased manually. This is done by the heater output control knobs/buttons. This is called the **manual mode** of operation.

- In the servo mode, whenever the baby's temperature rises by more than 0.5ºC above the set temperature, a visual /audible alarm is activated. You must pay attention to sort out the fault. Often this occurs when the temperature probe comes off the baby's skin.

Parts of an open care system (Fig 7.1)

- Bassinet
  For placing the neonate (with mattress and pre-warmed clean cloth)
- Quartz rod with reflector
  Provides radiant heat
- Skin probe
  When attached to the baby's skin, displays skin temperature
- Control panel
  Has a collection of display and control features/knobs
- Heater output display
  Indicates how much is the heater output
- Heater output control knobs
  For increasing or decreasing the heater output manually
- Temperature selection panel
  Select either set temperature or skin temperature
- Temperature selection knobs
  Select a desired set temperature
- Temperature display
  Display temperature as selected, either of the baby's skin (via skin probe) or the set temperature
- Mode selector
  Selects manual or servo mode

Fig. 7.1 : Radiant Warmer

The heating element (silicon quartz /infrared/ceramic/quartz crystal), the control panels (electronic/electrical /microprocessor based) and alarms (air temperature /skin temperature/air sensor fail /power failure etc.) form the basic unit of all the warming devices. Power consumption is around 750 watts. In good equipment, temperature stability is usually with an accuracy of ±0.5ºC.

The baby is placed in a pre-warmed bassinet covered with linen. Serve-mode should be used with skin probe applied to the baby and skin temperature set at 36.5ºC.

Steps in use of warmer

- Connect the unit to the mains. Switch it on.
- Select manual mode.
- Select heater output to 100% for some time to allow quick pre-warming of the bassinet covered with linen.
- Select servo mode.
- Select the desired set temperature of baby as 36.5ºC.
- Place the baby in the bassinet.
- Connect skin probe to the baby's abdomen with sticking tape.
- If you want the manual mode to be used, select the desired heater output.
- In the manual mode, record baby's axillary temperature at 30 minutes and then 2 hourly.
- Respond to the alarm immediately. Identify the fault and rectify it.

Application of skin probe

Do's

- Prepare the skin using an alcohol/spirit swab to ensure good adhesion to the skin.
- Apply probe over the right hypochondrium area in the supine position.
- Apply probe to the flank in the prone position.
- Check sensor probe regularly so as to ensure that it is in place. Ensure that skin probe is free of contact with bed.
- Cover probe with a reflective cover pad, if available (foil covered foam adhesive pad).

Don'ts

- Do not apply to bruised skin.
- Do not apply clear plastic dressings over probe.
- Do not use fingernails to remove skin surface probes.
- Do not reuse disposable probes.

Use of cling wrap to decrease insensible water losses

Use of cling wrap (transparent polythene used for covering fruits or vegetable for storage) over the baby, tied across the panels of warmer, has been shown to

reduce insensible water losses and result in better thermal control for VLBW (<1.5 kg) babies.

Potential pitfalls of servo-controlled warmer

In the event of probe getting displaced from baby's abdominal skin, overheating of the baby will occur because the skin probe depicts air temperature and heater output keeps on increasing till probe temperature matches control temperature. Also, repeated activation of alarm will occur when baby develops fever. In this situation, it is better to shift to manual mode with least heater output.

Useful tips for use of radiant warmers

- Don't use the warmer in a cold room. It works best when the environmental temperature is above 20ºC.
- Keeping the warmer where there are a lot of air currents reduces its efficiency.
- The warmer must be pre-warmed around 20 minutes before the arrival of the baby or till the set temperature is reached with less than 50% of total heater output.
- While using the manual mode in a warmer without a temperature display, record the baby's temperature regularly, preferably 2 hourly.
- The manual mode is used for initial preparation of bed for the baby or when rapid warming of a severely hypothermic baby has to be done. However, this may be hazardous as babies may become overheated. Except in the continuous presence of a nurse who is watching the skin temperature, it is preferable to use the skin probe with the warmer on servo-mode.
- Care should be taken ensure that the skin probe is applied to the baby's skin properly and has not come off. Else it will cause overheating of the baby.
- Radiant warmers provide dry heat and increase insensible water losses. Hence, the fluid received by the baby I/v or orally should be increased by giving extra breast feeds.

Disinfection and maintenance

We shall begin with disinfection and the talk about maintenance.

Disinfection

When the equipment is in use, all approachable external surfaces should be cleaned daily with an antiseptic solution like glutaraldehyde. Spirit or other organic solvents must not be used to clean the glass side panels or display panel. For disinfection of reusable probe, isopropyl alcohol swab should be used.

Every seventh day, after shifting the baby to another cot, the used equipment should be cleaned thoroughly first by light detergent solution and then by antiseptic solution. All detachable assemblies are to be treated similarly.

Maintenance

Ongoing maintenance is the key to increase the mean time between failures. The hospital biomedical engineer must regularly check equipment but the authorised company engineer must be called for preventive checks and major breakdowns. The control and power units should be calibrated every 4–6 months and thorough

servicing should be done annually. Temperature calibration should ensure sensitivity to ± 0.5ºC of the set value.

Troubleshooting – Radiant warmer

Fault	Possible Cause	Solution
1. Warmer is not running	No power from mains socket	Check power switch is on. Replace fuse with correct voltage and current if blown.Check mains power is present at socket using equipment known to be working. Contact electrician for re-wiring if power not present.
	Electrical cable fault	Try cable on another piece of equipment. Contact electrician for repair if required.
2. Fuse keeps blowing	Power supply or cable fault	Refer to electrician
3. Alarms not working	Alarm battery dead	Replace the battery and recheck. Send for repair if problem remains.
4. Temperature not properly controlled	Temperature probe and sensor not working	Check the temperature probes and sensor connections.Replace the temperature probe and sensor and recheck.
	Warmer placed in direct sunlight or near a draught / fan.	Move warmer if placed near heat or drought.
	Fan or air duct problem	Call technician if fan not working. Unblock air duct if obstructed.
5. Warmer not heating even when the heater lamp is on.	Heating element problem	If accessible, replace heating element. Otherwise refer to technician for repair.
6. Electrical shocks	Wiring fault	Refer to electrician immediately

User Maintenance Checklist – Radiant warmer

	Daily
Cleaning	√ Wipe dust off exterior and cover equipment after checks
	√ Remove any tape, paper or foreign body from equipment
Visual checks	√ Check all fittings and accessories are mounted correctly

Function checks	√ Check all the functions while starting the unit. Check skin temperature readings and cross check with a thermometer
	Weekly
Cleaning	√ Unplug, clean outside with damp cloth and disinfecting solution as per procedures and dry off √ Remove any dirt from wheels √ Wash (or replace) the air filters, dry thoroughly for reuse
Visual checks	√ Check mains plug screws are tight √ Check mains cable has no bare wire and is not damaged √ Check doors, cable and tray. Repair if damaged
Function checks	√ Check all controls operate correctly √ Check the readings of thermometer and oxygen sensors change when breathed upon √ Check any batteries are working properly
Every six months	
Biomedical Technician check required	

Key messages : Radiant warmers

- Radiant warmers are essential in the special care of newborn babies particularly the preterm and LBW babies to prevent morbidity and mortality due to hypothermia.
- Servo mode is the preferred method of running the open care system as the baby's temperature controls heat output.
- The baby should never be left unmonitored under the manual mode as it can lead to severe hyperthermia.
- While using the radiant warmer one must check that the temperature probe does not come off the baby because in that case a falsely low recording may lead to overheating of the baby in the servo mode.
- The radiant warmer and probe must be thoroughly cleaned and sterilised before use to prevent cross infection.
- Fluid intake of baby nursed in a radiant warmer should be increased as the insensible water losses.

Check Your Progress 1

i) What is the preferred mode for keeping a baby under the radiant warmer?

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ii) How should the probe be applied to a baby kept under the radiant warmer?

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7.2.2 Weighing Scales

Accurate weighing scale is a fundamental need for all special care neonatal units and delivery rooms.

- Weight record is essential to monitor the adequacy of nutrition as well as fluid balance. Weight at birth is the single most useful predictor of neonatal morbidity and mortality.
- Birth weight helps in identifying the level of care required for the baby and classification into weight for age categories.
- Babies below 2000 gm require special newborn care. Hence, a weighing scale for measuring the weight at birth is essential for all health care facilities where deliveries take place and neonates are looked after as given in Fig. 7.2.

Fig. 7.2 : Baby Weighing Scale

Indications

- All babies at birth.
- All LBW babies at 2 weeks (to check for regaining of the birth weight), 4 weeks (to ascertain a weight gain of 80–100 g/kg per week) and then every month.
- Sick new born once or twice a day
- VLBW (<1500 g) babies once or twice daily to monitor and plan fluid therapy
- Measuring urine output by pre-weighed napkin

Sick and VLBW babies need daily weighing to decide fluid requirements, drug dosages and weight gain patterns. Sudden weight loss in a baby who had been gaining weight satisfactorily suggests the possibility of dehydration.

Adequate daily weight gain in a newborn is a sensitive index of its well being. Term babies lose about 10% of birth weight and regain birth weight at 7 to 10 days of age while preterm babies lose weight up to 10-15 per cent of the birth weight and regain birth weight usually by 14 days of age.

After the initial weight loss, babies start gaining weight at a rate of 1-1.5% of birth weight per day.

Scales with an accuracy of ± 5 gm are essential in weight monitoring of VLBW babies. Newborn units that manage babies under 1000 g in weight need weighing scale with a accuracy of 1 gm. Excessive weight loss, delay in regaining birth weight or slow weight gain suggest that either the baby is not being fed adequately or the newborn is unwell and needs attention.

A weighing scale can also be employed to measure the urine output of the babies. Pre-weighed nappies should be used for nursing babies. Weighing the nappies post micturition would be helpful in assessing adequacy of feeding in breastfed newborns. A towel/paper is placed over the pan of the weighting scale and the scale is then adjusted to zero. The baby is then placed on this towel/paper to get the weight.

Procedure

- Put the weighing scale on a flat and stable surface.
- Record weight prior to feeding.
- Detach as many tubes/equipment as possible.
- Keep the naked baby on the towel and record the weight (Subtract the weight of the towel if the scale has no facility to zero).
- Keep baby in middle of scale pan: hold the remaining tubes lines in hand.
- Use separate sterile towel for each baby.
- If using pre-weighed splint, reduce the weight from baby's weight.
- For quality assurance check accuracy of weighing scale with standard known weights every week.

Operating instructions

- The weighing pan should be cleaned before weighing each baby.
- Connect to the mains and switch on the machine.
- The digital display will show some figure.
- Place a sterile towel or paper on the pan to reduce the chances of hypothermia and cross infection.
- Adjust the digital display to zero by manually adjusting the knob. Some weighing scales have automatic zero facility.
- Place the infant on the towel/paper in the middle of the pan.

- Note the reading on the digital display. Freeze reading facility will continue to show the reading.
- The machine should be switched off after use.
- Do not press the weighing pan with your hand. It could damage the load cell system in the weighing machine.

How should the baby pan be cleaned before use?

It is very important to clean the baby pan before and after weighing each baby. A single weighing scale in the unit, could be a source of infection. Commonly available disinfectants like savlon or Glutaraldehyde may be used to clean the pan. Spirit/ alcohol should be avoided as it can damage the pan material or LED display. If the baby pan is detachable major stains like blood and stools can be cleared with a detergent and water. Further a sterile towel / paper can be placed on the pan before weighing the baby which should then be changed before weighing each baby.

Troubleshooting – Scales

Fault	Possible Cause	Solution
1. Zero point cannot be set	Scales are not level Zero control broken or internal part jammed	Set scales on level ground and retest Send for repair
2. Movement is stiff or jerky	Dirt lodged inside Internal blockage	Remove any visible dirt or foreign body and retest Send for repair
3. Reading is inaccurate	Zero not properly set Calibration error	Reset zero and retest Recalibrate or send for repair
4. Electronic display is blank	Battery / power failed Internal error	Replace battery or power supply and retest. Send for repair

User Maintenance Checklist – Scales

Daily		
Cleaning	√	Wipe off dust and replace dust cover after checks
	√	Clear away any dirt or hair on controls and feet
Visual checks	√	If bent, cracked or damaged, send for repair
Function checks	√	Check zero at start of day and before each patient
Weekly		
Cleaning	√	Clean exterior with damp cloth and dry off
	√	Clean off then repaint any exposed or rusted metal

Visual checks	√ Tighten any loose screws and check parts are fitted tightly
Function checks	√ Check reading is accurate using a known weight √ Send for repair if inaccurate or sticking √ Replace battery if display shows low battery
Every six months	
Biomedical Technician check required	

Key Messages: Weighing Scale

Remember to adjust the scale to zero before weighing the baby.

The pan must be cleaned before weighing each baby to prevent infection.

Check Your Progress 2

What steps must one take before weighing a baby on the weighing scale?

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7.2.3 Pulse Oximeter

A pulse oximeter is a device used for the noninvasive monitoring of a patient's blood oxygen saturation. (Fig 7.3)

It also displays the pulse rate and produces a plethysmogram.

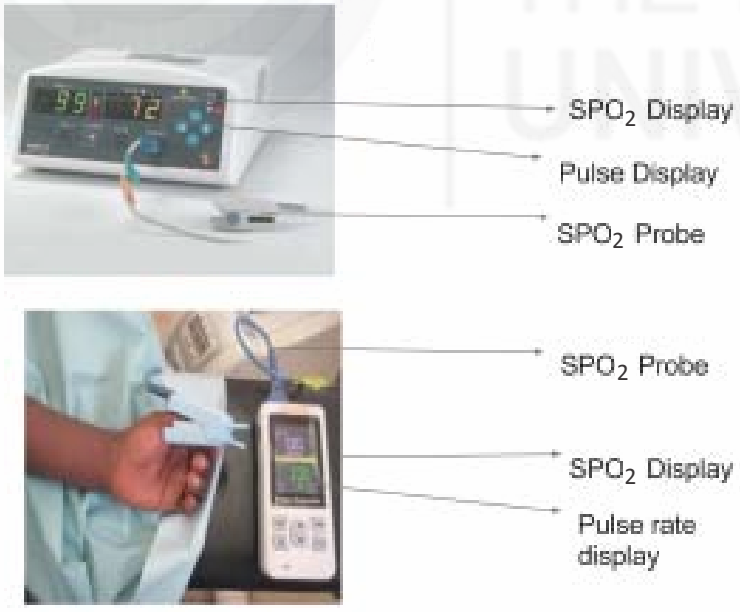

Fig. 7.3 : Hand held Pulse Oximeter

Uses

- To measure oxygen saturation in patients with respiratory or cardiac illnesses.

- To measure the oxygen saturation in newborns and infants suffering from respiratory distress, hypoxia, cardiac illness or sepsis.
- In newborn screening to detect the presence of critical congenital heart disease.
- During anaesthesia.
- During cardiopulmonary resuscitation.

Pitfalls and precautions

- Pulse oximeters are accurate mainly when the oxygen saturation is between 80 to 95%.
- Interference from other light sources can be avoided by covering the pulse oximeter probe with an opaque material.
- Movement by the newborn baby may lead to disrupted signal and artifacts.
- Avoid compromising blood flow to the limb to which the probe is attached e.g. by inflating a BP cuff to prevent a false low reading. Also, change the site of the probe every 2–3 hours.
- If probe does not fit properly, the light can be shunted from the LEDs directly to photo-detector affecting the accuracy of the measurement.
- Pulse oximeter is not reliable (in such conditions an ear probe may be more reliable than a finger probe.)
- Currently available pulse-oximeters are unable to distinguish different types of haemoglobins. Hence, in the presence of COHb (carboxyhaemoglobin) and MethHb (methemoglobin), the saturation readings may be falsely and significantly elevated, thus masking the presence of hypoxemia.
- Always remember that pulse-oximetry reflects only the state of oxygenation. It has no value in estimation of adequacy of ventilation.
- Accuracy of pulse–oximetry is about ± 4 to 5% at or above 80% saturation. Accuracy declines below a saturation of 80%(CO_2 Removal)

The oxygen saturation monitor is reliable, practical, and accurate for use in infants with a wide range of birth weights, postnatal ages and heart rates.

The probe can be positioned on the fingers or toes of a patient or on the hand, foot, or wrist of the neonate. Newer probes allow for forehead placement.

Cleanse the probe with alcohol and let it dry before using on another patient.

Procedure

- Assemble all necessary equipment.
- If saturation monitor probe is reusable, cleanse probe with alcohol, let it dry.
- Turn monitor on.
- Apply probe to a site that is well perfused.
- Ensure both sides of probe are directly opposite each other.
- Secure probe in place. Avoid oedematous, bruised sites and applying excessive pressure.

- Set high and low alarm limits for saturation and heart rate (2% above and below desired limits).
- Set pulse and alarm volumes.
- Check for correlation of depicted heart rate on monitor and the actual heart rate by auscultation.
- Record heart rate, respiratory rate, colour, oxygen saturation and FiO_2 hourly.
- Observe and change site atleast once per shift. (6–8 hrs)

Troubleshooting – Pulse Oximeters

Fault	Possible Cause	Solution
1. Equipment is not running	No power from mains socket	Check power switch is on. Replace fuse with correct voltage and current if blown. Check mains power is present at socket using equipment known to be working. Contact electrician for rewiring if power not present.
	Battery (if present) is discharged	Recharge or replace battery
	Electrical cable fault	Try cable on another piece of equipment. Contact electrician for repair if required.
2. SpO_2 or pulse rate not displayed or unstable	Probe is not mounted correctly	Connect probe and cable properly
	Probe not able to read through dirt, nail polish, etc.	Remove grease, dirt, nail polish and clean probe
	Patient movement	Request patient to remain still
	Patient's SpO_2 value is too low to be measurd	Further clinical examination of patient. Resite probe if necessary.
	Internal malfunction	Call biomedical technician
3. "Probe off" displayed on screen	Probe is not connected properly	Connect the sensor
	The connection between the probe and oximeter is loose	Refer to biomedical technician for repair
4. "Error" displayed on screen	Faulty probe or control circuit	Refer to biomedical technician
5. Continuous alarm sounds	Alarm limits set too low or high Power disconnected Internal malfunction	Set appropriate alarm limits Connect power cable Refer to biomedical technician
6. Electrical shocks	Wiring fault	Refer to biomedical technician immediately

User Maintenance Checklist – Pulse Oximeters

	Daily
Cleaning	√ Remove any dust / dirt and replace equipment cover √ Remove any tape, paper or foreign body from equipment √ Clean probe with alcohol wipe after each use
Visual checks	√ Check all parts are present and connected √ Check cables are not twisted and remove from service if any damage is visible
Function checks	√ Check operation on healthy subject before use
	Weekly
Cleaning	√ Unplug, clean outside with damp cloth and dry off
Visual checks	√ Tighten any loose screws and check parts are fitted tightly √ If plug, cable or socket are damaged, replace
Function checks	√ Check operation of all lights, indicators and visual displays √ Check probe disconnection alarm.
Every six months	
Biomedical Technician check required	

Key messages: Pulse oximeter

A pulse oximeter is a device used for noninvasive monitoring of patient's blood oxygen saturation. It is useful in patients suffering from respiratory or cardiac illnesses, monitoring during anaesthesia and during cardiopulmonary resuscitation.

Check Your Progress 3

What factors can give an erroneous reading with the pulse oximeter?

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7.2.4 Phototherapy Unit

Phototherapy is the use of visible light to treat severe jaundice in the newborn. It reduces the serum concentration of bilirubin and the risk of bilirubin toxicity. This has dramatically reduced the need for exchange transfusion. Unconjugated bilirubin in the skin gets converted to water soluble photo products on exposure to light of a particular wavelength (425–475 nm). These products are water soluble, nontoxic and excreted through the intestine and in the urine. Phototherapy involves

exposure of the skin of the jaundiced baby to blue or cool white light of wavelength 400–520 nm. Detoxification begins immediately by the production of configurational and structural photo-isomers of bilirubin in the skin and precedes the fall in serum bilirubin. Special lamps emitting light predominantly in these wavelengths are considered to be the most effective and specific for administering phototherapy. Light is effective in the treatment of hyperbilirubinemia mainly because of its blue content. (Fig 7.4)

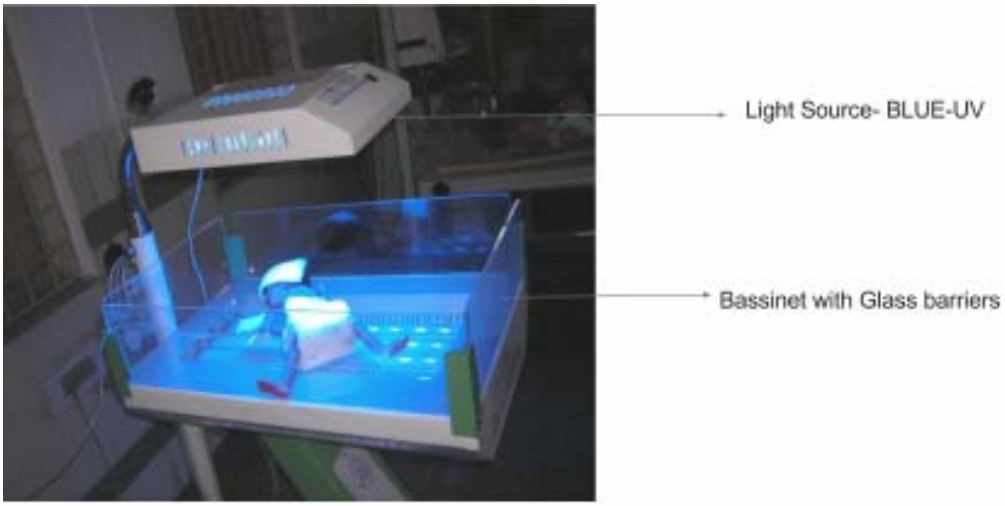

Fig. 7.4 : Phototherapy unit

Indications for phototherapy:

Phototherapy should be initiated whenever it seems that bilirubin may reach levels that can cause bilirubin induced brain damage. That generally means there is staining of the trunk of the baby and sole/palm staining with bilirubin begins to appear.

- For term healthy babies phototherapy may be required if –
  - Jaundice appears before 24 hrs. of age.
  - Jaundice is present on the arms and legs on day 2.
  - Staining of palms and soles is present.
  - Depth of jaundice is more.
- For VLBW babies phototherapy is initiated at a level equal to 1% of the body weight.
- In case of haemolysis, asphyxia, hypoglycemia or sepsis, consider early phototherapy.

Procedure for giving phototherapy:

- Undress the baby completely except for a small nappy.
- Cover the eyes to prevent damage by the bright lights.
- Keep the baby at a distance of 45 cm from the light source.
- Provide frequent breastfeeding. During breastfeeding switch off the phototherapy unit.
- Turn the baby after each feed to expose maximum surface area of the baby to light.

- Monitor temperature every 2 to 4 hourly or more frequently if temperature variation is noted.
- Record weight daily.
- Ensure that the baby passes adequate urine (6–8 times per day).
- Monitor bilirubin levels atleast once a day.
- Discontinue phototherapy when bilirubin returns to a safe level and watch for rebound increase after stopping phototherapy.

Precautions

- Do not give phototherapy without trying to find out the cause of jaundice.
- Always cover eyes well before starting phototherapy
- Phototherapy may lead to dehydration or hypothermia/hyperthermia.
- Blue light may interfere with monitoring of cyanosis.
- The efficiency of the phototherapy unit should be checked periodically with the help of a flux meter.

Troubleshooting –Phototherapy

Fault	Possible Cause	Solution
1. Photo therapy unit is not running	No power from mains socket	Check power switch is on. Replace fuse with correct voltage and current if blown.Check mains power is present at socket using equipment known to be working. Contact electrician for re-wiring if power not present.
	Electrical cable fault Tubes /CFL not working	Try cable on another piece of equipment. Contact electrician for repair if required.Check Tubes and chokes OR Check the CFL and replace the parts.
2. Fuse keeps blowing	Power supply or cable fault	Refer to electrician
3. Alarms not working	Alarm battery dead	Replace the battery and recheck. Send for repair if problem remains.
4. Intensity of light not properly controlled	Tubes/CFL has expired its life	Check Tubes and chokes OR Check the CFL and replace the parts. Check the life of operation and replace if it has served its life.
5. Electrical shocks	Wiring fault	Refer to electrician immediately

User Maintenance Checklist–Phototherapy Unit

Daily	
Cleaning	√ Wipe dust off exterior and cover equipment after checks √ Remove any tape, paper or foreign body from equipment
Visual checks	√ Check all fittings and accessories are mounted correctly
Function checks	√ Check all the functions while starting the unit. Check intensity readings while Tubes/CFL ON and OFF and cross check with a Lux meter.
Weekly	
Cleaning	√ Unplug, clean outside with damp cloth and disinfecting solution as per procedures and dry off √ Remove any dirt from wheels √ Wash (or replace) the air filters, dry thoroughly for reuse
Visual checks	√ Check mains plug screws are tight √ Check mains cable has no bare wire and is not damaged √ Check doors, cable and tray. Repair if damaged
Function checks	√ Check all controls operate correctly √ Check the readings of intensity sensors change when CFL/Tubes are in ON/OFF conditions and verify with the Lux meters/ irradiance meters. √ Check any batteries are working properly.
Every six months	
Biomedical Technician check required	

Key Messages : Phototherapy unit

Phototherapy uses visible light to convert unconjugated bilirubin in the skin to water soluble photoproducts which can be excreted through the intestine and urine. While giving phototherapy, eyes should be covered to prevent damage. Extra feeds should be given to the baby receiving phototherapy to prevent dehydration.Temperature of a baby receiving phototherapy should be monitored frequently to prevent hypo-or hyperthermia.

Check Your Progress 4

i) How will you start phototherapy in a newborn.

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ii) What precautions will you take while giving phototherapy to a newborn?

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7.2.5 Suction Device

Suctioning is used to remove secretions from the oral and nasopharyngeal area of a patient using a catheter to ensure patency. It is often used to prevent aspiration of oral or gastric secretions.

After each use the tubing of the device has to be cleared of the thick secretions before they dry and clog the pipe. Hence suck in clean water from a bowl to clear the entire tubing, so that the device is ready for use.

DeLee's suction trap and Suction bulb

DeLee's trap (Fig. 7.6) is a small portable plastic suctioning device.

- It consists of two tubes arising from a small plastic jar.
- The operator applies negative suction with his mouth to the tube with the mouthpiece. The other tube is inserted into the mouth of a baby.
- The mucous goes into the trap and not into the mouth of the operator.

Bulb syringe

It consists of a rubber bulb attached to a plastic tube. When the bulb is compressed air is expelled out and on releasing vacuum is created which pulls secretions into the bulb. It can be used for aspirating oral or nasal secretions in babies.

Suctioning a baby's nose with a suction bulb. (Fig 7.5)

Fig. 7.5 : Suctioning a baby's nose

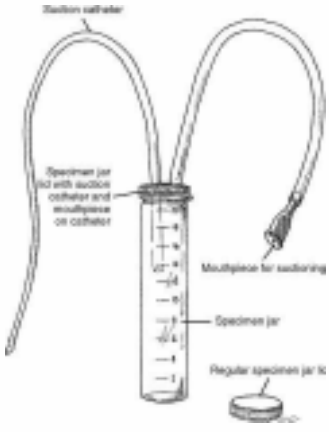

Fig. 7.6 : DeLee's Suction Trap

Other suction devices include following:

Electrically operated suction machine: (Fig 7.7(a))

It consists of a motor, vacuum gauge with a precision regulator, jars.

There should be a tight seal of the vacuum jar but it should be easy to open whenever the jar has to be emptied. The jar should be easy to clean and sterilise. There should be a regulator to adjust for the amount of suction required. If a lot of suctioned material is expected as in surgery or caesarean section, a two jar suction machine may be used.

Foot suction: (Fig 7.7(b))

It is useful even in the absence of electricity. When the bellows are compressed, air is forced through the air outlet valve in the upper part of the bellows. As the bellows re-expand, a vacuum is created and air is drawn through the tube connection out of the beaker. This vacuum transfers the secretions from the patient to the beaker.

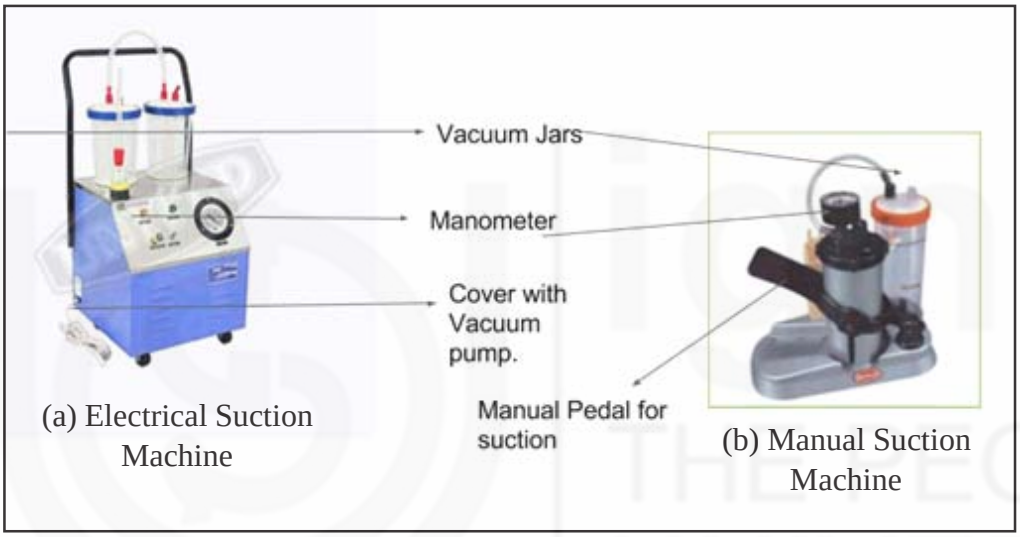

Fig. 7.7: Suction Machine

Check Your Progress 5

Name some devices which can be used for suction when electricity supply is erratic.

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7.2.6 Self Inflating Bag

It is also known as Ambu bag. (Fig. 7.8 a-b) As the name implies, it inflates automatically without a compressed gas source. Since it is not dependent on a compressed source for inflation, it is always ready to use and is portable. It has four parts as given below:

1) **Air inlet:** As the bag re-expands following compression, air is drawn through a one-way valve located at one end of the bag. This is the air inlet.

2) **Oxygen inlet:** It is located next to the air inlet where oxygen tubing can be attached if the patient is to be resuscitated with oxygen enriched air.

3) **Patient outlet:** This is where air/oxygen exits from the bag to the patient through a mask or an endotracheal tube.

4) An oxygen reservoir is an appliance that can be placed over the bag's air inlet. It helps in delivering a high concentration of oxygen to the baby and allows oxygen to be administered in a concentration as high as 90% to 100%.

5) **Valve assembly:** This is positioned between the bag and the patient outlet. It opens when the bag is squeezed during ventilation, releasing air/oxygen to the lungs of the patient. When the bag re-inflates, the valve is closed, preventing the patient's exhaled air from entering the bag and being rebreathed.

A resuscitation bag used in neonatal resuscitation has a safety mechanism in the form of a pressure release valve to guard against inadvertent transmission of excess pressure to the baby's lungs. Pressure release valves on self-inflating bags are generally set to release at 30 to 40 cm H_2O. If pressures greater than 30 to 40 cm H_2O are generated as the bag is compressed, the valve opens, limiting the pressure being transmitted to the lungs of infant. The ideal size of the bag for neonates is 240 to 500 ml capacity.

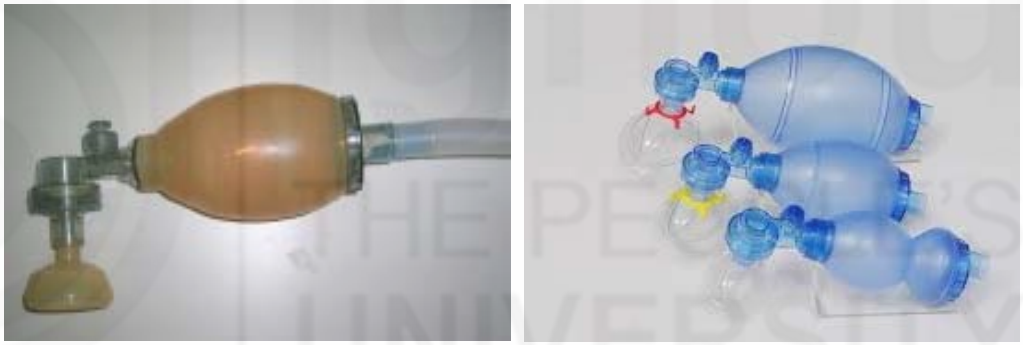

Fig. 7.8 (a): Self inflating bag (External view)

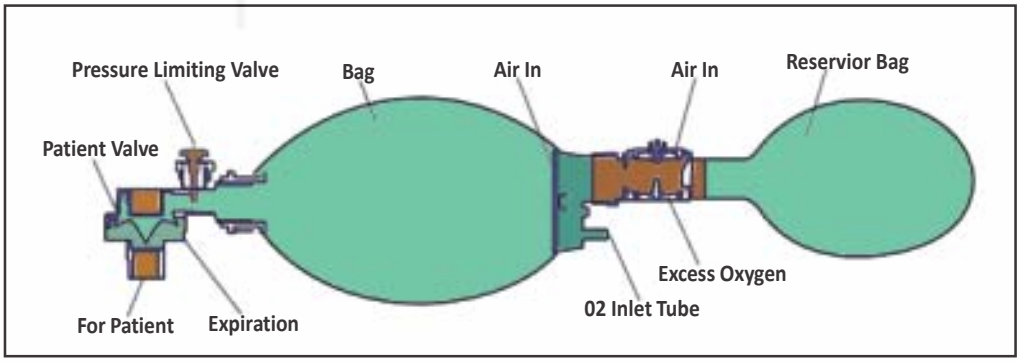

Fig. 7.8 (b): Self Inflating Bag (Internal view)

Using the bag:

- The self-inflating bag comes in different sizes– neonatal, infant, paediatric and adult. It is necessary to use an appropriate sized bag in a particular patient.
- When the self inflating bag is connected to 100% oxygen through the oxygen

inlet without an oxygen reservoir the oxygen concentration delivered to the patient is 40–70%.

- By attaching an oxygen reservoir one can deliver 90–100% oxygen to the patient.

Any resuscitation bag should have atleast one of the following two safety features:

1) A pressure release or pop-off or safety valve- In a neonatal bag this is set to release at 30–40 cm of water thereby preventing excess pressure from being transmitted to the neonate.
2) The second safety feature is a pressure gauge or manometer which measures the peak inspiratory pressure delivered.

Precautions

- The bag cannot be used for providing free flow of oxygen.
- Prolonged ventilation with 100% oxygen may lead to oxygen toxicity.
- Excessive pressure may lead to pneumothorax.
- Resuscitation masks are available in different sizes. For the mask to be the correct size, the rim must cover the tip of the chin, the mouth and the nose but not the eyes. Too large a mask will lead to ineffective seal and ventilation. Too small a mask will not cover the mouth and nose.

Decontamination

Thorough decontamination is necessary after each use. All parts should be washed with detergent and warm water and should be dried before reassembling. Chemical disinfection can be done by soaking in 2% glutaraldehyde solution for 20 minutes. All parts should be dried before reassembling.

7.2.7 The Flow Inflating Bag

The flow inflating bag is also called anaesthesia bag. It fills only when the source of compressed gas (oxygen, air, or a mix of two) is connected. They usually do not have a fixed safety pop off valve and may be used with/without an attached manometer. PEEP can be provided by adjusting the flow of gas out of the bag through the flow control valve. Large leaks at the face mask, or too low a flow, will result in collapse of the bag and inability to deliver any positive pressure breath. (Fig. 7.9)

Fig. 7.9: Flow inflating bag

7.2.8 T Piece Resuscitator

T piece resuscitator is a flow controlled pressure limited ventilator device (Fig. 7.10). Piped compressed gas is delivered at one port of T piece. A preset peak inspiratory pressure (PIP), positive end expiratory pressure (PEEP) and maximum circuit pressure is set. With a T piece device, gas flows into a face mask or endotracheal tube through a patient supply line. Inflation is achieved by interrupting the escape of gas through an outlet hole on the T piece using a thumb so that the pressure rises and is displayed by a manometer. Adjusting the PEEP valve varies positive end expiratory pressure. The newborn is ventilated by placing a finer over the outlet aperture (hole in the PEEP valve) and removing it periodically at about 40–60 times a minute.

Fig. : 7.10 T Piece Resuscitator

7.2.9 Resuscitation Masks

Masks come in a variety of shapes, sizes and materials. Resuscitation masks should have cushioned rim for better seal. The rim conforms more easily to the shape of the infant's face, making it easier to form a seal. It requires less pressure on the infant's face to obtain a seal. There is less chance of damaging the infant's eyes if the mask is correctly positioned. Masks come in several sizes (Fig. 7.11). Masks suitable for small, premature infants as well as for term infants should be available for use. For the mask to be of correct size, the rim will cover tip of the chin, the mouth and the nose but not the eyes.

Fig. 7.11: Resuscitation masks

Troubleshooting – Suction machines

Fault	Possible Cause	Solution
1. Machine is not running	No power from mains socket	Check power switch is on. Check mains power is present at socket using equipment known to be working. Contact electrician for rewiring if power not present.
	Fuse blown	Check for leaks or wire causing fuse to blow and correct this. Replace fuse with correct voltage and current rating. Test operation.
	Electrical cable fault	
	Internal wiring or switch fault	Try cable on another piece of equipment. Contact electrician for repair if required. Refer to electrician
2. Poor fluid flow, pressure gauge low	Tube /seal / bottle leaking or disconnected	Close different tubes by bending. When pressure gauge changes, leakage point has been passed. Replaced damaged tube or seal.
	Air outlet valve blocked	
	Control valve stuck	Clean outlet valve
	Internal or control error	Operate control valve through full range. Send for repair if stuck
		Refer to technician
3. Poor fluid flow, pressure gauge high	Blocked filter or tube	Disconnect each tube one at a time. When air flow is stopped, blockage has been passed. Replace filter or unblock tube.
4. Filter discoloured	Floating valve broken	Change filter, clean or replace floating valve
5. Electrical shocks	Wiring fault	Refer to electrician
6. Manual suction is jammed	Internal slider stuck	Refer to technician for greasing

User Maintenance Checklist – Suction Machines

		Daily
Cleaning	√	Wipe dust off exterior and cover equipment after checks
	√	Wash bottle and patient tubing with sterilising solution

Visual checks	√	Check all fittings and accessories are mounted correctly
	√	Check filter is clean
Function checks	√	If in use that day, run a brief function check before clinic
		Weekly
Cleaning	√	Unplug, clean outside with damp cloth and dry off
	√	Wipe round bottle seal with damp cloth, replace if cracked
	√	Remove dirt from wheels / moving parts
Visual checks	√	Check parts are fitted tightly and replace any cracked tubes
	√	Check mains plug screws are tight
	√	Check mains cable has no bare wire and is not damaged
Function checks	√	Check all switches and vacuum control operate correctly
		Every six months
		Biomedical Technician check required

Key Messages- Self-inflating bag

Always use the correct size bag and mask for ventilating any patient.

A tight seal should be provided with the mask while ventilating to increase the effectiveness of ventilation.

Check Your Progress 6

How does one determine if the mask being used with an ambu bag is the correct size for a patient?

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.....

7.3 OTHER EQUIPMENTS

There may be a few other equipments in a health facility which are not commonly used for newborn baby but are used for newborn child/ adult patients These are given below.

- Sphygmomanometer
- Oxygen Cylinder

Let us begin with Sphygmomanometer/Blood Pressure Apparatus.

7.3.1 Sphygmomanometer

A sphygmomanometer is a device used to measure blood pressure. It consists of an inflatable cuff to collapse and then release the artery under the cuff in a

controlled manner, and a mercury or mechanical manometer to measure the pressure and a mechanism for inflation which may be a manually operated bulb and valve or a pump operated electrically. (Fig 7.12)

Types of sphygmomanometers

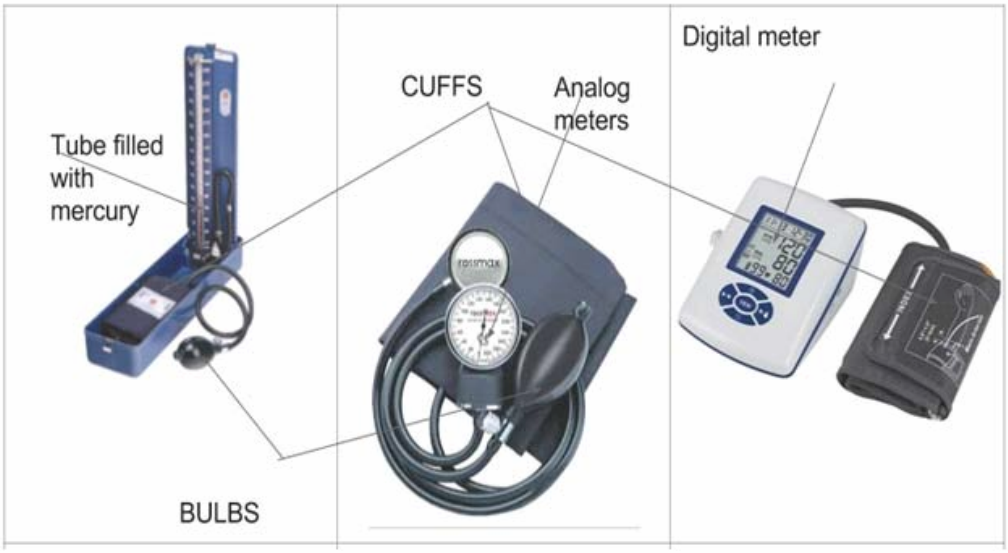

Fig. 7.12: Types of Sphygmomanometers

> **Remember:**
>
> Mercury Sphygmomanometer is no more used now.

Mercury sphygmomanometers and Aneroid sphygmomanometers require a stethoscope for auscultation.

Digital sphygmomanometers

They use oscillometric measurements and electronic calculations rather than auscultation. They are electronic and easy to operate without training.

Procedure

- The patient should be relaxed and sitting upright with the arm positioned at the level of the heart and feet flat on the floor.
- Choose the proper BP cuff size. The bladder length should be more than 80% of the arm circumference and the width should be atleast 40% of the arm circumference. If the cuff is too large the measured BP value is lower than the actual value whereas if the cuff is small one will record erroneous high values.
- Place the BP cuff on the patient's arm. For correct placement the midline of the cuff bladder should be placed over the arterial pulsation in the patient's arm after palpating the brachial artery. There should be a 2–3 cm space for the stethoscope between the lower end of the cuff and the antecubital fossa.
- Inflate the cuff to a point 30 mmHg above the point at which the radial pulse disappears.
- Slowly deflate the cuff while auscultating over the antecubital fossa.
- The first occurrence of rhythmic sounds heard as blood begins to flow through the artery is the patient's systolic BP.

- Continue to listen as the BP cuff pressure falls and the sounds fade. The reading where the rhythmic sounds stop corresponds to the diastolic pressure.
- For accuracy record two readings and take their average.

Troubleshooting – Sphygmomanometers (B.P. sets)

Fault	Possible Cause	Solution
1. Mercury leakage OR Mercury not at zero level	Mercury leakage or overfilling	Refer to technician for correction
2. Mercury is dirty	Oxidation of mercury	Refer to technician for cleaning
3. Pressure does not increase easily OR Pressure increases after inflation	Valve or tube blockage	Remove and clean all valves and tubes. Reassemble and test
4. Aneroid instrument does not return to zero	Zero setting has moved	Rotate collar on base until zero setting achieved and tighten. If still malfunctioning, refer to technician
5. Pressure does not remain steady	Leakage of air	Isolate leak by closing off parts of tubing. Replace leaking section and retest

User Maintenance Checklist – Sphygmomanometers (B.P. sets)

Daily		
Cleaning	√	Check equipment is safely packed
	√	If mercury is spilled, seal unit and send to technician
Visual checks	√	Ensure all parts are present and are tightly fitted
	√	Check display is zero when cuff deflated
Function checks	√	Before use, check pressure rises and returns to zero
Weekly		
Cleaning	√	Remove all dust and dirt with damp cloth or by hand
Visual checks	√	Remove or replace any cracked rubber parts
Function checks	√	Check correct operation of inflation bulb and valves
	√	Remove any batteries if not in use for more than one month
	√	Inflate to 200 mmHg and check leakage is not faster than 2 mmHg in 10 seconds

Every six months
√ Biomedical Technician check required
√ Check calibration of aneroid devices against mercury device

Check Your Progress 7

i). How should one determine the correct size of the BP cuff for a patient?

.....

.....

ii) How can the BP cuff size affect the reading while recording blood pressure?

.....

.....

7.3.2 Oxygen Cylinder

Oxygen is used as a medical treatment in several acute and chronic conditions both in and out of the hospital. It is commonly used in patients with hypoxia such as those with pneumonia, COPD, or heart failure. It is also indicated in emergency medicine for use in resuscitation, major trauma, convulsions, sepsis and shock.

Fig. 7.13: Oxygen Cylinder

Oxygen for hospital use is available as compressed oxygen stored in gas cylinders. The cylinder size can be small, medium or large. Small and medium sized cylinders are easily portable. (Fig. 7.13)

Use

Before using an oxygen cylinder a pressure gauge with a flowmeter is attached to the cylinder. The knob of the cylinder is opened with the help of a wrench. The pressure in the pressure gauge is checked to determine the amount of oxygen remaining in the cylinder. A tube is connected to the oxygen outlet the other end of which is connected to a facemask or nasal prongs which can be applied to the patient.

Precautions

- A humidifier containing fresh distilled water should be used to humidify the oxygen.
- A patient on oxygen therapy should be monitored with a pulse oximeter to prevent hypoxia or hyperoxia.
- The oxygen cylinder should be kept away from heat and open flames as oxygen can cause fire easily.
- When not in use oxygen cylinders should be stored in an open well ventilated space, after switching of the gas from the pressure reducing valve.
- Be sure to keep the wrench tied to the cylinder trolley, so that it is available immediately when required.
- Make sure to watch for correct COLOUR CODE of the cylinder. Oxygen cylinders are black in colour with white top and sometimes small cylinders are entirely black in colour, Care should be taken to ensure right colour coding while connecting the cylinder.

Troubleshooting – Oxygen Cylinders and Flowmeters

Fault	Possible Cause	Solution
1. No oxygen is flowing	Empty cylinder	Replace cylinder
	Flow meter knob or cylinder valve is closed.Faulty regulator	Open valves, then check flow meter registers flow Close all valves and replace regulator
2. Leakage from cylinder or flowmeter	Cylinder is not connected to pressure regulator properly	Tighten all fittings
	Faulty or missing washer between regulator and cylinder	Replace washer
	Flowmeter seal damaged or loose	Tighten flowmeter
	Cylinder faulty	Label ‘Faulty’ and return to manufacturer

Fault	Possible Cause	Solution
3. Leakage cannot be located	Leakage too small to be heard	Apply detergent solution (NOT oily soap) to joints. Bubbles will show at leak point. Clean/replace washer and tighten at that joint.
4. Flowmeter ball not moving, yet oxygen is flowing	Faulty flow meter	Close all valves, disconnect flowmeter and clean inside. Reconnect and test. If problem persists, replace flowmeter
5. Pressure gauge does not show pressure, yet oxygen is flowing	Faulty pressure gauge	Refer to biomedical technician for replacement

User Maintenance Checklist – Oxygen Cylinders and Flowmeters

Daily		
Cleaning	√	Ensure delivery tubes and masks are sterile
	√	If humidifier bottle is used, refill with clean water
Visual checks	√	Check cylinder is correct type and marked oxygen
	√	Check all parts are fitted tightly and correctly
Function checks	√	Before use, ensure cylinder is filled and flow is present
	√	Close cylinder valve after each use.
Weekly		
Cleaning	√	Clean cylinder, valve and flowmeter with damp cloth
Visual checks	√	Check for leakage: hissing sound or reduction in pressure
Function checks	√	Remove valve dust with brief, fast oxygen flow
	√	Check flow can be varied using flow control
Every six months		
Biomedical Technician check required		

Record the work

It is normally helpful to have some way of recording when user care has been done. This will tell colleagues or the next shift that the daily check has been carried out, or remind the user themselves that the weekly job has been done. It can also be helpful to show supervisors and patients that care is being taken of equipment. An example record sheet is shown below, which can be copied for use with each piece of equipment.

User care task record sheet – sign and date when user care done

Equipment:..... Location:.....

DAILY TASK

Date	Sign	Date	Sign	Date	Sign

WEEKLY TASKS

Date					
Sign					

Check Your Progress 8

i) How should oxygen cylinder be stored when in use and when not in use?

.....

.....

ii) How is the humidifier filled in an oxygen cylinder?

.....

.....

7.4 LET US SUM UP

While working in a newborn care unit, it is important for you to know the types of equipments used, their functions and techniques of using, disinfection and maintenance. In this practical unit you have learnt about use of various equipments such as radiant warmer, weighing scale, pulse oximeter, phototheraphy unit, Sphygmomanometers, Self Inflating Bag: Manual Resuscitator and oxygen cylinder. You need to practice using these equipments in order to be able to use the equipments effectively and efficiently.

7.5 MODEL ANSWERS

Check Your Progress 1

i) Servo mode.

ii) The probe should be cleaned with spirit before application. It should be applied over the right hypochondrium or the epigastric region with adhesive tape. It should not be applied over bruised skin.

Check Your Progress 2

- Movement artifact
- Ambient lights
- Cold extremities

Check Your Progress 3

- Clean the pan with spirit.
- Place a sterile towel or paper on the pan.
- Adjust the digital to zero by adjusting the knob.
- Place the baby in the middle of the pan.
- Note the reading.

Check Your Progress 4

i) 1) Undress the baby completely except for a small nappy.
   2) Cover the eyes to prevent damage.
   3) Keep the baby at a distance of 45 cm from the light source.

ii) Turn the baby after each feed to expose the maximum surface area of the baby to light.

Provide frequent feeds to prevent dehydration

Monitor temperature 2 to 4 hourly to prevent hypo- or hyperthermia.

Check Your Progress 5

A. 1) Foot suction
   2) DeLee's trap
   3) Bulb syringe

Check Your progress 6

The bladder length should be more than 80% of the arm circumference and the width should be atleast 40% of the arm circumference.

Check Your progress 7

i) Choose the proper BP cuff size. The bladder length should be more than 80% of the arm circumference and the width should be at least 40% of the arm circumference. If the cuff is too large the measured BP value is lower than the actual value whereas if the cuff is small one will record erroneous high values.

ii) If the cuff is too large the measured BP value is lower than the actual value whereas if the cuff is too small the measured value will be erroneously high.

Check Your Progress 8

i) When in use the oxygen cylinder should be kept away from heat and electrical appliances as oxygen can cause fire easily. When not in use oxygen cylinders should be stored in an open well ventilated place.

ii) The humidifier should be filled up to the given mark with fresh distilled water.

7.6 ACTIVITY

During your posting in Newborn Unit in District Hospital

a) Observe the functioning of all the equipments use in care of Newborn.

b) Identify the parts of each equipment.

c) Use the equipment while providing care.

d) Record in your log book.

7.7 REFERENCES

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