

Radiant Warmer

Lack of attention to thermoregulation continues to be a cause of unnecessary deaths in the neonatal population. Maintaining a stable body temperature is essential to ensure optimal growth. If temperature is maintained, caloric expenditure and oxygen consumption is minimal. Newborn babies, in particular the preterm and the low birth weight are exquisitely predisposed to hypothermia. No other equipment is identified more with the special care of newborn babies than the radiant warmers.

They provide intense source of radiant heat energy. They also reduce the conductive 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 on 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 temperature 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. This is called the **manual mode** of operation. Whenever the baby's temperature rises by more than 0.5°C above the set temperature, a visual/audible alarm is activated in the servo mode. Caregiver can pay attention to sort out the fault. Often this occurs when the skin probe comes off the baby.

Parts of open care system

- Bassinet
For placing the neonate
- Quartz rod
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

Heater assembly

The heating element (silicon quartz/infrared/ceramic/quartz crystal), the control panels (electronic/electrical/microprocessor based) and alarms (air over temperature/skin over temperature/air sensor fail/power failure etc.) forms 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 $\pm 0.5^{\circ}\text{C}$.

Steps for use of warmer

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

Application of skin probe

Do's

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

Don't

1. Do not apply to bruised skin.
2. Do not apply clear plastic dressings over probe.
3. Do not use fingernails to remove skin surface probes.
4. 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 with 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 displaced probe 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. In servo mode repeated activation of alarm will occur when baby develops fever. In this situation, one should 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 20°C.
- Ensure that the baby's head is covered with cap and feet secured in socks and the baby is clothed or covered unless it is necessary for the baby to be naked or partially undressed for observation or for a procedure
- Keeping the warmer where there is 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.
- Train junior doctors and nurses about the proper use of servo and manual modes.
- 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.

Precautions for manual mode

- Use maximum (100% output) for rapid warming of bassinet in labor room 10 minutes before delivery. Reduce output to 25-75% after 10 minutes depending on ambient temperature. If left on with heater output >80% alarm is activated within 15 or 20 minutes later and there after the heater

output goes to 40%; if alarm is silenced the heater will kept on for another 15 to 20 minutes as per manufacturers recommendation.

- Read temperature on display. Adjust heater output to:
 - High : If baby temperature is below 36°C-
 - Medium : If baby temperature is between 36-36.5°C and to
 - Low : If baby temperature is between 36.5-37.5°C-
- Once the baby's temperature is between 36.5-37.5°C, switch on the servo mode/skin mode.
- Never use full (100%) heater output unsupervised and always record baby temperature every 2-4 hourly.

Disinfection

When the equipment is in use, all approachable external surfaces should be cleaned daily with an antiseptic solution like 2% bacillocid or gluteraldehyde. 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 authorized 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 $\pm 0.5^\circ$ of the set value.

Conclusion

The use of warmers is now firmly established in special care units. The sophistication of equipment has also reached a mature state. Familiarity with the equipment and the control system, proper use, cleaning, disinfection and daily maintenance are of paramount importance.

Imported unit can buy two to four Indian products. The bottom-line is the quality of after-sales service, which often is equally unsatisfactory whether the companies deal with indigenous or imported equipment. It is best, therefore, to consult other colleagues using different models before purchasing one. Apart from quality and performance of a model, its cost, availability of spare parts and servicing facilities are also important considerations.