THERMAL PROTECTION

The thermal protection module is designed to complement in-service education and orientation of nursing personnel involved in care of newborns.

LEARNING OBJECTIVES

After going through this module, participants will be able to:

- **Enlist the factors which contribute to heat loss and know how they can be prevented**
- **Teach the mother how to keep her baby warm after birth and at home**
- **Plan appropriate nursing interventions for a baby experiencing hypothermia**
- **Explain what is hyperthermia and how to prevent it**

MODULE CONTENTS

The module includes following elements:

- ***Text material:*** Easy to read format for quick reproduction and essential reference material for the participants. Key messages are highlighted in the boxes.
- ***Case studies:*** Simple cases which involve nursing interventions related to thermoregulation.
- ***Oral drill:*** You will learn assessment of temperature in normal and hypothermic baby and steps to be undertaken as a nurse caring for the baby to maintain temperature.
- ***Role-play:*** Observing steps to keep baby warm in postnatal ward. Participants will also be provided with *an* opportunity to *do* role play.
- ***Self-evaluation:*** At the end of text, self evaluation based on what has been learnt is included. Feel free to refer your text material, if you need assistance in recapitulating.

1. IMPORTANCE OF TEMPERATURE REGULATION

Warmth is one of the basic needs of a newborn baby. It is critical to the baby's survival and wellbeing. Unlike adults, newborn babies are often not able to keep themselves warm especially if the environmental temperature is low. This results in low body temperature or hypothermia.

2. HANDICAPS OF NEWBORNS IN TEMPERATURE REGULATION

A newborn is more prone to develop hypothermia because of a large surface area per unit of body weight. In addition, LBW babies have decreased thermal insulation due to less subcutaneous fat and decreased heat production due to less brown fat.

Brown fat is the site of heat production. It is localized around the adrenal glands, kidneys, nape of neck, interscapular and axillary region. Metabolism of brown fat results in heat production. Blood flowing through the brown fat becomes warm and through circulation transfers heat to other parts of the body. This mechanism of heat production is called as non-shivering thermogenesis. LBW babies lack this effective mechanism of heat production.

Why are newborns prone to develop hypothermia?

- *Larger surface area*
- *Decreased thermal insulation due to lack of subcutaneous fat*
- *Less amount of brown fat*

3. CONSEQUENCES OF HYPOTHERMIA

The body cannot function well when it is cold. Being too cold means that the baby has to use a lot of energy to keep himself warm. A cold baby:

- is less active
- does not breastfeed well
- has a weak cry
- has respiratory distress

A small preterm baby who is too cold (hypothermic) is also at increased risk of becoming hypoglycemic. If the baby continues to be cold, these symptoms become more severe and eventually the baby might die.

4. MECHANISM OF HEAT LOSS AND HEAT GAIN

It is very easy for a baby to get cold especially at the time of delivery when the baby is wet with amniotic fluid. The temperature inside the mother's womb is 38°C; once the baby is born it is in a much colder environment and hence starts to lose heat immediately.

Newborn loses heat by :

1. Evaporation (particularly soon after birth due to evaporation of amniotic fluid from skin surface)
2. Conduction (by coming in contact with cold objects e.g. cloth, tray, etc.)
3. Convection (by air currents in which cold air from open windows replaces warm air around baby) and
4. Radiation (to colder solid objects in vicinity e.g. walls) (Figure 1)

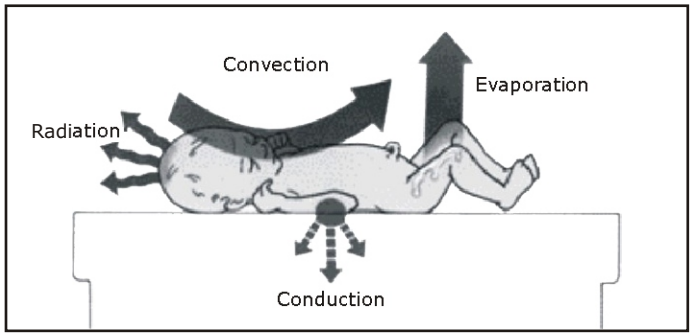


Figure 1: Mechanisms of heat loss

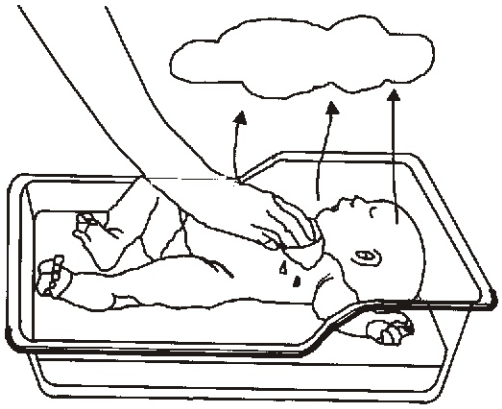
Four ways a newborn may lose heat to the environment

- *Radiation*
- *Conduction*
- *Convection*
- *Evaporation*

The process of heat gain is by conduction, convection and radiation in addition to non-shivering thermogenesis.

The steps of prevention of heat loss are summarized in Figure 2.

Evaporation: Involves the loss of heat when a liquid is converted to a vapour.

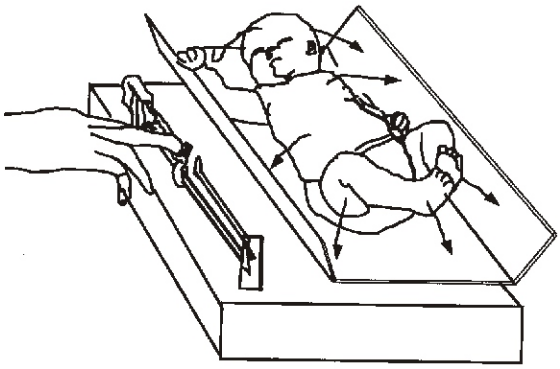


DRYING AT BIRTH

Nursing implication

- Keep infant dry
- Remove wet nappies
- Minimize exposure during baths

Conduction: Involves the loss of body heat to cooler objects which come in direct contact with baby's skin.

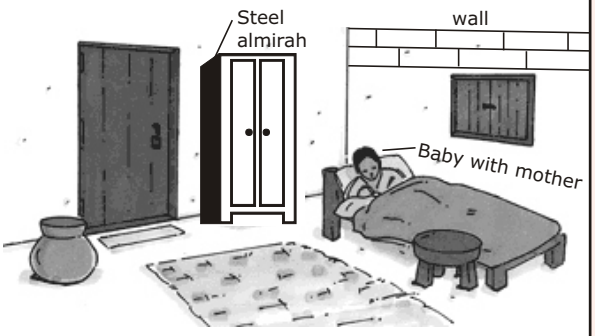


WEIGHING AT BIRTH

Nursing implication

- Put the baby on prewarmed sheet
- Cover weighing scales and X-ray cassettes with warm towel or blanket

Radiation: Involves loss of infant's body heat to cooler solid objects that are not directly in contact with him.

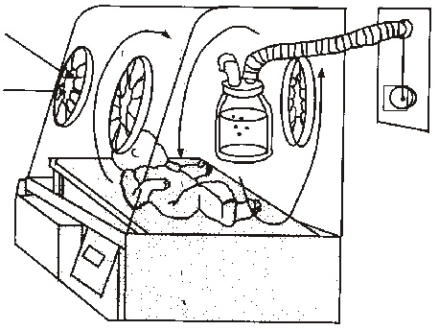


BABY INSIDE THE ROOM

Nursing implication

- Keep baby cot away from cold outside walls, almirah
- Cover the baby if stable

Convection: Involves the flow of heat from the body surface to cooler surrounding air or to air circulating over body surface.



INCUBATOR WITH HUMIDIFICATION

Nursing implication

- Avoid air current
- Manage babies inside incubator, if possible
- Organize work to minimize opening portholes
- Provide warm humidified oxygen

Figure 2: Prevention of heat loss in newborns

DEMONSTRATION

Place a naked wet doll on the table. Discuss the four ways a baby can lose heat and demonstrate how to prevent them.

5. TEMPERATURE RECORDING

Normal temperature in a newborn is 36.5ºC-37.5°C.

Accurate temperature recording is needed if a baby is:

- Preterm/low birth weight or sick
- Admitted to hospital for any reason
- Suspected of being either hypothermic or hyperthermic (too hot)
- Being re-warmed during the management of hypothermia
- Being cooled down during the management of hyperthermia

When an accurate temperature is needed, one should always use a thermometer. A temperature taken in the axilla (under the arm in the arm pit) is one of the safest methods of taking a baby's temperature.

Preferably a low reading thermometer that can measure temperature as low as 30°C should be used in the newborn to record temperature (should be able to record between 30°C to 40°C).

5.1 Axillary temperature

Axillary temperature is as good as rectal temperature but much safer (less risk of injury or infection). It is recorded by placing the bulb of thermometer against the roof of dry axilla free from moisture. Baby's arm is held close to the body to keep thermometer in place. **The temperature is read after three minutes.**

The steps of axillary temperature recording are summarized in the box below.

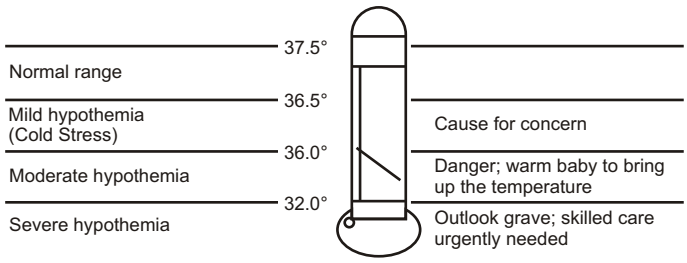
Recording the axillary temperature

Precautions:

- Wash your hands before taking a baby's temperature
- Keep the baby warm throughout the procedure. He/she does not need to be in a special position for the temperature to be taken

Steps:

1. Make sure that the thermometer is clean.
2. Shake it down, so that it reads less than 35°C.
3. Place the silver/red/bulb end of the thermometer under the baby's arm in the middle of the armpit after cleaning and drying.
4. Gently hold the baby's arm against the body.
5. Keep the thermometer in place for 3 minutes.
6. Remove the thermometer and read the temperature. DO NOT add 0.5ºC or 1°C to this.
7. Keep thermometer in a sterile container after cleaning with spirit.
8. Record the temperature in the baby's case notes.



Axillary temperature in the newborn infant (°C)

Figure 3: Axillary temperature in newborns

5.2 Rectal temperature

Do not use this method for routine monitoring. However, it can be used as a guide for core temperature in cold (hypothermic) sick neonates. It is recorded by inserting the greased bulb of the special thermometer backwards and upwards to a depth of 3 cm in a term baby (2 cm in a preterm baby). Keep thermometer in place at least for 2 minutes.

Rectal temperature is not recorded as a routine procedure in neonates; record rectal temperature only for a sick hypothermic newborn

The difference in rectal and axillary temperatures is not significant.

5.3 Skin temperature

Skin temperature is recorded by a thermister. The probe of the thermister is attached to the skin over upper abdomen. The thermister senses the skin temperature and displays it on the panel.

6. ASSESSMENT OF TEMPERATURE BY TOUCH

Baby's temperature can be assessed with reasonable precision by touching his/her abdomen, hands, and feet with the dorsum of your hand. In newborns, abdominal temperature is representative of the core temperature.

When feet are cold and abdomen is warm, it indicates that the baby is in cold stress. In hypothermia, both feet and abdomen are cold to touch.

In normothermic baby (baby with normal temperature), both abdomen and feet are warm to touch

DEMONSTRATION

The facilitator will conduct a demonstration on 'Recording the axillary temperature with a thermometer'.

7. WARM CHAIN

The "warm chain" is a set of interlinked procedures carried out at birth and later which will minimize the likelihood of hypothermia in all newborns. Baby must be kept warm at the place of birth (home or hospital) and during transportation from home to hospital or within the hospital. Satisfactory control of baby's temperature demands both prevention of heat loss and providing extra heat using an appropriate source.

7.1 Common situations where cold stress can occur

i. At birth
ii. After giving bath
iii. During changing of nappy/clothes
iv. Malfunctioning heat source or removing the baby from heat source
v. While transporting a sick baby

7.2 Steps to prevent heat loss in labor room

i. Keep delivery room warm (25°C)
ii. Newborn care corner temperature to be maintained at 30°C
iii. Drying immediately. Dry with one towel. Remove the wet towel and cover with another pre-warmed towel
iv. Skin-to-skin contact between mother and baby
v. Warm transportation

7.3 Steps to prevent heat loss in postnatal ward

i. Promote breast feeding
ii. Appropriate clothing, cover head and extremities
iii. Keep mother and baby together
iv. Keep the room warm
v. Postpone bathing till next day

Use a wall-mounted thermometer to ensure that room temperature is maintaned 25°C

*7.4 How to keep baby warm?**

i. Use dry, warm towel to hold the baby at birth. Remove wet towel after cleaning
ii. Adequate and appropriate clothing
iii. Skin-to-skin contact or next to mother (Rooming-in)
iv. Radiant warmer in nursery
v. Keep the room temperature of baby care area >25°C.

7.5 How to keep room warm?

i. Avoid using air conditioner during summer
ii. Don't use ceiling fan especially at high speed
iii. Keep windows and doors closed in winter
iv. Warm the room by convector/heater

Using a 200 watt bulb may not be sufficient to keep the baby warm. There is also a risk of breakage of bulb

नवजात शिशुओं में ठंडापन (हाइपोथरमिया)

ठंडापन क्या है?

जब शिशु के शरीर का तापमान 36.5 °C से कम हो जाता है, तो ऐसी अवस्था को ठंडापन कहते हैं

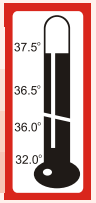
आप तीन मिनट के लिए बगल के ऊपरी हिस्से में थर्मामीटर लगाकर शिशु का तापमान माप सकते हैं।

ठंडापन क्यों महत्त्वपूर्ण है?

1. कम वजन वाले शिशु में ठंडापन मौत का कारण हो सकता है।
2. ठंडापन का बीमार शिशु में रोगों का हमला जल्दी होता है।
3. ठंडापन एक कम वजन वाले बच्चे के शारीरिक विकास को कम करता है।

ठंडेपन की गंभीरता

सामान्य श्रेणी	(36.5°C to 37.5°C)
कुछ ठंडापन	(36.1°C to 36.4°C)
ज्यादा ठंडापन	(32.0°C to 36.0°C)
गंभीर ठंडापन	(<32.0°C)



ठंडापन क्यों होता है?

1. जब प्रसूति कक्ष बहुत ठंडा होता है।
2. शिशु को जन्म के बाद तुरंत सुखाया नहीं जाता है।
3. शिशु को माँ से दूर रखा जाता है।
4. शिशु को पर्याप्त कपड़े नहीं पहनाए गए हों।
5. नहलाने के दौरान पानी या कमरा उचित गर्म न हो।

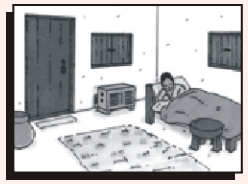
कौन से बच्चों में ठंडापन होने की संभावना होती है?

1. कम वजन वाले शिशु
2. बीमार शिशु
3. जन्म के तुरन्त बाद

नवजात शिशु को उचित गर्मी कैसे दें

- जन्म के समय उष्मा की हानि की रोकथाम
  - प्रसूति कक्ष का तापमान कम से कम 25°C रखें।
  - शिशु को तत्काल सुखाएं, एक गरम तौलिए में लपेटें।
  - शिशु को छाती के सम्पर्क में रखें; स्तनपान प्रारम्भ करें।
- शिशु को नहलाना
  - अगले दिन तक के लिए स्थगित करें।
  - बीमार शिशु को न नहलाएं।
  - जब तक कम वजन वाले बच्चें में नाल न गिर जाए, नहीं नहलायें।
  - शिशु को एक गरम कमरे में गरम पानी से नहलाएं। तत्काल सुखा लें और सूखे गरम तौलिए में लपेट लें। शिशु के सिर को ढक लें। माँ के पास लिटा दें
- नवजात शिशु को कई ढ़ीले कपड़े पहनाएं तथा तापमान पर नज़र रखें
- माँ और नवजात शिशु को एक साथ गरम कमरे में रखें

कम वजन वाले शिशु को घर पर किस तरह गर्म रख सकते हैं



कमरे को गरम रखें

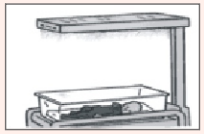
शिशु को गर्म कपड़े में लपेट कर रखें

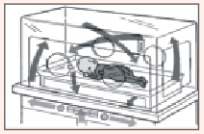
शिशु को स्तनपान करायें

कँगारू माता देखभाल प्रदान करें

सुविधा में एक बीमार/कम जन्म-भार वाले शिशु को कैसे गरम रखते हैं

1. शिशु को तापक (warmer) के नीचे अथवा इन्क्यूबेटर में रखें





2. शिशु को कँगारू माता देखभाल दें

3. यदि तापक/इन्क्यूबेटर उपलब्ध नहीं है तो नर्सरी को गरम रखें

जन्म भार (कि.ग्रा.)	नर्सरी तापमान
1.0-1.5	30-33°C
1.5-2.0	28-30°C
2.0-2.5	26-28°C

ठंडेपन से ग्रसित शिशु को दुबारा कैसे गरम करें

- गरम कमरा सुनिश्चित करें।
- गीले-ठण्डे कपड़े हटा दें, और गरम कपड़े पहना दें।
- तत्काल छाती-से छाती चिपकाकर शिशु को गरम करें और/अथवा रेड़ीयन्ट हीटर अथवा इन्क्यूबेटर का प्रयोग करें।
- स्तनपान जारी रखें।
- समय-समय पर तापमान की जाँच करते रहें।
- यदि ठंडापन बना रहता है तो संक्रमण रोग की संभावना के लिये देखें।

www. newbornwhocc.org

नवजातविज्ञान प्रभाग, बालचिकित्सा विज्ञान विभाग, अखिल भारतीय आयुर्विज्ञान संस्थान, नई दिल्ली

Hypothermia in Newborns

What is hypothermia?

Hypothermia is defined when baby's body temperature falls below36.5°C

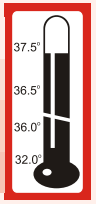
You can measure temperature of a baby by keeping thermometer in roof of axilla for three minutes

Why it is important ?

1. Hypothermia decreases chances of survival of a low birth weight baby
2. Hypothermia aggravates the illness severity in a sick baby
3. Hypothermia decreases growth of a low birth weight baby

Severity of hypothermia

Normal range	(36.5°C to 37.5°C)
Cold stress	(36.1°C to 36.4°C)
Moderate hypothermia	(32.0°C to 36.0°C)
Severe hypothermia	(<32.0°C)



Why does it occur?

1. When delivery room is too cold
2. Baby is not dried immediately after birth
3. Baby is kept away from mother
4. Baby has inadequate clothing
5. Exposure during bathing

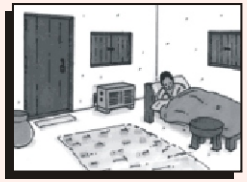
Which babies are at highest risk?

1. Low birth weight babies
2. Sick babies
3. Babies immediately after birth

Prevent heat loss: The warm chain

- **Prevent heat loss at birth**
  - Keep delivery room temperature at least 25°C
  - Dry immediately; wrap in a warm towel
  - Provide skin-to-skin contact, initiate breastfeeding
- **Bathing the infant**
  - Postpone till next day
  - Do not bathe a sick baby
  - Avoid till cord falls in LBW baby
  - Bathe using warm water in a warm room. Dry immediately. Wrap in dry warm towel, cover head. Place near mother.
- **Dress newborns with several layers of loose clothing and monitor temperature**
- **Keep mother and newborn together in a warm room**

How to keep a LBW baby warm at home


Keep the room warm

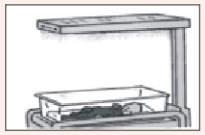
Keep baby wrapped in warm clothes

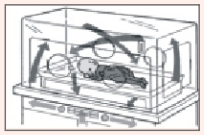
Keep baby on exclusive breast feeding

Provide Kangaroo Mother Care

How to keep a sick/LBW baby warm in facility

1. **Keep baby under radiant warmer or inside an incubator**





2. **Provide Kangaroo Mother Care**

3. **If radiant warmer/incubator not available keep the nursery warm**

Birth weight (kg)	Ideal nursery temperature
1.0-1.5	30-33°C
1.5-2.0	28-30°C
2.0-2.5	26-28°C

How to rewarm a hypothermic baby

- **Ensure a warm room**
- **Remove wet cold clothes, replace with warm clothes**
- **Rewarm quickly by skin-to-skin contact and/or a heating device such as radiant heater or incubator**
- **Continue breast-feeding**
- **Monitor temperature at regular intervals**
- **Assess for infection if hypothermia persists**

www. newbornwhocc.org

Division of Neonatology, Department of Pediatrics, All India Institute of Medical Sciences, New Delhi

ORAL DRILL

There will be an oral drill by the facilitator on **'ASSESSMENT OF TEMPERATURE AND MANAGEMENT OF HYPOTHERMIA'.**

The assessment, clinical features and management of hypothermia are summarized in the following table:

Category	Temp. range	Feel by touch	Clinical features	Action
Normal	36.5 to 37.5°C	Warm trunk Warm extremities	Normal baby	o Cover adequately with pre-warmed cloth o Keep the baby next to mother o Encourage breast feeding
Mild hypothermia (Cold stress)	36 to 36.4°C	Warm trunk Cold extremities	Extremities bluish and cold Lethargy Poor weight gain if chronic cold stress	o Skin-to-skin contact o Cover adequately o Ensure room is warm o Provide warmth o Encourage breast feeding
Moderate hypothermia	32 to 35.9°C	Cold trunk Cold extremities	Poor sucking Lethargy Weak cry Fast breathing	o Cover mother and baby together using pre-warmed clothes o Cover adequately o Provide warmth o Vitamin K (if not given earlier) o Reassess every 15 minutes; if temperature doesn't improve, provide additional heat o Encourage breast feeding
Severe hypothermia	Less than 32°C	Cold trunk & Cold extremities	Lethargic Poor perfusion/mottling Fast or slow breathing Slow heart rate Hardening of skin with redness and edema Bleeding Low blood sugar	o Rapid re-warming till baby is 34°C and then slow re-warming o Oxygen o IV fluids - Dextrose (warm) o Inj-vitamin K o Reassess every 15 minutes; if temperature doesn't improve, provide additional heat

Inform the doctor immediately if temperature is less than 36°C

Remove the wet cloth, place the baby under heat source, encourage breastfeeding. Start oxygen administration if the baby has respiratory distress or cyanosis.

- ***Avoid use of hot water bottle for (re) warming the baby***
- ***Use warm clothes to cover the baby for providing extra warmth; in places where electricity is not available use a tawa to warm the clothes***
- ***During transportation to another hospital, the baby is kept warm by keeping the baby in direct skin-to-skin contact with the mother***

SELF EVALUATION

1. Newborn baby is prone to develop hypothermia due to

   _____

   _____

   _____

2. Enumerate four mechanisms of heat loss in neonates:

   i _____

   ii _____

   iii _____

   iv _____

3. Steps of "Warm chain" in hospital include following:

In labor room	In postnatal ward
i. _____	i. _____
ii. _____	ii. _____
iii. _____	iii. _____
iv. _____	iv. _____
v. _____	v. _____

4. Routine temperature should be recorded by _____ route.

5. Normal axillary temperature range is_____to_____

6. How can you assess baby's temperature by touch?

   _____

7. A baby with cold stress will have warm abdomen and _____ soles/palms.

You will be given individual feedback after you have evaluated yourself.

GROUP DISCUSSION - CASE STUDY

You are posted in postnatal ward. A recently delivered mother complains that her baby is lethargic. On examination you find a 6 hr old, 2.2 kg baby lying away from mother. The baby has not been dressed in any clothes and only wrapped in a hospital cotton sheet. Heart rate is 140/minute, RR 56/minute. Extremities are cold to touch and bluish while abdomen is warm to touch. You record axillary temperature which is 36.1°C. The room temperature is 22°C.

Q1. What is the problem with this baby?

Q2. What are the adverse effects of this condition?

Q.3 What led to this situation in the baby?

Q.4 What will you do to rectify those conditions?

ROLE PLAY

You will observe the role play being conducted by two facilitators on 'How to keep baby warm in postnatal ward'. Write your comments for discussion at the end of the role play.

Objective: To demonstrate how to keep a baby warm in postnatal ward.

Checklist for the demonstration role play

A (Ask)

L (Listen)

P (Praise)

A (Advise)

C (Check understanding)

Checklist for role play by the participants

A (Ask)

L (Listen)

P (Praise)

A (Advise)

C (Check understanding)

8. KEEPING RADIANT WARMER READY TO RECEIVE A BABY

Prepare a bed at least 30 minutes before the baby arrives in the nursery to ensure the baby is received in warm, comfortable environment.

Keeping radiant warmer ready

1. Clean the radiant warmer/incubator properly before use.
2. Switch on the mains.
3. Put the baby sheet on the bed. Arrange all the necessary items near the bed.
4. Put the radiant warmer on the manual mode with 100% heater output so that the temperature of all items likely to come in contact with baby are warm.
5. Switch to skin mode with desired setting after baby is brought under warmer

9. HYPERTHERMIA/HIGH TEMPERATURE

9.1 What is a high temperature?

High temperature, fever or hyperthermia, occurs when the body temperature rises above 37.5°C. It is not as common as hypothermia, but it is equally dangerous. The causes of high temperature may be:

- The room is too hot
- The baby has too many layers of clothes
- The baby has an infection

9.2 How to prevent high temperature?

- Keep the baby away from sources of heat (warmer, hearter, etc.), direct sunlight
- If the baby feels hot, remove a layer of clothing
- If the baby has been under a radiant warmer
  - Measure the baby's body temperature every hour until it is in normal range.
  - Measure the temperature under the radiant warmer every hour and adjust the temperature setting accordingly. If there is no obvious reason to suspect overheating, inform Doctor who will evaluate.
  - Ensure the temperature probe is properly secured .

9.3 Steps to be undertaken if the elevated body temperature is due to overheating.

The steps to be undertaken in case of hyperthermia due to overheating are summarized in the box below:

Treatment of hyperthermia due to overheating

1. Place the baby in a normal temperature environment (25ºC to 28°C), away from any source of heat.
2. Undress the baby partially or fully, if necessary.
3. Give frequent breastfeeds.
4. Measure the baby's axillary temperature every hour until it is in the normal range.
5. If the body temperature is very high (>39°C), sponge the baby with tap water. Examine the infant for infection.

Both hypothermia and hyperthermia can be signs of sepsis. If a baby has been in a stable temperature environment with fairly constant temperature readings, but begins to have fluctuating temperature readings (low, high or both) inform the Doctor for evaluation.

Avoid ice cold water or ice for sponging. Use tap water

Recommended reading

- Thermal Protection of the Newborn: A Practical Guide WHO WHO/RHT/MSM/97.2
- Teaching Aids NNF, Publication of National Neonatology Forum of India 2005, 3rd Ed., Deorari AK (Ed)