सत्यमेव जयते

NATIONAL HEALTH MISSION
राष्ट्रीय स्वास्थ्य मिशन

Facility Based Newborn Care (FBNC)

Ministry of Health & Family Welfare
Government of India

2023

Training Module For Doctors & Nurses

सुधांश पंत
सचिव
Sudhansh Pant
Secretary

सत्यमेव जयते

आज़ादी का अमृत महोत्सव

भारत सरकार
स्वास्थ्य एवं परिवार कल्याण विभाग
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
Government of India
Department of Health and Family Welfare
Ministry of Health and Family Welfare

MESSAGE

Today, the Indian healthcare network is among the largest in the world as it reaches out to every mother and child in the country through a continuum of care approach. India has made significant reductions in maternal, neonatal and child mortality rate in last decade and is committed to achieve Sustainable Development Goals (SDGs) by 2030.

The Government has put in various policies and programmes to ensure universal access to health and special attention is being given to those living in hard to reach and remote areas in the country. Improving the quality of newborn and child care is a critical challenge faced by every healthcare setting dealing in maternal and child health. This may be overcome by equipping the Doctors, Nurses and ANMs with appropriate knowledge and skills to improve the quality of service delivery. With the aim of delivering quality healthcare services for newborns, training package for Facility Based Newborn Care (FBNC) was developed which targets the capacity building needs of pediatricians, medical officers and nurses posted at SNCUs at District and Sub-district level and provide knowledge and skills of high order required for management of common conditions. With advances in healthcare and based on evidence, training package for FBNC has been revised with the latest guidelines so as to provide the updated knowledge and skills.

I wish that this will be instrumental in achieving desired outcome and improve overall health status of the children in our country.

Sudhansh Pant

(Sudhansh Pant)

Room No. 156, A-Wing, Nirman Bhawan, New Delhi-110 011
Tele : (O) 011-23061863, 23063221, E-mail : secyhfw@nic.in

एल. एस. चाँगसन, भा.प्र.से.
अपर सचिव एवं मिशन निदेशक (रा.स्वा.मि.)
L. S. Changsan, IAS
Additional Secretary & Mission Director (NHM)

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भारत सरकार
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
निर्माण भवन, नई दिल्ली - 110011
Government of India
Ministry of Health & Family Welfare
Nirman Bhawan, New Delhi - 110011

FOREWORD

Health system strengthening over the last decade has brought about a considerable improvement in the infrastructure, availability of human resources, drugs and equipment along with supportive services all across India. Efforts are also being made to improve the availability of specialists and trained medical officers dealing with sick newborns admitted in Neonatal Intensive Care Units (NICUs), Special Newborn Care Units (SNCU) and Newborn Stabilization Units (NBSUs).

The Ministry of Health and Family Welfare (MoHFW) has developed Facility Based Newborn Care (FBNC) training package in 2014 to strengthen clinical services in these units. Recently, the training package has been revised based on latest evidences and strengthening of public health system. These will be helpful in setting up better standards of care for our newborns and ensure that each newborn gets a better start of life with an equal opportunity to survive and thrive.

I hope that this revised training module for FBNC will be rolled out expeditiously all across the States and UTs, to ensure essential and emergency care to the children as a first step towards healthy childhood and adult life.

With best wishes!

(Ms. L S Changsan)

'A' Wing, Nirman Bhawan, New Delhi-110011
Tel. : 011-23061723, 23061773, e-mail : lschangsan@nic.in

NATIONAL HEALTH MISSION
राष्ट्रीय स्वास्थ्य मिशन

सत्यमेव जयते

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निर्माण भवन, नई दिल्ली-११००११

GOVERNMENT OF INDIA
MINISTRY OF HEALTH & FAMILY WELFARE
NIRMAN BHAVAN, NEW DELHI-110011

डॉ. पी. अशोक बाबू, भा.प्र.से.
संयुक्त सचिव

Dr. P. Ashok Babu, IAS
Joint Secretary

PREFACE

Maternal and Newborn survival is one of the important agenda under National Health Mission (NHM) of Ministry of Health and Family Welfare (MoHFW) and this Ministry is committed to achieve targets of newborn mortality goals under National Health Policy (2017). Newborn and Child health is the central pillar in the Reproductive, Maternal, Newborn, Child, Adolescent Health and Nutrition (RMNCAH+N) strategy and inter-linkages of various RMNCAH+N life cycle stages have a significant impact on the further reduction of mortality and morbidity of children.

Under the NHM, many new interventions and service delivery platforms have been implemented in the child health programme over the last decade. In order to incorporate these new topics and skill sets based on the new evidences and practices that have emerged over the years and a review of existing training packages has been undertaken. Based on this revised Facility Based Newborn Care training package has been developed. The training package consists of three modules, Facility Based Newborn Care (FBNC) Training Module, Neonatal Resuscitation Module and a Facilitator Guide. The package emphasizes on the skill imparting techniques by the facilitators and ensures uniform messaging.

I am hopeful that by adopting this revised training package, the trainers along with service providers will feel more confident in carrying on their roles and responsibilities. I would also like to place on record my appreciation for the hard work and untiring efforts put in by the Child Health Division in revising and developing the training package.

I assure the States and UTs of full support by my team in taking this important initiative forward.

(Dr. P. Ashok Babu)

Room No. 243 (A), 'A' Wing, Nirman Bhawan, New Delhi - 110011
Tel. : 011-23061447 E-mail : jsrch-mohfw@gov.in

DR. SHOBHNA GUPTA
Deputy Commissioner Incharge
Child Health & RBSK
Telefax : 011-23061218
E-mail : shobhna.gupta@gov.in
drshobhna.mohfw@gmail.com

GOVERNMENT OF INDIA
MINISTRY OF HEALTH & FAMILY WELFARE
NIRMAN BHAVAN, MAULANA AZAD ROAD
NEW DELHI - 110011

ACKNOWLEDGEMENT

India has witnessed a huge transformation in the scenario of newborn's health evident by faster reduction in newborn mortality over the last decade as compared to global rates. This has been made possible by India's continued investments in the healthcare system including capacity building of healthcare providers with required skills at different levels to deliver quality newborn and child health services.

The Facility Based Newborn Care (FBNC) training package was first released in India in the year 2014 guiding appropriate management of newborn care in SNCUs, which has now been revised in the year 2023 in collaboration with National Collaborative Center, Kalawati Saran Children's Hospital (KSCH), New Delhi and other technical experts. The training package consists of three modules namely FBNC Training Module, Neonatal Resuscitation Module and a Facilitator Guide. Training package has been updated based on latest global practices and evidences to improve newborn survival with special focus on importance of Mother- Newborn Care Units (MNCUs) for Zero separation of mother-newborn; provisioning of respiratory support to neonates (CPAP); focus on newborn screening at delivery points and at newborn units; and evidence-based developmental supportive care for clinical and psycho-emotional support to vulnerable newborns, their families and health system.

Cont'd on next page

These training packages are a culmination of the work initiated by Ms. Vandana Gurnani as Ex Additional Secretary & Mission Director (NHM) and led by my previous colleague Dr. Sumita Ghosh, Ex Additional Commissioner & In-charge (C&AH) and technical consultants of the Child Health Division. I convey my sincere appreciation to Dr. Sushma Nangia (NCC, KSCH, New Delhi) and her team, Dr. S. Ramji (Ex Dean, MAMC) and support from academicians, Experts from NIPI, UNICEF, WHO and other Development Partners.

I am sure that this revised FBNC training package will help in equipping our healthcare providers with knowledge and skill to deliver essential and emergency newborn care services in NICUs/ SNCUs across the country.

Child Health Division will provide all the necessary support to the States/ UTs to roll out this training package at the earliest and contribute towards further improving neonatal health and survival.

I wish you the very best for your efforts and look forward to your continued support, as we move together on the mission to improve the quality of life of children and to attain the National Health Policy goals.

(Dr. Shobhna Gupta)

LIST OF CONTRIBUTORS

Ministry of Health and Family Welfare (MoHFW)

- Dr. P Ashok Babu, Joint Secretary (RCH), MoHFW
- Dr. Shobhna Gupta, Deputy Commissioner & Incharge (CH & RBSK), MoHFW
- Dr. Kapil Joshi, Senior Consultant (Newborn Health), MoHFW
- Mr Vishal Kataria, National Technical Consultant (CH) , MoHFW
- Dr. Vaibhav Rastogi, Lead Consultant (CH), MoHFW
- Mr. Sharad Singh, Lead Consultant (CH), MoHFW
- Ms. Sumitra D Samanta, Senior Consultant (CH), MoHFW

Editorial team

- Dr. Sushma Nangia, NCC- KSCH, New Delhi
- Dr. Sadhana Mehta, NCC- KSCH, New Delhi
- Dr. S. Ramji, New Delhi
- Dr. Debashish Nanda, Odisha
- Dr. Sandeep Jhajra, Jharkhand
- Dr. Gunjana Kumar, Rajasthan
- Dr. Shrishti Goel, Punjab
- Dr. Tapas Bandyopadhyay, New Delhi
- Dr. Rohit Anand, Chhattisgarh
- Dr. Murgeshan, Puducherry

Experts & Reviewer

- Dr. V. K. Paul, Member (Health and Nutrition), NITI Aayog
- Dr. Sumita Ghosh, Ex. Additional Commissioner (CH), MoHFW
- Dr. J. N. Srivastava, Advisor, NHSRC
- Dr. A. K. Deorari, New Delhi
- Dr. A. S. Kireeti, Andhra Pradesh
- Dr. Anu Sachdeva, New Delhi
- Dr. Anurag Singh, Rajasthan
- Dr. Arti Maria, New Delhi
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- Dr. Asim Kumar Mallick, West Bengal
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- Dr. Deepak Chawala, Chandigarh
- Dr. Harish Chellani, New Delhi
- Dr. J. Kumutha, Chennai
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- Dr. Shashi Vani, Ahmedabad
- Dr. Srinivas Murki, Andhra Pradesh
- Dr. Sriparna Basu, Uttarakhand
- Dr. Suchandra Mukherjee, West Bengal
- Dr. Sugandha Arya, New Delhi
- Dr. Suman Rao, Karnataka
- Dr. Surender K Bisht, New Delhi
- Dr. Tapas Som, Odisha

Development Partners

- Dr. Ashfaq A Bhat, NIPI India
- Dr. Deepti Agarwal, WHO India
- Dr. Harish Kumar, IPE Global
- Dr. Renu Srivastava, UP-IHAT
- Dr. Vinod Kumar Anand, Save the Children
- Dr. Vivek Singh, UNICEF India

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CHAPTER 1

CARE OF A NORMAL NEWBORN DURING "FIRST GOLDEN HOUR" AND BEYOND

Birth is a crucial period of transition from in-utero dependent life to ex-utero independent existence. Effective care at birth is needed in anticipation of problems during this transition to provide support and to ensure stabilization. A majority of newborns after birth are transferred to the postnatal wards for rooming-in with their mothers and need to be monitored for hypothermia and feeding difficulties during the first few days of life. Some of these babies can also become sick and develop danger signs, for which they will require appropriate treatment.

Learning Objectives

After completion of this chapter the participant should be able to:

1. Provide care at birth
2. Screen babies for visible birth defects
3. Provide postnatal care for normal babies

The aims of neonatal care following birth include:

- Prevention of hypothermia
- Establishment of respiration
- Initiation of breastfeeding
- Prevention of infection
- Detection of danger signs

A. Care at Birth

Personnel

- The care at birth is same irrespective of birthing place or person attending the birth (medical or paramedical personnel).
- At least one health care provider trained in neonatal resuscitation should be physically available before birth of all infants irrespective of risk status.

Skin to skin contact and Initiation of Breast Feeding

- All babies 34 weeks and above who do not need resuscitation and are stable should be placed prone on the mother's chest and abdomen in skin to skin contact for at least one hour and the mother should be assisted to initiate breast feeding.
- The time of initiation of breastfeeding should be documented.
- Subsequent care like administering inj. Vit. K, weighing the baby, examining the baby, documenting the baby's details etc., should be done only after one hour of skin to skin care and initiation of breastfeeding.

Care of Umbilical Cord

- Umbilical cord should be clamped and cut at 3 – 5 cm from the umbilicus between 1 to 3 minutes of birth.
- Umbilical cord should be clamped / tied by a sterile commercial clamp, rubber band (grips the cord better even after the cord shrivels) or sterile thread.
- Cord should be kept clean, dry & free of any application (antiseptic etc.).

Baby Identification Marking

- A method of identification should be followed as per local guidelines.
- The identification should have the name of the mother and father, hospital registration number, date of birth, gender and birth weight of the infant.

Initial weight Recording

- All infants should be weighed after one hour of skin to skin contact, on an infant weighing scale with at least 5 gm sensitivity.
- A single-use paper towel or a sterile cloth towel should be placed on the weighing scale beneath the infant.
- The weighing scale must be periodically (at least weekly) calibrated.

Vitamin K

- Inj. Vitamin K1 should be administered after one hour of skin to skin contact, intramuscularly on the antero-lateral aspect of the thigh using a 26 gauge needle and one ml syringe.
- Dose to be used is 0.5 mg for babies weighing less than 1000 g and 1.0 mg for those weighing above 1000 gms at birth.

DO NOT PERFORM STOMACH WASH IN NEWBORNS AT BIRTH

Clinical screening should be quick to identify any life threatening congenital anomalies and birth injuries and a thorough clinical examination prior to discharge should ensure complete assessment as per figure 1.1 (RBSK).

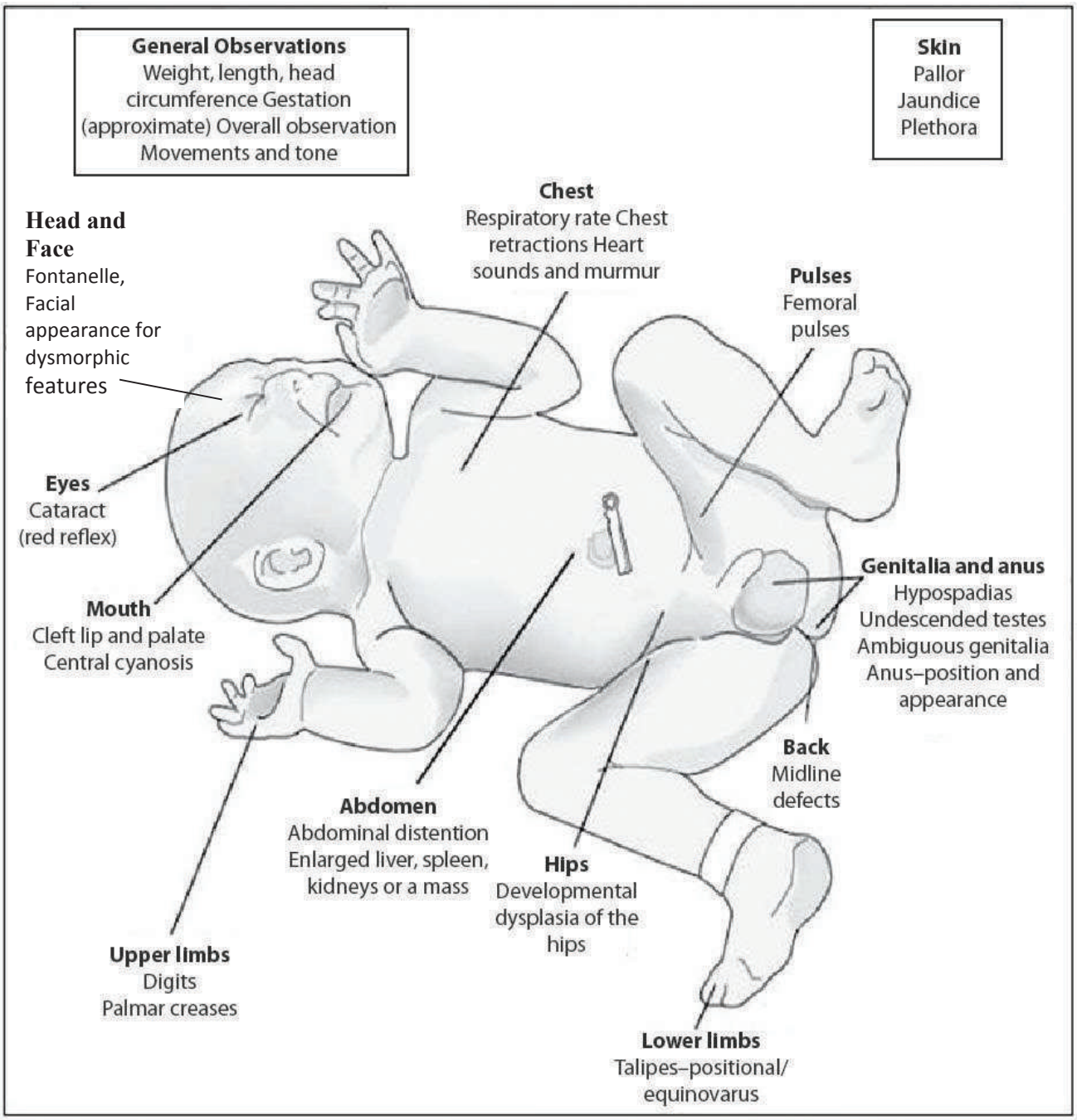


Fig. 1.1: Examination of newborn

Source: RBSK

Fig. 1.2: Examination of a Newborn for birth defects *Source:* RBSK

B. Identification of 'At Risk neonates' needing Hospitalization in the Special Newborn Care Unit (SNCU)

- Babies with birth weight < 1800 gms
- Babies with gestation < 34 weeks
- Babies with major congenital malformations
- Babies with asphyxia needing post-resuscitation care (PPV for > one minute, chest compressions, drugs)
- Babies with breathing difficulty

C. Communication with the Family

- The healthcare provider must communicate the time, birth weight, gender and condition of the infant to the mother and other family members.
- The infant should be shown to the family with particular attention to the gender and the identity tag on the infant.

CARE BEYOND GOLDEN HOUR

The baby should be thoroughly examined at birth from head to toe and the findings should be recorded in neonatal record sheet. Examine midline structures for malformations (e.g. cleft lip, neck swelling, chest abnormality, omphalocele, meningocele and anorectal anomalies). Special attention should be given to identify and document the anal opening. There is no need for routine passage of catheter in the stomach, nostrils and the rectum for detection of oesophageal atresia, choanal atresia and anorectal malformation, respectively. The baby's temperature should be recorded before transfer to postnatal ward. The baby should be examined for presence of birth injuries including cephalohematoma, brachial plexus injury, facial paralysis, fracture etc. and assessed for dislocation of hip (specially in Breech presentation, first born, female sex, family history and oligohydramnios) prior to discharge.

Defects at Birth (RBSK Operational Guidelines - shown in Figure 1.2) should be looked for, although not all of them can be detected at birth with certainty. These are:

1. Neural Tube Defect
2. Down's Syndrome
3. Cleft Lip & Palate
4. Congenital talipes equino varus (club foot)
5. Developmental Dysplasia of Hip
6. Congenital Cataract
7. Congenital Deafness
8. Congenital Heart Disease

Care in the Postnatal ward

The baby should be observed in the postnatal ward at least twice daily by a medical officer from the SNCU and the nurse in the postnatal ward. The baby should be observed for

1. Cry, activity, reflexes daily
2. Adequacy of breast feeding

3. Maintenance of temperature
4. Jaundice
5. Passage of urine and meconium
6. Danger signs

Weight Record

Most healthy term babies lose weight during the first 2 to 3 days of life. The cumulative weight loss can be up to 5 to 10 percent of the birth weight. The weight remains stationary during next one to two days and birth weight is regained by the end of first week. However, preterms experience 2-3% weight loss daily up to a maximum of 10-15%. Any weight loss >5% in a 24-hour period is abnormal. A preterm newborn should regain birth weight by 10-14 days of age. Delayed feeding and unsatisfactory feeding schedule may be associated with excessive weight loss.

- An adequately fed baby passes urine at least 6-8 times in a day after 48 hours of life. Many babies pass urine (even stools) after each feed during the first few months of life.
- The average daily weight gain in term babies is around 20-30 g per day.

Evaluation for Jaundice

- All the infants must be examined in daylight for the development and severity of jaundice twice a day for first few days of life.
- Transcutaneous bilirubinometer (TCB), if available should be used to supplement the clinical examination and assess the severity of jaundice.

Developmental Variations & Physiological Conditions

Knowledge of developmental variations, physiological conditions and their evolution in newborns is important for advising and assuring the mother. Mothers observe their babies very carefully and are often worried by minor physical peculiarities, which may be of no consequence and do not warrant any therapy.

Vomiting

- Many normal babies regurgitate or spit out some amount of milk, this regurgitation or vomiting seen soon after feeds is often due to faulty technique of feeding and aerophagy. Proper advice regarding feeding and burping must be imparted to all mothers.
- If the vomiting is persistent/projectile/bile stained associated with abdominal distension or tenderness, the baby should be further investigated.

Stool Pattern

- Any baby who has not passed meconium for 24 hrs after birth needs to be evaluated.
- Transitional stools are passed on the third and fourth day after birth. The frequency is increased and these are often semi-loose and greenish-yellow. This settles within 24 to 48 hours. Baby continues to feed well and there is no need for treatment.
- Breast fed babies pass frequent golden yellow, sticky, semi loose stools.
- Many babies pass stools while being fed or soon after a feed due to exaggerated gastrocolic reflex which may persist for a couple of weeks. These infants continue to gain weight satisfactorily & mother should be reassured.

- The increased frequency of stools in breast fed babies is normal and should not be confused with diarrhea.
- Some breastfed babies may pass stools infrequently (once every few days) This is not constipation.

Excessive Crying

- During the first few days of life babies sleep throughout the day and they are awake, and noisy during the night.
- Babies cry when they are hungry or in discomfort. Discomfort may be due to the unpleasant sensation of a full bladder before passing urine, painful evacuation of hard stools or mere soiling by urine and stools.
- An experienced mother or nurse can usually distinguish between the cry used as a signal for food and the cry of discomfort. Persistent crying needs examination and detailed evaluation for inflammatory conditions and other causes.

ADVICE AT DISCHARGE

Maintenance of body temperature

- Keep the baby dry at all times.
- During winter, the linen and clothes of the baby should be pre-warmed before use. Cover the baby adequately using cap, socks and mittens. Keep the room warm with the help of a heating device.
- During summer months, depending upon the environmental temperature, the baby should be dressed in cotton clothes and kept indoors as far as possible.
- Exposure of the baby to direct sunlight during the hot summer months can lead to serious hyperthermia.

Breast feeding

- The mother should be advised to feed the baby every two to three hours on a semi-demand schedule, both during day and night. During each feed, one breast should be completely emptied before the baby is put to the other breast. There is no need for additional water or other fluids except under medical supervision.

Skin care/ Bathing

- Keep the baby clean and dry at all times.
- Special precautions must be taken during bathing to prevent draught and chilling.
- During the winter months, instead of bathing, the baby can be sponged daily to avoid unnecessary exposure and risk of hypothermia.

Care of the umbilical stump

- The cord must be left open without any dressing. Do not apply any medication on the cord. The cord usually falls after 4 to 10 days.

Care of the eyes

- Routine application of antiseptic ointment for prevention of ophthalmia neonatorum is not recommended.
- Some neonates may develop persistent epiphora (watering) due to blockage of nasolacrimal duct by epithelial debris. The mother should be advised to massage the nasolacrimal duct area (by massaging either side of the nose adjacent to the medial canthus) 5 to 8 times daily or each time before she feeds the baby.
- Avoid the use of kajal as it may lead to infections, injury and may even cause lead poisoning.

Immunization: It is recommended to give BCG, zero dose of oral polio vaccine and Hepatitis B vaccine as early as possible preferably within the first 24 hours of life. Refer to Annexure I for complete immunization schedule as per National guidelines.

Newborn screening (NBS) blood test should be done when infants are 72-96 hours of age/ pre discharge in facilities where comprehensive NBS is available.

DANGER SIGNS in the baby should be explained to the mother before discharge and she should be adviced to bring the baby to the facility if any of the following danger sign is observed.

Danger signs

- Poor feeding
- Appearance of jaundice within 24 hours of age or yellow staining of palms or soles
- Failure to pass meconium within 24 hours or urine within 48 hours
- Undue lethargy
- Excessive crying
- Respiratory difficulty, apneic attacks or cyanosis
- Sudden rise or fall in body temperature
- Bleeding from any site
- Persistent vomiting
- Diarrhea/loose stools
- Drooling of saliva or choking during feeding
- Seizures
- Evidence of superficial infections such as conjunctivitis, pustules, umbilical sepsis

PRACTICES TO BE DISCOURAGED

A variety of traditional practices are common in many communities. These can be beneficial such as oil massage, or inconsequential such as putting black mark on forehead. However, a variety of harmful traditional practices must be actively discouraged such as

- Applying kajal/surma in eyes
- Putting oil or boric acid in nostrils
- Applying cow dung on the cord

CHECKLIST BEFORE DISCHARGE

Ideally the infant should be discharged after 48 hours once all of the following criteria are fulfilled:

- Infant is free from any illness including significant jaundice.
- The infant has been immunized.
- Adequacy of breastfeeding has been established. This must be assessed in all infants and the same would be indicated by passage of urine 6 to 8 times/24 hr and baby sleeping well for 2-3 hours after a feed.
- Mother is free from any significant illness and confident to take care of her infant.
- Mother has been advised regarding danger signs and to return immediately in case the neonate develops any danger sign.

- Next follow up visit is scheduled.
- Vit D 400 IU/day has been advised.

FOLLOW UP

Each baby should be followed up in the well-baby clinic for assessment of growth and development, early diagnosis and management of illnesses and health education of parents. It is preferable that every baby is seen and assessed by a health care worker at each immunization visit. The developmental assessment should be organized both in the community and the facility. (All details of follow up are described in chapter 17)

EXERCISE

1. You have been called to attend a full term normal delivery. The baby cries soon after birth. How will you manage this baby?

2. Baby Asha was born three days back and is on breast feeds, the mother complains of loose stools. The baby is feeding well and is passing urine 6-8 times in 24 hours, what advice will you give to this mother?

3. Female Baby Veena is 4 days old today and the mother is complaining of blood on the diaper. How will you manage this baby?

4. You are taking rounds in the postnatal ward and find Baby Anita who is 4 hours old being given honey and on asking you find out that the baby has not been breast fed because the paternal aunt has not come. What will you do?

5. Baby Prema is being discharged at 48 hours of life and is on breast feeds. She has jaundice up to the chest. What advice will you give the mother?

CHAPTER 2

THERMAL CONTROL

Provision of warmth to prevent hypothermia is one of the cardinal principles of newborn care. Hypothermia can lead to hypoglycemia, bleeding diathesis, pulmonary haemorrhage, acidosis, apnea, respiratory failure, shock and eventually death. Neonatal hypothermia continues to be a very important cause of neonatal deaths due to lack of attention by health care providers.

Learning Objectives

After completion of this chapter the participant should be able to-

- Enumerate the mechanisms of heat loss in neonate
- Understand the concept of warm chain
- Record body temperature & grade hypothermia
- Prevent & manage hypothermia

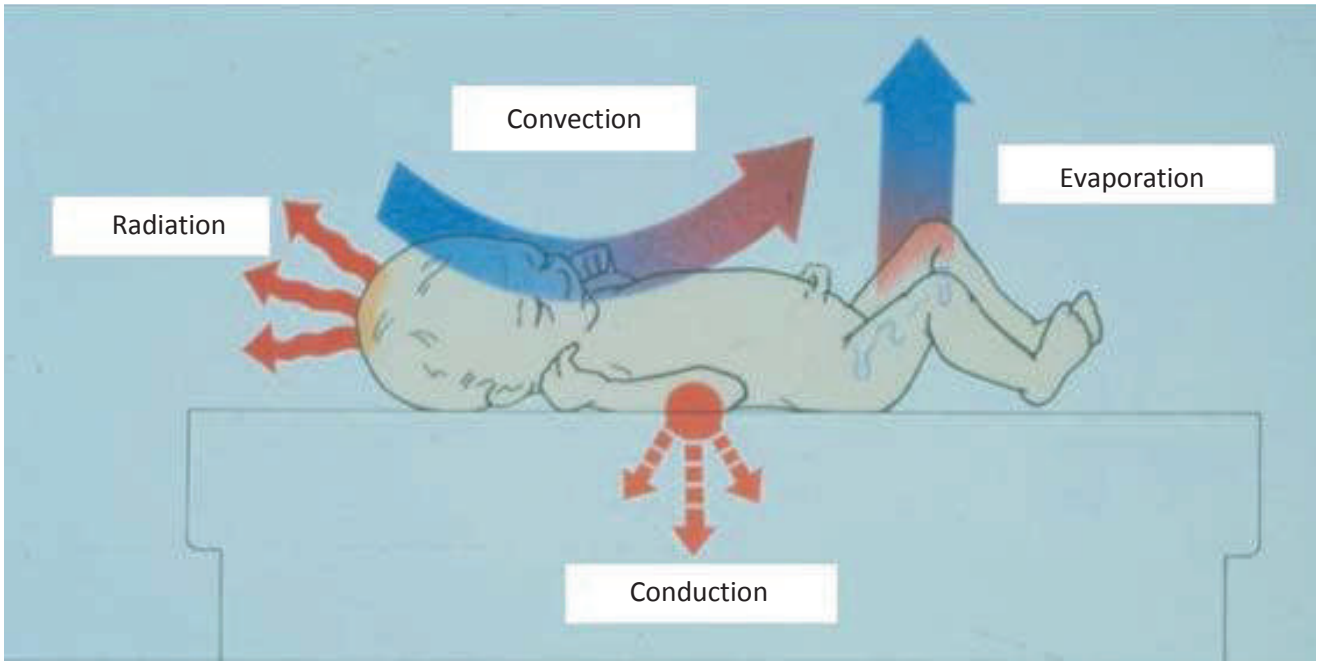


Fig. 2.1: Mechanism of heat loss in a newborn

Why are newborns prone to develop hypothermia?

- **Larger surface area**
- **Decreased thermal insulation due to lack of subcutaneous fat (LBW infant)**
- **Reduced amount of brown fat (LBW infant)**
- **Lack of shivering**

Mechanisms of Heat Loss

Newborn loses heat by:

- Evaporation (particularly soon after birth due to evaporation of amniotic fluid from skin surface)
- Conduction (by coming in contact with cold objects-cloth, tray, etc.)
- Convection (by air currents in which cold air replaces warm air around baby-open window, fans)
- Radiation (to colder solid objects in vicinity-walls) (Fig 2.1).

The process of heat gain is by conduction, convection and radiation.

Concept of Warm Chain

In order to prevent the heat loss which can occur in a newborn after delivery, the baby must be kept warm at all times right from birth. Satisfactory control of temperature demands both prevention of heat loss and promotion of heat gain. The "warm chain" is a set of ten interlinked interventions carried out at birth and later, which will minimize the likelihood of hypothermia in all newborns.

1. Warm delivery room (26-28^{0}C)
2. Warm resuscitation
3. Immediate drying and removal of wet linen
4. Skin-to-skin contact between baby and the mother
5. Breastfeeding
6. Postpone bathing and weighing
7. Appropriate clothing and bedding
8. Keep mother and baby together
9. Warm transportation
10. Awareness raising of healthcare provider

Assessment of Hypothermia
What is hypothermia?

Normal axillary temperature is 36.5 _ 37.5^{0}C (97.7 _ 99.5^{0}F). In hypothermia the temperature is below 36.5^{0}C

Grading of Hypothermia

Cold stress: 36.4 _ 36.0^{0}C (97.5 – 96.8^{0}F)
Moderate hypothermia: 35.9 _ 32.00C (96.2 – 89.6^{0}F)
Severe hypothermia: < 32^{0}C (89.6^{0}F)

Temperature Recording

Following are the methods of assessment of temperature in a newborn:

1. **Axillary temperature** is as good as rectal and safer (less risk of injury or infection).
   A digital thermometer needs to be switched on for recording the temperature.
   Temperature 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 the thermometer in place. The temperature is read when the thermometer beeps.
2. **Skin temperature:** In a baby being nursed under a radiant warmer, the baby's temperature is usually recorded by a thermister probe. The thermister probe is attached to the skin over upper abdomen. The thermister senses the skin temperature and displays it on the panel.
3. **Human touch:** Baby's temperature can be assessed with reasonable precision by human touch dorsum of hand, the reliability of which can be enhanced by training. Abdominal temperature is representative of the core temperature and it is reliable in the diagnosis of hypothermia.

- **Warm and pink feet: Thermal comfort**
- **Feet cold, abdomen warm: Cold Stress**
- **Both feet and abdomen cold: Moderate to Severe Hypothermia**

Clinical Signs and Symptoms

The signs and symptoms in a hypothermic baby may be subtle and nonspecific; therefore it is essential to have a high index of suspicion for hypothermia especially in LBW and preterm babies. The common signs and symptoms in a hypothermic baby are lethargy, irritability, poor feeding, poor weight gain and breathing difficulty (tachypnea/apnea). Severe hypothermia may manifest with hypoglycemia, sclerema, DIC and internal bleeding.

Prevention & Management of Hypothermia

Common situations where hypothermia can occur:

1. At birth (Delivery Room)
2. During changing of nappy/clothes
3. Malfunctioning heat source or moving the baby away from a heat source
4. While transporting a sick baby

Kangaroo Mother Care (KMC)

KMC is a humane, evidence based, low-cost method of care of preterm and Low birth weight newborns. The neonate is held, skin-to-skin, with mother or any other adult caretaker. Kangaroo Mother Care should be provided to all these babies whenever and wherever possible for the maximum duration of time.

Components of KMC

a. KMC Position - prolonged skin to skin contact between mother and her baby on mother's chest
b. KMC Nutrition - exclusive breast milk feeding as much as possible KMC Discharge and Follow up - Planned early discharge after satisfying the unit criteria and regular scheduled follow up including the neuro development

KMC helps in

Benefits for Baby

- Reduced morbidities including infections and mortality (32% reduction in mortality)
- Prevents hypothermia and chances of hypoglycaemia
- Improves breastfeeding, growth, quality of sleep and neurodevelopment
- Improves mother baby bonding and satisfies all the five senses, touch, taste, smell, vision and hearing

Benefits for mother

- Better breastfeeding, early bonding
- Improved self-esteem, confidence, competence and compliance for the care of small and sick newborns
- Less postpartum haemorrhage, mood disorders and depression

Benefits to hospitals

- Less cost for the care of small and sick high-risk babies
- Reduced duration of hospitalization

Benefits to community and nation

- Improved survival rates of vulnerable small and sick newborns
- Improved intact survival of the babies

Assessing the eligibility for KMC

Mother/Father or any adult caretaker who is willing, free of illness and maintains a good hygiene can provide KMC.

Baby

1. Initiate KMC soon after birth in all Preterm (<37 weeks gestation) or LBW (<2500g) infants soon after birth, except if the infant is unable to breathe spontaneously after resuscitation, in shock or requiring mechanical ventilation. The ongoing medical support like, oxygen therapy, IV fluids and tube feeding, even CPAP are not contraindications to KMC.
    - Monitor heart rate, breathing, colour, temperature and oxygen saturation.
    - Provide the same for 8–24 hours per day (as many hours as possible).
2. Babies less than 1800 g and sick babies 1800-2500 g need to be shifted with their mothers to Mother-Newborn Care Unit for management including KMC.
3. Stable infants 1800- 2500 g at birth and those recovered are to be shifted with their mothers to post-natal wards/KMC wards for post-natal care including KMC.
4. All preterm or LBW infants after discharge, continue KMC at home.

Technique & Position

Counsel the mother regarding KMC, provide privacy, and request her to sit or recline comfortably. Place the baby between the breasts of the mother in skin to skin contact in upright position. Turn the head to one side to prevent airway obstruction. Slight extended position of the head facilitates eye contact with the mother. Ensure that the abdomen of the baby is in close proximity to the epigastrium of the mother. Regular respiratory movements of mother prevent the occurrence of apnea. The hips should be flexed and the bottom of the baby should be supported, in this way the baby clings to the mother in a frog like position. Twins can also be provided KMC at the same time as shown in Fig 2.2 a-d.

Clothing for the mother and baby

When KMC is being initiated soon after birth or in a sick neonate including respiratory support, prefer to use binder along with KMC shirt to keep neck in slightly extended position to maintain airway as shown in Fig 2.2 e (Annexure 21).

When KMC is being initiated after stabilization, the mother can wear whatever she finds comfortable as per the environmental temperature prevailing at that time, provided the dress accommodates the baby, i.e. keeps the baby comfortably in contact with her skin. Special garments are not needed unless traditional ones are too tight. The baby is placed naked in kangaroo position, except for a diaper, cap and socks.

Duration of KMC and Discontinuation

KMC should be provided for as long as possible preferably using the KMC chair (Annexure 22). Each session should be for a duration of at least one hour, this ensures a complete cycle of deep quiet sleep which helps in better brain development. KMC may be continued till the baby finds it comfortable. When the baby on KMC wriggles, pulls limbs out or cries, KMC can be discontinued. This generally happens as the baby reaches a weight of 2500 gms or a post menstrual age of 40 weeks. KMC duration, counted as cumulative completed hours during a 24 hour period, is defined as short (4 hours), extended (5-8 hours), long (9-12 hours), and continous (more than 12 hours). Skin to Skin contact is the most practical, preferred method of warming a hypothermic infant in a health facility.

Source: Neonatal Unit, LHMC

Fig. 2.2.a: Mother providing KMC

Source: Neonatal Unit, LHMC

Fig. 2.2.b: Mother providing KMC to twins

Source: Neonatal Unit, LHMC

Fig. 2.2.c: Father providing KMC

Source: Neonatal Unit, LHMC

Fig. 2.2.d: Grandmother providing KMC

Source: Neonatal Unit, LHMC

Fig. 2.2.e: Mother providing KMC to baby on respiratory support

Transport in KMC position

Transport in KMC position Preterm or LBW infant can be transported in KMC position (Fig 2.2 f) within the hospital, at the time of discharge, to higher facility or during follow-up visit. Neonates remain euthermic and stabilize better in KMC position. Ensure that baby is wearing diaper, cap, mittens and socks, is well secured with a binder and the head and bottom is supported before initiating the transport. Cover with additional blanket/ shawl as required. Preferable a health worker should accompany and monitor the oxygen saturation and heart rate during the transport.

Source: Neonatal Unit, SJH

Fig. 2.2.f: Transport in KMC position

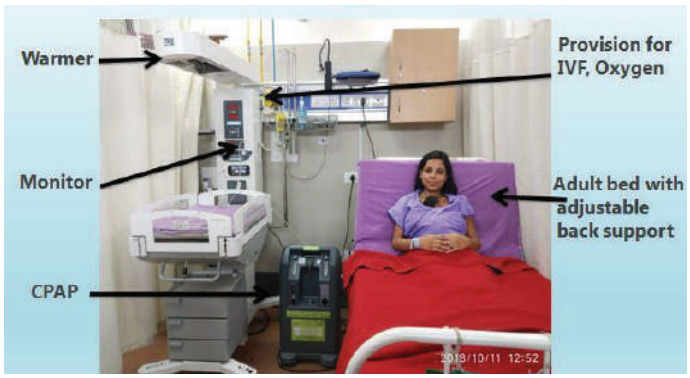
Mother-Newborn Care Unit and Family participatory Care

Family Participatory Care provides a conceptual framework for nurturing care by the mother along with other family members including the father. The care provision should include KMC, feeding mother's own milk and performing activities of daily routine like sponging, changing diaper and helping with monitoring the baby.

To ensure zero separation along with provision of KMC for prolonged duration, establishment of Mother Newborn Care Unit (MNCU) is required. MNCU is a facility where sick and small newborn are cared for with their mothers 24 × 7 with all facilities of SNCU for sick newborn care and provision for post natal care to the mother. The mother is not a visitor but she has her bed next to her baby and is actively involved in providing care. MNCUs should be designed with all the provisions for mother's stay combined with respectful medical and supportive care for the mothers and their preterm or LBW infants until discharge. While MNCUs are being established, mothers should be encouraged to visit SNCU frequently to provide KMC for long hours.

Source: Neonatal Unit, SJH

Fig. 2.2.g: Baby on CPAP in KMC position



Source: Neonatal Unit, SJH

Fig. 2.2.h: Mother newborn care unit

VIDEO on KMC Counselling and Technique

Management of hypothermia

For the sake of management, WHO classifies Hypothermia as mild hypothermia (35.5-36.4^{0}C) and significant hypothermia (<35.5^{0}C).

Management of Mild Hypothermia (35.5 to 36.4^{0}C)

- Providing supervised Kangaroo Mother Care (KMC), skin to skin contact is the best method to re-warm a baby with mild hypothermia.
- If KMC is not possible, warm the room using room heater or other appropriate heating device.
- Cover adequately and ensure to replace the cold clothes of the baby with warm clothes.
- Keep the room warm (26 – 28^{0}C) and draught free.
- Continue breastfeeding.
- Monitor temperature & capillary filling time during rewarming. Watch for apnea and hypoglycaemia.
- Monitor axillary temperature every ½ hour till it reaches 36.5^{0}C, then hourly for next 4 hours, 2 hourly for 12 hours, thereafter once per nursing shift as a routine.
- Most of the babies will regain their normal temperature. However, if the baby remains hypothermic one hour after supervised KMC, or if danger signs appear at any stage of monitoring the baby, sepsis should be suspected and treated accordingly.

Wrapping the Baby: To be demonstrated in Clinical skills station

The baby should be comfortable & clothed in multiple layers. Head should be covered with a cap and the baby should then be wrapped in 1-2 layers of sheets/blankets. The technique of wrapping will be demonstrated in the skill station.

Fig. 2.3.a: Well covered newborn

Management of Significant Hypothermia (Temp <35.5^{0}C)

- Remove wet clothes from the baby and replace with warm cotton clothes.
- Place under radiant warmer with clothes including cap, socks and mitttens.
- Monitor temperature every 15-30 minutes.
- Monitor B.P., HR, temperature and glucose.
- The baby should be stabilized before being transported in case he/she needs to be referred to a higher centre.

- Following additional steps may be required in some babies:
  - Continue breast feeding. If baby can not breast feed, given EBM through paladai/ gavage
  - In case baby has vomiting/feed intolerance, start IV fluids
  - If perfusion is poor, give 10ml/kg of normal saline
  - Give Inj. Vit. K1
  - Provide oxygen if required and maintain O_2 saturation between 91-95%

Fever

Fever (temperature above 37.5^{0}C) may be either due to an environmental cause or it may be a sign of infection (usually in a term neonate). In all febrile neonates, a diligent search for a possible infective focus must be made.

Common Causes of Hyperthermia

- Environment too hot for the baby.
- Baby is overdressed, wrapping the baby in too many layers of clothes, especially in hot, humid climate.
- Keeping newborn too close to a heater/hot water bottle.
- Leaving baby under a heating device like radiant warmer, incubator, phototherapy, etc. that is not functioning properly and/or is not checked regularly.
- Sepsis.

Management of Hyperthermia

- In summer months, hyperthermia may occur due to raised environmental temperature. This may be managed by moving the baby into colder environment and clothing the baby in light cotton clothes.
- Remove the baby from the source of heat (heater, radiant warmer).
- When the temperature is 37.6^{0}C - 39^{0}C, undressing and exposing the neonate to room temperature is usually all that is necessary.
- If the temperature is above 39^{0}C, the neonate should be undressed and sponged with luke warm water at approximately 35^{0}C until the temperature is below 38^{0}C. (do not use cold / ice water for sponging).
- Give frequent breast feeds to replace fluids. Only if the baby cannot breast feed, give EBM by katori spoon or gavage. If the baby does not tolerate feeds, intravenous fluids may be given.
- Measure the temperature hourly till it becomes normal.
- Work up a hyperthermic baby for infection when there is:
  - undue lethargy
  - excessive cry
  - seizures
  - poor feeding
  - persistent vomiting
  - respiratory distress
  - apnoeic attacks
  - cyanosis
  - bleeding from any site
  - pustules, umbilical sepsis

Discharge Advice and Follow Up

At home, in term babies, ensure that the baby is adequately covered, and breastfeeding is continued. In case of low birth weight and preterm babies, however, extra care is required to maintain the body temperature. Baby should be provided KMC. If this is not possible, the baby should be nursed next to the mother, as the mother herself is a good source of warmth for the baby. Further, the room where a LBW baby is nursed should be kept warm. The baby should be clothed well. Two or three layers of clothes are generally required. If the room is not warm enough, the baby needs to be clothed in warm clothes (woollens) including socks, mittens and a cap. A blanket should also be used to cover the baby.

In addition, the mother and the family must be counseled for care at home. They should be informed regarding:

- Exclusive breast feeding.
- How to keep the baby warm at home.
- Identifying 'Danger signs' for seeking medical help.

EXERCISE

1. A baby has a 'Lo' reading on digital thermometer. How will you ascertain his actual temperature?

2. A new born is brought to you in the SNCU by a nurse from the postnatal ward as the baby felt cold to touch. On Examination, the peripheries and abdomen are both cold to touch and the temperature when recorded in the axilla is 34^0C. The baby is lethargic, RR is 40/min, and HR is 130/min. What is the degree of hypothermia in this baby and how will you manage this baby?

3. What do you understand by Mother Newborn Care Unit?

4. You have to transport a hemodynamically stable newborn to a higher centre along with the mother how will you ensure temperature maintenance on the way?

CHAPTER 3

BREASTFEEDING

It is a well-established fact that the best milk for a neonate is breast milk. It provides optimal nutrition to the baby. It is estimated that over one million children die each year from diarrhea, respiratory and other infections because they are not adequately breastfed. Exclusive breastfeeding has the potential to prevent 13 percent of under five deaths globally each year. Early initiation of breastfeeding within the first hour of birth in addition to exclusive breastfeeding can cut down 22% of all newborn deaths. Government of India has launched 'Mother's Absolute Affection (MAA) Programme' so as to create an enabling environment for promoting and supporting breastfeeding in the country. However, several challenges still remain and according to the National Survey (NFHS-5) only 41.86% children under age 3 years are breastfed within one hour of birth and only 64% of children under 6 months of age are exclusively breastfed.

Learning Objectives

The participant after completing this chapter should be able to:

1. Enumerate advantages of breastfeeding
2. Help mother(s) with the correct technique of breastfeeding
3. Identify factors enhancing lactation
4. Identify difficulties associated with breastfeeding and provide solutions
5. Help mothers in expression of breast milk

ADVANTAGES OF BREAST FEEDING

Benefits to the newborn

- Optimum nutrition for growth and development of the neonate.
- Protection against infection: First immunization of the newborn.
- Easily available at an appropriate temperature.
- Easily digested.
- Protects against allergies, including eczema & asthma.
- Enhances emotional bonding between mother and baby.
- Studies have demonstrated that breastfed babies have a higher IQ.
- Breastfed babies have less chance of developing hypertension, diabetes mellitus, coronary heart disease, and even cancer in later life.

Benefits to the mother

- It accelerates the process of involution of uterus, reducing chances of postpartum haemorrhage.

- Exclusive breastfeeding helps delay the next pregnancy by providing almost 98% protection against conception when the baby is exclusively breastfed during the first four months of life.
- It lowers the risk of breast and ovarian cancer in the mother.
- It reduces her workload.

Benefits to the family and society

- Breastfeeding is more economical than artificial feeding.
- It promotes family planning.
- Since it decreases the risk of infection in infants, the need for their hospitalization is also reduced. It contributes to reduction in infant morbidity and mortality.

Colostrum is the breast milk that mothers produce in the first few days after delivery.

- It is thick and yellowish in color.
- It contains more antibodies, white blood cells and other anti-infective proteins as compared to mature milk. These anti-infective proteins and white cells provide the first immunization against diseases that a baby is likely to be exposed after delivery.
- Colostrum has a mild purgative effect, which helps to clear the baby's gut of meconium. This clears bilirubin from the gut and also helps to prevent hyperbilirubinemia.

RECOMMENDED BREASTFEEDING PRACTICES

- Initiate breastfeeding soon after (within half to one hour) birth.
- Do not introduce Prelacteal feeds (ghutti, gripe water, honey or any other milk). This will reduce the breast milk intake by the baby.
- Ensure exclusive breastfeeding during first 6 months of life (feeding only breast milk and medications if required).
- Breastfeed day and night on-demand at least eight times or more per day. Allow baby to feed at one breast till the baby stops sucking and releases the breast. Then offer him the other breast if the baby demands more. However, if he does not feed from this breast now, then offer this breast first at the next feeding session.
- The adequacy of milk intake can be assessed by counting the number of wet diapers per day (6 – 8 times / day), and weight gain (20 – 30 gms a day in 1st 3-4 months after regaining birth weight).
- Initiate complementary foods after 6 months of age.
- Continue breastfeeding up to 2 years of age or beyond.

ANATOMY AND PHYSIOLOGY

For a better understanding of the breastfeeding practice, its technique and problems, it is important to know the relevant anatomy and physiology of the breast.

Anatomy:

The breast consists of partly glandular tissue and partly supporting tissue and fat. Milk is secreted by the glands and travels through tubules, which drain into lactiferous ducts which converg and open into the nipple. A thin layer of muscle (myoepithelium) surrounds each gland. The contraction of these muscles causes ejection of milk from the glands. (Figure 3.1)

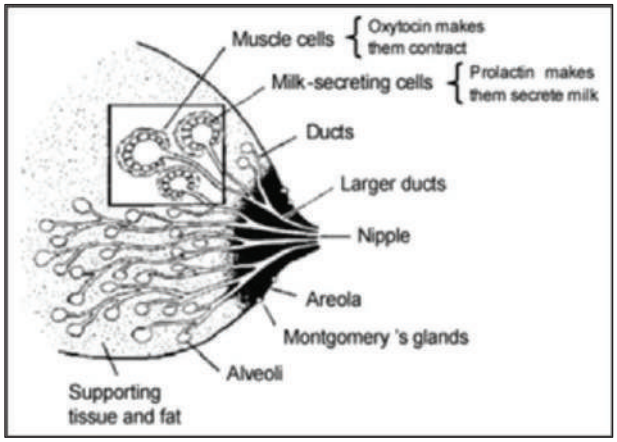


Fig. 3.1: Anatomy of the breast

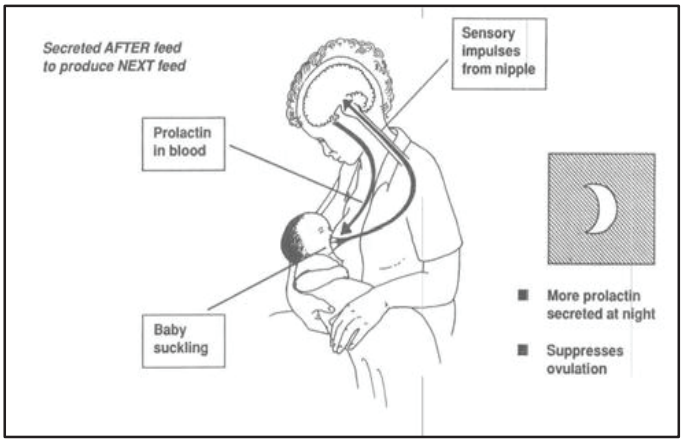


Fig. 3.2: Prolactin reflex

Physiology: Reflexes in the Mother

Prolactin Reflex

Prolactin is a hormone secreted by the anterior Pituitary gland and is responsible for milk production. Its secretion increases at night so night feeding is very important. Its secretion also increases by the sensory impulses from the nipple during suckling and when the breast is emptied after feed or after expression, to produce the next feed. This hormone suppresses ovulation and hence prevents conception. (Figure 3.2)

Oxytocin Reflex

Oxytocin is the hormone secreted by the posterior Pituitary gland and it is responsible for the ejection of milk from the breast. It's secretion also increases by sensory impulses from the breast when the baby is suckling. The secretion of oxytocin also increases by the smell, sound and touch of the baby and when the mother is calm, stress free and relaxed. Back massage also increases the secretion of oxytocin. (Figure 3.3 and 3.4)

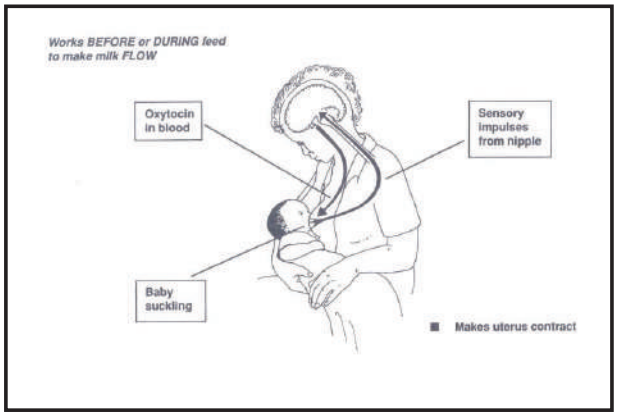


Fig. 3.3: Oxytocin reflex

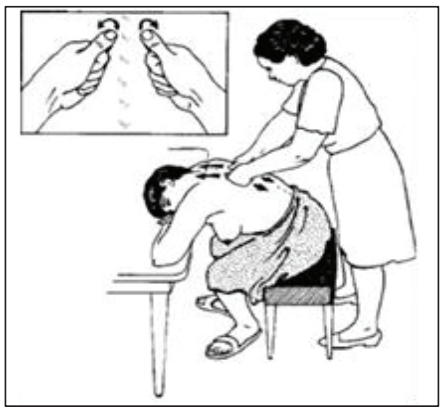


Fig. 3.4: Back massage for stimulating lactation

Reflexes in the Baby (Figure 3.5):

Rooting, sucking and swallowing reflexes help the baby to take the milk secreted from the breast. When the breast or nipple touches a baby's lip or cheek, he opens his mouth and may turn his head to find it. He puts his tongue down and forward. "This is the rooting reflex." When something touches a baby's palate, he starts to suck it, and when his mouth fills with milk, he swallows. A full term healthy neonate is endowed with all these reflexes, which help him feed at the breast without the need to learn them.

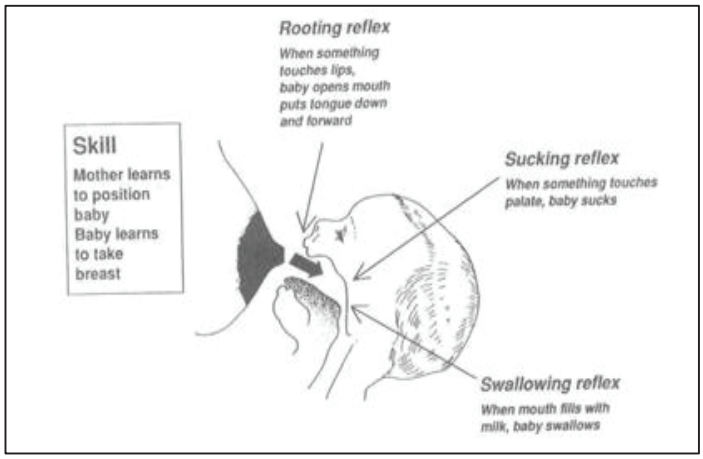


Fig. 3.5: Reflexes in the baby

Fig. 3.6: Correct positioning

BREASTFEEDING TECHNIQUE

Breastfeeding is natural and most mothers can feed without any problem. There are many ways to breastfeed and each mother develops her own style to suit her baby. However, few mothers need some assistance in positioning and attaching the baby to the breast. For a mother to produce adequate milk, her baby must suckle often enough, and must also suckle in the right way. Antenatal counseling & examining the mother's breasts & nipples during pregnancy helps to reassure the mother about her ability to breastfeed successfully & also to identify mothers who may require some extra help.

Correct positioning (Figure 3.6) is important because it will ensure correct attachment and effective suckling and prevent sore nipples and breast engorgement. Proper position of the baby while breastfeeding should ensure that:

1. Baby's body is well supported.
2. The head, neck and the body of the baby are kept in the same plane.
3. Entire body of the baby faces the mother.
4. Baby's abdomen touches mother's abdomen.

Attachment of baby on mother's breast (Figure 3.7)

Four signs of good attachment are:

1. Baby's mouth wide open.
2. Lower lip turned outwards.
3. Baby's chin touches mother's breast.
4. Majority of areola inside the baby's mouth.

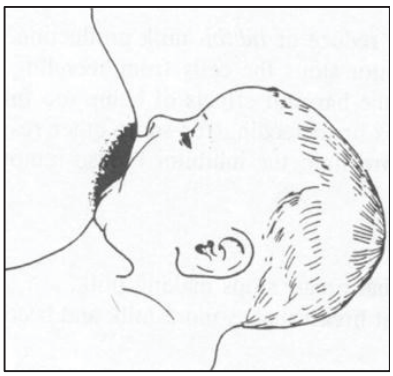


Fig. 3.7: Good attachment

Effective Suckling

Effective suckling is when the infant shows slow deep sucks, sometimes pausing. If the infant is not sucking well, then look for ulcers and white patches in the mouth (Thrush).

It is very important to ensure good attachment because poor attachment results in

- Pain or damage to nipple leading to sore nipples.
- Breast is not emptied thus causing breast engorgement.
- Poor milk supply hence baby is not satisfied and is irritable after feeding.
- Mother produces less milk resulting in a frustrated baby who refuses to suck. This leads to poor weight gain.

Drill

The facilitator will now conduct a drill on correct positioning and attachment at the breast.

Video

There will now be a video on the method of breastfeeding. This will include correct attachment and positioning along with effective suckling.

BREAST CONDITIONS & BREASTFEEDING PROBLEMS

1. **Inverted/flat nipples:** Flat or short nipples which protract well (become prominent or pull out easily) do not cause difficulty in breast feeding. Inverted or retracted nipples cause difficulty in attachment to the breast. This condition should be diagnosed in the antenatal period. These mothers need additional support to feed their babies. Treatment will be discussed during the clinical skills session in the afternoon.
2. **Sore Nipple:** A sore nipple is caused by incorrect attachment of the baby to the breast. A baby who only sucks at the nipple does not get enough milk so he sucks more vigorously resulting in a sore nipple. Frequent washing with soap and water as well as pulling the baby off the breast while he is still sucking may also result in a sore nipple. Candida infection of the nipple can also be a cause of a sore nipple.
   Treatment consists of correct positioning and attachment of the baby to the breast. Hind milk should be applied to the nipple after a feed and the nipples should be aired, to allow healing in between feeds. If fungal infection is suspected, treat with antifungal medication.
3. **Breast engorgement:** The milk production increases during the second and third day after delivery. If feeding is delayed or infrequent or the baby is not well-positioned at the breast, milk accumulates in the alveoli. Such a breast becomes swollen, hard, warm and painful and is termed as an engorged breast.
   Treatment: Breast engorgement can be prevented by early and frequent feeding and correct attachment of the baby to the breast. Treatment consists of local warm water packs and analgesics (Paracetamol) to the mother to relieve pain. Milk should be gently expressed to soften the breast and then the mother must be helped to correctly attach the baby to the breast.
4. **Breast abscess:** If a congested, engorged breast, an infected cracked nipple, or a blocked duct and mastitis are not treated in the early stages, then an infected breast segment may form a breast abscess. The mother may also have high grade fever and a raised blood count.

Treatment: Mother must be treated with analgesics and antibiotics. The abscess is to be incised and drained. Breastfeeding must be continued from the other breast.

5. Reduced milk supply / Not enough milk: Many mothers complain that they do not have enough milk. Reassurance is needed if the baby is gaining weight adequately, passing urine 6-8 times/day and sleeping for 2-3 hrs after each feed. Common causes of reduced milk supply / not enough milk include not breastfeeding often enough, too short or hurried breastfeeds, poor attachment, poor oxytocin reflex, breast engorgement or mastitis.

   Treatment: If baby is not gaining weight adequately, ask the mother to feed the baby more frequently and feed especially during the night. Make sure that attachment is proper. Any painful condition in the mother such as sore nipple, mastitis should be managed promptly. Back massage is especially useful for stimulating lactation. Advice KMC for LBW babies.

BREASTFEEDING IN PRETERM & LBW BABIES

The ability of an infant to breastfeed depends on the suck, swallow, & breathing coordination of the innate reflexes. The coordination of suck, swallow, & breathe actions is seen at 34 – 35 weeks. The unique composition of preterm milk with higher concentration of proteins, calories, & protective substances makes it particularly suited for preterm babies. Mother must begin expression within 6 hrs of delivery & repeat 8 – 10 times per day to maintain milk production & to feed the baby. Mother must be encouraged to visit, touch, & care for her baby as often as possible. The baby should be put to the breast every 2 – 3 hrs for feeding or nonnutritive sucking. The mother needs extra support for establishing breastfeeding in preterm and LBW babies.

Breast milk expression

It is useful for all mothers to know how to express and store their milk. Mothers should be encouraged to come to SNCU to learn how to express milk manually. Expression of breast milk is required in the following situations:

- To maintain milk production and for feeding the baby who is premature, low birth weight or sick and cannot breast feed.
- Working mothers, who plan to return to work can express the milk in advance and store it to ensure exclusive breastmilk feeding for their babies.
- To relieve breast engorgement.

Storing expressed breast milk

- Wash the container thoroughly with soap and water.
- Cover the container of expressed breast milk (EBM).
- EBM can be kept at room temperature for 8 hours, and in the refrigerator for 24 hours.

The Ten steps to Successful Breast Feeding

Every facility providing maternity and newborn care services should implement the ten steps comprising of critical management procedures and key clinical practices as elaborated below to improve breastfeeding.


The TEN STEPS to Successful Breastfeeding
1 HOSPITAL POLICIES
Hospitals support mothers to breastfeed by...
Not promoting infant formula, bottles or teats
Making breastfeeding care standard practice
Keeping track of support for breastfeeding
2 STAFF COMPETENCY
Hospitals support mothers to breastfeed by...
Training staff on supporting mothers to breastfeed
Assessing health workers' knowledge and skills
3 ANTENATAL CARE
Hospitals support mothers to breastfeed by...
IMPORTANCE OF BREASTFEEDING
Discussing the importance of breastfeeding for babies and mothers
Preparing women in how to feed their baby
4 CARE RIGHT AFTER BIRTH
Hospitals support mothers to breastfeed by...
Encouraging skin-to-skin contact between mother and baby soon after birth
Helping mothers to put their baby to the breast right away
5 SUPPORT MOTHERS WITH BREASTFEEDING
Hospitals support mothers to breastfeed by...
Checking positioning, attachment and suckling
Giving practical breastfeeding support
Helping mothers with common breastfeeding problems
6 SUPPLEMENTING
Hospitals support mothers to breastfeed by...
Giving only breast milk unless there are medical reasons
Prioritizing donor human milk when a supplement is needed
Helping mothers who want to formula feed to do so safely
7 ROOMING-IN
Hospitals support mothers to breastfeed by...
Letting mothers and babies stay together day and night
Making sure that mothers of sick babies can stay near their baby
8 RESPONSIVE FEEDING
Hospitals support mothers to breastfeed by...
Helping mothers know when their baby is hungry
Not limiting breastfeeding times
9 BOTTLES, TEATS AND PACIFIERS
Hospitals support mothers to breastfeed by...
Counsel mothers on the use and risks of feeding bottles, teats, and pacifiers
10 DISCHARGE
Hospitals support mothers to breastfeed by...
Referring mothers to community resources for breastfeeding support
Working with communities to improve breastfeeding support services
World Health Organization
unicef

Critical Management Procedures

1a. Comply fully with the International Code of Marketing of Breast-milk Substitutes and relevant World Health Assembly resolutions.
1b. Have a written infant feeding policy that is routinely communicated to staff and parents.
1c. Establish ongoing monitoring and data-management systems.
2. Ensure that staff have sufficient knowledge, competence and skills to support breastfeeding.

Key clinical practices

3. Discuss the importance and management of breastfeeding with pregnant women and their families.
4. Facilitate immediate and uninterrupted skin-to-skin contact and support mothers to initiate breastfeeding as soon as possible after birth.
5. Support mothers to initiate and maintain breastfeeding and manage common difficulties.
6. Do not provide breastfed newborns any food or fluids other than breast milk, unless medically indicated.
7. Enable mothers and their infants to remain together and to practise rooming-in 24 hours a day.
8. Support mothers to recognize and respond to their infants' cues for feeding.
9. Counsel mothers on the use and risks of feeding bottles, teats and pacifiers.
10. Coordinate discharge so that parents and their infants have timely access to ongoing support and care.

Lactation Management

Under NHM, lactation management centres are being established in the country at 3 levels to provide lactation support to the mothers to help them breastfeed.

Comprehensive Lactation Management Centre (CLMC): It is a centre at a premier/tertiary/referral health facility which serves the purpose of:

a. Providing comprehensive lactation support and management for all mothers within the hospital.
b. Ensuring facilities exist for collection, screening, processing, storage and dispensing of donated human milk for babies without access to their own mother's milk.
c. Facilitating expression and storage of mother's own breast milk for consumption by her baby.

Lactation management centre (LMC): It is a centre established at a secondary level health facility such as District Hospital with SNCU, for the purpose of providing lactation support to all mothers within the health facility for collection, storage and dispensing of mother's own milk for consumption by her baby.

Lactation support unit (LSU):: is a centre established at the Sub District hospital/Community Health Centres/ Primary Health Centres (delivery points) for promoting and providing lactation support to all mothers within the hospital.

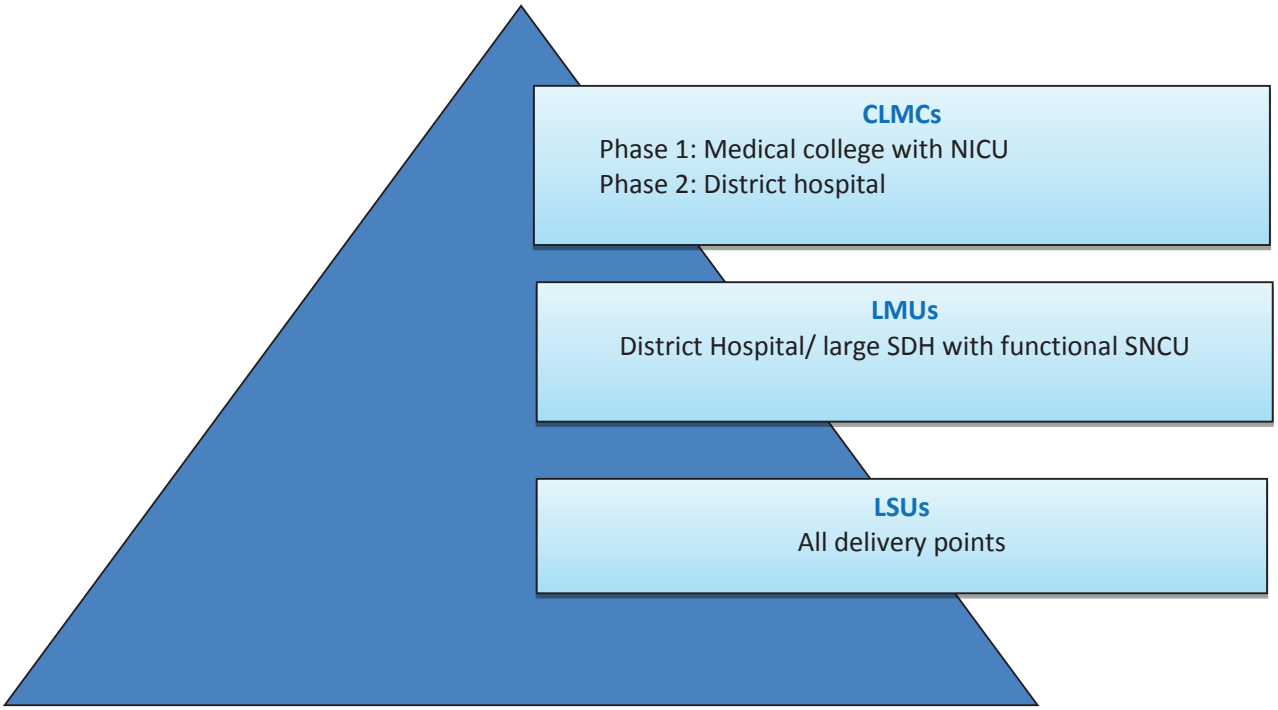


Fig. 3.8: Three levels of lactation management centres

The facilitators will discuss the art of communication in neonatal practice before the role play.
Role Play of Not Enough Milk

(Focus on content, remedy and counselling)

Baby Rupa Bwt 2.1 Kg is 23 days old and Rupa feels she does not have enough milk and is very anxious because she feels that the baby is not thriving.

Discussion

Facilitator now initiates a discussion on breastfeeding problems.

EXERCISE

1. Anu comes to the SNCU with her 15 days old baby. She complains that the baby cries a lot and does not "sleep properly". The baby's birth weight was 3000 gms and today's weight is 2900 gms. The baby passes urine 4-5 times in a day. On examination the baby is active; sucking his fingers vigorously and there is nothing abnormal on clinical examination. How will you proceed?

2. Sheela delivered a male baby by cesarean section 10 days back. She is giving exclusive breastfeeds to her baby but finds it very painful. On examination she has cracked nipples. How will you proceed to solve her problem?

3. Baby Maya is a two month old baby growing well on exclusive breastfeeds. Maya has to join work in two weeks' time. She has a six hour shift and it takes her 30 mins to travel to her workplace. You advise her regarding feeding of the baby?

CHAPTER 4

CARE OF LOW BIRTH WEIGHT BABY

In India, 25 million babies are born every year out of which 4.5 million(18%) are born low birth weight (<2500 grams) and 3.5 million (14%) are born prematurely. This exposes them to an enormous risk of dying early, often shortly after their birth.

Even after recovering from neonatal complications, some LBW babies may remain prone to malnutrition, recurrent infections, and neurodevelopmental handicaps. LBW, therefore, is a key risk factor for adverse outcome in early life. Appropriate care of the LBW infants, with adequate attention to feeding and nutrition can improve their survival.

Preterm birth is the leading cause of newborn deaths (in the first four weeks of life) and the second leading cause of death after pneumonia in children under five years.

What is reassuring is that more than three-quarters of these premature babies can be saved with simple and cost effective interventions without the need for sophisticated gadgets and neonatal intensive care. These interventions include antenatal steroid injections, kangaroo mother care, feeding with breast milk, maintaining hygiene and supportive and specific measures to treat newborn infections.

Definitions

When a baby is born, 2 parameters should be considered namely birth weight and gestation:
Birth weight of the baby (normally babies weigh more than 2500 grams)

1. LBW (Low birth weight) <2500 grams
2. VLBW (Very Low birth weight) <1500 grams
3. ELBW (Extremely Low birth weight) <1000 grams

The gestation or the maturity of the baby

Pre-term: < 37 completed weeks, Preterm is defined as a baby born alive before 37 completed weeks of pregnancy. The sub-categories based on gestational age are:

- Extremely preterm (<28 weeks)
- Very preterm (28 to <32 weeks)
- Moderate to Late preterm (32 to <37 weeks)

Term: 37 to 41weeks +6 days
Post-term: ≥ 42 completed weeks

Note: The baby is 40 weeks on the EDD (Expected Date of Delivery).

Learning Objectives

The participant after completing this chapter should be able to:

1. Classify types of LBW neonates
2. Identify risk factors for preterm delivery
3. Identify physical features of preterm neonates and assess the weight for gestation using Intergrowth 21 charts
4. Enumerate problems of preterm & small for gestational age (SGA) babies
5. Chart fluid and feed requirements for a sick LBW neonate
6. Enumerate modes of enteral feeding for a LBW neonate
7. Enumerate the nutritional supplements needed for LBW babies
8. Monitor the nutrition and growth of a LBW baby

Type of LBW

Newborn baby can be LBW because of two reasons:

1. Prematurity : Babies born before 37 completed weeks of gestation.
2. Small for gestational age (SGA): Babies with birth weight below the 10th percentile, for that gestational age and sex. 60% of our LBW neonates fall in this category.

Note: At times, a LBW neonate may be both preterm as well as SGA.
Intra-Uterine Growth Restriction refers to a condition where a fetus has not reached its growth potential. Although many use the terms "small for gestational age" (SGA) and "intrauterine growth restriction" (IUGR) interchangeably, they refer to two subtly different populations. IUGR describes diminished growth velocity in the fetus as documented by at least two intrauterine growth assessments (e.g., a fetus that is "falling off" its own growth curve).

Risk factors for preterm delivery

Most of the times there is no identifiable risk factor but some of the common ones incriminated are listed below:

- History of a previous premature birth
- Mother's age – < 18 years & > 35 years
- Being underweight or overweight before &/or during pregnancy
- Multiple pregnancy
- Conceiving through in vitro fertilization
- Multiple miscarriages or abortions
- Physical injury or trauma
- Uterine, cervical or placental abnormalities
- Substance abuse
- Poor nutrition
- Infections
- Chronic conditions, such as high blood pressure and diabetes
- Stressful life events, such as the death of a loved one or domestic violence

Identification of a Preterm Baby

- The gestational age of a baby can be estimated by LMP, antenatal sonography (especially 1st trimester), however gestational age estimation is also possible by doing a detailed physical and a neuromuscular examination. An illustrated scoring system like, Expanded New Ballard Score (ENBS) (Annexure 2) can be used for this purpose. The following are some of the physical parameters used in the gestational age assessment.

Physical maturity

- ***Skin:*** The skin of preterm neonate is thin, transparent and gelatinous whereas that of a term neonate is thick non- gelatinous and keratinized.
- ***Hair:*** The back of the preterm babies has abundant growth of fine hair called lanugo. The hairy area turns bald as the gestation matures.
- ***Ear Cartilage:*** The external ear or the pinna is soft and devoid of cartilage in preterm neonates and hence, it does not recoil back promptly on being folded. In a term baby there is instant recoil.
- ***Breast Nodule:*** Breast nodule measures less than 5mm in preterm neonates and 5 mm or more in term babies.
- ***Sole Creases:*** Anterior one third of the sole reveals a deep transverse skin crease in preterm neonates and in term neonates they are present over the anterior two thirds or over the entire sole.
- ***External Genitalia:*** In males, the scrotum does not have rugae and testes are not descended into the scrotum. In female infants, the labia are widely separated, not covering the labia minora, resulting in the prominent appearance of the clitoris.

Classification of a Baby: Babies are classified to determine the risk of problems. At birth each baby should be classified based on period of gestation as preterm, term or postterm. The baby is further classified according to the birth weight as AGA (appropriate for gestational age), SGA or LGA (large for gestational age). Refer to Figure 4.1 – Intergrowth 21 'Newborn size at birth'.

The babies who are preterm as well as SGA are more at risk than the babies who are only preterm.

Drill: The facilitator will conduct a drill on classification of babies using Intergrowth 21 charts (Annexure 15).

Problems: A baby born too soon faces a variety of problems, due to immaturity of various organs, presenting immediately after birth or later during the neonatal period requiring special care. The baby is at risk for both short term and long term complications during the SNCU stay and thereafter. Some complications that may arise during the course of stay in SNCU may lead to lifelong disability requiring long term Follow-up.
The basic underlying feature of the preterm LBW infant is immaturity of its organ systems. They are prone to develop:

- ***Asphyxia:*** Birth of a preterm neonate poses additional challenges that make the transition to extra-uterine life more difficult. Generally the degree of prematurity determines the extent of support required to achieve this transition smoothly. Preterm neonates need additional resuscitative measures due to the presence of a large body surface area, immature organ systems, fragile brain capillaries, weak chest muscles coupled with immature lungs and a frail immune system. Special skills including gentle handling are required to prevent neurologic injury and heat loss, optimize oxygenation, provide respiratory support and prevent infection during resuscitation of these vulnerable neonates.

- ***Hypothermia:*** The problem of hypothermia in preterm babies needs special attention because of their large body surface area and decreased brown fat. The maintenance of the ambient temperature of the labour room at 26-28^{0}C and ensuring warm and gentle resuscitation, is essential for prevention of hypothermia. Chapter 2 describes in detail the management of hypothermia in neonates.

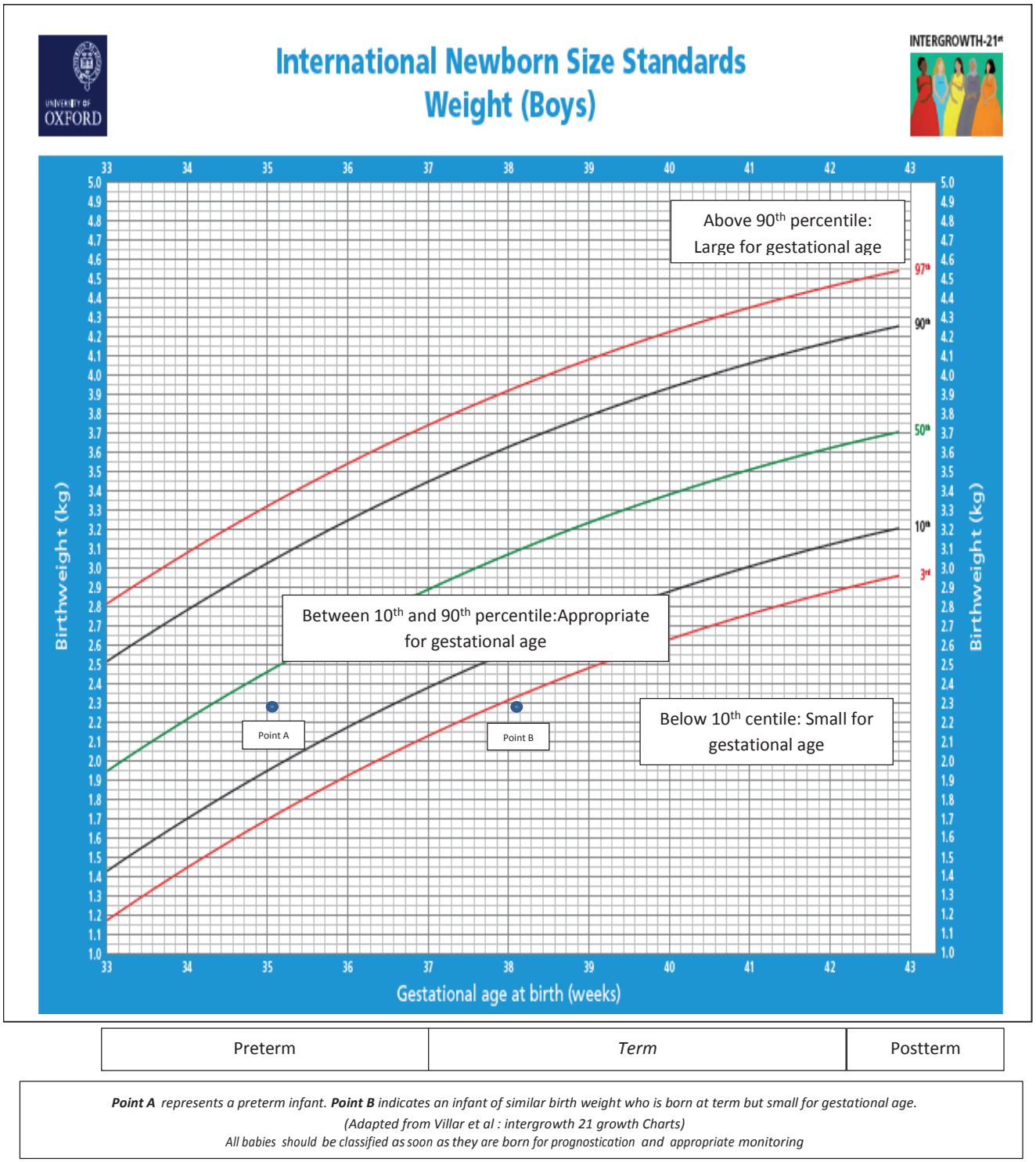


Fig. 4.1: Intergrowth 21 'Newborn size at birth'

- ***Feeding difficulty:*** Preterm neonates have immature oropharyngeal coordination and poor reflexes for feeding. If direct breastfeeding is not possible, they should be fed expressed breast milk as they benefit, not only nutritionally but also immunologically and developmentally from breastmilk. In order to accomplish this, the mother needs extra support for expressing breast milk and the baby needs to be fed using an orogastric tube, cup or paladai. A neonate at 31 weeks attains the ability to co-ordinate swallowing with respiration, but still has no suck-swallow coordination. Hence, neonates less than 31 wks (or 1200 gms), need to be gavage fed to avoid aspiration. At 34 wks (1800 gms), the suck-swallow-breathing co-ordination is gained and hence, babies > 1800gms can be breastfed. Those weighing less than 1800 gms but more than 1200 gms can to be fed by katori spoon/ paladai as they can swallow but cannot suckle at the breast. One should also consider the presence or absence of sickness and individual feeding efforts of the baby to decide how a LBW neonate should be provided with nutrition. Some of the sick preterm babies and those who are extremely preterm need i/v fluids initially. Chapter 4 & 6 describe the details of feeding and intravenous fluid requirements of preterm neonates.
- ***Respiratory distress:*** Due to physical immaturity of the lungs (deficiency of surfactant) preterm babies often present with respiratory distress soon after birth. They may also develop respiratory distress later due to hypothermia, pneumonia, late onset sepsis or metabolic problems like hypoglycemia etc. Precaution needs to be taken while giving oxygen to these small babies to avoid further complications related to hyperoxia. Details of managing a neonate with respiratory distress are addressed in chapter 11.
- ***Metabolic Problems:*** Most common metabolic problem associated with prematurity is hypoglycemia. This can be avoided by careful monitoring of blood glucose at specified intervals and providing appropriate fluids and feeds. Calcium and other electrolytes also need careful monitoring. For details regarding metabolic problems refer to chapter 6 & 7.
- ***Infections:*** Prematurity is one of the most important risk factor for both early and late onset sepsis. Decreasing invasive interventions, maintaining temperature, minimal handling, promoting breastfeeding & KMC and maintaining proper hand hygiene are the best preventive strategies to reduce the occurrence of sepsis. For details of management of Neonatal sepsis refer to chapter 14.
- ***Jaundice:*** Preterm babies, due to the functional immaturity of the liver and other factors related to prematurity have increased bilirubin production and poor bilirubin conjugating capability leading to high bilirubin levels. They are at risk of developing neuro-toxicity at lower bilirubin levels than full-term babies due to immaturity of the blood brain barrier. To prevent this, frequent monitoring of bilirubin levels and timely initiation of phototherapy is required. Refer to chapter 12 for details of management of Neonatal Jaundice.
- ***Brain injury:*** Babies born before 28 weeks are at risk of bleeding in the brain, known as an intra-ventricular haemorrhage due to fragile capillaries. Most haemorrhages are mild and resolve with little short-term impact. But some babies may have larger bleeds which can cause permanent brain injury. To minimise the risk of occurrence of bleeds, fluids and drugs should be administered slowly and sudden changes in blood pressure should be avoided. A policy of minimal handling should be followed.
- ***Apnea of prematurity:*** Preterm babies may have apneic spells without any evident attributable cause due to immaturity of the respiratory centre. Close monitoring and prompt action by way of stimulation, drugs or assisted ventilation may be required. (Refer to chapter 11)
- ***Anemia of prematurity:*** Physiological anemia gets exaggerated in preterm babies due to various factors. It is prudent to monitor the hemoglobin levels and treat the anemia according to standard protocols. (Refer to chapter 15)
- ***Retinopathy of Prematurity (ROP):*** The immature retina of preterm babies is very susceptible to oxidant damage. Oxygen levels should be meticulously monitored during respiratory therapy using pulse oximetry and at no time should the saturation be more than 95%. This would help reduce oxidant damage and the risk of development of ROP, a major cause of blindness. (Refer to chapter 17 on Follow up of high risk neonate).

- ***Hearing loss:*** The risk for sensorineural hearing loss increases as the gestation and birth weight decreases. Hearing loss can be caused by ototoxic drugs like aminoglycosides and furosemide which are commonly used in preterm. Asphyxia, severe jaundice needing exchange transfusion, prolonged ventilator support (> 5 days), sepsis and meningitis are all important risk factors of sensorineural hearing loss. All preterm babies must undergo hearing screening at specified times. (Refer to chapter 17 on Follow up of high-risk neonate).
- ***Others:*** A few babies develop other long term complications like cerebral palsy, impaired cognitive skills, behavioural and psychological problems, chronic health issues, etc. It is very important to follow these babies to detect and treat disabilities as early as possible. (Refer to chapter 17 on Follow up of high risk neonate.)

Problem of SGA Neonates

The basic underlying problem amongst them is in-utero undernutrition and hypoxia. They are more prone to:

- Fetal distress, meconium passage in utero and perinatal asphyxia
- Polycythemia
- Hypothermia
- Hypoglycemia
- Congenital malformations

MANAGEMENT OF LBW BABIES

Delivery of LBW Babies

Ideally, the delivery of an anticipated LBW baby should be conducted in a hospital with established newborn care facilities. The in-utero transfer of a LBW fetus is far more desirable, convenient and safe than transport after birth.

Deciding the place where a LBW baby should be managed

LBW babies weighing >1800 grams (>34 weeks): These babies are shifted with the mother in postnatal care area. However, they are provided with extra assistance and monitoring. The mothers of these babies are counselled and educated on a regular basis by the health care provider, doctor or Yashoda (Mother's aide). The training of mother during her stay should include (1) Kangaroo Mother care (KMC) and assessment of temperature by touch technique (2) Breastfeeding and expression of milk (3) LBW feeding (content and technique) (4) Recognition/ reporting of danger signs and (5) Inputs into all her queries related to care of a LBW baby. Once the mother and the family are confident and the health worker has assessed the knowledge and practice personally, the LBW baby can be discharged and managed at home. A baby who is unable to feed from the breast or katori spoon or is sick should be immediately admitted to the SNCU/NBSU.

LBW babies less than 1800 grams (<34 weeks): These babies should be monitored and cared for in the SNCU, till they can be shifted to the mother side. The period of stay in the SNCU may be for a very short or for several days depending on the sickness level of the baby.

Keeping LBW Babies Warm

At home

Baby should be provided KMC/nursed next to the mother and the room should be kept warm. If the room is not warm enough, the baby should be made to wear 2-3 layers of clothes, cap and socks and wrapped well in a blanket. The mother should be trained to monitor the baby for cold stress by hand touch. The baby in cold stress should be given additional warmth immediately.

In the hospital

Apart from the above methods, overhead radiant warmer or incubator may be used to keep the baby warm. Regular monitoring of axillary temperature at least once every 6-8 hours should be carried out in all hospitalized babies.

Nutrition and fluids

Enteral feeds should be initiated as early as clinically appropriate in all stable LBW babies.
While planning the feeding of the LBW baby, one should consider; (1) Type of feeding (2) Quantity of feeds (3) Frequency of feeding and (4) Modality of feeding that is appropriate for the baby. We will discuss each of this one by one;

Type of Feeding

Mother's milk is the best feeding option for the LBW infants. It should be ensured that the LBW baby always receives 'hind' milk. Hind milk comes towards the end of feeds (hence, the baby should be fed for adequate time on each breast). This is rich in fat content and provides more energy. Alternating the breast too often to feed the baby may result in predominant fore-milk delivery and poor growth.

LBW babies with poor weight gain may be predominantly fed expressed hind milk. The multi-component fortified breast milk should be only reserved for the preterm <32 weeks gestation or <1500 grams, who fail to gain weight despite full volumes of breastfeeds.

Quantity of Feeding

Total daily requirements can be estimated from the table on fluid requirements (Table 6.1). In a stable, growing LBW baby daily intake of feeds should be gradually built up to 150 ml/kg and increased thereafter if needed (generally up to 180mL-200ml/Kg). The quantity delivered should be monitored and charted.

Frequency of Feeding

LBW babies should be fed every 2 hours starting as soon as possible after birth.

Mode for Providing Feeds

The neonate at 30 weeks attains the ability to co-ordinate swallowing with respiration, but still has no suck-swallow coordination. Hence, neonates less than 30 wks (or 1200gms), need to be tube fed to avoid aspiration.

At 34 wks (1800 gms), the suck-swallow-breathing coordination is gained. Hence, babies > 1800gms can be breastfed and those less than 1800 but more than 1200gms can be fed by katori spoon/ paladai. One should also consider the presence or absence of sickness and individual feeding efforts of the baby to decide how a LBW neonate should be provided fluids and nutrition. Table 4.1 should be used for making assessment regarding feeding till the baby is on full breast feeds.

Note: Many of these babies do not need IV fluids, antibiotics and oxygen

Table 4.1: Guidelines for the mode of providing fluids and feeding

Mode of feeding				
Gestation (wks)	<28	28 - <32	32 - <34	≥ 34
Birth Weight (gms)	<1000	1000-<1500	1500-2000	>2000
Age of the neonate and mode of feeding				
Day 1	Start Gavage feeds, remaining requirement as Intravenous fluids	Provide Gavage feeds	Katori-spoon. If unsatisfactory give Gavage	Breastfeeding. If unsatisfactory give Katori-spoon
Week 1	Gavage	Gavage/Katori- spoon	Katori-spoon	Breastfeeding
Week 2-3	Gavage/Katori-spoon	Katori-spoon/ Breastfeeding	Breastfeeding	Breastfeeding
Week 4-6	Katori-spoon/ Breastfeeding	Breastfeeding	Breastfeeding	Breastfeeding
At Discharge	Breastfeeding	Breastfeeding	Breastfeeding	Breastfeeding
1. All small and sick babies should be initiated on MEN using Gavage method on day 1 in the absence of contraindications to enteral feeding 2. Transition to KATORI SPOON Feeding should be attempted at PMA of 31 weeks 3. Transition to Breastfeeding should be attempted at PMA of 34 weeks				

DRILL

The facilitator will now conduct a drill on mode of feeding considering different examples.

Trophic Feeds (Minimal Enteral Nutrition)

Minimal enteral nutrition or trophic feeds are small volumes of expressed breast milk (typically 12 to 24 ml/kg/day every 1 - 3 hours) delivered via intragastric tube and started early in sick babies. These feeds enhance the gut growth, hormonal secretion and gut motility in a LBW neonate. The clinical benefits of MEN are; less feed intolerance, reduction in the days required for attaining full feeds, improved weight gain, fewer days on parentral nutrition and decreased hospital stay.

The augmentation of feeds after MEN may be done as per guidelines in the chapter 6.

Techniques or Methods of Feeding

(a) Non-Nutritive Sucking

An infant born prematurely develops the sucking behaviour (co-ordinated sucking, swallowing and breathing) over time to be able to feed at the breast. This transition may be facilitated by encouraging Non-Nutritive sucking (NNS) in these small babies. NNS is initiated by allowing the baby to suck on an empty breast (after expression). NNS may be started right from the time the baby is on gavage feeds. NNS may encourage the development of sucking behaviour, improve digestion of the feed, blood oxygenation and has been shown to reduce hospital stay.

(b) Gavage feeds

- For gavage feeding; 5-6 French size polyethylene feeding catheter is required for orogastric placement irrespective of weight of the baby.
- Details on insertion of feeding catheter will be taught at the skill station.
- At the time of feeding, the outer end of the tube is attached to a 10 ml syringe (without plunger) and milk is allowed to trickle by gravity.
- The baby should be placed in the left lateral position after feed for 15 to 20 minutes to avoid regurgitation. There is no need to burp a gavage-fed baby.
- The orogastric tube may be left in situ for 2 or 3 days or more if not displaced.
- While pulling out a feeding tube, it must be kept pinched and pulled out gently to avoid trickling of gastric mucus into the trachea.
- The position of the tube should always be checked if in doubt. This can be done by small aspiration of gastric content or by injecting one ml of air and hearing for a gurgling sound with a stethoscope placed over the stomach.

Gavage-fed babies may be prone to regurgitation and aspiration, hence it is important to take precautions during feeding. Before every feed, the abdominal girth (just above the umbilical stump) should be measured. If the abdominal girth increases by more than 2 cm from the baseline, the baby should be evaluated for the cause of ileus. The feeds may have to be suspended till the abdominal distension improves.

Routine pre-feed gastric aspirates are not recommended

(c) Cup/Katori-spoon/paladai feeds

- Feeding with a spoon (or a similar device such as 'paladai') and katori (or any other container such as a cup) has been found to be safe in LBW babies. This mode of feeding is a bridge between gavage feeding and direct breast feeding.
- It is based on the premise that neonates with a gestation of 30-32 weeks or more are in a position to swallow the feeds satisfactorily even though they may not be good at sucking or coordinated sucking and swallowing. Feeds can therefore, be given by a katori and a spoon/paladai.
- All utensils must be washed, cleaned and boiled before use.
- Take the required amount of expressed breast milk in the katori. Place the baby in a semi-upright posture with a napkin around the neck to mop up the spillage.
- Fill the spoon/paladai with milk, a little short of the brim, place it at the lips of the baby in the corner of mouth and let the milk flow into the baby's mouth slowly avoiding spilling. The baby will actively swallow the milk.
- Repeat the process till the required amount has been fed. If the baby does not actively accept and swallow the feed, try gentle stimulation. If the baby is still sluggish, do not insist on this method. It is better to switch back to gavage feeds till the baby is ready.

(d) Breast feeding

The method of breastfeeding is essentially the same as for normal weight babies. LBW babies may be slow in sucking and take longer to feed.

Video on Gavage and Paladai Feeding

This video demonstrates the methods of enteral feeding. It includes gavage feeding, feeding with paladai, katori-spoon and cup.

Fluid requirement

The fluid requirement of neonates is summarized in Table 6.1 in chapter 6.

i. On the first day the fluid requirements range from 60 to 80 ml/kg.
ii. The daily increment in all the groups is around 15 ml per kg till 150 ml/kg is reached.
iii. Adequacy of therapy is indicated by the weight pattern in the expected range.

Judging Adequacy of Nutrition

- The key measure of optimal feeding is the weight pattern of the baby. A preterm LBW baby loses up to 1 to 2 percent weight every day amounting to 10 percent cumulative weight loss during the first week of life. Birth weight is regained by the 14th day.
- SGA-LBW babies who are otherwise healthy should not have any appreciable weight loss at all and they should start gaining weight early.
- It is desirable to weigh all LBW babies at 2 weeks (to check regaining of the birth weight). Once birth weight is regained, the LBW baby should gain 15 to 20 gm/kg/day. Hospitalized LBW babies should be weighed every day on the same weighing machine.
- Optimal weight gain: Daily weight gain of 15-20 gm/kg/day.
- Suboptimal weight gain: A gain of less than 10 gm/kg/day for three consecutive days.

Check the following if weight gain is suboptimal:

1. **Insufficient intake**
   - *a. Breastfed infants:*
     - Improper technique – (positioning/attachment)
     - Infrequent breastfeeding (less than 8–10 times in 24 hours including nighttime feeding)
     - Incomplete emptying of breast (prematurely terminating feed at breast- depriving baby of hindmilk)
   - *b. Infants on assisted feeding (spoon/paladai)*
     - Inadequate amount (error with calculation/measurement or missed feeds)
     - Improper technique of feeding (e.g. excess spillage)
     - Inadequate supplementation/fortification

2. **Increased requirement**
   a. ***Conditions :***
      - Hypothermia/cold stress
      - Feed intolerance
      - Anemia
      - Hyponatremia
   b. ***Late onset Disease states:***
      - Metabolic acidosis
      - Late onset sepsis
      - Bronchopulmonary dysplasia
      - Osteopenia of prematurity
      - Haemodynamically significant patent ductus arteriosus (PDA)
      - Gastroesophageal reflux (GER)

Management of suboptimal weight gain:

1. Breastfeeding counseling of mothers and families including importance of MOM along with correct technique, frequency and nighttime feeding.
2. Counseling regarding correct frequency and technique of assisted feeding (spoon/paladai).
3. Provide practical support for breastfeeding and assisted feeding if required.
4. Look for signs of fatigue during assisted/breastfeeding and modify mode of feeding.
5. Ensure appropriate and timely supplementation/fortification of breast milk.
6. Prevent and manage underlying condition and disease states.

Delayed initiation and slow augmentation of enteral feeds remains the most important cause of delay in regaining birth weight and subsequent adequate weight gain

Initiation and progression of assisted enteral feeds

In stable preterm and VLBW Infants: It is important to initiate feeding as soon as possible after birth. First feed can be given as early as within 2 hours of birth and subsequent feeds can be given every 2 hours. Stable preterm and VLBW infants can be given the entire fluid requirement for the day as enteral feeds starting from day one of life. This strategy of ETEF (Early total enteral feeding) saves the infant from invasive interventions (needle pricks, intravenous fluids) and associated complications like skin breach, pain, suboptimal weight gain, sepsis and parenteral nutrition associated metabolic syndromes. ETEF is not associated with increased feed intolerance or NEC. This has been found to reduce antibiotic usage, duration of hospital stay and cost of therapy while promoting optimal growth.

In sick preterm and ELBW infants: In babies with significant respiratory distress or other signs of sickness and in infants weighing <1 kg at birth, initiate minimal enteral feeding @ 15–20 mL/kg/day as soon as the baby is hemodynamically stable. If the feeds are tolerated (abdomen is soft and not distended with no increase in abdominal girth), consider increasing feeds @ 20-30 mL/kg/day. Further increments of 30-50ml/kg/day can be considered depending on the baby's clinical condition. Such increments in enteral feeding have shown no increase in NEC, late onset sepsis or neurodevelopmental disability.

Nutritional Supplements needed by LBW Babies:

Vitamin K1 (Phytonadione, 0.5ml=1 mg of $VitK_1$)
All LBW <1000 gms should receive 0.5 mg IM of Vitamin K1 at birth and >1000 gms, 1 mg IM.

Vitamin D

All LBW infants who are exclusively breastfed should receive 400 IU vitamin D daily, whereas those on expressed breast milk via gavage or spoon, the same should be administered, once the infant is receiving 100ml/kg/day of feeds.

Iron

Initiate Iron supplementation with 2-3 mg/Kg/day at 2 wks of age and continue till one year of age.
All very low birth weight babies (< 1500 gms) should receive the following supplements once they are on 100ml/kg/day of feeds and should be continued till 40 weeks post menstrual age (PMA).

a. ***Multivitamin drops with Zinc:*** 1ml /day
b. ***Calcium and Phosphorous:*** Calcium at 120-140mg/Kg/day and phosphorous at 60-90mg/Kg/day (use preparations containing calcium and phosphorous in a 2: 1 ratio)

Discharge Planning of LBW Babies

The discharge of LBW babies should be planned once the neonate is free from any significant illness and the following points should be considered prior to discharge:

- Weight gain should be consistently demonstrated for 3 consecutive days. The weight, head circumference and the length should always be recorded at the time of discharge.
- Mother should be confident in feeding the neonate (Breastfeeding/ any alternate feeding method like paladai or spoon).
- The required nutritional supplements should have been started.
- The baby should have received BCG, Hep B and OPV.
- The methods of temperature regulation like the KMC and any other skills should be well known to the mother and adequately practiced in the hospital under medical supervision.
- All danger signs (as below) should be explained in detail to the parents with information regarding whom and where to contact mentioned on the discharge slip.
    a. Feeding difficulty
    b. Fast or difficult breathing
    c. Fever or cold to touch
    d. Mother feels that the baby is unwell/sick

The babies who are <2000 grams should be advised for a screen for ROP at 32wks of postmenstrual age(PMA) or 4wks of corrected/ postnatal age, whichever is later. For infants less than 28wks, screen at 3wks of postnatal age to detect Aggressive ROP. Hearing evaluation after completion of 34 weeks of corrected/postmenstural age or at discharge.

Vaccinations in LBW Babies

If the LBW baby is not sick, the vaccinations schedule is the same as for normal babies. Hence, BCG, OPV & Hepatitis B should be given at the earliest. A sick LBW baby however, should receive these vaccines only on recovery at discharge.

Growth monitoring in LBW Babies

All LBW infants should be checked for weight (daily), head circumference (weekly) and length (weekly or fort-nightly) during their SNCU stay. Serial growth monitoring allows early identification of growth faltering. Intergrowth charts (Annexure 15) are to be used for preterm babies. WHO Growth charts (2006) should be used from corrected age of 64 weeks into childhood (Annexures 17 & 18).

Screening

Screening for ROP, Hearing and Intracranial haemorrhage (USG brain) should be done at an appropriate time for prevention of blindness, hearing disability and diagnosis of intracranial haemorrhage respectively, at a higher facility.

Follow up: All preterm babies discharged from SNCU must be followed up for growth monitoring, feeding, immunization, systemic examination and early detection of disability by a team of specialists (Chapter 17).

Prevention of Premature births: It is difficult to prevent all premature births as most often risk factors cannot be identified but timely attention to the following aspects will go a long way in preventing premature birth and its complications.

- ***Antenatal steroids (ANS) to mother:*** The complications related to preterm birth and the mortality can be significantly decreased by **giving antenatal steroids (ANS) to mother**. Government of India recommends Dexamethasone 6 mg IM every 12 hrs (4 doses) to mothers at risk of imminent preterm birth (24-34 weeks). ANS have optimal benefit when the delivery occurs 24 hrs after completion of therapy. However, even a single dose is beneficial.
- Antibiotics for Preterm prelabour rupture of membranes (PPROM) may help to prolong pregnancy giving time for ANS to act thus reducing number of short term morbidities. Amoxyclav to the mother should be avoided to prevent risk of necrotising entrocolitis (NEC).
- ***Magnesium Sulphate to mothers during labour for neuroprotection:*** For women with imminent preterm birth (≤ 31+6 weeks), antenatal magnesium sulphate administration should be considered for fetal neuroprotection. Dose: 4g IV loading dose, over 30 minutes, followed by a 1g/hr maintenance infusion until birth or 24 hours, whichever is first.
- Female education, better nutrition, better access to family planning and increased empowerment, as well as improved care before, between and during pregnancies.
- Institutional deliveries attended by trained staff.
- Ensuring availability of functional equipment, essential drugs and trained staff in the health facilities.
- Safe transport & a functional and effective referral system.

Prognosis

Mortality of LBW babies is inversely related to gestation and birth weight and directly to the severity of complications. In general, over 90% Low birth weight babies who survive the newborn period have no neurodevelopmental handicaps. Therefore, essential care of the LBW neonates is a highly rewarding experience.

There is no role of giving steroids to the baby after birth to prevent the complications of prematurity

EXERCISE

1. Mention the fluid requirement of a 1500 gm baby on D6 of life?

2. How will you initiate feeding in a 1400 gm, 32 weeks gestation baby on D3 of life?

3. A 32 weeks preterm baby, weighing 1350 gm, is on enteral feeds @ 100ml/kg/day. What supplements will you advise; in what quantity and till what time will you continue the supplements?

4. A 1200 gms baby who has been admitted in the SNCU for the last 12 days is being discharged today. Mention the advice you will give the mother regarding care and feeding of this baby at home.

CHAPTER 5

DEVELOPMENTALLY SUPPORTIVE CARE

Developmentally supportive care is an integrated approach comprising of a set of do's and don'ts which are potentially beneficial for sick preterm neonates to help them cope with the adverse external environment of the NICU. For operationalization of evidence based developmental care program, the following core measures are proposed:

- Protected Sleep
- Pain and stress assessment and management
- Developmentally supportive activities of daily living
- Family centered- care
- Creating a healing environment

These patient centered core measures need to be integrated into routine clinical practice and their performance needs systematic audit, so as to reap maximal benefits. Many measures overlap and are beneficial in more than one way.

Protected Sleep

- All non-emergent 'care giving procedures' are performed while infant is awake (No disturbance while baby is sleeping).
- Promote sleep by facilitative tuck, swaddling and skin-to-skin contact (Nesting/swaddling).
- Kangaroo mother care.
- Environment:

a. Light and sound levels are minimized.
b. Day-night pattern is simulated by reducing lights at night to facilitate nocturnal sleep.
   - Family education on care giving activities that promote safe sleep.
   - Use focussed lighting for procedures.
c. Minimize sound by:
   - Creating awareness (staff and family members).
   - Minimizing conversation in NICU.
   - Addressing alarms in NICU.
   - Avoiding cross door talks.

Prevent and Treat Pain

- Cluster care.
- Care giving activities should be adapted to minimize pain and stress. Adhesive should be removed only when it has loosened from skin surface. Wet the adhesive tape with normal saline before removal.

- Parents must be educated regarding infant pain and involved in its management.
- Unit protocol to document and manage pain and stress should be in place. Documentation should be done every 4 -6 hours using standard scores. Every painful procedure should have a documentation of the score before, during, and following the intervention till return of the infant's pain scores to pre-procedural level.
- There should be use of both non-pharmacologic and / or pharmacologic measures prior to painful or stressful procedures.
- Pain and stress management care plan should be shared with parents.

Provide Developmentally Supportive Care for Activities of Daily Living (ADL)

- Use boundaries around the infants to maintain them in flexed posture (similar to in- utero posture).
- Gentle handling of baby should be ensured during sponging, weighing, lifting for changing bedsheets and all other care giving activities.
- Diaper should be changed gently without lifting the legs.
- Provide non-nutritive sucking (NNS) while the infant is being fed by gavage or paladai by allowing the baby to suck on mother's empty breast. NNS should be initiated soon after starting the baby on assisted feeding.
- Mothers must be encouraged to participate in ADL such as gavage or paladai feeding, oil application, diaper change and sponging etc., under supervision.

Provide Family Centered Care

According to Govt. of India guidelines, 70% of the admitted LBW babies can be roomed in with the mother and provided LBW care without separation. **Developmentally supportive care practices such as Nesting, Swaddling, Non-Nutritive Sucking, Breastfeeding, Facilitated Tuck or Hand Containment, Kangaroo Mother Care etc. need the presence of the mother by the side of her baby**. Neonatal intensive care units (NICU) in the developed regions of the world allow the mothers and families to visit the Neonatal unit freely to participate in the care of their baby and stay with them. In India, family access into the neonatal units is limited. Mothers do visit the SNCU in most of the centres, but merely as visitors, not care givers. MNCU is an effort for family centered care.

Family Participatory Neonatal Care (FPC) as a strategy was initiated by the Government of India in 2014, and subsequently, the National Operational Guideline was released in 2017.

There is sufficient evidence from developed countries to show that neonatal outcome improves as a result of increased parent-infant interaction in NICU. Mother infant separation leads to significant psychological stress in mothers and has substantial negative impact on mother-infant bonding. Providing facilities for parents to stay in the neonatal unit have the potential of early initiation of breastfeeding and skin to skin care, improving weight gain, reducing length of hospital stay, and possibly better neurodevelopmental outcomes.

FPC Initiative imparts skills and knowledge related to baby care to the mother/caregiver.
These are:

1. Hand-washing skills; importance of infection prevention; protocol for entry to nursery.
2. Developmentally supportive care (cleaning, sponging, positioning, nesting, handling and interacting with the baby; breastfeeding techniques, expression of breast milk and assisted feeding).
3. Kangaroo mother care.
4. Preparation for discharge and care at home.

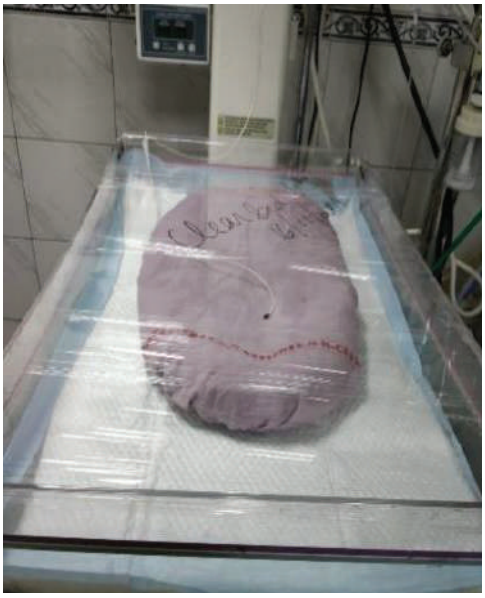
Mothers and family members are actively involved in care of sick newborns. Mothers are encouraged to visit SNCU as frequently as possible.

However, to achieve effective family participatory care, mother needs to be with her baby for the entire day. In existing SNCU, mother should be allowed to visit frequently and to stay longer to provide KMC and breast milk feeding. At the time of admission mothers are briefed about hand hygiene, asepsis routines, provided support for breastfeeding and Kangaroo mother care (KMC). She is also trained to monitor a neonate and identify danger signs.

Govt. of India has decided to expand the concept of M-NCU and reorganize Special newborn units in the country to accommodate both baby and mother together to ensure mothers and family members are involved in neonatal care.

There is no additional risk of neonatal infections due to presence of mother in SNCU. There is strong evidence that KMC reduces risk of severe infections in neonates which suggests that exposure to maternal flora has protective effect on neonates.

Presence of the mother in the Newborn Care unit results in a paradigm shift of her role from a visitor to care provider for her baby & empowers her to take care of her baby.



Source: Neonatal Unit, LHMC

Fig. 5.1 a: Bed with nest for the arrival of new baby

Source: Neonatal Unit, LHMC

Fig. 5.1 b: Baby in Nesting Position

Source: Neonatal Unit, LHMC

Fig. 5.1 c: Nurses Counselling Mothers and other family members regarding KMC, Breastfeeding

Source: Neonatal Unit, LHMC

Fig. 5.1 d: Mother giving feeds via oro-gastric tube

Source: Neonatal Unit, LHMC

Fig. 5.1 e: Mothers giving feeds via spoon

Source: Neonatal Unit, LHMC

Fig. 5.1 f: Fathers providing KMC

Source: Neonatal Unit, LHMC

Fig. 5.1 g: Mothers providing Kangaroo Mother Care

The post-partum care provided to the mothers inside the M-NCU, is similar to the care given in the post-natal ward. This benefit gets extended even to mothers of outborn babies. This also ensures better coordination between the obstetrics and neonatal team.

Healing Environment

- Minimize sound and lights. Do not place anything on baby bassinets. Cover bassinets with a cloth sheet to minimize light. Do not use procedure light unnecessarily.
- Make sure health professionals practice 'good care giving behaviour' such as adherence to infection control protocols, have cultural sensitivity and empathetic attitude towards families and involve parents in babycare and decision making.
- Do not perform investigations as a routine. Consider utility of an investigation prior to ordering it. **Any test result that is unlikely to change the management is unnecessary and can be potentially harmful (pain, infection risk, blood loss)**.
- Promote free and healthy communication between physicians, nurses and other professionals working in NICU/SNCU. A cohesive team is more likely to avoid errors and provide a healing touch.

DSC is a continuous process starting at birth which has to be individualised for each infant. It reduces stress, promotes growth and provides much needed stimulation to the developing brain.

VIDEO on Developmentally Supportive Care

Developmentally Supportive Care

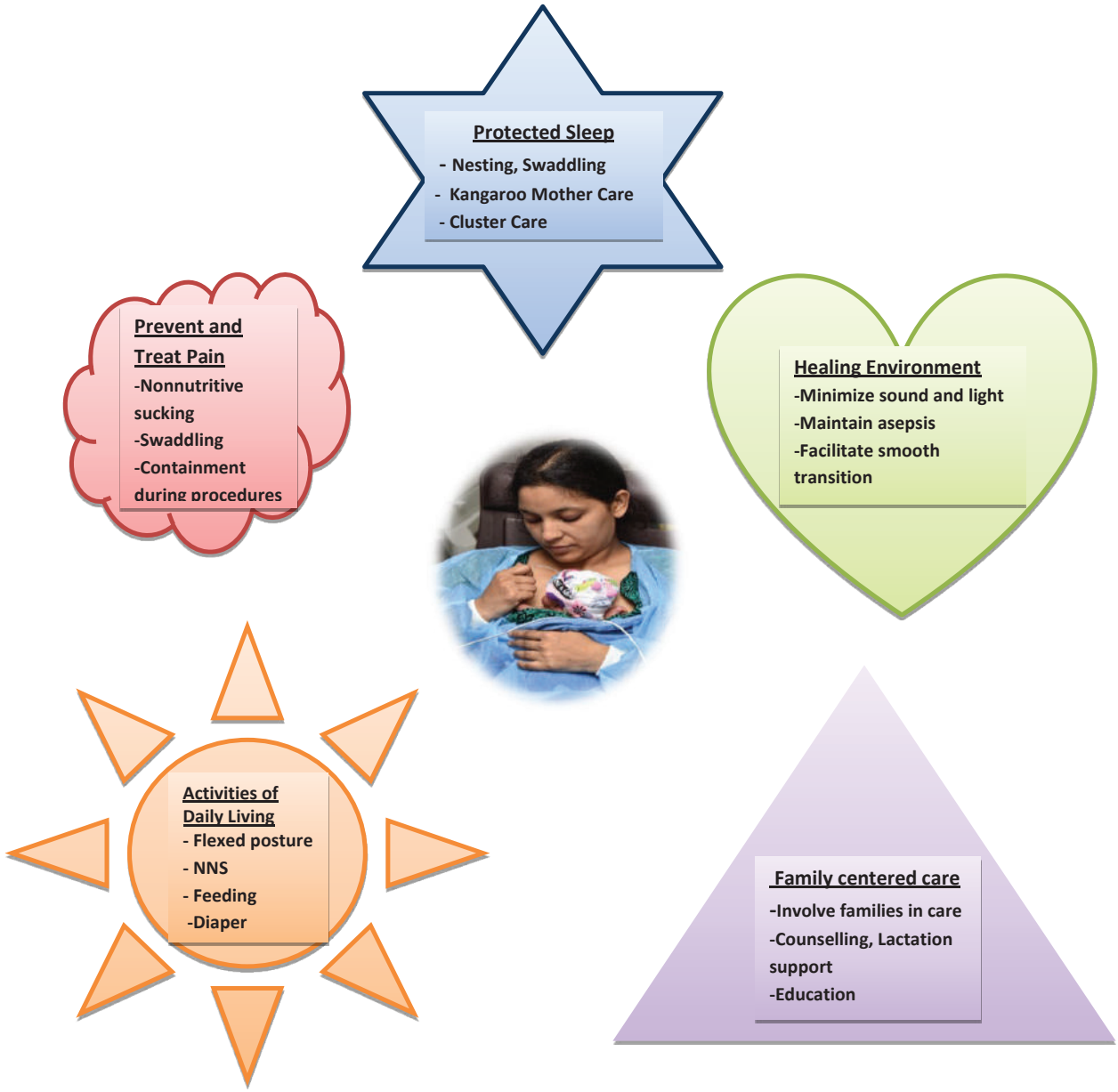


Fig. 5.2: Core Components of DSC

CHAPTER 6

FLUID MANAGEMENT

Maintenance of fluid and electrolyte balance is an integral aspect of neonatal care. Breast milk is sufficient to maintain fluid balance in most clinically stable newborns in SNCU who can be fed orally. However, sick newborns require intravenous fluids and electrolytes for sustenance. The goal of early fluid management is to allow normal weight loss while ensuring physiological stability.

Learning Objectives

After completion of this chapter the participant should be able to:

- Identify babies who need IV fluids (not all admitted babies need IV fluids)
- Calculate daily fluid and electrolyte requirement
- Administer IV fluids with micro drip infusion set/syringe pump
- Monitor babies receiving IV fluids
- Adjust IV fluids with enteral feeding

Indications of IV fluid therapy

- Any sick baby not tolerating enteral feeds
- Shock
- Severe perinatal asphyxia (chapter 9)
- Abdominal distension (suspected congenital GI anomalies, Necrotising enterocolitis)

Choice of fluids

Electrolyte-free fluids such as 10% dextrose are used in the first 48 hours of life. Sodium supplementation is not required in the first 48 hours unless intravascular expansion is necessary as in shock. After 48 hours if the baby is passing urine 6-8 times a day, use commercially available IV fluid such as Isolyte P.

Administration of IV fluid

- Use micro drip infusion set or syringe pump to deliver a measured volume of fluid.
- In micro drip infusion set, e.g. Pedia Drip Set, one ml is equal to 60 micro drops. In this device, number of drops per minute is equal to ml of fluid per hour e.g. if a baby needs 6ml/hr provide 6 micro drops/minute. Adjust drop rate carefully and check it periodically to ensure delivery of correct amount of fluid.
- Syringe pump is a more reliable way to deliver small volume of fluids and medications in sick babies. In this device a presure monitoring line (PMO) is connected to a syringe containing fluid which is then connected to the IV cannula. Fill PMO line with infusate to ensure rapid delivery of medication to the baby.

- Use aseptic precautions including sterile gloves while filling syringe pump or micro-drip set with fluid or giving IV medications.
- Calculate fluid requirement for 24 hours. The burette of micro-drip set should contain fluid for no more than 8 hours and should be refilled in every nursing shift.
- Maintain strict input/output chart and review it every 8 hours. Include the volume of medications and IV flushes in the total fluid calculations.
- Secure the IV cannula properly with a skin friendly adhesive tape. Generally, there is no need to splint the extremity.
- Before infusing IV fluid, check:
    - The expiry date of the fluid
    - The seal of the infusion bottle or bag for its intactness
    - That the fluid is clear and free from any visible particles

Change syringe, PMO line and micro-drip infusion set and fluid bag every 24 hours to avoid contamination and nosocomial infection; discard any unused fluid.

Volume of IV fluids to be given (table 6.1)

Volume of fluids depends on birth weight, gestational age, and postnatal age. Fluid needs of preterm newborns are more as compared with term babies due to higher insensible losses.

Table 6.1: Fluid requirement of neonates (ml/kg body weight/day)

Day of Life	Birth weight≥1500 g	Birth weight<1500 g
1	60	80
2	75	95
3	90	110
4	105	125
5	120	140
6	135	150
7	150	150

Table 6.2: Estimation of Energy Requirement of the Low Birth Weight Infant

	Average Estimation (kcal/kg/day)
Energy expended Resting metabolic rate Activity Thermoregulation	**40-60** 40-50 0-5 0-5
Synthesis	15
Energy stored	20-30
Energy excreted	15
Energy intake	90-120

Example

Calculation of IV fluids for a 4 day old neonate with birth weight of 1.2 kg: Total fluid requirement on Day 4 of life as per Table 6.1 = 125 ml/kg day. 125 x 1.2 = 150 ml/day = 150 ml/24 hours = 6.2 ml/hour (fill 50 ml for 8 hrs at a time).

Fluid order: IV Fluid as Isolyte P 150 ml in 24 hr@ 6.2mL/hr with a syringe pump or 6 µdrops/min with a microdrip set. Give this fluid with a microdrip set at a rate of 6 µdrops/minute OR with a syringe pump at a rate of 6.2 ml/hour.

Monitoring of babies receiving IV fluids

- Inspect the infusion site every hour. Look for redness and swelling around the insertion site of the cannula, which indicates that the cannula is not in the vein and fluid is leaking into the subcutaneous tissues. If redness or swelling is seen at any time, stop the infusion, remove the cannula, and establish a new IV line in a different vein.
- Check the volume of fluid infused and compare to the prescribed volume, record all findings every 2 hrs in the fluid monitoring chart.
- Measure blood glucose every nursing shift i.e. 8 hourly. If the blood glucose is less than 45 mg/dL, treat for low blood glucose. If the blood glucose is more than 150 mg/dL on two readings one hour apart-reduce the GIR and check blood glucose after 30 mins. (Refer to chapter 7)

Daily monitoring

- Weight - Weigh the baby daily, preferably using electronic weighing scale in the morning.
- Urine output - Urine output can be roughly estimated by counting the frequency of passage of urine, or more accurately by weighing wet nappies on electronic weighing scale or using urobag. Oliguria is defined as urine output <1 ml/kg/hr over a 6-hour period beyond 48 hours of age.
- Signs of over hydration - puffiness of eyelids, excessive weight gain and respiratory distress.

Use birth weight for all calculations (fluids and drugs) as long as baby's postnatal weight remains below birth weight. Once birth weight is regained use actual body weight for weight based calculations.

- If the daily weight loss is more than 5%, increase the total volume of fluid by 10 ml/kg body weight for one day and then reassess. If there is no weight loss or there is weight gain in the initial 3 days of life, do not give the daily increment, keep the fluid rate same as the previous day. However, if there is excessive weight gain (3-5%) decrease the fluid intake by 15 – 20 ml/kg/day.
- If there is oliguria and weight loss, increase daily fluid intake by 10-20 ml/kg. However, if there is oliguria with weight gain, decrease daily fluid volume by 10 ml/kg and evaluate renal function. In case of acute kidney injury replace insensible losses (25 ml/kg in term babies and 50 ml/kg/day in preterm babies) as electrolyte free 10% Dextrose solution and urine output as half-normal saline (0.45% N). During fluid restriction, glucose infusion rate should not be below 4 mg/kg/min to avoid hypoglycemia. This may necessitate giving higher dextrose concentrations.

- In intestinal obstruction gastric aspirate is replaced by half normal saline and bilious aspirate by Ringer lactate/NS on volume basis every 8 hours.
- Fluids for dehydration: Serial recording of weight is the most reliable way to assess the severity of dehydration. Physical signs of dehydration are less reliable in newborns. Dehydration is corrected slowly over 24 hours in newborns. The fluid used for deficit correction is N/2 saline. Half of the deficit is corrected over 8 hours and remaining half over 16 hours. This is in addition to maintenance needs plus ongoing losses.
- If there is severe dehydration secondary to diarrhea it should be corrected as per Plan C of National IMNCI guidelines.
- Potassium (2 meq/kg/day) is added to IV fluids after urine flow is established. One ml of IV KCl solution contains 2 meq of potassium. Add 1 mL IV KCl to 100 ml of IV fluid.

Sample table for fluid intake instructions and monitoring

Date: 10/06/2012 Name: B. Meena CR No: 123456 Wt: 1310 gms Day of life: 3
Total fluid requirement (TFR) 110 mL/Kg
Total volume 1.310 Kg x 110 ml = 144 mL
IV fluid as Isolyte P 48 ml 8 hrly @ 6ml/hr or 6 µdrops/min

Table 6.3: Chart to be maintained by nursing staff

Time	Total Fluid	Fluid Infused	Fluid Remaining	Remarks and Initials
8 am	48 ml	0 ml	48 ml	
9 am	48 ml	6 ml	42 ml	
10 am	48 ml	12 ml	36 ml	
11 am	48 ml	18 ml	30 ml	
12 noon	48 ml	24 ml	24 ml	
1 pm	48 ml	30 ml	18 ml	
2 pm	48 ml	36 ml	12 ml	
3 pm	48 ml	42 ml	6 ml	
4 pm	48 ml	48 ml	0 ml	

Adjusting IV Fluid with enteral feeding

- Initiation of oral feeding: As soon as the baby's clinical condition improves, begin breastfeeding provided there is no abdominal distension. If the baby cannot be breastfed, give expressed breast milk using cup feeding or tube feeding.
- If the baby is tolerating cup or tube feeds, increase the volume of feeds by 20- 40ml/kg/day (lower range for VLBW), while decreasing the volume of IV fluid to maintain the total daily fluid volume according to the baby's daily requirement.
- Chart the total fluid requirement per day as per Table 6.1. Subtract the daily volume of feeds and give the remaining as IV fluid.
- Discontinue the infusion of IV fluid when the baby is receiving 100 ml/kg/day or about two- thirds of the daily fluid volume as oral feeds and has no abdominal distension or vomiting.

Example

Conventional enteral feeding
Birth weight: 1200gm, gestation 31 weeks, hemodynamically stable on CPAP/oxygen by nasal prongs

Day of Life:1
Total fluid requirement 80 x 1.2 kg = 96 mL/day
Total feeds (MEN) 30ml/kg/day = 36 mL
Amount per feed = 36 ÷ 12 = 3 mL
(No of feeds) x (Feed vol) = Total feed volume
Feeds are 3 ml 2 hrly i.e. 12 feeds x 3 mL = 36 mL
Total fluid requirement – Total feed volume= IV fluids to be provided= 96 ml – 36 ml = 60 mL
Provide this as 10% Dextrose 20 ml 8 hrly @ 2.5 mL/hr or 2/3 µdrops/min

Day 2
Total fluid requirement 95 x 1.2 kg = 114 ml/day
Total feeds 60 ml/kg = 72ml
Amount per feed = 72 ÷ 12 = 6 mL
(No. of feeds) x (Feed vol) = Total feed volume
Feeds are 6 ml 2 hrly i.e. 12 x 6 = 72 ml/day
Total fluid requirement – Total feed volume= IV fluids to be provided= 114 – 72 = 42 ml
Provide this as 10% Dextrose 14 ml 8 hrly @ 1.75ml/hr or 1-2 µdrops/min

Day 3
Total fluid requirement 110 x 1.2 kg = 132 ml/day
Total feeds 100 ml/kg = 120 ml/day
Amount per feed = 84 ÷ 12 = 7 mL
(No. of feeds) x (Feed vol) = Total feed volume
Feeds are 10 ml 2 hrly i.e. 12 x 10 = 120 ml/day
One can stop IV fluids at this juncture as the neonate is receiving 100 mL/Kg. This baby receives IV fluids just for 48 hrs of life.

Day 4
Total fluid requirement 125 x 1.2 kg = 150 ml/day
Total feeds 125ml/kg = 150 ml/day
(No. of feeds) x (Feed vol) = Total feed volume = 12 x 13 = 156 ml
Hence, Oral feeds on D4 = 13 ml 2hrly
No IV fluids

Day 5
Total fluid requirement
140 x 1.2 kg = 168 ml/day
Total feeds 140ml/kg = 168ml/day
(No. of feeds) x (Feed vol) = Total feed volume = 12 x 14 = 168 ml
Hence, Oral feeds on D5 = 14 ml 2hrly

Early total enteral feeding

Birth weight: 1200gm gestation 31 weeks, hemodynamically stable on CPAP/oxygen by nasal prongs

Day of Life:1
Total fluid requirement 80 x 1.2 kg = 96 mL/day
Total feeds 80ml/kg/day = 96 mL
Amount per feed = 96 ÷ 12 = 8 mL
(Feed vol) x (No of feeds) = Total feed volume
Feeds are 8 ml 2 hrly i.e. 8 mL x 12 feeds = 96 mL
Provide this as Expressed breastmilk/donor milk or available preterm formula.

Daily increments are as per the daily fluid requirements (i.e.15ml/kg/Day - Refer to Table 6.1) subject to tolerance assessed by abdominal girth and daily weight.

Key messages

- Use 10% Dextrose in first 48 hours of life.
- After 48 hours of life, use 5% Dextrose containing sodium & potassium as maintenance fluid e.g. Isolyte P.
- Use of syringe pump or microdrip infusion set facilitates the administration of small volume of IV fluids.
- Serial weight recording and urine output are useful in assessing fluid balance in newborns.
- Initiate enteral feeding as soon as baby's hemodynamic condition stabilizes.
- ETEF is feasible, safe and advantageous and should be initiated in all stable neonates.

EXERCISE

Preterm neonate weighing 1.4 kg with breathing difficulty is brought to SNCU at 2 hours of age. The health care provider has decided to provide IV fluids along with other supportive treatment.

1. What IV fluid will you start? How much volume of IV fluid is needed and at what rate?

2. After 48 hours this baby still needs IV fluids. What changes in IV fluids are required?

3. Baby's respiratory distress settled on day 3 and he was started on minimal feeds. Today on day 4 he is on 5 ml 2 hrly feeds of EBM. How will you adjust the IV fluid?

4. What are the steps of monitoring this baby who is on IV fluids?

5. On Day 6 of life baby is receiving 12 ml of EBM every 2 hours. How will you adjust IV fluids?

CHAPTER 7

MANAGEMENT OF HYPOGLYCEMIA

Introduction

Hypoglycemia is the most common metabolic disorder in newborn babies. Anticipation, prevention, and early treatment are essential to reduce morbidity and mortality, and long-term neuro developmental sequelae associated with hypoglycemia.

Definition

Hypoglycemia is defined as a blood glucose level of less than 45 mg/dL in all newborns.

Learning objectives

After completion of this chapter the participant should be able to:

- Identify babies at risk of hypoglycemia
- Perform blood glucose estimation using dextrostix or glucometer
- Screen babies for hypoglycemia
- Manage hypoglycemia

Types

Hypoglycemia may be symptomatic or asymptomatic. It is important to realize that even asymptomatic hypoglycemia can cause brain damage and should be treated without delay.

Neonates at risk of hypoglycemia

- Premature and LBW neonates especially those weighing less than 2.0 kg.
- Infants of diabetic mother/LGA (large for gestational age).
- Sick neonates (perinatal asphyxia, hypothermia, poor and/or delayed feeding, sepsis, shock, respiratory distress and polycythemia).
- IUGR/SGA babies.
- Babies on IV fluids.
- Mothers on drugs like Propanolol, Labetalol, oral hypoglycemic agents, etc.

Technique of estimating blood sugar using reagent strips

- Things needed for blood sugar estimation using reagent strips: a) soap and water to wash hands, b) alcohol for skin preparation, c) test strips, d) glucometer and e) 26 gauge needle or lancet.
- Even though heel is the commonly used site one can also directly prick over the vein to obtain blood sample. This is less painful compared to the heel prick.
- Make sure heel is not cold. Heel can be warmed by holding it in your hand for a few minutes.
- Prepare the site with 70% isopropyl alcohol/spirit, using a scrubbing/circular motion. Allow spirit to dry. Contamination by alcohol may lead to erroneously high values. Do not use povidone iodine/betadine, as specimen contamination may elevate some results.
- Take appropriate non-pharmacologic pain relieving measures like swaddling, facilitated tuck and giving few drops of EBM or 25% dextrose atleast 30 seconds before the procedure.
- Make a needle stick puncture on the postero-lateral/postero medial aspect of heel. Avoid the middle portion of heel and avoid making deep punctures (Fig. 7.1).
- Follow the instruction on the reagent strip bottle for obtaining blood for analysis.
- If blood glucose is low send blood sample to laboratory for confirmation. However, treatment should be started immediately based on this estimation. Plasma glucose is 10% higher than blood glucose.
- Delay in laboratory analysis of blood sample may result in fall of plasma glucose level by 14-18 mg/dL/hour.

Screening for hypoglycemia: Newborn at risk of hypoglycemia should be screened at 2 hours, 6 hours, 12 hours, 24 hours, 48 hours and if indicated at 72 hours of age. The purpose of screening is to anticipate and prevent symptomatic hypoglycemia in at risk newborns.

Symptoms of hypoglycemia: There are no specific or characteristic features of hypoglycemia in newborns. The common symptoms in newborns are:

- Jitteriness, irritability
- Lethargy
- Weak or high-pitched cry
- Poor feeding, vomiting
- Tachycardia (>180/min)
- Sweating
- Hypothermia
- Poor respiratory effort or apnea, tachypnea
- Dusky color or cyanosis
- Seizures, coma

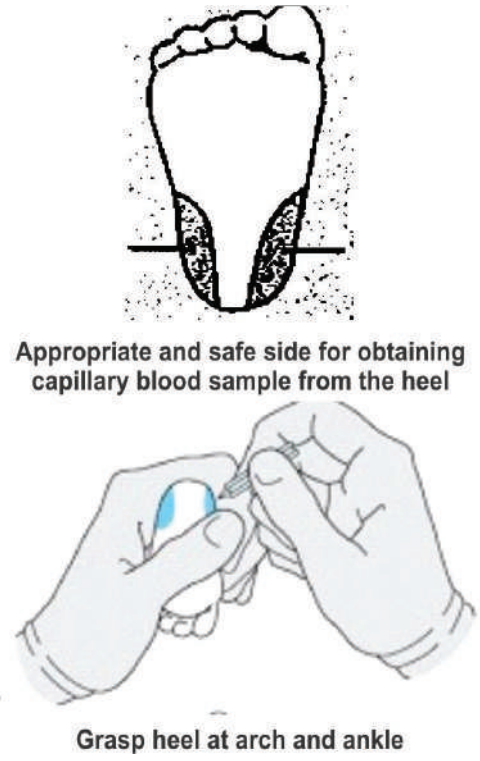


Fig. 7.1: Heel lancing - site and method of sampling

Differential diagnosis

The clinical features of hypoglycemia are non-specific and can mimic any other illness in newborn. Moreover, hypoglycemia can occur as a complication during the course of illness. Therefore, it is a good clinical practice to check blood glucose in any sick newborn. Important differential diagnoses include sepsis, hypothermia, and perinatal asphyxia.

If the signs are not alleviated by correction of hypoglycemia, consider other diagnostic possibilities for the symptoms.

Management

Manament of symptomatic hypoglycemia and when the blood sugar is <25mg/dl:

- Establish an IV line and give a bolus of 2 ml/kg body weight of 10% Dextrose IV slowly over 1 minute.
- If an IV line cannot be established quickly, give 2 ml/kg body weight of 10% Dextrose by orogastric tube.
- Start infusion of dextrose containing fluid at the daily maintenance volume according to the baby's age so as to provide a glucose infusion rate (GIR) of 6 mg/kg/min.
- If the blood glucose remains below 45 mg/dL, GIR should be increased in steps of 2 mg/kg/min to a maximum of 12 mg/kg/min.

- Check blood glucose 30 minutes after starting the infusion of glucose or any change in GIR. If blood glucose is above 45mg/dL, continue glucose infusion at this rate and recheck blood glucose 1 hour later. With two blood glucose values in normal range, the frequency of glucose monitoring is reduced to 6 hrly.
- If the blood glucose is less than 25mg/dL, repeat the bolus of 10% dextrose, 2ml/kg and increase GIR.
- If the blood glucose is between 25-45mg/dL, do not give dextrose bolus but increase GIR.
- The upper concentration of dextrose solution which can be infused safely through peripheral vein is 15%. Concentrations higher than this necessitate central line placement and referral.

- Tapering of glucose infusion: Once the blood glucose levels remain above 45mg/dL for more than 24 hours, begin tapering GIR in steps of 2mg/kg/min every 6 hours, ensuring blood glucose levels are above 45mg/dL before changing GIR. If blood glucose drops below 45mg/dL any time, go back to the previous GIR.
- Initiate enteral feeding (preferably breastfeed/ EBM) at the earliest and continue Breast feeds/ EBM.
- As the baby's ability to feed improves, gradually decrease the volume of IV fluids while increasing the volume of oral feeds. Stop IV fluids if baby is able to maintain normal blood glucose levels at GIR of 4mg/kg/min and is accepting breastfeeds well. Do not discontinue the dextrose infusion abruptly to prevent rebound hypoglycemia.

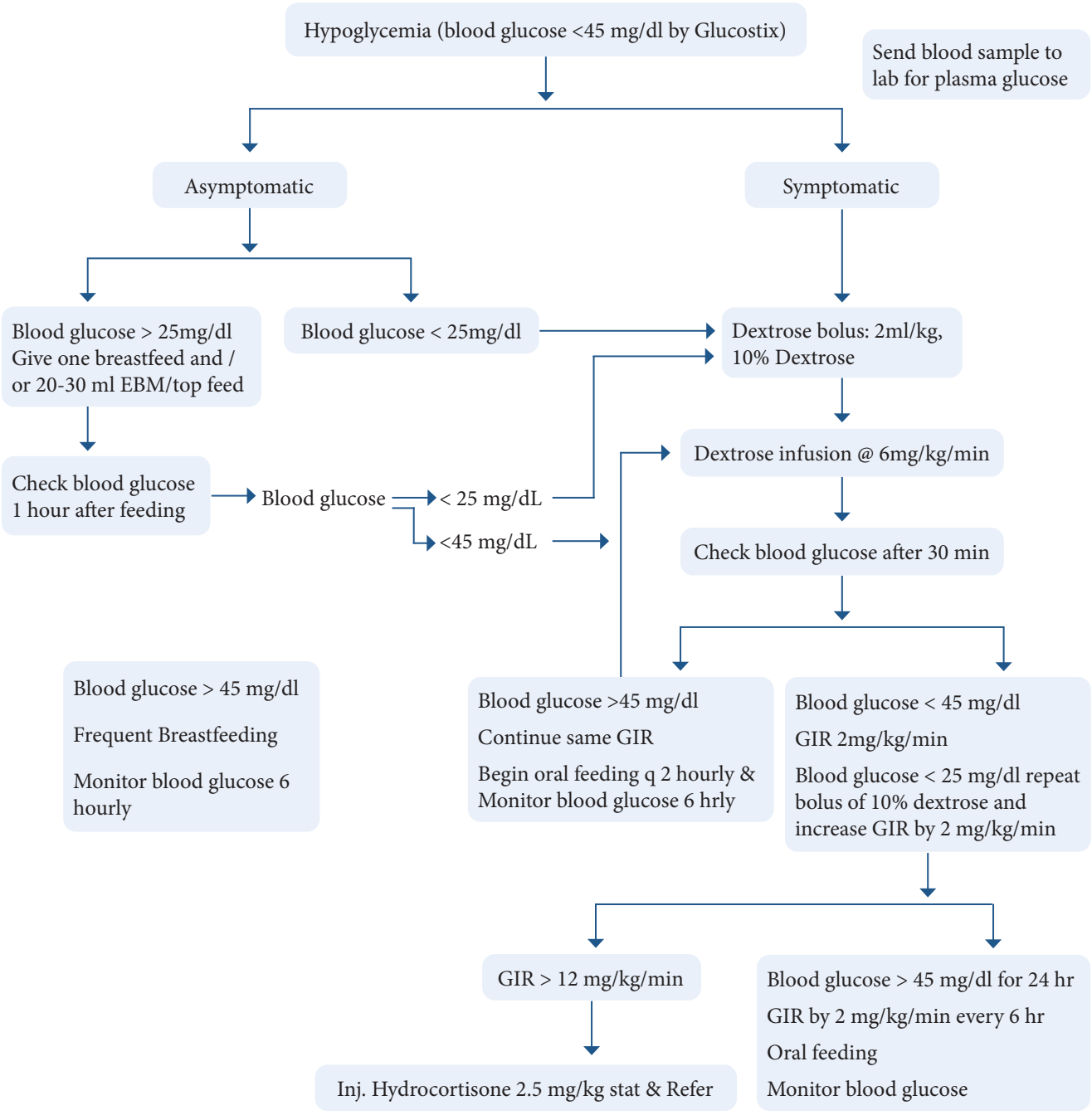


Fig. 7.2: Management of hypoglycemia (Annexure 3)

When to Refer

- If hypoglycemia persists despite above management, give one dose of hydrocortisone: 2.5 mg/kg IV and refer with the glucose infusion being administered to a higher health facility for further evaluation and management.
- All babies requiring GIR of 10 or infusion containing more than 15% dextrose would require referral to a higher centre.
- Refractory and Persistent/prolonged hypoglycemia(>7days) should be evaluated and managed at a higher centre.

Table 7.1 (a): Achieving appropriate glucose infusion rates for neonates with Birth weight ≥ 1500 gms using a mixture of D10 and D25 Volume (ml/ kg/d)

Volume (ml/ kg/d)	Glucose Infusion Rate 6 mg/kg/min				Glucose Infusion Rate 8 mg/kg/min				Glucose Infusion Rate 10 mg/kg/min		
	D10 (ml/kg/d)	D25 (ml/kg/d)	Normal saline (ml/kg/d)	Distill water (ml/kg/d)	D10 (ml/kg/d)	D25 (ml/kg/d)	Normal saline (ml/kg/d)	Distill water (ml/kg/d)	D10 (ml/kg/d)	D25 (ml/kg/d)	Normal saline (ml/kg/d)
60	42	18	-	-	24	36	-	-	5	55	-
75	68	7	-	-	49	28	-	-	30	45	-
90	60	10	20	-	40	30	20	-	20	50	20
105	85	-	20	-	65	20	20	-	45	40	20
120	86	-	20	14	88	12	20	-	70	30	20
135	86	-	20	29	115	-	20	-	95	20	20
150	86	-	20	44	115	-	20	15	120	10	20

Table 7.1 (b): Achieving appropriate glucose infusion rates for neonates with Birth weight < 1500 gms using a mixture of D10 and D25 Volume (ml/ kg/d)

Volume (ml/ kg/d)	Glucose Infusion Rate 6 mg/kg/min				Glucose Infusion Rate 8 mg/kg/min				Glucose Infusion Rate 10 mg/kg/min		
	D10 (ml/kg/d)	D25 (ml/kg/d)	Normal saline (ml/kg/d)	Distill water (ml/kg/d)	D10 (ml/kg/d)	D25 (ml/kg/d)	Normal saline (ml/kg/d)	Distill water (ml/kg/d)	D10 (ml/kg/d)	D25 (ml/kg/d)	Normal saline (ml/kg/d)
80	76	4	-	-	55	25	-	-	35	45	-
95	87	-	-	8	80	15	-	-	60	35	-
110	87	-	20	-	70	20	20	-	50	40	20
125	87	-	20	15	70	20	20	15	75	30	20
140	86	-	20	34	70	20	20	30	100	20	20
150	86	-	20	44	115	-	20	15	120	10	20

The GIR can also be calculated using this simple equation. The same can also be used to crosscheck the GIR used using Table 7.1 a & b.

----------ml/kg/day x----------% dextrose x 0.007 =----------mg/kg/min (GIR)

Example 1 (Calculation): If a baby is on 100ml/kg/day and is being given 10% Dextrose, he is receiving a GIR of 7 mg/kg/min.

Example 2 (Crosscheck): If a baby is on 49 ml/kg/day of 10% Dextrose, and 26 ml/kg/day of 25% Dextrose, he is receiving a GIR of 8 mg/kg/min.

On calculation

49 x 10 x 0.007 = 3.43
26 x 25 x 0.007 = 4.55 + 3.43 = 7.98, the GIR calculated is again 8 mg/kg/min

Frequency of blood glucose measurements after blood glucose returns to normal

If the baby is receiving IV fluid for any reason, continue blood glucose measurements every 8 hours for as long as the baby requires IV fluid. If the blood glucose is less than 45mg/dL, treat as described above.

If the baby no longer requires or is not receiving IV fluids, two more blood glucose estimations should be done at an interval of 12 hours. If blood glucose remains normal, stop further glucose monitoring.

Post discharge advice and follow-up

Babies, who have had hypoglycemia, whether symptomatic or asymptomatic, are at risk of neuro-developmental sequelae such as seizures, developmental delay, cognitive deficits and visual defects. Therefore, these babies should have close follow-up of their neurodevelopmental status.

Key messages

- Hypoglycemia is a common problem in preterm/LBW infants, sick newborns, and infants of diabetic mothers
- Hypoglycemia can lead to brain injury with long-term neurodevelopmental consequences
- Newborns at risk of hypoglycemia should be screened using glucometer
- The symptoms of hypoglycemia are nonspecific and can be confused with other common neonatal problems
- Initiation of breastfeeding within one hour of birth and frequent breastfeeding helps prevent hypoglycemia
- Newborns with hypoglycemia should be followed-up for neurodevelopmental status and visual defects

EXERCISE

1. A 2-day old baby weighing 2.0 kg is brought to SNCU with refusal to feed and with a temperature record of 36.1^{0}C. His blood sugar by glucometer is 20 mg/dL. How will you manage this baby?

2. After 30 minutes baby's blood sugar is 36 mg/dL. How will you manage?

3. After 12 hours baby's blood sugar is 56 mg/dL, baby is active with normal body temperature. How will you proceed?

4. How will you monitor this baby whose blood sugars have returned to normal?

CHAPTER 8

NEONATAL SHOCK

A sick neonate may present with shock or it may appear during the course of the disease. The success of management depends on its early diagnosis and prompt and appropriate management.

Definition

The term shock denotes a clinical state of poor perfusion of the body tissues in which the body's demands of oxygen and nutrients are not met. This can result in tissue hypoxia and metabolic acidosis causing irreversible tissue damage. Shock and hypotension are not synonyms as hypotension is a late sign of shock. Hypotension refers to a BP that is lower than the expected reference range (see Annexure 4 Zubrow's charts) as measured by non-invasive blood pressure (NIBP) method. Mean arterial pressure (MAP) is roughly equal to gestational age.

Learning objectives

After completion of this chapter the participant should be able to:

- Identify shock
- Perform fluid resuscitation
- Use vasopressors and calculate their doses

Identification of shock

Tachycardia

Unexplained tachycardia (HR> 160/min) may be an early sign of shock. Heart rate can also increase if the baby is in pain/ stress or is hyperthermic or is on drugs like caffeine.

Capillary refill time (CRT)

This is the rate at which the capillaries refill following emptying by pressure and indicates adequacy of tissue perfusion.

Technique: CRT is checked on the central part of the body such as the sternum. Gentle pressure is applied by the tip of finger for 3-5 seconds e.g. by slowly counting from 1 to 5, this results in blanching of the underlying surface. Observe how fast the blanched area refills and becomes pink after the tip of the finger is lifted from the skin surface. Normal capillary refill time is <3 seconds. A prolonged CRT of >3 seconds indicates poor circulation and tissue perfusion. However, this may be fallaciously prolonged in hypothermic babies.

Other clinical features in shock

- Poor peripheral pulses
- Pallor
- Mottling of skin
- Cold extremities
- Decreased urine output
- Lethargy or obtundation
- Low blood pressure

Low blood pressure is a late sign of shock

Mottled skin and prolonged CRT can be seen in hypothermia; hence one must rule out hypothermia.

Management

The outcome of shock depends on early diagnosis and prompt management.

Supportive

- Maintain TABC
- Hypothermia – Maintain normothermia (Temperature 36.5-37.5^{0}C)
- Hypoxia – Give oxygen to maintain oxygen saturation 91-95%
- Hypoglycemia – Maintain normal blood glucose (>45 mg/dL)

Specific

Restoring perfusion is the cornerstone in shock management

Fluid resuscitation- Infuse fluid bolus of 10 ml/kg of normal saline over 20-30 minutes. e.g. in a baby weighing 3 kg, 30 ml of normal saline should be infused over 30 minutes.

Assess for improvement by

- Improvement in CRT.
- Decrease in heart rate by at least 10 beats per minute.

If no or partial improvement (i.e. tachycardia and CRT still prolonged), a repeat bolus of 10 ml/kg of normal saline should be given. Improvement in pulse volume and an increase in urine output over the next 4-6 hours is a sign of improvement.

Vasopressors

If the signs of poor perfusion persist despite 2 fluid boluses, start vasopressor support.

Along with vasopressor support, supportive care should be continued. Underlying causes should be treated.

These drugs are used to enhance myocardial contractility and consequently cardiac output. Some degree of myocardial depression is present in all types of shock. The most commonly used vasopressor in neonatal practice is dopamine.

Dopamine is used as the first line agent. Though Dopamine affects all 3 components (preload, myocardial contractility and afterload), the most important effects are on afterload and myocardial contractility.

Dose: Usual starting dose is 10 µg/kg/min and if no improvement occurs, the dose can be increased by increments of 5 µg/kg/min every 20 - 30 minutes to a maximum of 20 µg/kg/min.

How to give dopamine

Use Insulin syringe for loading Dopamine

One ml of dopamine injection contains 40 mg of dopamine.
In a baby weighing 2.5 kg if we want to start dopamine at a rate of 10µg/kg/min:
= 10 x 2.5 = 25 µg/min = 25 x 60 = 1500 µg/hour = 1500 x 24 = 36000 µg/day
= 36 mg (0.9 mL) of dopamine in 24 hours
= 12 mg (0.3 mL) of dopamine in 8 hours

It means if we add 0.9 ml of dopamine in 24 ml of fluid and give @ rate of 1 ml/hr with syringe pump, we will give dopamine at the desired rate i.e. @ 10 µg/kg/min. If infusion pump is not available, then add 12 mg (0.3 mL) Dopamine to 8 hour maintenance fluid and run at the rate desired for maintenance fluid. After starting dopamine drip, monitor the neonate's status of perfusion by assessing the HR, CRT and pulse volume. If available, use a non-invasive blood pressure monitor to check the improvement in blood pressure. Assess after 20-30 minutes and if there is inappropriate response increase the dopamine rate by 5 µg/kg/min by increasing the rate of infusion to 1.5 ml/hr (infusion pump) to provide 15µg/kg/min. Further increments can be done to reach upto 2ml/hr (20 µg/kg/min). On the other hand with improvement in perfusion, decrease the infusion rate in decrements of 5 µg/kg/min. As long as the infant is on dopamine drip, the status of circulation needs to be monitored.

If despite dopamine of 20µg/kg/min the baby continues to be in shock, Dobutamine is the next inotrope of choice and has to be used in similar doses along with ongoing dopamine.

Dobutamine: Dobutamine improves cardiac output and decreases vascular resistance without increasing heart rate. It is mostly used in combination with dopamine to improve cardiac output. It is also used to decrease peripheral vascular resistance in asphyxia and to improve myocardial contractility. Dose is same as Dopamine. (Dobutamine 1 mL=50 mg).

Steroids in shock

- Hydrocortisone may be considered in neonates who do not respond to maximal doses of both dopamine and dobutamine (20 mcg/kg/min). Hydrocortisone can be given in a dose of 1mg/kg iv 8 hourly, then depending on the response (assess every 6-8 hrs). It can be given every 8 hours in a dose of 1 mg/kg/dose for 2-3 days.

Unresponsive shock

- Neonates with shock may not respond to above treatment in presence of hypoglycemia, hypoxia, hypothermia, hyperkalemia, anemia, severe sepsis, pneumothorax and cardiac tamponade etc.
- Consider blood transfusion if Hb <12gm%.
- Consider referral after stabilization of temperature, oxygenation and blood glucose

Therapeutic end points

Treatment should be modified as per assessment and response to achieve

- Capillary refill time <3 seconds
- Normal heart rate
- Normal pulses
- Warm extremities
- Normal blood pressure
- Urine output >1 ml/kg/hour

Weaning from inotropes

Once hypotension improves (normal BP for 6-8 hours) and tissue perfusion improves, inotropes should be tapered slowly @ 5 µg/kg/min every 1-2 hrly provided the neonate continues to maintain the above listed therapeutic end points.

Tapering of inotropes

- Inotropes to be tapered if BP>90th centile (Zubrow's chart, Annexure 4) at any point of time.
- If the baby is stable atleast for 6-8 hours after inotrope initiation, consider tapering inotropes.
- The dose of Dopamine and Dobutamine should be reduced at the rate of 5mcg/kg/min every 1-2 hrly provided the neonate continues to maintain the above listed therapeutic end points.
- Omit the inotropes when the neonate has been stable on 5 mcg/kg/min of dopamine.
- Inotrope which was added last to be tapered first and omitted.

When to refer

If the neonate has unresponsive shock, refer urgently.

What to do if referral not possible

i. Continue inotropes.
ii. Consider use of adrenaline if possible, Adrenaline infusion at a rate of 0.2ug/kg/min can be started. Assess tissue perfusion after 20-30 minutes. If there is inadequate response increase the rate by 0.1µg/kg/min till a maximum of 1µg/kg/min is reached.
iii. Continue supportive care.

Key messages

- Monitor all sick babies for early signs of shock.
- Start treatment immediately if shock appears.
- Supportive care, fluid resuscitation and inotropes are mainstay of therapy

Table 8.1: Sample monitoring chart for a sick neonate

Parameter/ Time	At Ad m.	2 hrs	4 hrs	6 hrs	8 hrs	10 hrs	12 hrs	16 hrs	20 hrs	24 hrs	28 hrs	32 hrs	36 hrs
Temp													
HR													
RR													
SpO_2													
CRT													
MBP													
Ur Output 8 hrly (mL/kg/hr)													
Downe's Score													
Levene Score													
Blood glucose													
S. Electrolytes													
Serum Calcium													
Bld. Urea and creatinine													

Drill on fluid resuscitation and Vasopressors: The facilitator will now conduct a drill on fluid resuscitation and use of vasopressors.

EXERCISE

A 7 days old baby Neena weighing 2 kg is admitted with refusal of feeds, fast breathing, mottling of skin, cold extremities, poor peripheral pulses and a CRT of 5 seconds.

1. What is your provisional diagnosis?

2. How do you assess the CRT and how do you interpret the capillary refill time?

3. What are the steps of initial management of a neonate with shock?

CHAPTER 9

POST-RESUSCITATION MANAGEMENT OF AN ASPHYXIATED NEONATE

Perinatal asphyxia is a common neonatal problem and contributes significantly to neonatal morbidity and mortality. It ranks as the second most important cause of neonatal deaths after infections, accounting for around 20% mortality worldwide. Perinatal asphyxia is an insult to the fetus or the newborn due to lack of oxygen (hypoxia) and perfusion (ischemia) to various organs.

Learning objectives

After completion of this chapter the participant should be able to:

- Perform initial stabilization and management of an asphyxiated neonate
- Monitor an asphyxiated neonate
- Recognize poor prognostic factors in asphyxia

Definition of asphyxia

Clinically a neonate should be labeled as having suffered perinatal asphyxia if there is presence of any one of the following:

- Gasping or ineffective breathing or lack of breathing at one minute of life.
- Need for positive pressure ventilation for > 1minute.
- Apgar Score <3 at 5 minutes or longer.

Other features which evolve over time include

- Clinical: neurologic manifestations such as seizures, hypotonia, coma or hypoxic ischemic encephalopathy (HIE) in the immediate neonatal period (First 72 hours of life).
- Evidence of multi-organ system dysfunction manifested as breathing difficulty or renal failure or feeding intolerance or hepatic dysfunction or hematological abnormality in the immediate neonatal period.

Clinical presentation

- Perinatal asphyxia may result in adverse effects on all major body systems including the kidney, brain, heart and lungs. The clinical features in asphyxiated babies range from mild to severe impairment.
- The extent of multi-organ dysfunction determines the early outcome of an asphyxiated neonate.
- The most severely affected babies may manifest with stupor or coma, periodic breathing or irregular respiration, hypotonia and loss of neonatal reflexes like Moro's and suck.
- About 50 % of the moderate to severely asphyxiated babies may have seizures.

- Severely affected babies may have progressive deterioration of the CNS function in terms of decreasing tone, increasing degree of coma and prolonged apnea over the next 48-72 hours. These neonates would eventually die or have permanent neurologic sequelae.

Grading of severity of hypoxic ischemic encephalopathy

Levene's system of grading clinical severity of HIE is functionally appropriate, easy to use and serves as a useful clinical guide which is based on assessment of consciousness, tone, seizure, autonomic disturbances and abnormalities of peripheral and brain stem reflexes.

Table 9.1: Grading of HIE (Levene)

Feature	Mild	Moderate	Severe
Consciousness	Irritable	Lethargy	Comatose
Tone	Hypotonia	Marked hypotonia	Severe hypotonia (Flaccid)
Seizures	No	Yes	Prolonged or uncontrolled
Sucking	Poor suck	Unable to suck	Absent suck
Respiration	Spontaneous	Periodic or Irregular	Unable to sustain spontaneous respiration

Initial stabilization and management

The management consists of supportive care to maintain temperature, perfusion, ventilation and a normal metabolic state including glucose, calcium and acid-base balance. Early detection by clinical and biochemical monitoring and prompt management of complications must be done to prevent extension of cerebral injury.

a. **Temperature:** Baby should be placed under radiant warmer. The temperature should be maintained in the normal range of 36.5-37.5^{0}C.
   Uncontrolled hypothermia and hyperthermia are both detrimental. If therapeutic hypothermia facility is available in a nearby higher centre, referral may be considered.
b. **Airway and breathing:** Patent airway should be maintained by appropriate positioning and any secretions should be cleared. The breathing should be monitored and supported as required.
c. **Oxygenation:** Should be kept in the normal range by monitoring oxygen saturation by pulse oximetry. SpO_2 should be maintained between 91-95%. Hypoxia should be treated with oxygen supplementation if the baby does not improve, he/she may need referral for CPAP or mechanical ventilation. Hyperoxia should always be avoided.
d. **IV fluids and Enteral Feeding:** Initiate IV fluids as per day's requirement. (Refer to chapter 6). **Not all babies require prolonged IV fluids and many can be fed enterally by gavage, spoon or at the breast**. Assess for feeding every 4-6 hrs. As soon as the baby is hemodynamically stable, there is no abdominal distension and the baby has passed meconium, start enteral feeds with expressed breast milk (EBM) @ 30ml/kg/day and increase daily by 20-30 ml/kg/day or more as the baby tolerates. In those feeding directly at the breast allow feeding ad libitum.

   - **Blood glucose:** Blood glucose should be monitored for at least first 48 hrs. If the baby is hypoglycemic, treat appropriately. (Refer to chapter 7 on Hypoglycemia)

- **Blood glucose:** Blood glucose should be monitored for at least first 48 hrs. If the baby is hypoglycemic, treat appropriately. (Refer to chapter 7 on Hypoglycemia)
- **Calcium:** If a neonate has jitteriness or seizures check serum calcium (if facility is available). Manage hypocalcemia. (Refer to chapter 10 on neonatal seizures). Give it as slow bolus under cardiac monitoring preferably using syringe infusion pump.
- Inj. Vitamin K1 mg IM must be administered to all those babies who have not received Vit K at birth.
- **Blood Pressure:** In an asphyxiated neonate cerebral blood flow depends on systemic blood pressure. Hence, maintain systemic mean arterial BP at 40 mm of Hg for term infants. The mean BP for preterm neonates should be maintained equal to gestational age in weeks as mmHg. If the neonate is in shock manage as per chapter 8 on shock.
- **Seizures:** For management of seizures refer to chapter 10 on Neonatal seizures.

Steroids, Mannitol, Furosemide and Sodium-bicarbonate HAVE NO ROLE in Management of Asphyxia

Monitoring

Clinical monitoring

All neonates who have suffered asphyxia must be closely monitored clinically as well as by performing certain bedside tests.

- Neurological status should be monitored by using Levene's staging every 8 hrs which has been found to be useful to detect improvement or further deterioration.
- Respiratory status must be monitored by meticulous record of the respiratory score (Downe's score) every 2-3 hours.
- Cardiovascular status assessment should include heart rate, color, CRT, peripheral pulses, pulse oximetry and non-invasive blood pressure (NIBP).
- Abdominal circumference should be recorded to rule out any ileus due to gut ischemia. (Refer to chapter 4)
- Urine output should be measured daily. It should normally be > 1ml/kg/hr after the first 24 hrs of life. If it remains < 1mL/kg/hr, check serum electrolytes, blood urea and serum creatinine every 48 hours.
- Blood sugar should be monitored every 6-8 hrs during the first 24 hrs and then as required.

Facilitator will now demonstrate the monitoring chart for a sick neonate (Annexure 5).

Poor prognostic factors

The presence of one or more of the following features may point towards poor neurodevelopmental outcome in the long term. These are:

1. Need for PPV for 5 minutes or longer.
2. Onset of seizures within 12 hours.
3. Refractory seizures (uncontrolled with Phenobarbitone and Phenytoin).
4. Severe HIE (See Levene Chart).
5. Inability to establish direct oral feeds by 1 week.

When to refer

- Need for respiratory support.
- Refractory seizures (uncontrolled with Phenobarbitone and Phenytoin).
- Shock unresponsive to vasopressors.
- Renal failure.

Post discharge and follow-up advice

- All neonates discharged with diagnosis of Perinatal asphyxia must attend the follow-up clinic for monitoring of their growth and development, and to identify post asphyxia sequelae.

EXERCISE

1. Baby Kumud was born to a primigravida through vaginal delivery, needed positive pressure ventilation for five minutes, and was admitted to NICU. How will you manage this baby?

2. After 24 hours the baby is haemodynamically stable. How will you take care of the fluid requirement?

3. How will you counsel the parents of this baby?

CHAPTER 10

NEONATAL SEIZURES

A seizure in the neonatal period is an emergency. Seizures can occur due to problems like asphyxia (commonest cause), birth injuries, meningitis, intracranial bleeding or due to metabolic problems like hypoglycemia, hypocalcemia and hypo or hypernatremia. Inborn errors of metabolism and epileptic syndromes are rare causes of neonatal seizures. Neonatal seizures should be differentiated from spasms of neonatal tetanus and jitteriness.

Learning objectives

The participants after completing this chapter should be able to:

1. Identify neonatal seizures
2. Enumerate causes of neonatal seizures
3. Manage neonatal seizures
4. Wean anticonvulsants and plan a follow-up

Definition

A seizure is a sudden alteration in neurologic function of a neonate i.e motor, behavior and/or autonomic function.

Common types of neonatal seizures

Neonatal seizures are classified into 4 subtypes based on the nature of movements, they can be localized (Focal) or seen in multiple parts of the body (Multifocal) or involve the whole body (Generalized).

1. Subtle (Automatisms): These are the commonest and may present as
    - Repetitive blinking, eye deviation, or staring
    - Repetitive movements of mouth or tongue
    - Purposeless movement of the limbs, as if bicycling or swimming
2. Clonic (Repetitive movements of the limbs or face)
3. Tonic (Continuous extension or flexion of arms/legs)
4. Myoclonic (sudden jerky movements of limbs)

Table 10.1: Difference between seizure and jitteriness

Clinical features	Seizure	Jitteriness
Abnormal gaze or eye movements	Present	Absent
Movements are stimulus sensitive (present on stimulating the baby)	No	Yes
Predominant movement	Clonic jerks	Tremors
Movements stop on passive flexion by examiner	No	Yes
Associated autonomic changes	Present	Absent
Neurological examination	May be Abnormal	Normal between episodes
EEG	May be abnormal	Normal

Reference: Volpe's neurology of the newborn 6th edition

Stepwise treatment for seizure

1. First step: Resuscitate if needed: Place in thermoneutral environment and ensure a patent airway, effective breathing and adequate circulation (TABC). Oxygen should be started if required and IV access should be secured and blood samples drawn for complete blood count, blood sugar, serum calcium and electrolytes.
2. Second step: If blood sugar is less than 45 mg/dL, correct hypoglycemia by a bolus of 2 ml/kg 10% dextrose followed by a maintenance infusion of 6-8 mg/kg/min.
3. Third Step: If blood sugar is normal, collect sample for serum calcium level give 10% Calcium gluconate 2mL/Kg IV over 5-10 minutes.
   IV 10% Calcium gluconate is diluted with equal volume of distilled water and administered slowly under cardiac monitoring preferably by an infusion pump (withhold infusion if HR<100/min). Do not add calcium to maintenance IV Fluid instead give it as a slow bolus preferably using syringe infusion pump.
4. Fourth step: Anti convulsant drugs (ACD) should be given if no hypoglycemia or hypocalcemia is detected or if seizures persist even after correction of hypoglycemia and hypocalcemia.

   a. 1st Line ACD: Injection Phenobarbitone 20mg/kg IV as infusion over 20 minutes. If the baby has no further seizures do not start maintenance.
   b. If seizures persist or recur after loading dose of Phenobarbitone, administer further boluses of 5 mg/Kg up to a total of 40 mg/Kg. Start maintenance phenobarbitone at a dose of 3-4 mg/Kg/day after 12 hrs of the last loading dose of Phenobarbitone.
   c. 2nd Line ACD: Injection Phenytoin or Fosphenytoin 20 mg/Kg IV over 20 minutes if seizures are not controlled with Phenobarbitone. Start maintenance phenytoin at a dose of 3-4 mg/kg/day after 12 hours of the bolus.
      Both Phenobarbitone and Phenytoin are administered at a maximum rate of 1 mg/kg/min. Phenytoin should only be mixed with saline and not with dextrose as it precipitates in dextrose.
   d. If seizures persist then Lorezepam 0.05-0.10mg/Kg IV may be infused.
   e. Midazolam infusion may be considered if Lorazepam is not available. Dose to be used is 0.15mg/kg loading followed by 0.1 to 0.4 mg/kg/hr infusion.

Caution

Do not use Diazepam for control of convulsions in neonates

5. If seizures persist inspite of the above management refer the baby to a higher center for further management.
6. Continue supportive treatment and management of the underlying cause.

Video on neonatal seizures

The facilitator will now show a video on neonatal seizures.

Demonstration

The facilitator demonstrates Phenobarbitone and Phenytoin ampoules and discusses the amount of medication in 1 ml of each.

Drill

The facilitator conducts a drill on calculation of the dose and administration of the ACD.

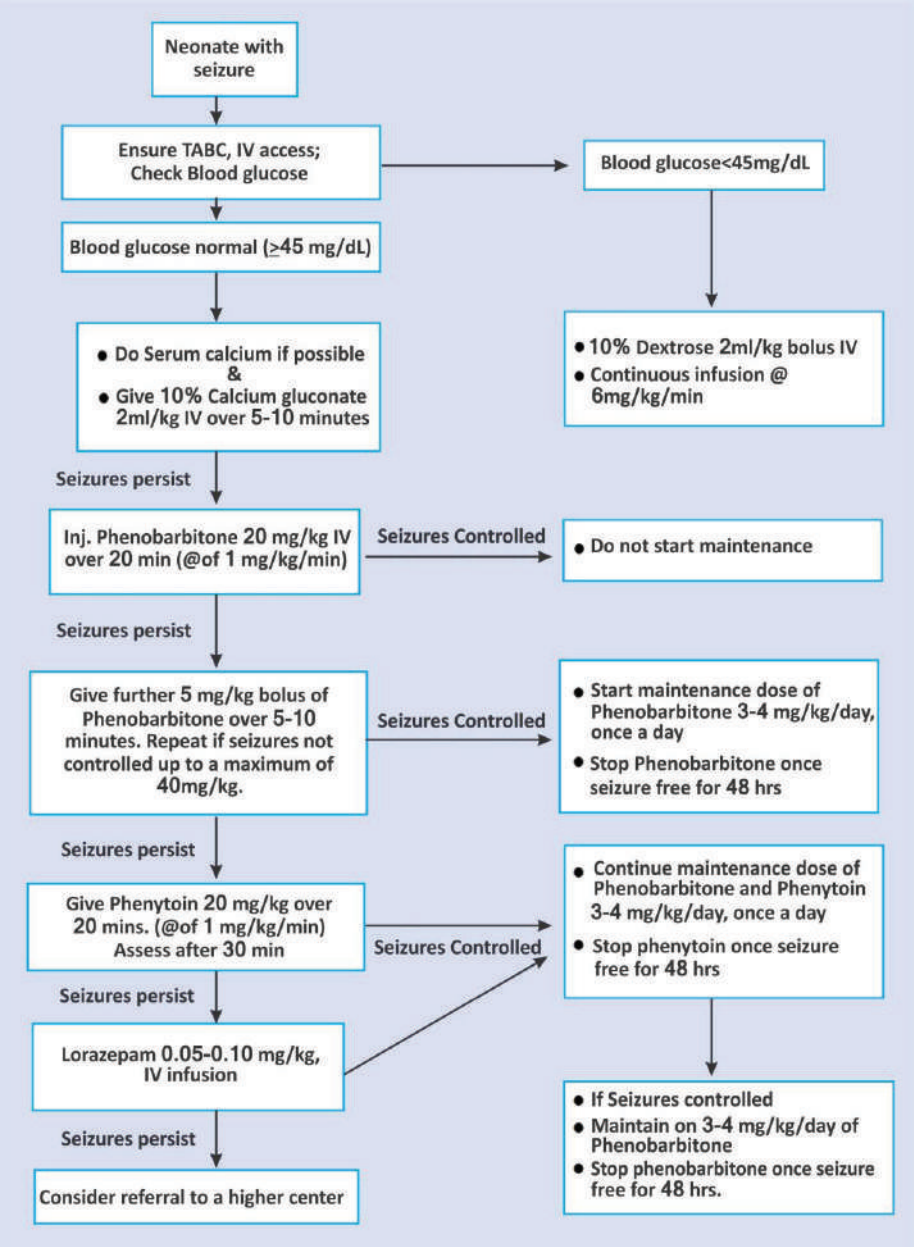


Fig. 10.1: Flow chart for management of neonatal seizures

When to discontinue ACD

The optimal duration of the ACD should be based on the neurological examination, cause of seizures and associated specialized investigations like the EEG. Continuing a baby on long term ACD when not required is unlikely to prevent further seizures instead it may lead to potential long term adverse effects of the drugs.

Table 10.2: Optimal duration of the ACD

Transient metabolic problem such as hypoglycemia, hypocalcemia, dyselectrolytemia	Treat the cause. Stop the ACD immediately if started initially
Seizures controlled with first bolus of Phenobarbitone	No maintenance ACD, observe for at least 48 hrs for seizure recurrence
Seizures controlled with multiple doses of Phenobarbitone	Start maintenance Phenobarbitone. Stop Phenobarbitone once seizure free for 48 hrs
Difficult to control seizures (Need of multiple ACD)	Stop phenytoin if seizure free for 48 hrs Continue maintenance Phenobarbitone Assess neurological status: If normal – stop Phenobarbitone If abnormal – May continue oral maintenance Phenobarbitone
If neurological examination abnormal at discharge	May continue maintenance Phenobarbitone
Assess neurological status at 1 month	If normal Stop Phenobarbitone If abnormal - may continue Phenobarbitone maintenance
If Neurological examination abnormal after 1 month	Consult Pediatric Neurologist and decide further ACD therapy or Refer to higher center for further management.

EXERCISE

1. Raju a fourteen days old infant weighing 3 kg is brought to the SNCU with generalized tonic seizures with refusal to feed and multiple pustules. What is the probable cause of convulsions and first step in management?

2. Raju's blood sugar is 20 mg/dL. How will you manage?

3. Raju continues to have seizures even after correction of hypoglycemia and administering calcium. What anticonvulsant would you use, in what dose, by which route and over how much duration?

4. The seizures are controlled after the first loading dose of ACD. How would you plan further ACD therapy?

CHAPTER 11

RESPIRATORY DISTRESS IN NEWBORN

Respiratory distress accounts for significant morbidity and mortality in neonates. It occurs in 4 to 6 percent of neonates. Preterm neonates are at a higher risk of developing respiratory distress. The aim of managing respiratory distress is to identify and treat the underlying cause and maintain oxygenation. Delayed or inappropriate management may result in hypoxic respiratory failure which has high mortality and morbidity.

Learning objectives

After completion of this chapter the participant should be able to:

- Define respiratory distress/breathing difficulty
- List common causes of respiratory distress in Term and Preterm neonates
- Identify babies with respiratory distress and assess severity of respiratory distress
- Administer oxygen and manage babies with respiratory distress
- Monitor babies on oxygen therapy
- Identify neonates needing referral

Definition

Breathing difficulty or Respiratory distress is characterized by any one of the following:

- Respiratory rate > 60 breaths per minute (count for one minute)
- Severe chest in-drawing
- Grunting
- Apnea (not breathing) or gasping Newborn

If the baby is apneic or gasping, resuscitate the baby immediately

Common causes of respiratory distress

Preterm baby

- Respiratory distress syndrome (RDS/HMD)
- Congenital Pneumonia
- Miscellaneous: hypothermia, hypoglycemia, hypocalcemia, anemia, polycythemia, etc

Term baby

- Transient tachypnea of newborn (TTNB)
- Meconium aspiration syndrome
- Pneumonia
- Asphyxia

Surgical causes

- Diaphragmatic hernia
- Tracheo-esophageal fistula
- B/L choanal atresia

Other causes

- Cardiac: Congenital heart disease
- Metabolic: Acidosis, Inborn errors of metabolism

Approach to respiratory distress

History

A detailed relevant antenatal and perinatal history should be taken based on common causes of respiratory distress. It should include details of the following:

- Gestational age
- Onset of distress/breathing difficulty
- Previous preterm baby with respiratory distress
- Antenatal steroids if preterm delivery is anticipated
- Rupture of Membranes > 24 hours, Intrapartum fever, chorioamnionitis, foul-smelling liquor
- Meconium stained amniotic fluid (MSAF)
- Perinatal asphyxia
- Maternal diabetes mellitus
- Poor feeding, lethargy, convulsions
- Excessive frothing

Examination

- Severity of respiratory distress as assessed by Downe's score and Silverman Anderson Score (Table 11.1 and Annexure – 6)
- Neurological status: Activity, Altered sensorium
- CRT (Capillary refill time)
- Hepatomegaly
- Central cyanosis or low oxygen saturation on pulse oximeter
- Features of sepsis like umbilical sepsis, pustules
- Look for malformations

Objective assessment of severity of respiratory distress

Table 11.1: Downe's Score and its Interpretation

Score	Respiratory rate	Cyanosis	Air entry	Grunt	Retraction
0	<60/min	Nil	Normal	None	Nil
1	60-80/min	In room air	Mild decrease	Audible with Stethoscope	Mild
2	>80/min	In >40% FiO_2	Marked decrease	Audible with unaided ear	Moderate

Interpretation

Score 1-3 Mild respiratory distress.
Score 4-6 = Moderate respiratory distress (may need CPAP).
Score >6 = Impending respiratory failure (May need CPAP or mechanical ventilation).

Investigations

Chest X-ray

All babies with moderate to severe respiratory distress should preferably have a chest x-ray to identify the underlying cause. Those with mild respiratory distress may be observed for few hours; however, if the respiratory distress does not settle in 4 – 6 hrs or the baby continues to need supplemental oxygen, chest x-ray should be done to look for:

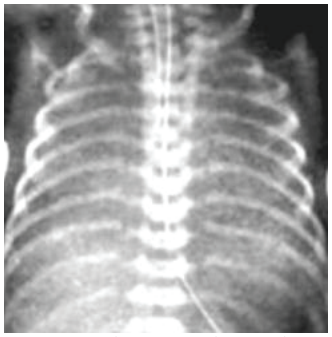


Fig. 11.1: Chest X-ray showing hazy lungs with air bronchogram

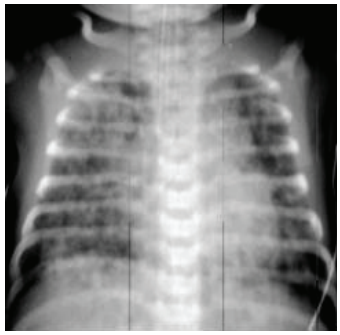


Fig. 11.1: Chest X-ray showing fluffy shadows in lungs suggestive of meconium aspiration syndrome

- Air bronchogram, decreased lung volume and hazy lungs – s/o Respiratory Distress Syndrome (RDS).
- Fluffy shadows involving both lungs with hyperinflation – s/o Meconium Aspiration Syndrome (MAS).
- Infiltrates – s/o Pneumonia.
- White out (Opaque lung) – s/o Pulmonary hemorrhage, RDS.

X-ray findings alone may not be conclusive for a diagnosis. These findings should be interpreted keeping in mind the history and clinical examination.

Sepsis screen and blood culture: (Refer to chapter 14) Sepsis screen is ordered in the following situations:

1. Respiratory distress lasting for more than 4 to 6 hrs.
2. History of prolonged rupture of membranes (>24 hrs), chorioamnionitis.
3. Unexplained preterm delivery.
4. History of maternal infections: Intrapartum fever, UTI, foul-smelling liquor etc.
5. Meconium aspiration syndrome (Babies born through MSAF and having respiratory distress).

Management

Supportive Management

- Maintain TABC.
- Give oxygen with an oxygen hood or nasal prongs to achieve appropriate oxygen saturation. Titrate oxygen delivery, targeting an oxygen saturation of 91-95%.
- Expressed breast milk by gavage feeding may be given to stable neonates with mild to moderate respiratory distress.
- Watch for feeding intolerance (Refer to the section on Feeding in Chapter 4).
- IV fluids may be started if the baby does not tolerate oral feeds/ in initial stage of severe respiratory distress.
- Maintain blood glucose, if low treat hypoglycaemia.
- If the baby has apnea:
  a. Stimulate to breathe by rubbing the back.
  b. If does not begin to breathe, provide positive-pressure ventilation with bag and mask immediately.
  c. Administer Caffeine (Aminophylline only if caffeine not available) if baby is preterm with no other evident cause of apnea.
  d. If apneic spells are recurrent, obtain sepsis screen along with blood culture and initiate treatment for sepsis. If available, start nasal CPAP and/or organize transfer to a specialized centre for assisted ventilation.

All babies born through MSAF DO NOT require antibiotics

Specific management

Mild breathing difficulty

- Monitor respiratory distress and oxygen saturation. Give oxygen / start CPAP if needed.
- Allow breast feeds, if does not accept, give expressed breast milk by oro-gastric tube.
- All babies with mild and transient respiratory distress do not need antibiotics. However, if the respiratory distress persists for more than 6 hours and there are risk factors, start antibiotics after taking a sepsis screen and blood culture. Once respiratory distress settles and the sepsis screen and culture are reported negative – STOP ANTIBIOTICS.

Moderate to severe breathing difficulty

- Monitor and record the baby's respiratory rate, presence of chest indrawing or grunting on expiration (Annexure 5), and episodes of apnea every hour until the baby no longer requires oxygen and then every 2 – 4 hourly for an additional 24 hours.
- Monitor the baby's response to oxygen/CPAP support by oxygen saturation.
- Insert an oro-gastric tube to empty the stomach of air.
- After taking a sepsis screen and blood culture start first-line antibiotics (Refer to the chapter on Neonatal Sepsis).

Duration of antibiotics

- If baby shows clinical improvement, sepsis screen is negative and blood culture is sterile stop antibiotics.
- If baby shows clinical improvement and if sepsis screen is positive and culture is negative give antibiotics for 5-7 days.
- If blood culture is positive for Gram-positive cocci (GPC) give antibiotics for 7 – 10 days and for Gram-negative bacilli (GNB) for 10 – 14 days.
- Modify antibiotics based on clinical response and blood culture sensitivity patterns.

When the baby begins to show signs of improvement:

- Give expressed breast milk by oro-gastric tube even if oxygen support is continuing.
- Allow the baby to begin breastfeeding as the respiratory distress settles. Baby can be put on to the breast while on oxygen by nasal cannula with continuous monitoring.
- If the baby cannot be breastfed, give expressed breast milk using a cup and spoon or paladai.

Oxygen Therapy

1. Oxygen is a drug and should only be used if the baby has hypoxia, as it is harmful to the eyes, brain and lungs.
2. Ideally, pulse oximeter should be used to monitor oxygen saturation, which should be maintained in the range of 91 – 95%.
3. Saturation below 91% should be treated with oxygen supplementation. However, transient drop in saturation below this level especially when the baby is moving or crying, which improves spontaneously should be ignored.
4. At NO TIME babies under supplemental oxygen should have oxygen saturation above 95%.

Oxygen delivery will be discussed in the afternoon during equipment demonstration. Demonstration and detailed discussion of CPAP and Blender with case studies will be done during the 2nd week of observership training.

Video demonstration on breathing difficulty, oxygen delivery, pulse oximeter and CPAP

Apnea

Apnea is defined as spontaneous cessation of breathing for more than 20 seconds or any cessation associated with desaturation/cyanosis/ pallor and/or bradycardia (heart rate less than 100). This may occur because of prematurity or secondary to respiratory, metabolic, neural or infective causes.

Management of apnea

- Maintain temperature.
- Provide tactile stimulation.
- Check blood glucose.
- Preterm neonates with no other evident cause of apnea may be given Caffeine citrate (Aminophylline only if caffeine unavailable) for recurrent apneic spells. Caffeine seems to have a better safety profile as compared to aminophylline with equal efficacy.

Dosage and route of administration: Loading dose- 20 mg/kg caffeine citrate (10mg/kg caffeine base) IV or orally. Infuse over 30 min via syringe pump.

Maintenance dose- 5 mg/kg/d (can go up to 8-10 mg/kg if apnea persists) once a day, 24 hrs after loading dose.

Indication for caffeine in apnea

- When apneic episodes are frequent > 3 in 24 hours.
- If a baby requires PPV for any episode of apnoea which is unresponsive to tactile stimulation.
- Before extubation of a preterm VLBW infants (Loading dose of caffeine should be ideally given 24 hours before the planned extubation or within 6 hrs of unplanned extubation).
- Bronchopulmonary dysplasia/cronic lung disease (BPD/CLD) prevention – It is prophylactically started in ELBW and extremely preterm (<28 weeks) neonates.
- Caffeine or aminophylline should be stopped once the neonate is apnea free for at least 1 week and may be continued till 34 completed weeks of gestation.
- Ideally baby should be observed for 5-7 days for recurrence of apnea after stopping caffeine.
- Neonates with recurrent apneic spells may require CPAP or mechanical ventilation.

When to refer

1. If a baby with breathing difficulty needs mechanical ventilation or in facility where CPAP is not available.
2. Persistent central cyanosis or low oxygen saturation despite oxygen supplementation.
3. Repeated apneic spells.

Always stabilize before referral and transport

Prognosis

With timely and appropriate management most babies with respiratory distress have a good outcome. Hypoxic respiratory failure can be prevented with a good supportive management and judicial use of oxygen. However, if the baby does not improve, timely referral should be done for CPAP/mechanical ventilation.

Discharge advice and follow-up

Babies with respiratory distress should be seen 48 hrs after discharge, either at the hospital or during a home visit by ASHA. A detailed advice regarding exclusive breastfeeding, temperature maintenance and immunization should be provided.

Key messages

1. Respiratory distress is a common occurrence in neonates.
2. Early identification, timely and appropriate management is the key to good outcomes.
3. Oxygen should be used judiciously and treated as a toxic drug.
4. Maintain oxygen saturation in the range 91–95%.
5. Perform sepsis screen with blood culture if you suspect sepsis.
6. Do not use antibiotics in all cases of respiratory distress.

EXERCISE

1. 7 day old baby Chitra born at term with a birth weight of 2.8 kg is brought with complaints of difficulty in breathing and inability to feed at the breast. The present weight is 2.65 kg, the temperature is 36°C and respiratory rate is 96/min with moderate retractions, grunting and central cyanosis.

   a. What is your assessment of the respiratory status of this baby and what is the likely diagnosis?

   b. What supportive management would you do for this baby?

   c. What are the ways of providing oxygen to the baby and how will you monitor the efficacy of oxygen therapy?

2. a. A baby is born prematurely at 32 weeks of gestation and develops respiratory distress soon after birth with grunting and chest retractions. What is the likely diagnosis?

   b. What are the principles of management of severe breathing difficulty?

   c. How will you manage a baby who is brought with breathing difficulty and develops apneic spells?

CHAPTER 12

NEONATAL JAUNDICE

Jaundice is a yellow discoloration of the skin and sclera. About 60% of term and 80% of preterm neonates are clinically jaundiced. However, jaundice in the newborn might signal a serious, potentially treatable illness and may cause neurological damage if the bilirubin level is significantly elevated.

Learning objectives

The participant after completing this chapter should be able to:

1. Enumerate the characteristics of physiological jaundice
2. Enumerate the characteristics of pathological jaundice and alert signs
3. Assess the severity of jaundice based on the clinical estimation
4. Institute phototherapy based on recommended guidelines
5. Assess a neonate with conjugated hyperbilirubinemia

Classical pattern of physiological jaundice

(All of the following)

- Jaundice that first appears between 24-72 hours of age
- Maximum intensity is seen on the 3rd day in term and 7th day in preterm neonates
- Does not exceed 15 mg /dL
- Clinically undetectable after 14 days
- No treatment is required but the baby should be observed closely for signs of worsening jaundice

Alert signs in neonatal jaundice (pathological jaundice)

(Any of the following)

- Clinical jaundice in first 24 hrs of life
- Total serum bilirubin (TSB) increasing by >5mg /dL/day or 0.3 mg /dL/hr in. the first 24 hours and 0.2 mg/dl/hr later
- TSB ≥15 mg /dL (staining of palms and soles)
- Conjugated serum bilirubin >1 mg /dL
- Clinical jaundice persisting for >2 weeks in full-term and >3 weeks in preterm neonates

Causes of jaundice

Hyperbilirubinemia in the first week of life is usually of the unconjugated (indirect) variety. Conjugated hyperbilirubinemia (Direct) although occurs less commonly but is always pathological. Causes are usually classified based on the time of onset of jaundice.

1. **Appearing within 24 hours of age**
   - Hemolytic disease of newborn: Rh, ABO and minor group incompatibility
   - Infections: intrauterine-viral, bacterial, malaria
   - G-6PD deficiency
2. **Appearing after 24 hours of life**
   - All of the above
   - Physiological
   - Polycythemia
   - Concealed hemorrhages: cephalhematoma, subarachnoid bleed, IVH
   - Suboptimal breastfeeding
   - Sepsis
   - Neonatal hepatitis
   - Metabolic disorders

Persistent jaundice- causes- ongoing hemolysis in blood group incompatibility, congenital hypothyroidism, liver disorders, sepsis, hereditary blood disorders (Hereditary spherocytosis, G6PD deficiency, pyruvate kinase deficiency), malrotation, atresias.

Clinical assessment of a jaundiced neonate

In the assessment of a jaundiced neonate, the history and examination are directed towards assessing the etiology, severity and complications of jaundice. When a neonate is clinically jaundiced, the Total serum bilirubin (TSB) is usually >5–7 mg /dL. Jaundice in newborns progresses in the cephalocaudal direction and thus the extent of yellowness of the skin is useful to assess the level of bilirubin. Kramer's criteria are used to clinically estimate severity (Figure 12.1).

Jaundice restricted to

Face and Trunk S.bili < 12mg%
On Hands and Feet S.bili > 15mg%

Once the baby is under phototherapy, these assessments may be incorrect. Transcutaneous Bilirubin (TcB) estimation is better to assess jaundice clinically.

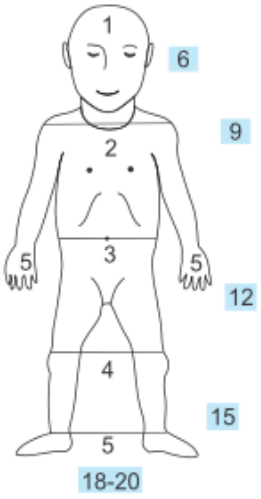


Fig. 12.1: Visual perception of jaundice (Kramer 1969)

Approach to a jaundiced baby

The following questions need to be addressed:

- What is the gestation?
- What is the birth weight and the current weight?
- What is the postnatal age in hours?
- Does the baby need evaluation for jaundice?
- Does the baby need phototherapy/exchange transfusion?
- Does the baby have any risk factors for bilirubin neurotoxicity?
- Does the baby have features of encephalopathy?

Features of acute bilirubin encephalopathy

Hypotonia, lethargy, high-pitched cry, poor suck, hypertonia of extensor muscles, irritability, fever, seizures, opisthotonus, shrill cry, apnea, coma and death.

Evaluation

All babies visibly jaundiced below knees, should have a blood sample for TSB estimation. Plot the values on AAP charts on bilirubin nomograms and decide the intervention.

Please ensure that the decisions are based on estimation of Total Serum Bilirubin (TSB) value only.

TSB may be estimated by transcutaneous bilirubinometer also. TSB should be measured if the TcB exceeds or is within 3 mg/dl of the phototherapy treatment threshold or if the TcB is ≥ 15 mg/dl.

Babies needing phototherapy should have a jaundice workup

- Haemoglobin, reticulocyte count, peripheral smear for evidence of hemolysis
- Blood group: Mother and baby
- G6PD
- DCT
- TSH

Save baby's and mother's blood samples for cross matching.

Management

For 35 weeks or higher

Management of jaundice is directed towards reducing the level of bilirubin and preventing CNS toxicity.

1. Prevention of hyperbilirubinemia: by early and frequent feeding
2. Identify the predisposing risk factor for significant hyperbilirubinemia
3. If there is jaundice, identify the risk factors for hyperbilirubinemia associated neurotoxicity

Reduction of bilirubin: This is achieved by phototherapy and/or exchange transfusion.

The decision to treat depends on the severity and the cause of jaundice.

Risk Factors for Developing Significant Hyperbilirubinemia

Table 12.1: Risk Factors for Developing Significant Hyperbilirubinemia include

Lower gestational age (ie, risk increases with each additional week less than 40 wk)
Jaundice in the first 24 h after birth
Predischarge transcutaneous bilirubin (TcB) or total serum bilirubin (TSB) concentration close to the phototherapy threshold
Hemolysis from any cause, if known or suspected based on a rapid rate of increase in the TSB or TcB of >0.3 mg/dL per hour in the first 24 h or >0.2 mg/dL per hour thereafter.
Phototherapy before discharge
Parent or sibling requiring phototherapy or exchange transfusion
Family history or genetic ancestry suggestive of inherited red blood cell disorders, including glucose-6-phosphate dehydrogenase (G6PD) deficiency
Exclusive breastfeeding with suboptimal intake
Scalp hematoma or significant bruising
Down syndrome
Macrosomic infant of a diabetic mother

Hyperbilirubinemia Neurotoxicity Risk Factors

Table 12.2: Hyperbilirubinemia Neurotoxicity Risk Factors

Risk Factors
Gestational age <38 wk and this risk increases with the degree of prematurity
Albumin <3.0 g/dL
Isoimmune hemolytic disease (ie, positive direct antiglobulin test), G6PD deficiency, or other hemolytic conditions
Sepsis
Significant clinical instability in the previous 24 h

The decision to treat with Phototherapy or Exchange transfusion will depend on the total bilirubin level plotted on the charts (Fig. 12.2-12.5) given below as per the gestational age, the age of the newborn in hours and the associated neurotoxicity risk factors mentioned in Table 12.2

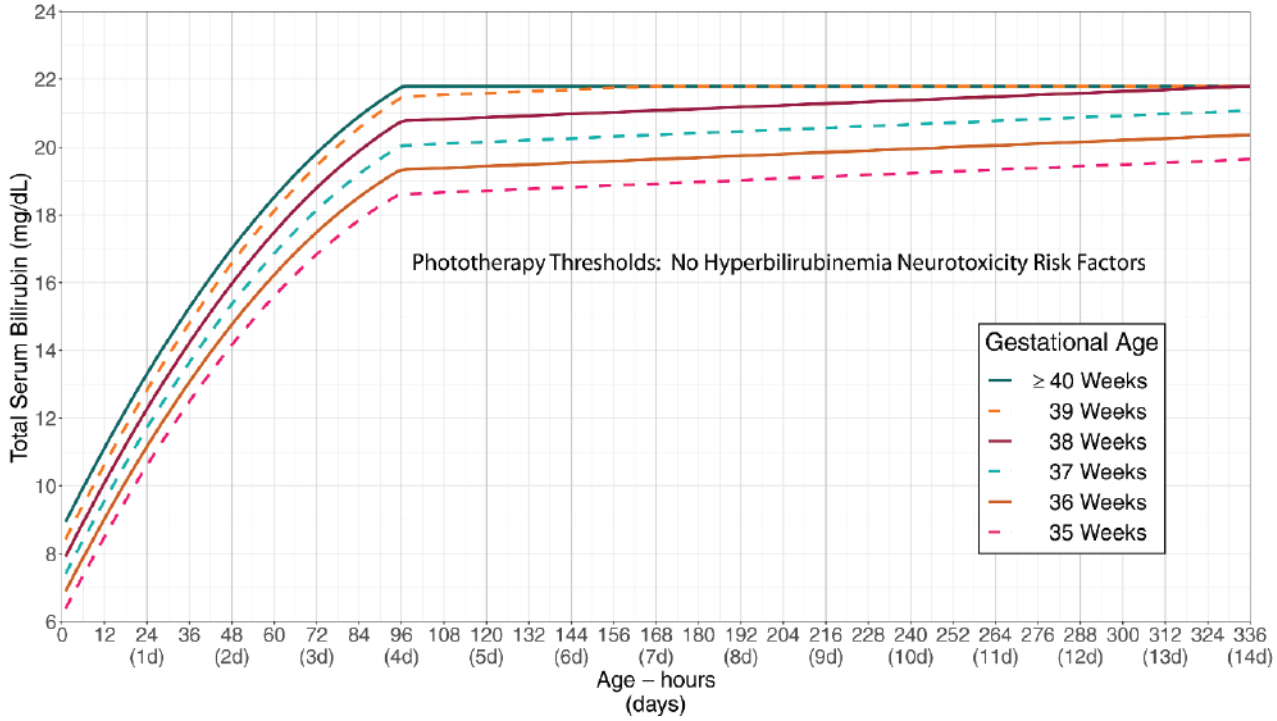


Fig. 12.2: Phototherapy threshold by gestational age and age in hours for infants with no recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age (AAP 2022)

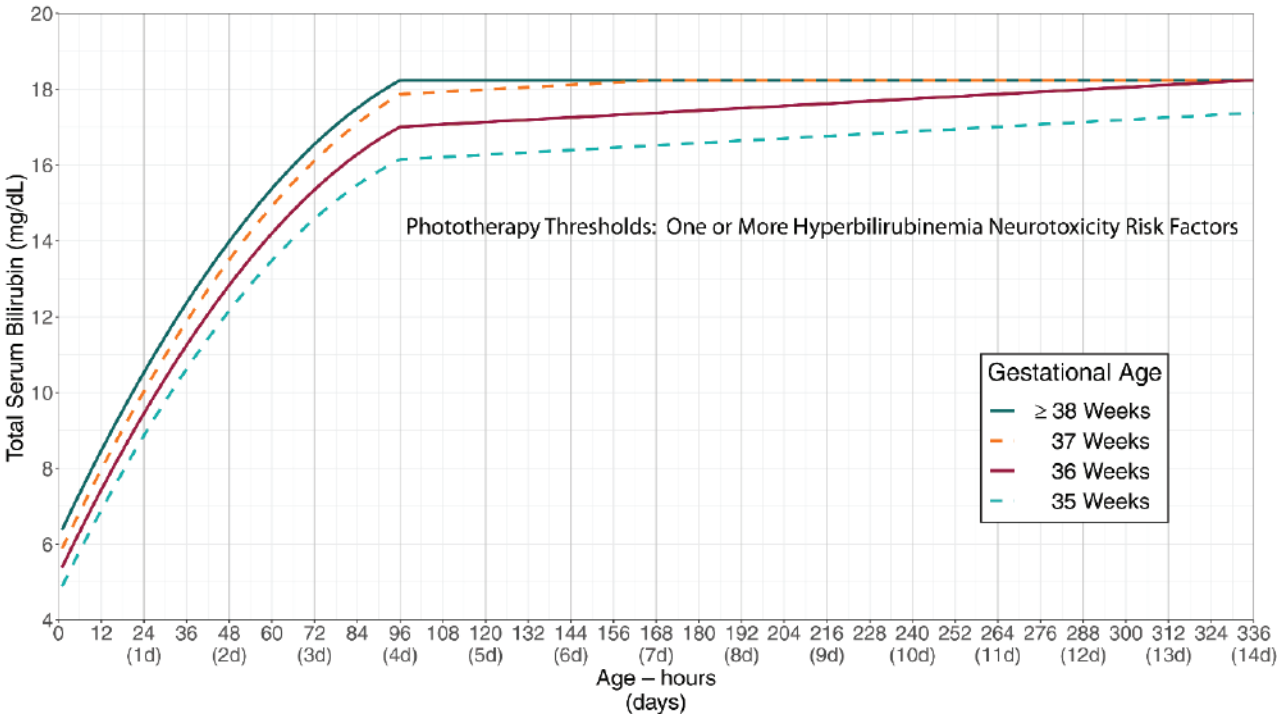


Fig. 12.3: Phototherapy thresholds by gestational age and age in hours for infants with any recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age (AAP 2022)

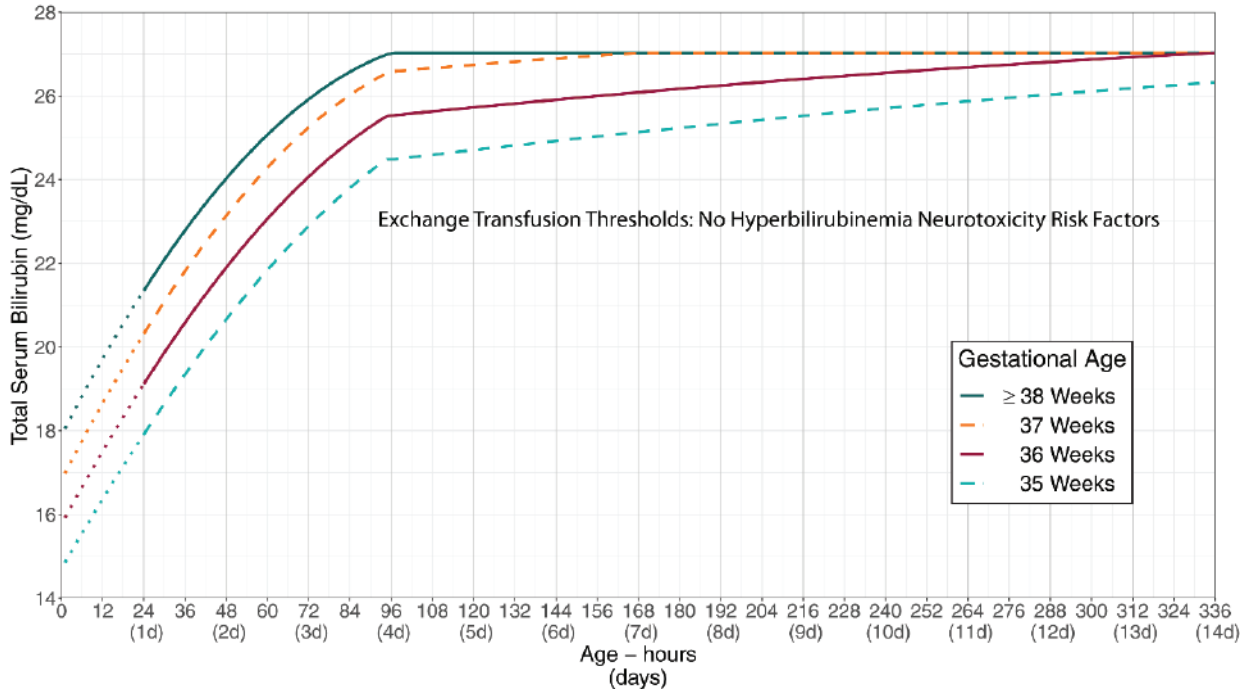


Fig. 12.4: Exchange transfusion thresholds by gestational age for infants with no recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age (AAP 2022)

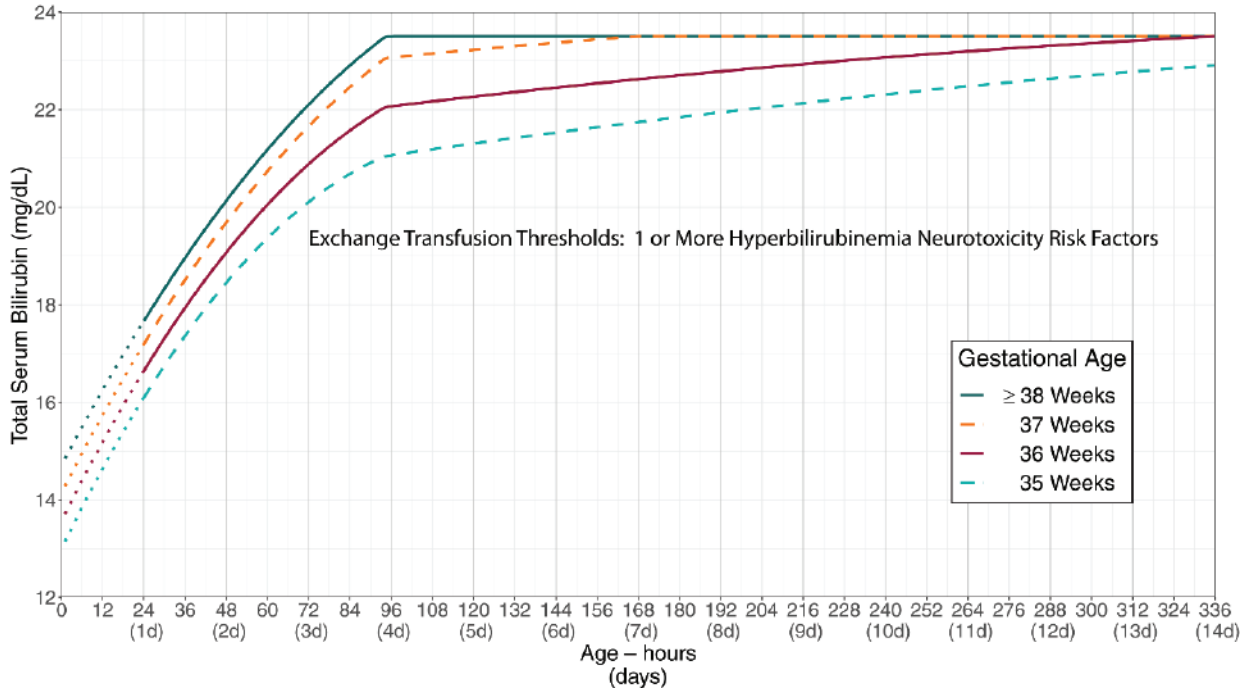


Fig. 12.5: Exchange transfusion thresholds by gestational age for infants with any recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age (AAP 2022)

Drill on use of charts

The facilitator will now conduct a drill on use of these charts with case scenarios.

For <35 weeks and birth weight <2000 gm

Table 12.3 Guidelines to treat hyperbilirubinemia in preterm neonates

Birth Weight (grams)	Guidelines for PT* (m g /dL) Healthy Infant	Guidelines for PT* (m g /dL) Sick Infant	Consider BET (m g /dL)
<1000	05-07	04-06	10-12
1000-1500	07-10	06-08	12-15
1501-2000	10-12	08-10	15-18

Martin and Fanaroff, Neonatal Perinatal Medicine, 8th Edition p1450.

Neonates with gestation at birth<35 weeks, birth weight<2000 gm and onset of jaundice at <60 h of postnatal age are at higher-risk.

Drill on use of Table 12.3

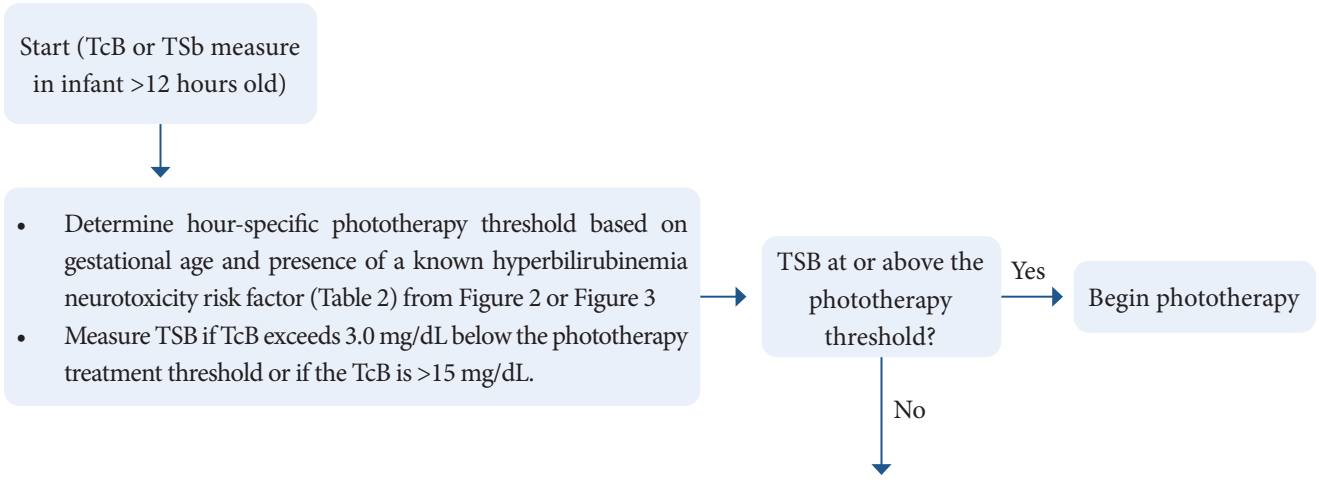
The facilitator will now conduct a drill on use of this table with case scenarios

Phototherapy

Will be discussed in the afternoon at the equipment station.

Follow-up

A follow up plan may be devised based on the pre-discharge bilirubin level and timing of the discharge of neonates:



Phototherapy threshold minus TcB or TSB		Discharge Recommendations
0.1-1.9 mg/dL	Age<24 hours	Delay discharge, consider phototherapy, measure TSB in 4 to 8 hours
	Age≥24 hours	Measure TSB in 4 to 24 hours[a] Options: • Delay discharge and consider phototherapy • Discharge without phototherapy if all considerations in the guideline are met • Discharge with phototherapy but with close follw-up
2.0-3.4 mg/dL	Regardless of age or discharge time	TSB or TcB in 4 to 24 hours[a]
3.5-5.4 mg/dL	Regardless of age or discharge time	TSB or TcB in 1-2 days
5.5-6.9 mg/dL	Discharging<72 hours	Follow-up within 2 days; TcB or TSB according to clinical judgment[b]
	Discharging≥72 hours	clinical judgment[b]
≥7.0 mg/dL	Discharging<72 hours	Follow-up within 3 days; TcB or TSB according to clinical judgment[b]
	Discharging≥72 hours	clinical judgment[b]

Fig. 12.6: Flow diagram for infants during the birth hospitalization to determine postdischarge follow-up for infants who have not received phototherapy (AAP 2022)

Exchange transfusion

It is an effective and reliable method to reduce serum bilirubin. It should be performed if the TSB remains in exchange transfusion range as per charts, despite effective phototherapy. Immediate exchange transfusion is indicated if features of bilirubin encephalopathy are evident. If facilities for exchange transfusion are not available at your center, early referral to a higher center is indicated. Delay in treatment may result in permanent brain damage. However, if the facilities and skills for performing exchange transfusion are available, the same can be done.

While referring a baby with jaundice, make sure that the mother accompanies the baby. In case this is not possible the mother's blood sample should be sent along with the baby.

Type and volume of blood: For 'Rh' isoimmunization, the best choice would be O negative packed cells suspended in AB positive plasma. O negative whole blood or cross-matched baby's blood group (Rh negative) may also be used.

For 'ABO' isoimmunization, O group (Rh compatible) packed cells suspended in AB plasma or O group whole blood (Rh compatible with baby) should be used.

In other situations, the baby's blood group should be used. All blood must be cross matched against maternal plasma.

Conjugated hyperbilirubinemia

This is rare in the newborn period and is defined as a direct bilirubin level of > 1 m g /dL when TSB is <5m g /dL, and > 20% of TSB of TSB is> 5 m g /dL. It is important to document a cause as it is never physiological.

Approach

The following four questions need to be answered

- Is the baby SGA?
- Is the stool white or clay-colored?
- Is the urine high colored?
- Are liver and spleen enlarged?

Never discharge a baby with conjugated hyperbilirubinemia without attempting to find the cause. Rule out or establish the diagnosis of extra hepatic biliary atresia within eight weeks of life till it is still surgically correctable. These babies are preferably managed in a Level III neonatal unit. Give Inj Vitamin K and refer to higher centre. Rule out congenital hypothryroidism and underlying sepsis.

Use of Phototherapy will be explained in the equipment section.

When to refer

1. Baby requiring exchange transfusion and facility for same is not available
2. Baby with persistent jaundice for further workup
3. Baby with conjugated hyperbilirubinemia for workup and management

EXERCISE

1. Anju delivered a full term female baby at home 2 days back. The baby is feeding well at the breast, has passed urine and meconium but she notices that the baby has yellow discoloration of the body. She is very apprehensive as her previous baby also had jaundice. What do you suspect and how will you manage this baby?

2. Baby Prerna was born at 34 weeks and has been brought to you with yellow palms and soles. The baby is four days old and the mother's Blood group is AB positive. What is the estimated bilirubin and how will you treat this baby?

3. Do the following babies require phototherapy/exchange transfusion based on AAP guidelines (Answer as Yes/ No)?

Age hrs	Gestation in weeks	Risk factors	Total in Serum Bilirubin	Phototherapy Yes/ No	Justification for your answer
48	36	None	12 m g /dL		
10	39	Asphyxia and Acidosis	6 m g /dL		
120	38	None	20 m g /dL		
28	35	None	11 m g /dL		
12	39	Rh Negative	18 m g /dL		
30	36	OB incompatibility	22 m g /dL		

CHAPTER 13

EMERGENCY TRIAGE ASSESSMENT AND TREATMENT (ETAT)

Learning objectives

After completion of this chapter the participant should be able to:

- Understand the process of identification of sick neonates requiring urgent attention
- Carry out ETAT of all sick neonates when they arrive at a health facility

Process and steps of management of sick neonates

Triage should be the first step in assessing neonates brought to a health facility. This helps to ascertain the category a referred neonate belongs to. Sick newborns are triaged into following categories:

E	**Emergency**
P	**Priority**
N	**Non-urgent**

Categories after Triage	**Action required**
Emergency cases	**Need emergency treatment**
Priority cases	**Need assessment and rapid action**
Non-urgent cases	**Need assessment and counseling**

- Once emergency signs are identified; prompt emergency treatment needs to be given to stabilize the condition of the neonate.
- After the neonate with emergency signs is stabilized, a detailed history should be taken and relevant examination pertaining to the presenting problems should be performed.
- Relevant laboratory investigations should be performed.
- A list of possible diagnoses should be made. A sick neonate often has more than one diagnosis or clinical problem requiring treatment.
- After deciding the main diagnosis and any secondary diagnoses or problems, treatment should be started (Specific and Supportive).
- Once the diagnosis is made and treatment given, the neonates should be closely monitored for response to treatment. When the neonate recovers and is fit to be discharged, he can be sent home with follow-up advice.
- At discharge, teach the mother all the treatments needed to be carried out at home and advise her as to when she should return to the health facility.

Assessing triage signs (refer to Table 13.1)

- First assess every neonate for **emergency signs**. Those with emergency signs require immediate emergency treatment.
- If emergency signs are not present, look for **priority signs**. Those with priority signs should alert the health provider to a neonate who is seriously ill and needs immediate assessment and treatment.
- Neonates with no emergency or priority signs are treated as **non-urgent cases**.

Table 13.1: Signs of triage

Emergency signs	Priority signs	Non urgent signs
• Significant Hypothermia (Temp <35.5^{0}C) • Apnea or gasping respiration • Severe respiratory distress (rate >70, severe retractions, grunt) • Central cyanosis • Shock (cold periphery, CFT >3 secs, weak fast pulse) • Coma, convulsions or encephalopathy	• Tiny neonate (<1800 gms) Temp 36.4^{0}C – 35.5^{0}C • Respiratory distress (rate >60 but no or minimal retractions) • Irritable/restless/jittery • Refusal to feed • Abdominal distension • Severe jaundice (appears in <24 hours / stains palms and sole/lasts >2 weeks) • Severe pallor • Bleeding from any site • Major congenital malformations (Tracheo esophageal fistula, Menigomyelocele, Anorectal malformation • Large baby >3.8 kg or according to the percentile charts. (See Chapter 4)	• Jaundice • Transitional stools • Developmental pecularities • Minor birth trauma • Possetting • Superficial infections • Minor malformations • All cases not categorized as Emergency/Priority
• Neonates with emergency signs are at high risk and require urgent intervention and emergency measures. These neonates with emergency signs after stabilization are to be admitted in the SNCU (Special Newborn Care Unit)	**ACTION** • Neonates with priority signs are sick and would need immediate assessment. They should be attended to on a priority basis. These will also need to be admitted to SNCU.	• In neonates with no emergency or priority signs, proceed with assessment and further treatment according to neonate's requirement

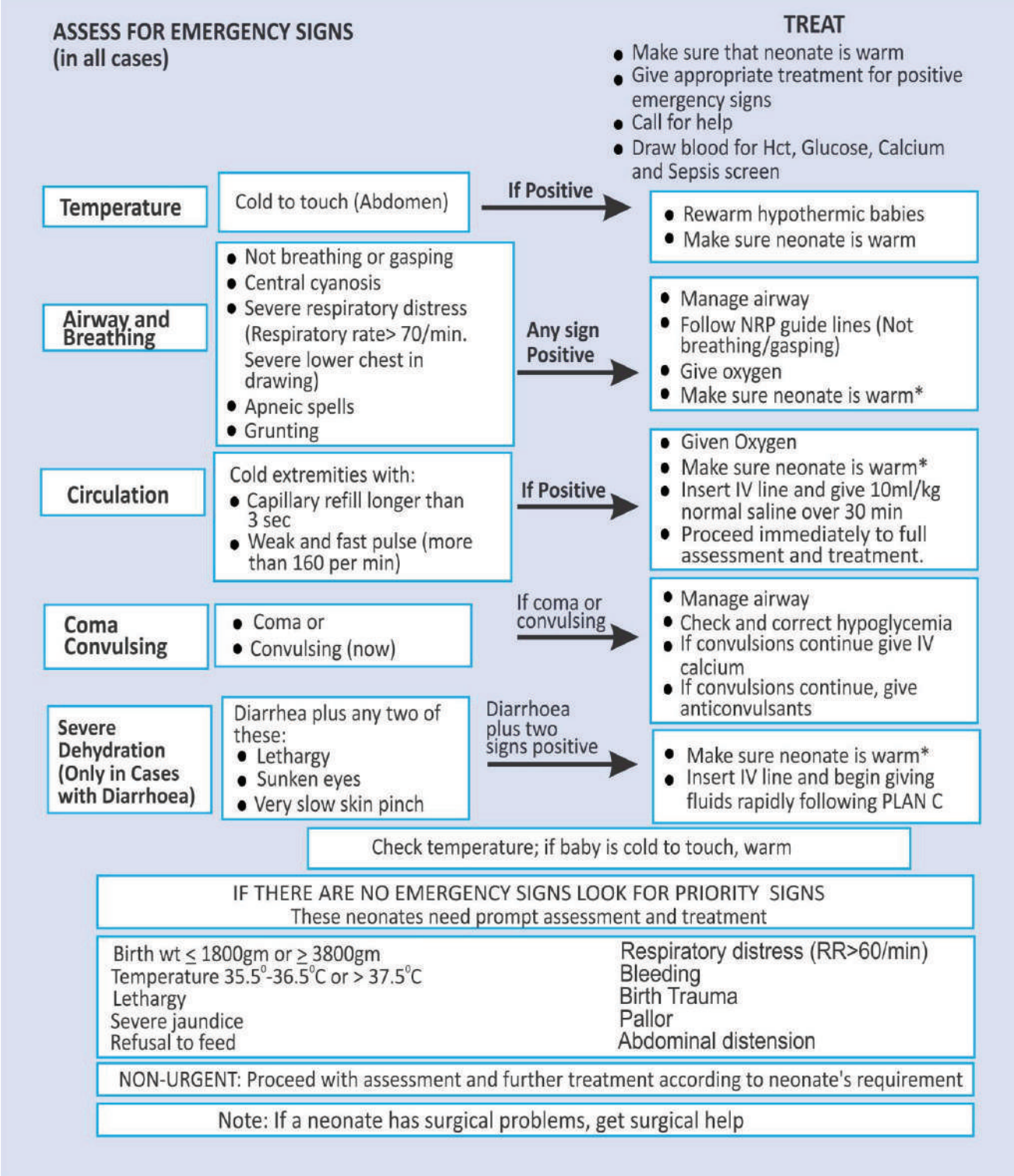


Fig. 13.1: Triage

How to triage

To carry out the process of triage: the reception and resuscitation (RR) area or the casualty of the hospital managing sick neonates should be earmarked as the triaging area. The site at the facility where a neonate is first brought should be the triaging area. All the staff involved in the initial management of a neonate should be trained in the triaging process. The most experienced doctor who is trained in neonatal care should undertake the responsibility of emergency treatment of the neonate keeping in mind the TABCD steps: Temperature, Airway, Breathing, Circulation, Coma, Convulsion, and Dehydration. Make sure that the neonate is warm at all times.

i. Maintain temperature (Refer to Chapter 2).
ii. Maintain the airway (Refer to NRP guidelines).
iii. Assist breathing (Refer to Chapter 11).
iv. Support circulation (Refer to Chapter 8).
v. Check and treat hypoglycemia (Refer to Chapter 7).
vi. Manage Coma and convulsions (Refer to Chapter 10).

A neonate who is not alert, but responds to voice, is lethargic. An unconscious neonate may or may not respond to pain. A neonate with a coma scale of "P" or "U" will receive emergency treatment for coma. Ensure TABC.

Once the baby is triaged and stabilized, the next step is to decide whether the baby requires admission to SNCU or referral.

To help you assess the consciousness level of a neonate a simple scale (AVPU) is used

A Alert **V** Responding to Voice **P** Responding to Pain **U** Unresponsive

EXERCISE

On the basis of the triage chart, categorize each of the following neonates. List the signs on the basis of which you assigned the category. Outline the steps of management as required.

1. Harsh a 3 day old neonate with birth weight 2400g is brought to SNCU with complaint of inability to feed. His temperature is 36.2^{0}C, he is lethargic and breathing normally with respiratory rate of 55 per minute, his hands are cold and capillary refill is 2 seconds. He does not have diarrhea.

2. 8 days old newborn with birth wt 2600g is brought to SNCU with fast breathing and inability to feed. His temperature is 35.8^{0}C, respiratory rate is 72 per minute with severe lower chest in drawing. Baby has cold extremities with capillary refill of 4 seconds, weak peripheral pulses and HR of 170/min. He does not have diarrhea.

3. 15 days old newborn with birth wt 3900g is brought to SNCU with fever and history of abnormal movements for 2 days. On examination, his temperature is 38.0^{0}C and baby is convulsing. His respiratory rate is 62 per minute with no signs of respiratory distress. Capillary refill time of this baby is 2 sec and the baby does not have diarrhea.

4. 2 days old newborn with birth weight 2000g has been brought to SNCU with complaint of deformity of both feet since birth. On examination baby has bilateral Clubfoot, he is feeding well at breast and has no respiratory problem. His temperature is 36.8^{0}C, respiratory rate is 44 per minute and capillary refill time is 2 seconds. Baby does not have diarrhea.

CHAPTER 14

NEONATAL SEPSIS

Introduction

Sepsis is the most common cause of neonatal deaths worldwide including India, contributing to almost one- third of all neonatal deaths. World Health Organization estimates that 1 million deaths per year are due to neonatal sepsis. If diagnosed early and treated with good supportive care and antibiotics, it is possible to save most cases of neonatal sepsis. Decreasing invasive interventions, promoting breastfeeding and maintaining proper hand hygiene are the best preventive strategies to reduce the occurrence of neonatal sepsis.

Learning objectives

The participant after completing this chapter should be able to:

1. Identify neonate with sepsis
2. Enumerate the important etiological organisms
3. Interpret the 'sepsis screen'
4. Treat neonatal sepsis

Definition

Neonatal sepsis is a clinical syndrome characterized by signs and symptoms of infection with or without accompanying bacteremia in the first month of life. It encompasses various systemic infections of the newborn such as septicemia, meningitis, pneumonia, arthritis, osteomyelitis and urinary tract infections (UTIs).

Classification

Depending on the age of onset, two patterns of the disease have been recognized:

i. ***Early onset sepsis (EOS),*** where the signs and symptoms of sepsis appear within 72 hours of birth. The source of pathogens is the maternal genital tract or the delivery area. Respiratory distress due to congenital (intrauterine) pneumonia is the predominant manifestation of EOS.

ii. ***Late onset sepsis (LOS),*** where the signs and symptoms of sepsis appear after 72 hours of age. The pathogens are acquired from community or hospital (nosocomial). LOS commonly presents as septicemia, pneumonia or meningitis.

Etiology

Most cases of neonatal sepsis are caused by Escherichia coli, Klebsiella and Staphylococcus aureus.

Risk Factors

Early-onset sepsis is caused by organisms prevalent in the maternal genital tract or in the delivery area. The risk factors for early-onset sepsis include:

- Very low birth weight (<1500 g), prematurity, spontaneous preterm delivery
- Prolonged rupture of membranes (>24 hours)
- Foul smelling liquor
- Multiple (>3) per vaginum examinations in 24 hours/single unclean p/v examination
- Intra-partum maternal fever (>38^{0}C)

Late-onset sepsis is caused by the organisms thriving in the external environment of the home or the hospital. The infection is often transmitted through the hands of the care-providers. The associated factors of late-onset sepsis include:

- Very low birth weight, prematurity
- Lack of breastfeeding
- Delayed enteral feeding
- Frequent handling
- Disruption of skin integrity with needle pricks and use of intravenous fluids
- Poor hygiene
- Poor maintenance of asepsis in neonatal units including improper hand washing techniques
- Superficial infections (pyoderma, umbilical sepsis)
- Previous or prolonged hospitalization

Clinical Features

The clinical picture of neonatal sepsis is highly variable. The signs and symptoms may be minimal, subtle, or nonspecific.

Common clinical features of neonatal sepsis are listed in Table 14.1.

Table 14.1: Clinical manifestations of neonatal sepsis

Lethargy	Cyanosis*
Refusal to feed	Tachypnea*
Poor cry	Chest retractions*
Not arousable, comatose	Grunt*
Abdominal distension	Apnea/gasping*
Vomiting	Fever+
Hypothermia	Seizures+
Poor perfusion	Blank look+
Sclerema[b]	High pitched cry+
Poor weight gain	Excessive crying/irritability+
Shock	Neck retraction+
Bleeding	Bulging fontanel+
Diarrhea[a]	Renal failure[c]

*Particularly suggestive of pneumonia.

+ Particularly suggestive of meningitis.

[a] Diarrhea should be suspected if there is passage of watery stool or an increase in usual stool frequency.

[b] Sclerema Neonatorum manifests as diffuse hardening of the subcutaneous tissue resulting in a tight smooth skin that feels bound to the underlying structures.

[c] Renal failure can be suspected clinically by presence of edema/excessive weight gain and oliguria/anuria.

Meningitis

About 25-30% of septicemic neonates may have meningitis which is often silent without signs of meningeal irritation. Symptoms suggestive of meningitis are excessive or high-pitched cry, fever, seizures or bulging anterior fontanel.

Diagnosis

Direct Method

Isolation of microorganisms from blood, CSF, urine or pus is diagnostic. In clinically suspected cases of sepsis, **blood culture should be sent prior to starting antibiotics**.

Collection of sample for blood culture: *Inoculation of 1-2 mL of blood (at least 1 mL) is recommended for adequate and appropriate growth in a pediatric blood culture bottle. The ideal ratio of blood to culture medium should be 1:10. The physician should ensure proper aseptic technique during collection of blood to avoid contamination. Before collection of blood, automated system's blood culture bottles should be stored at temperature below 25^{0}C and that of conventional system may be stored at ambient temperature. However, after inoculation of blood in the culture bottle, both types should be kept at room temperature or in an incubator at 37^{0}C (for facilitation of growth of microorganisms) till their dispatch to the laboratory.* (This skill will be demonstrated during the skill station on IV Cannulation)

Indirect Method

There are a variety of tests which are helpful for screening of neonates with sepsis.

- **Total leukocyte count (TLC):** A total leucocyte count below 5000/cu mm.
- An **absolute neutrophil count (ANC)** of <1800 per cu mm is an indicator of infection. Neutropenia is more predictive of neonatal sepsis than neutrophilia.
- **Immature neutrophils** (Band cells + myelocytes + metamyelocytes) **to total neutrophils ratio (ITR)** >0.20 means that immature neutrophils are over 20 percent of the total neutrophils. This happens because bone marrow pushes even the immature cells into circulation to fight infection.
- **Micro-ESR** may be elevated with sepsis and a fall of >15 mm during first hour indicates infection.
- **C-reactive protein (CRP):** A CRP value of >10mg/L is taken as positive. **A negative CRP is reassuring** The CRP can also be positive in other conditions like perinatal asphyxia, shock and meconium aspiration syndrome.

A negative sepsis screen helps to rule out sepsis however a positive screen may not be confirmatory as the screen parameters may be positive due to many other clinical conditions like PIH, Perinatal asphyxia, shock, meconium aspiration syndrome etc. Neonate with a positive sepsis screen may have an infection or it could be positive due to other reasons.

A practical positive "sepsis screen" takes into account two or more positive tests out of the five given below:

1. Leukopenia (TLC <5000/mm^3)
2. Neutropenia (ANC <1800/ mm^3)
3. Immature neutrophil to total neutrophil (I/T) ratio (> 0.2)
4. Micro ESR (> 15 mm 1st hour)
5. CRP +ve (>10mg/L)

Perform Sepsis Screen if

- Early onset Sepsis is suspected clinically or
- There are two or more risk factors in an asymptomatic baby.
- Late onset of sepsis

CSF Examination and Values of CSF for Diagnosing Meningitis

- Lumbar puncture (LP) must be performed in all neonates with late-onset sepsis. In EOS, CSF examination may be deferred in a neonate with RDS without any risk factors for sepsis. In all cases it must be done preferably before starting antibiotics.
- In a neonate with meningitis not showing clinical recovery after institution of antibiotics, LP should be repeated after 48 hours.
- Ideally, the CSF WBC count & CSF sugar must be performed within 30 minutes of drawing the sample. It must be noted that CSF WBCs and glucose rapidly fall with time, giving spurious results.

Treat for Meningitis if

CSF Cells >25 per uL with polys >60%
OR
[(CSF glucose <20 mg/dL OR CSF:blood* glu ratio <0.6) AND (CSF protein >150 mg/dL in term OR >180 mg/dL in preterm)]
This means in the absence of pleocytosis, BOTH hypoglycorrhachia and raised protein must be present to call it probable meningitis.
Pleocytosis alone, with or without cytochemistry changes, is enough to call it probable meningitis.
*Performing Pre-LP blood glucose is not mandatory, and an absolute value of CSF
Glucose 20 mg/dL is enough to call it hypoglycorrhachia. In case a pre-LP blood glucose is available, either absolute value or ratio can be used to define hypoglycorrhachia

Management

Table 14.2: Supportive care of a septic neonate

1. Maintain TABC
2. Ensure optimum oxygenation (maintain SpO_2 91-95%)
3. Maintain normoglycemia
4. Maintain circulation
5. Give Inj Vit K 1mg if required
6. Avoid enteral feed if hemodynamically compromised, give maintenance IV fluids but start orogastric feeds as soon as hemodynamically stable
7. Consider exchange transfusion if there is sclerema

Supportive care and antibiotics are two equally important components of the management.

Antibiotic Policy

Antibiotic therapy should cover the common causative bacteria, namely, *Escherichia coli, Staphylococcus aureus and Klebsiella pneumonia (Table 14.3).*

Table 14.3: Antibiotic Therapy for Neonatal Sepsis

I. Septicemia or Pneumonia

B wt < 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 14 days age	>14 days age		
Inj Ampicillin*	50 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj cloxacillin#	50 mg/kg/ dose	12 hrly	8 hrly	IV	7-10 days
AND					
Inj Gentamicin	5 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

B wt ≥ 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Ampicillin* or	50 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj cloxacillin#	50 mg/kg/ dose	12 hrly	8 hrly	IV	7-10 days
AND					
Inj Gentamicin	5 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

II. Septicemia IInd Line Drugs

B wt < 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 14 days age	>14 days age		
Inj Piperacillin+ Tazobactum***	100 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

B wt ≥ 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Piperacillin+ Tazobactum***	100 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

III. Meningitis (For confirmed meningitis)

B wt < 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Cefotaxime*	50 mg/kg/dose	12 hrly	8 hrly	IV	3 weeks
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks

B wt ≥ 2 Kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Cefotaxime*	50 mg/kg/dose	12 hrly	6 hrly	IV	3 weeks
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks

IV. Meningitis – IInd Line

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Meropenem****	40 mg/kg/dose	8 hrly	8 hrly	IV	3 weeks
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks

\# Start if pustules/umbilical sepsis.

* Infuse as an IV infusion using syringe infusion pump over 30 minutes or longer
Use a concentration not higher than 100 mg/ml for infusion.

** Infuse as an IV infusion using syringe infusion pump over 30 minutes or longer
Use a concentration not higher than 5mg/ml for infusion.

*** Infuse as an IV infusion using syringe infusion pump over 30 minutes or longer
Use a concentration not higher than 50 mg/ml for infusion.

**** Infuse as an IV infusion using syringe infusion pump over 30 minutes or longer
Use a concentration not higher than 10mg/ml for infusion.

The above tables are suggested guidelines to begin with as it is not possible to advocate a single antibiotic policy for use in all newborn units.

- **Every newborn unit must have its own antibiotic policy based on the profile of pathogens and local sensitivity patterns.**
- Preferably choose Penicillin plus an Aminoglycoside combination for sepsis and not cephalosporins as they rapidly induce the production of extended spectrum ß-lactamases (ESBL), cephalosporinases and fungal colonization leading to increased resistance and fungal sepsis.
- IIIrd generation Cephalosporins like cefotaxime should be reserved for meningitis in view of good CSF penetration. Avoid using ceftriaxone in neonates as it may displace bilirubin from albumin binding sites and may also induce cholestasis.

Duration of Antibiotic Therapy
Positive sepsis screen: 5-7 days. Stop earlier if culture is sterile and baby is well.
Positive blood culture: 10 -14 days.

Change of Antibiotics

- Empirical upgradation can be considered if there is no clinical improvement by 48 hours of institution of antibiotics or there are signs of deterioration earlier than that.
- In such circumstances (presence of signs of deterioration) one must look for alternate explanation (hypoglycemia, hypothermia, MAS, TTNB, RDS, Perinatal asphyxia) for the clinical signs and augment supportive care. However, despite this, if improvement does not occur in 48-72 hrs one may consider changing to IInd line antibiotics. Current evidence does not support the use of serial CRP as a guide for deciding whether or not antibiotics should be upgraded empirically.

Following conditions do not require antibiotics for their management (unless workup for sepsis is positive).

- Meconium Stained Amniotic Fluid
- Meconium Aspiration Syndrome
- Respiratory Distress Syndrome
- Perinatal Asphyxia
- Asymptomatic neonates with presence of 1-2 risk factors for EOS
- Jaundice
- Prematurity
- Cyanotic heart disease

When to Stop Antibiotics

Culture negative sepsis: If the blood culture is reported sterile at 48 hours, the following guidelines must be adhered to:

- Asymptomatic neonate (at risk of EOS) with positive sepsis screen/screen not performed initiated on antibiotics: stop antibiotics.
- Symptomatic neonate with positive sepsis screen becomes completely asymptomatic: stop antibiotics by 5-7 days.

Culture positive sepsis: Stop antibiotics after 10-14 days.

- Meningitis: Stop antibiotics after completion of 21 days.

Antibiotic stewardship and rational use of Antibiotics:

WHO states that "Rational use of medicines requires that patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their community."

- Emergence of multidrug resistant organisms (MDR) has been linked to the inappropriate use & overuse of antibiotics.
- Broad spectrum antibiotic exposure is associated with development of necrotizing enterocolitis (NEC), LONS, alteration of microbiota, invasive candidiasis, increased morbidity & mortality, duration of hospital stay & healthcare costs.
- Antimicrobial stewardship is recognized as a critical patient safety & quality imperative to combat the emergence of MDR.

Principles of Antibiotic Stewardship are:

- Timely & appropriate antibiotic utilization.
- Appropriate selection of a regimen.
- Optimization of the dose, route & duration of therapy.

These principles should be applied to empiric use as well as definitive use.

Best Practices to Prevent Neonatal Infections

- Safe delivery practices
- Maternal tetanus immunization
- Early diagnosis and prompt treatment of all maternal infections
- Early & Exclusive breastfeeding
- No pre-lacteal feeds
- Cord should be kept clean and dry
- Avoid overcrowding
- Maintain hygiene

Hand washing is the simplest and the most effective method for control of infection in the hospital.

Prevention of Infection in Hospitals

- Nursery environment should be clean
- Ensure round the clock water supply
- Ensure adequate ventilation
- Maintain temperature 26-28^{0}C
- Avoid overcrowding
- Ensure strict asepsis during procedures
- Minimize invasive interventions such as needle pricks and IV alimentation
- Initiate early enteral feeds

The use of prophylactic antibiotics for prevention of nosocomial infections is strongly condemned. They are not only useless but are dangerous due to the potential risk of emergence of resistant strains of bacteria.

When to Refer

After initial stabilization, if the baby's condition worsens or no improvement is noted after 48 hours of treatment, the baby could be considered for referral to higher center.

Worsening is Defined as Development of the Following Features

- Respiratory failure requiring mechanical ventilation
- Unresponsive shock
- Persistent or refractory convulsions
- Disseminated intravascular coagulation diagnosed by bleeding from puncture sites, gastro intestinal hemorrhage or pulmonary haemorrhage
- Baby requiring exchange transfusion but facility is not available

Video on prevention of infection

This video will demonstrate the skill of proper hand washing for prevention of infection. It also includes the methods of disinfecting instruments and equipment.

EXERCISE

1. Interpret the following Sepsis screen(s) as positive or negative –
   a. TLC -3800/cu mm, CRP Positive, ANC 2020, IT ratio NA, µESR 12 mm.
   b. TLC -9900/cu mm, CRP Positive, ANC 2020, IT ratio NA, µESR 12 mm.
   c. TLC -9200/cu mm, CRP Negative, ANC 1270, IT ratio NA, µESR 18 mm.
   d. TLC -8800/cu mm, CRP Positive, ANC 1920, IT ratio 0.02, µESR 14 mm.
   e. TLC -22800/cu mm, CRP Positive, ANC 2020, IT ratio 0.10, µESR 12 mm.
   f. TLC -2300/cu mm, CRP Positive, ANC 1870, IT ratio NA, µESR 12 mm.
2. Write treatment orders for a 2000 gm 9 days old baby diagnosed to have sepsis today.

3. Baby Tara has come to you with refusal to feed, fever and excessive crying. O/E the baby is irritable, AF is full, CFT is 2 secs, and Temp is 39^0C. There is pus discharge from the umbilicus. The R/R is 70/min and the HR is 180/ min. What is your initial impression? How will you prove your diagnosis and what treatment will you start?

4. Baby Neha, a 15 days old neonate was born in the hospital at 35 weeks gestation with a birth weight of 2100 gms. The baby was receiving breast feeds along with diluted animal milk with a bottle. She has been brought to you with complaints of lethargy, not taking feeds well and loose motions. Mother does not know when the baby last passed urine. On examination her weight is 2000 gms, she is lethargic with cold hands and feet and a CFT of 4 seconds. Her temperature is 36.5^0C with a RR of 64/min and a HR of 180/min. What is your diagnosis and how will you manage this baby?

CHAPTER 15

ANEMIA AND BLEEDING IN NEONATES

Introduction

Anemia is a common finding in babies admitted to NICU, especially preterm babies. Timely diagnosis and appropriate management are essential for optimal growth and development of these young infants. Bleeding in the neonate is an emergency. A variety of disease processes and disorders can exacerbate the physiological haemostatic immaturity present in a newborn and can lead to significant haemorrhage at times.

Learning objectives

The participant after completing this chapter should be able to:

1. Assess and identify the causes of anemia and bleeding
2. Provide guidelines for transfusion of Blood and Blood products/components in neonates

A. Neonatal anemia

Definition

In the newborn period, the hemoglobin concentration undergoes constant physiologic changes. At term, cord hemoglobin ranges between 14 – 20 gm/dl. Hb level in VLBW infant is 1 – 2g/dl below that of term infants. In a neonate, anemia is generally defined as venous hemoglobin less than 13 g/dL in the first 2 weeks of life and less than 12 g/dL in a premature baby less than 28 weeks gestation.

Anemia of prematurity

In preterm infants physiological anemia occurs earlier, is more severe and prolonged. Anemia in a preterm is multifactorial due to immature erythropoiesis, decreased erythropoietin, illness and repeated blood sampling.

Table 15.1: Hemoglobin nadir in babies in the first year of life

Maturity	Hb Level at Nadir	Time of Nadir(weeks)
Term	9.5-11.0	6-12
Preterm (1,200-2,500g)	8.0-10.0	5-10
Small Preterm (<1200g)	6.5-9.0	4-8

Glader B, Naiman JL. Erythrocyte disorders in infancy. In Taeusch HW, Ballard RA, Avery ME, eds. Diseases of the Newborn. Philadelphia: WBsaunders; 1991.

Causes of anemia

Anemia in a neonate is broadly due to three causes

1. Blood loss
2. Haemolysis
3. Diminished RBC production (rare)

1. **Blood loss**
   - Obstetric causes – Antepartum Hemorrhage, Umbilical cord rupture.
   - Occult blood loss – Feto-placental bleeding, Feto-maternal bleeding, Twin to twin transfusion.
   - Neonatal bleeding – Cephalohematoma, Intracranial bleed, Bleeding from umbilicus, GI bleeding, Adrenal haemorrhage and Ruptured liver or spleen.
   - Iatrogenic – Excessive blood sampling (commonest cause).

2. **Hemolysis**
   Rh or ABO incompatibility, G6PD deficiency, hereditary spherocytosis (HS), hemoglobinopathies, sepsis, DIC, malaria.

3. **Decreased production**
   Infections, drugs, congenital leukemia and pure red cell aplasia.

Approach to anemia

If the cause of anemia is not apparent, identify the underlying cause (hemolytic or acute blood loss) by taking a detailed history and clinical examination. Look for hepatosplenomegaly, bulging fontanel, petechiae, etc.

Laboratory tests

1. Complete blood count, reticulocyte count and peripheral smear.
2. Coombs test.
3. Bilirubin level.
4. Ultrasound of the abdomen and head is usually diagnostic in suspected cases of retroperitoneal, adrenal or intracranial hemorrhage.

Importance of reticulocyte count: Once anemia is detected, the reticulocyte count provides a further clue to diagnosis. Normal reticulocyte count is about 1-5% of the total RBC count. High reticulocyte count points towards a hemolytic cause like hereditary spherocytosis, ABO/Rh incompatibility or G6PD deficiency. Low reticulocyte count indicates decreased RBC production or hypoplastic anemia. A normal reticulocyte count warrants a peripheral smear for type of anemia. A normocytic picture on smear suggests an acute blood loss or infections, whereas a microcytic picture indicates a chronic loss.

Management of anemia

The management of newborn with anemia depends on the severity of anemia and clinical presentation. The priority should be initial stabilization (TABC) in the form of airway maintenance and management of shock.

Intravenous access should be obtained and oxygen therapy should be provided if required. Definitive therapy involves transfusion of packed red blood cells.

Transfusion therapy

Indications of packed RBC transfusion/blood transfusion (Table 15.2):

Table 15.2a: Indications For PRBC Tranfusions In Preterm Infants (Hemoglobin levels and Haematocrit thresholds)

Post natal age	Respiratory support*	No respiratory support
Week 1	11.5 g/dL (35%)	10 g/dL (30%)
Week 2	10.0 g/dL (30%)	8.5 g/dL (25%)
Week 3 and older	8.5 g/dL (25%)	7.5 g/dL (23%)
*Respiratory support is defined as baby requiring supplementary oxygen/CPAP/MV Data presented as haemoglobin(g/dL) (haematocrit %)		

Table 15.2 b: Indications For PRBC Transfusions In Term Infants

Hb <13 g/dL	Severe cardiopulmonary disease (requiring machenical ventilation with >0.35 FiO_2)
Hb <10 g/dL	Moderate cardiopulmonary disease
Hb <10 g/dL	Prior to major surgery
Hb <8 g/dL	A symptomatic anemia

Choosing type of blood for transfusion

In case of Rh incompatibility, first choice is Rh-ve blood of the baby's ABO group and cross matched against mother's serum. If this is not available, O-ve blood may be used.

In case of ABO incompatibility, first choice is O cells suspended in AB plasma or type O blood that is same Rh type of baby or O-ve and cross matched against mother's serum.

In case of no incompatibility, blood should be newborn's ABO and Rh blood group and cross matched against mother's serum.

Quantity to be transfused

The maximum packed red blood cell (PRBC) transfusion should be 15 ml/kg and should be given at the rate of 5-6ml/kg/hr and the total period of transfusion should be 3 – 4 hours. 20 ml /kg transfusion raises the Hb level by about 1-2 g/dL.

In all cases (below three months), the blood should be cross matched with maternal serum. For anemia, prefer to give packed RBC blood transfusion, except when there is acute blood loss.

Ensure Safe Transfusion: While giving transfusion, one should follow and ensure certain principles of safe transfusion.

Before transfusion check.

a. The blood bag no.
b. Date of donation – Blood should not be more than 7 days old.
c. Name and medical record/registration no. of the patient.
d. Blood group of baby and mother.

- Routine administration of diuretic e.g. furosemide is not recommended. Furosemide 0.5-1 mg/kg IV can be given during transfusion in patients with impending heart failure.
- Baby's vitals should be monitored, before, during and after blood transfusion (at least for 2 hours).
- PCV of the baby may be checked 4 hours after transfusion, if needed.
- If untoward transfusion reaction like hemodynamic instability such as tachycardia, desaturation, rash or shock is observed, the transfusion should be immediately stopped and baby managed accordingly. The bag with blood set, post transfusion sample and duly filled reaction form should be sent to the blood bank.

Prevention of late onset anemia

To prevent iron deficiency, prophylaxis in the form of oral iron in dose 2 – 4 mg/kg of elemental iron is recommended for all term babies from 6 months of age and in preterm babies on full enteral feeds after 2 weeks of life till 1 year of age.

Bleeding in Neonates

Bleeding in the neonatal period usually presents a diagnostic and therapeutic challenge. Bleeding disorders may be due to either congenital or acquired coagulation disorders, and may be related to mortality or long-term morbidity. While severe congenital coagulation defects usually present in the first hours to days of life in otherwise well newborns, acquired coagulation disorders usually present in sick newborns with a variety of presentations and distinct etiologies that differ from older children and adults (Fig. 15.1).

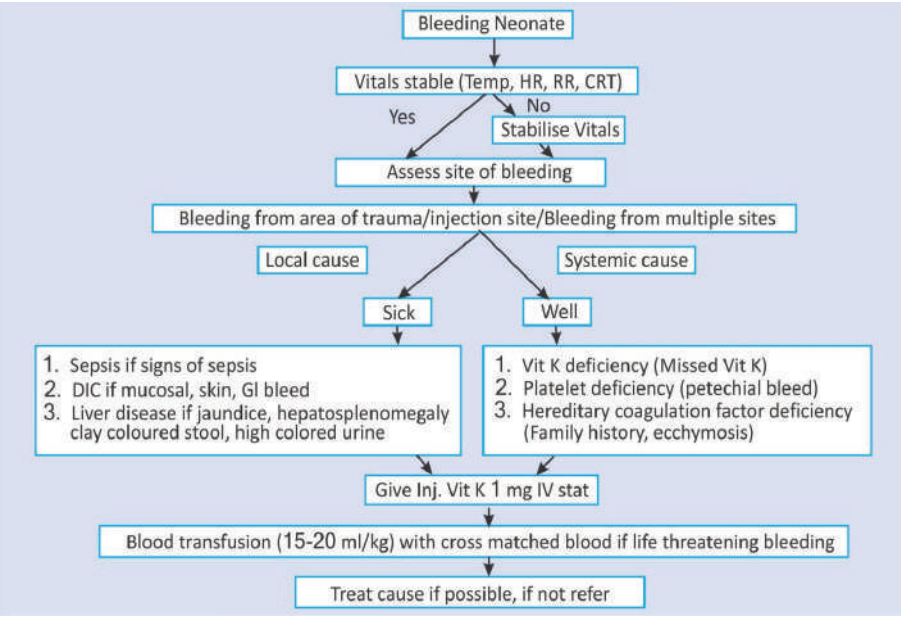


Fig. 15.1: Management of a bleeding neonate

Inj. Vitamin K1 should be administered once a week for all babies on prolonged antibiotic therapy.

EXERCISE

1. Baby Usha was found lying with the mother in the postnatal ward in a pool of blood at 6 hours of age. On examination the baby was pale, Cord tie had slipped, R/R was 62/min HR was 170/min. The baby was shifted to the SNCU immediately, placed under a radiant warmer and given oxygen by hood. What will you do next?

2. A preterm baby with a birth weight of 1300gms was admitted in the SNCU for RDS 15 days back. He was on oxygen, IV fluids and antibiotics. OG feeds were started on D5 when the baby was stable. He has been with the mother in the step down unit for two weeks. He looks pale today, his Hct is 26%. How will you manage this baby?

3. Baby Sudha was born at home and was brought to you with refusal to feed, lethargy, vomiting and abdominal distension and blood mixed stools. You are treating him for septicemia. Baby looks pale, his Hct is 28%. He is still on IV fluids and is sick. How will you treat his anemia?

4. Baby Veena was born at home and is 3 days old. The mother has brought the baby with the complaints of bleeding from the umbilical stump. O/E the baby is feeding well, active, there is oozing from the umbilical stump. There are no petechial spots and no bleeding from any other site. What is your initial impression and how will you manage this baby?

CHAPTER 16

NEONATAL TRANSPORT

During the course of treatment a neonate may need to be transferred for further management to a higher centre equipped with better facilities. It is important to ensure a safe and timely transfer. It is also important to prepare the baby for transfer, communicate with the receiving or sending facility, and provide care during transfer.

If delivery of a high risk baby is expected and adequate facilities are not available at the primary centre, it is always best to organize in-utero transfer.

The elements of safe transport include anticipation, preparation, stabilization, transport and handover.

Learning objectives

After completion of this chapter the participant should be able to:

1. Identify type of transfer
2. Identify babies who need referral
3. Prepare and organize transport
4. Counsel and support the family
5. Provide pre referral stabilization and en route care
6. Document the details and handover the baby

1. Types of transfer

The need to transport a neonate can be from home or from a peripheral health facility to a SNCU or a higher referral centre.

- From home or peripheral facility to SNCU/Hospital.
- Intra hospital transport (LR/OT/Radiology).
- Inter facility transport (SNCU to tertiary care facility).
- Reverse transport after treatment (tertiary centre to SNCU, SNCU to NBSU).

2. Identify babies who need referral

a. From community to SNCU any neonate who has

- Lethargy
- Refusal of feeds/difficulty in feeding
- Hypothermia
- Tachypnea, grunt, gasping, apnea, cyanosis

- Seizures
- Abdominal distension
- Bleeding
- Deep jaundice over palms and soles
- VLBW neonates
- Congenital malformations

b. From SNCU to tertiary centre any neonate who has:

- Need for CPAP/mechanical ventilation
- Unresponsive shock
- Jaundice needing exchange transfusion, if facilities not available
- Refractory seizures
- Refractory hypoglycaemia
- Need for surgical intervention
- Acute kidney injury
- Extreme prematurity

3. Preparation and organization of transport

a. Communication

- Explain the condition, prognosis and the reasons for transfer of the baby.
- Explain where to go and whom to contact.
- Inform the referral facility beforehand.

b. Personnel

A nurse/ANM/Doctor/ASHA should accompany the baby in the vehicle to provide care en route and to facilitate transfer. **Mother or any other relative should accompany the baby and transport team.**

Remember to send 5ml of mother's blood in a plain vial if she is not accompanying the baby

c. Vehicle

The ambulance used for neonatal transport should have the following requirements:

1. Secure fixation for the transport incubator.
2. Secure fastening of other equipment (e.g. Oxygen and monitoring equipment).
3. Independent power source to supplement equipment batteries. This will ensure uninterrupted operation of the equipment.
4. Necessary adapters to access the ambulance power source.
5. Equipment and drugs

d. Equipment and drugs

Equipment needed for thermal control, maintaining the airway, resuscitation, oxygen therapy, administration of IV fluids and monitoring should be available and functional. Availability of all essential medicines should be ensured.

4. Counselling and support to the family

One of the most important and often difficult aspect of transport is the need for providing emotional support to the parents and family.

Hospitalization and the need for transport of a newborn can precipitate a crisis for the entire family. Accepting emotional outbursts calmly and reassuring the parents that their child is being cared for can reduce parental anxiety. Interventions to reduce stress and support grief response must be incorporated into the transport process:

1. Allow parents to see and touch their infant prior to transport.
2. Thoroughly explain the clinical problems and anticipated care during transport.
3. Provide information about the receiving hospital including location, visiting policies and transport.
4. General NICU facts should be provided.
5. Consider maternal transfer whenever possible.
6. Obtain consent for transfer.

5. Pre referral stabilization and en route care

Once a decision for transport is taken it is important to carry out the following;

a. Assessment:

Make a careful assessment of the baby by performing a thorough examination. Make sure that there is a genuine indication for referral.

b. Stabilization:

It is advisable to stabilize the baby while waiting for the ambulance rather than transferring the neonate by an unorganized transport (auto, car, train). Stabilize with respect to temperature, airway, breathing, circulation and blood sugar. (TOPS: Temperature, Oxygenation, Perfusion, Sugar)

I. Temperature:

Ensure warm transport. Use one of the following approaches to keep the baby warm during transportation:

Skin to skin care

This is probably the most effective, safe and convenient method. Skin to skin contact can be provided by the mother or by a caretaker, if the mother is not accompanying the baby due to some reason. Unstable babies need to be transported in an incubator/warmer.

Cover the baby

Cover the baby fully with clothes including the head, hands and feet.

Transport incubator

This is the ideal mode of transport and should be made available.

Do not use hot water bags

II. Oxygenation: Airway and breathing

Assess by checking the position of the neck and look for presence of secretions. Check respiratory rate, assess for respiratory distress, central cyanosis, gasping respiration or apnea.

Maintain the airway by keeping the head of the baby in a slightly extended position.

Clear the mouth and nose of any secretions with the help of mucus aspirator. In case the baby develops apnea provide gentle tactile stimulation. If the baby remains apneic provide PPV.

If respiratory distress is present administer oxygen to a term baby and provide CPAP to a preterm baby if needed and available. If a baby has severe respiratory distress or gasping respiration or apnea, provide PPV. Use pulse oximeter to monitor oxygenation.

III. Perfusion

Check HR, CRT, temperature and BP (if feasible).
If perfusion is compromised secure a venous access (preferably two). Give fluid bolus and inotropes for shock management (Refer to chapter 8).

IV. Sugar

Check sugar with glucometer. Ensure normoglycemia. If glucose levels are low, take appropriate measures (Refer to chapter 7).

c. Pre transport medication

Give first dose of antibiotics as Injection ampicillin and gentamicin if needed. Give Inj. Vitamin K if not administered earlier.

d. En route care

Constant vigilance (maintaining TOPS) is required during the journey because neonates can deteriorate suddenly and without warning. This may be due to neonate's clinical condition or equipment failure. Prompt action is needed to handle both.

It is best not to attempt feeding sick babies with abnormal sensorium or severe respiratory distress before or during transfer. A well-baby at risk of hypoglycemia may be fed. If the baby can suck give breast feeds. If unable to suck give expressed breast milk (EBM) with spoon or paladai. If EBM is not available give formula feed. IV fluids may be required for very sick babies.

6. Documentation and handover

Write a precise note for the providers at the referral facility providing details of baby's condition, reasons for referral and treatment given to the baby (Sample referral note on page 130 & 131).

Janani Shishu Suraksha Karyakram (JSSK)

There is provision for transport of both mother and baby from home to a facility and back home after delivery or treatment of the mother and neonate which could be utilized for neonatal transport through JSSK. The guidelines for the State for implementation are as follows:

1. Ensure universal reach of the referral transport (no area left uncovered), with 24 x 7 referral services of 108/104/102 transport service.
2. State is free to use any suitable model of transportation e.g. Government Ambulances, referral transport PPP model etc.
3. Establish linkages for the inaccessible areas (hilly terrain, flooded or tribal areas etc.) to the road head/pick up points.
4. Widely publicize the free and assured referral transport through print and electronic media.

Safe transportation of a Neonate to a centre with expertise and facilities for provision of optimal neonatal care has shown definite improvement in neonatal outcome. Hence we should strive to provide optimal transport for sick neonates.

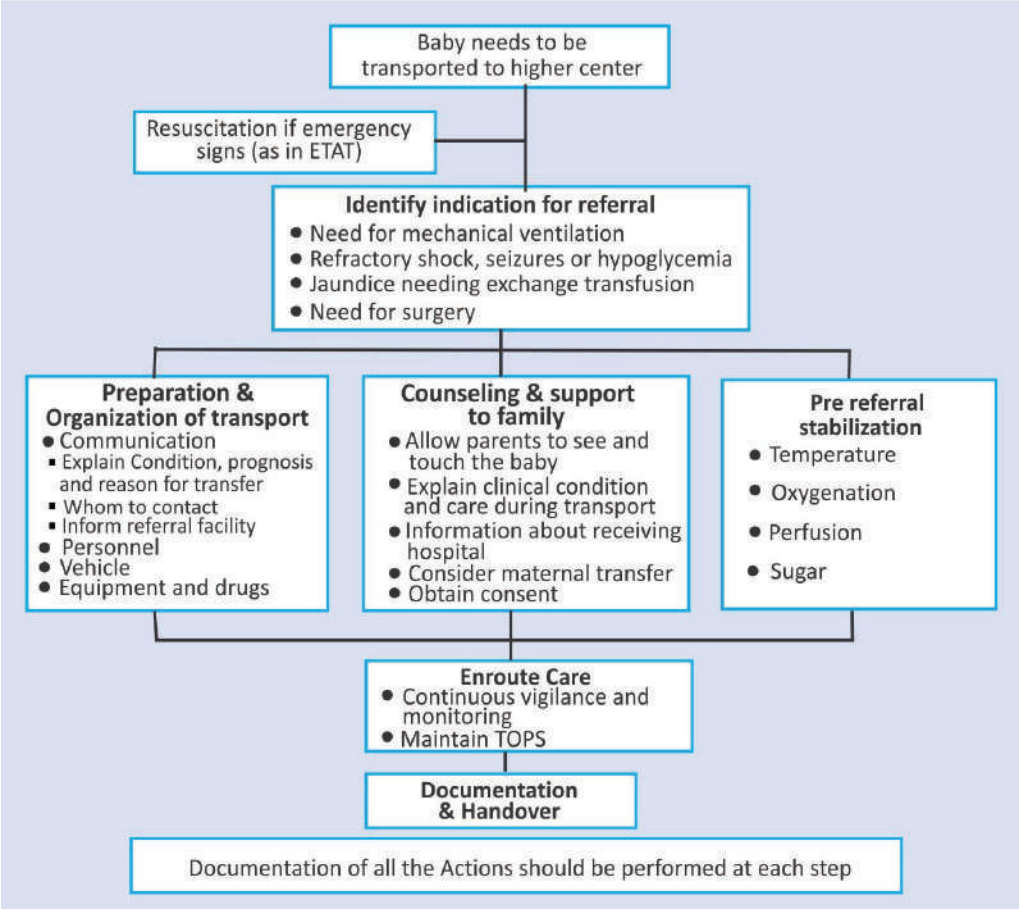


Fig. 16.1: Flow diagram for Neonatal transport

Table 16.1: Ideal Requirements for Neonatal Transport; Equipment and Supplies (Mandatory)

1.	Transport Incubator with temperature probes	16.	Sterile gloves
2.	Digital Thermometer	17.	Stethoscope
3.	Plastic wrap	18.	Pulse oximeter
4.	Oxygen cylinders	19.	Glucometer
5.	Flow meters, Oxygen tubing and adapters	20.	Intravenous cannula (24, 26 guage)
6.	Oxygen hood, neonatal size masks and cannula	21.	Syringes (2, 5, 10, 20, 50 ml)
7.	Resuscitation bag	22.	Transparent dressings or micropore
8.	Nasal prongs	23.	Three way stopcocks, Micro drip sets
9.	Endotracheal tubes: 2.5, 3.0, 3.5 mm	24.	Intravenous administration tubing
10.	Laryngoscope with size 00, 0 and 1 blades	25.	Infusion pump
11.	Laryngoscope batteries and extra bulbs	26.	Normal saline, 10% dextrose, Isolyte-P
12.	Tape to secure ET tube	27.	Calcium gluconate 10%
13.	Mucus suction trap, Suction catheters (5, 6, 8, 10, 12 F)	28.	Epinephrine (1:10000),
14.	Regulated suction with gauge limiting < 100 mm Hg	29.	Dopamine, Dobutamine
15.	Feeding tube (5/6 Fr) and 20 ml syringe for oro-gastric decompression	30.	Phenobarbitone, Midazolam

SAMPLE REFERRAL NOTE

Date_____Time_____Address_____

Name _____ Mother's Name_____ Father's Name _____

DOB _____ TOB _____ Sex __ Mother's Blood Gp: _____

Birth Details

Mode of Delivery _____ Place of Delivery _____

Time of 1st Cry _____ Apgar 1 min ___ 5 min ___ 10 min ___

Resuscitation details: Initial steps / Free flow oxygen / Bag & Mask Ventilation / Chest compressions/ Medications

Duration of: O_2 _____,Bag & Mask Vent. _____, Chest compression _____

Birth weight _____ grams

Clinical course

Feeding well - Yes / No, Breast feeds -Yes / No, Spoon Feeds -Yes / No

Type of feeds - EBM / Formula / Any other milk Diluted milk - Yes / No

Passage of Urine - Yes / No Stool passed- Yes / No

Reason for transfer LBW / Respiratory distress/ Not feeding well/ Convulsions/ Jaundice/ Malformation/ Any other

Examination Findings

Jaundice - Yes / No Any congenital malformations _____

Soles - Warm/Cold, Trunk - Warm/Cold Temperature _____ oC

Heart Rate ____ / min Resp Rate ____ / min Chest Retractions - Yes / No

Central Cyanosis - Yes / No CFT - < 3 sec / > 3 sec

Receiving oxygen - Yes / No With Nasal canula / Face mask / hood SpO_2 ____%

Dextrostix _____ mg% Time of Last Feed _____am/pm

Investigations with date

_____

Treatment Given

_____

Place to which being referred _____

Mode of transport _____ Accompanying person _____

Name and Phone number of person at Referral Hospital _____

_____

EXERCISE

1. Baby Veena was brought to the SNCU with the complaints of RD and frothing from the mouth O/E the baby is lethargic, temperature is 37^0C, respiratory rate 62/min, with subcostal retractions, and bilateral crepts on auscultation. CVS and per abdomen examination is essentially normal. You feel this baby has a TEF and confirm it by passing an oro-gastric tube. You decide to refer this baby to a tertiary care centre. How will you plan and execute the referral?

2. Write a sample referral note for Baby Veena.

CHAPTER 17

FOLLOW UP OF HIGH RISK NEWBORNS

All health facilities caring for sick and preterm neonates must have a comprehensive follow up program. This requires thoughtful planning and regular support from a multidisciplinary team.

Learning objectives

After completion of this chapter the participant should know:

- Which babies need follow up (Identify at-risk newborn)
- Where should the SNCU graduate be followed up
- Who should do the follow up
- How to use the 'Follow up protocol'

Which babies need follow-up?

All SNCU discharges need follow up. These babies are at risk of neurodevelopmental, growth, nutritional, visual and hearing impairment. Special social support and education of the mother and the family of these high risk neonates is very important for their intact survival.

Risk factors

Biological risk factors: Prematurity, Low birth weight, Severe IUGR (Less than 3rd percentile), Malformations (major) and Multiple births.

Morbidity: Asphyxia, shock, respiratory distress requiring support, sepsis (culture proven meningitis), jaundice in near exchange level, hemodynamically significant PDA (patent ductus arteriosus-significant), NEC, hypoglycemia etc.

Interventions: e.g. Inotrope use, multiple anti-convulsants, prolonged antibiotic course, need for resuscitation.

High risk identification checklist: (this is a sample/each unit may customize)

- Babies with <1800 g birth weight and/or gestation <34 weeks
- Babies requiring respiratory support
- Perinatal asphyxia – Apgar score 3 or less at 5 min and/or hypoxic ischemic encephalopathy of stage II and above
- Small for gestational age (<3rd centile) and large for gestational age (>97th centile)
- Hypoglycemia
- Neonatal Seizures
- Sepsis with meningitis or culture positive sepsis
- Shock requiring inotropic/vasopressor support
- Total serum biliurbin in the near exchange range/ neonate who underwent exchange transfusion
- Suboptimal home environment

Discharge Criteria

- Weight gain should be consistently demonstrated for 3 consecutive days. The weight, head circumference and the length should always be recorded at the time of discharge.
- Mother should be confident in feeding the neonate (Breastfeeding/ any alternate feeding method like paladai or spoon).
- The required nutritional supplements should have been started.
- The baby should have received BCG, Hep B and OPV.
- The methods of temperature regulation like KMC and any other skills should be well known to the mother and adequately practiced in the hospital under medical supervision.
- All danger signs should be explained in detail to the parents with information regarding whom and where to contact mentioned on the discharge slip.

The SNCU team needs to prepare a Checklist (in duplicate) comprising of important events and information related to SNCU admission at the time of discharge. This needs to be shared with the parents and one copy should be a part of the follow up folder of the baby. (Refer to Table 17.1)

Where should the baby be followed up and who should do the follow-up?

All high risk babies discharged from the SNCU should be followed up in the SNCU on a fixed day and time. Routine examination including anthropometry, growth, breastfeeding issues, immunization and developmental screening should be done by the SNCU doctor. Any abnormality detected, needing specialized evaluation should be referred to a higher centre equipped with developmental/interventional facilities. Such a center (DEIC) should be identified by the SNCU doctor and should preferably be the nearby medical college or any other tertiary care facility. The SNCU staff should provide support to the family during referral to such a centre. The SNCU doctor should act as a responsible primary physician and liaise, whenever required, with a clinical psychologist, developmental pediatrician, ophthalmologist, audiologist and neuro-developmental therapist for complicated cases needing special investigations and care.

Community follow up is done by ASHA under HBPNC (Home based postnatal care).

Team required

On a day-to-day basis (Primary team at SNCU)

- Pediatrician/Medical officer of SNCU
- Nursing staff (for coordinating and assisting in the clinic)
- Data Entry Operator to send reminders and ensure follow up visits

Referral base to be established with:

- Developmental Pediatrician (with skills for detailed developmental evaluation)
- Pediatric neurologist
- Developmental therapist (With experience in neuro-motor and stimulation therapy)

- Radiologist (With skills to perform cranial sonography of the preterm)
- Ophthalmologist (With skills to perform the ROP screen)
- Orthopedician
- Audiologist (for OAE/BERA)
- Physiotherapist, speech therapist, occupational therapist
- Social worker (To organize and assist the attenders to accomplish this multidisciplinary management)
- Dietician

Early intervention

The problems associated with at risk infants are often identified very late when little can be done. No drug has been conclusively proven to be effective in improving outcome in high risk infants such as those with post-asphyxial encephalopathy, intra-ventricular hemorrhage and periventricular leucomalacia etc. Hence, developmental follow up and early intervention is important for optimum outcomes.

Early intervention programme (early stimulation) must be started in the SNCU itself once the neonate is medically stable and continued till at least 1 year of age at DEIC under RBSK. All the babies before being discharged from the SNCUs must be referred to DEIC for screening services as available under the RBSK including screening for visible birth defects and common metabolic disorders. If any congenital defect or delays are detected during stay in SNCU, the DEIC team should be informed and details be shared with them. All very low birth weight (<2 kg) or premature (<34 weeks) babies must be mandatorily screened for hearing and vision at DEIC/ appropriate facility before discharge.

The following interventions are a part of this programme

- Optimize lighting
- Reduce noise, gentle music
- Club painful procedures, allow breast feeds or give EBM or 25% dextrose, hand holding/swaddling immediately before the procedure
- Tactile stimulation – touch, gentle massage
- Kangaroo Mother Care
- Non-nutritive sucking
- Passive exercises
- Motivate the parents to stimulate the baby with appropriate stimuli; the parents of an at-risk baby are likely to be demoralized and at-risk of not being involved in stimulation of the child

Community Follow up: HBNC (Home based postnatal care) is the process of providing care through ASHA for child survival, monitoring growth and development, promoting exclusive breastfeeding, preventing and responding to illness.

The government has provided the Mother Child Protection card (MCP card) to be prepared for each child.

Focus is on delivery of care through **home visits** during the critical 42 days after birth (Six visits in the case of institutional delivery Days 3, 7, 14, 21, 28 and 42 and Seven visits in the case of home delivery; Day 1, 3, 7, 14, 21, 28, and 42).

Follow-up protocol after the discharge of the baby

A set follow up schedule is very important so that timely assessment and specific interventions can be carried out. Suggested schedule along with the follow up protocol is detailed below.

Schedule

Initially call after 48 hrs of discharge/within a week of discharge. Thereafter fortnightly for the next two visits then on Immunization days till 18 months of age with a visit at 6 months and 12 months of age. Follow this by yearly review till school entry.

Table 17.1: Checklist to be completed at the time of discharge

S. Category	Details
Morbidity Details of the important morbidities eg. RDS, Sepsis, Asphyxia, DIC, NEC, MAS, etc (in chronological order)	1. 2. 3. 4. 5. 6.
Therapy Oxygen, Antibiotics, Anticonvulsants, Inotropes, Ibuprofen, Prolonged tube feeding etc.	1. 2. 3. 4. 5. 6.
Anthropometry - Weight, Length, OFC at discharge	Weight Length OFC (Occipito frontal circumference)
Special consultation if any. e.g . Endocrine, Genetics, Pulmonology, etc.	Date Age Details
ROP Screening: All babies < 34 wks and /or <2000 gms, 34 – 36 wks; who needed O_2, or were hemo-dynamically unstable. First screen should be performed not later than 4 wks of age or 30 days of life in infants >28 wks of GA. Infants <28 wks or < 1200 gms, should be screened early, by 2-3 wks of age, to enable early identification of APROP (Aggresive posterior ROP).	Calculate and write the date when the screen is needed. The contact details of the ophthalmologist should be mentioned First Screen: DD/ MM/ YYYY
Hearing Screen: Initial screening can be performed using OAE(otoacoustic emissions)/ AABR(Automated auditory brainstem response) or both.	First screen date: 40 wks corrected age/predischarge: DD/ MM/YYYY Next evaluation if first abnormal: 4-6 wks Postnatal age: DD/MM/YYYY Next evaluation if second abnormal: Before 3 months of age: DD/MM/YYYY
Nutrition counseling: quality, quantity and supplements	Details of supplements needed by baby Supplement Amount Duration 1. 2. 3. 4
Immunization Counsel and provide the immunization card	Immunization card given and explained to mother YES NO
Neurological Examination: Note any abnormality in tone, posture, reflexes, movements, orientation and behavior.	Normal Mild abnormal Gross abnormal
Neuro Imaging: USG, CT &/or MRI All preterm babies born before 32 weeks and <1500 gms must undergo neurosonograms at 1 – 2 weeks and 36- 40 weeks corrected age. With limited facility available, it is advisable to have at least one USG at 40 wks of gestation in preterm babies.	1st Week of life : DD/MM/YYYY 2-3rd week of life : DD/MM/YYYY 40 weeks corrected age : DD/MM/YYYY

Table 17. 2: Follow Up Protocol After Discharge of a High Risk Baby

S.No	Area	Frequency	Details	Remarks
A	Anthropometry	Every visit	Weight, Head Circumference, Length	Always estimate if the gain is adequate
B.	Breastfeeding	Every visit	Attachment Positioning Problems	Observe a breastfeeding session if possible
C.	Counselling	Every visit	Feeding Hygiene KMC Innocuous issues	Ask mother about her concerns
D.	Development screening	3, 6, 9, 12 months	Use TD screening chart (Annexure 16)	Fill up the chart and refer where needed for detailed developmental evaluation
E.	Eye	1 month for babies <2000 &/ or < 34 weeks & 34-36 weeks with stormy NICU course For babies < 28 weeks gestation or < 1200 gms First Screening for ROP should be done at 2-3 weeks after birth Detailed examination at 9-12 months of age	Emphasize on getting a ROP screening from a skilled ophthalmologist	Review in next visit if required
F.	Follow-up USG	At discharge and at 1 month	To rule out PVL and other abnormalities	
G.	Growth Monitoring	Every Visit	Plot the growth of the baby on the WHO growth charts	Use of intergrowth 21 charts till 64 post menstrual weeks and WHO charts subsequently (Annexure 15,17,18)
H.	Hearing	At 40 wks PMA and in case questionable, at 6 weeks of age	One can use the OAE / AABR or combination as per the policy. For neonates with complicated NICU course/ NICU stay > 5days and VLBW neonates (< 1500g) should undergo AABR. Stable neonates without risk factors can undergo OAE	
I.	Immunization	As per schedule		
	Others Anaemia of Prematurity Osteopenia of Prematurity (all babies<32 weeks) Language / speech Behavior and IQ testing	 Screening at 4 - 6 weeks and repeat 2 weekly Screen at 4-6 weeks, repeat every 2 weeks At 1,2,3 year At 3 years of age	 Hb/Hct & Peripheral smear S. Ca, S.PO4 (<4mg/dL) and ALP (>800IU/L)	 BT if indicated Supplement Cal, Po4 and Vit D (2000IU/day) Any delay detected should prompt early intervention

Timely specific interventions and compliance must be ensured after detection of deviation from normal for optimal outcome of high risk babies.

Specific interventions

- Motor impairment / Hypertonia – medications, occupational therapy and physiotherapy.
- Treatment of seizures.
- Speech therapy.
- Hearing aid.
- Squint correction and ophthalmologic aids.
- DDH and other Orthopedic problem correction.
- Behavior therapy and pharmacotherapy for behavioral disorders.
- Therapy for learning disabilities.

CHAPTER 18

COMMUNICATION IN NEWBORN CARE

Good communication is an integral part of comprehensive patient care. It assumes special importance in neonatal care because of technical and physical complexities involved, rapid changes in the clinical course and associated stress of the parents.

Effective communication is crucial for

- Making informed decisions on the behalf of the neonate, by the parents.
- Medico legal issues.
- Maintaining a healthy association between the health care provider and the parents.

Learning objectives

After completion of this chapter the participant should be able to:

- Understand forms of communication
- Understand the types of information to be provided
- Understand various levels and components of communication in newborn care
- Communicate effectively with the family

Forms of communication

Information can be provided through two forms of communication:

I. **Verbal:** involves the exchange of information using words including spoken and written. The following steps can be followed for effective verbal communication(GALPAC).

   G Greet the mother/attendant who has brought the infant to the facility. Make him/her feel welcome and comfortable

   A and **L** Ask and Listen. Ask questions relevant to the infant's illness including feeding and any other issue you feel is important and will contribute towards reaching a right diagnosis. Then listen carefully to all the answers and also respond to any other information that the attendant may want to share.

   P Praise the mother and other members of the family for their concern and also for doing something helpful for the infant like seeking medical advice, care, breastfeeding, etc. Be sure that the praise is genuine and only for actions which are indeed helpful for the infant.

   C Check mother's understanding by asking questions which have to be answered in sentences and not just with a simple yes/no. Praise the mother for her understanding and repeat advice if required.

II. **Nonverbal Communication:** involves transmission of information without the use of words. It is in the form of suitable body language like eye contact, touch, facial expressions, posture, gestures etc.

Types of Information to be Provided In Neonatal Unit

Communication begins right at the time of admission of the neonate to the unit and this two-way dialogue continues till the time of newborn's discharge or referral to a higher centre and during follow up visits. Parents need to be informed regarding each step of neonatal care which includes:

- Reason for admission to SNCU
- Initial diagnosis of the neonate at the time of admission
- Outline of medical management
- Initial/Current prognosis
- Changing clinical course/adverse event
- Information and consent regarding any intervention/procedure
- Reason for referral and care during transport in case of referral to a higher centre
- Follow up information in case of discharge

Points to Remember

- Information provided should be practical and in simple language easily understood by the parents/relatives and should be of immediate relevance.
- Do not flood the parents with too much information at a single contact.
- Avoid use of technical jargon.
- Information provided may require repetition and reiteration for the parents to understand.
- Timing of providing the information is crucial: Fix up a specific time daily for the parent doctor interaction e.g. 12 noon after the morning rounds are over and the neonate is stabilized and as and when required.
- Discussion should be unhurried and relaxed.
- Preferable to provide information at bedside so that the parents are oriented to the current situation of the newborn.
- Any bad news/adverse event should be disclosed in a quiet and private setting.
- Documentation of the information provided to the parents is important. (explanation regarding poor prognosis/adverse events etc.)
- Information regarding procurements (medicines, reports), if any, to be provided by the parents should preferably be at single visit each day to avoid inconvenience and repeated calls to the parents, unless urgent.

Levels of Communication In Neonatal Care

A health personnel (Nursing staff/Doctor) needs to communicate at various stages while working in a neonatal unit, as personnel trained specifically for this task are generally not available.

1. Communication on admission to the Neonatal Unit.
2. Communication during the course of stay.
3. Communication in case of death of a baby admitted in the Unit.
4. Communication at the time of discharge of neonate from Neonatal Unit.
5. Communication at the time of referral.

1. Communication at the time of admission to the neonatal unit

It is crucial to talk to the parents and relatives at the time of admission of a neonate to the SNCU. This discussion should be done once the baby has been stabilized and a reasonable clinical diagnosis has been made. The discussion should be relaxed and unhurried.

The first contact should preferably be made by the senior most person of the unit available at the time and he/she should also introduce the staff (junior doctors and staff nurses) who would be available round the clock.

Honest opinions should be given and all aspects of the illness should be explained in detail. Parental anxiety regarding finances should be allayed by providing information about Janani Shishu Suraksha Karyakram under which free medical services are provided to both mother and baby during the first month of life.

In case of babies with congenital malformations, provide information about the consequences of the disorder/malformation, and ways to prevent or treat the disorder. This involves assisting the family in comprehending medical facts, including the diagnosis, available management and prognosis.

Words should be carefully chosen as tactlessly uttered opinions may result in tremendous conflict resulting in providing poor or no care for the baby. If the baby's father is not available, a responsible member of the immediate family should be identified and all the relevant information should be given to that person.

2. Communication during the course of stay

1. If the baby is admitted in the Unit, it is the duty of the health personnel to communicate with the parents about the condition every day and more frequently if required. The treatment plan should be appropriately communicated to the family and the changes informed timely.
2. Health care provider must be available when the mother visits her baby for the first time in Neonatal Unit. She should be encouraged to get involved in the care of her baby provided her baby is stable. Even if the baby is very sick, the mother should be encouraged to visit often, express breast milk, clean and touch the baby.
3. Nursing staff should be very considerate and compassionate as mothers at this point are often sick themselves and worried about their babies.
4. The doctor and the nursing staff should be able to explain the equipment surrounding the baby and give the right amount of information so that the family members can make informed choices about any procedure that is to be performed.
5. In case of critically ill babies the family should be informed and prepared in advance for a poor outcome.

3. Communication in case of death

The death of an infant is a major loss for the entire family. The mother's separation from her new, sick infant leaves her emotionally and physically helpless. Events may occur too fast for the parents to comprehend. Dealing with the death of a newborn is traumatic for both the family and caregivers. The most important goal is to be compassionate and humane.

If the babies are critically ill, as explained earlier the family members should have been prepared for any eventuality. The exact cause of death should be informed to the parents in a simple language.

- As soon as possible, sit down with the parents (or another support person) to tell them about the condition of the baby. The role of the health personnel should be to support the parents by giving clear and honest information in a supportive and caring manner. Avoid using phrases and sentences that may make the family members uncomfortable like, "it was for the best" or "it was meant to be".
- Avoid negative comments regarding the parents, referring doctor or the obstetrician (such as, you came too late, baby was sent when very sick, delivery was not conducted well). Offer to bring the baby to the mother and father to hold. Baby should be cleaned and wrapped well, soon after being declared dead and should not be lying dead with intravenous lines and other monitoring equipment. All queries should be answered with utmost sincerity and genuine concern for the bereaved parents.
- If an autopsy is required, the parents' consent and the formalities should be completed as soon as possible, so that the parents are free to take care of other things. All the formalities with the other departments should be completed quickly and the body handed over to relatives as early as possible. Parents can be called a month later to explain the findings of the autopsy and if required, discuss the possibility of the problem recurring in the next baby and also be offered support.

4. Communication at discharge

The families should be informed well in advance regarding discharge. They may require a lot of information related to home care of the neonate e.g. about breastfeeding, keeping babies warm, how to prevent infection, and explanation of danger signs for which the parents need to come to the health facility immediately.

- Standardized information should be provided to ensure that every family member receives uniform information.
- The family may be counselled regarding care, nutrition, immunization and follow up.
- Parents should be encouraged to contact the unit for any queries. Write the contact number of the SNCU on the discharge sheet.
- Information should address well baby clinics, high risk clinics, developmental issues, information regarding ROP, hearing and other screening tests and infection prevention.

5. Communication at the time of referral to a higher centre

Some of the critically ill neonates may require referral to a higher centre for tertiary care. One of the most important and often very difficult aspects of transport is the need for emotional support to the parents and family. The need for transport of a newborn can precipitate a crisis for the entire family. Address the concerns of the family. Accepting emotional outbursts calmly and reassuring the parent that their newborn is being cared for can reduce parental anxiety.

1. Allow parents to see and touch their child prior to transport and encourage them to accompany the baby.
2. Explain thoroughly the clinical problems and anticipated care during transport.
3. Explain where to go and indicate whom to contact.
4. Ensure communication with the referral facility and request for feedback.
5. Consider maternal transfer with her medical records whenever possible.

6. *Breaking bad news*

Explaining about death or deteriorating condition of a newborn can be very challenging and has to be done in a compassionate, sensitive manner. Unfortunately, not many of us in the health sector are trained to deliver bad news in an appropriate way.

Some basic principles should be kept in mind when breaking bad news about the baby to the parents and family-

- Breaking bad news to the family is a sensitive and difficult task and should be done by a senior and experienced staff of the NICU.
- Introduce yourself.
- Display kindness, care, compassion.
- Ensure that you are fully aware of the name of the baby/name of mother, gender of the baby and basic clinical details like gestation age, birth weight and important clinical events.
- Ensure parents are in a comfortable environment with privacy.
- Use suitable body language like eye contact, touch, facial expressions, posture, gestures, etc.
- Ask the family what they already know about the child's condition.
- Offer information regarding the deterioration/death empathetically and unhurriedly.
- Spend as much time as necessary with the family in an unhurried manner.
- Allow the parents to hold the baby and be with the baby as long as they like.
- Be sensitive and respectful to the varying cultural norms and rituals surrounding death amongst various families.
- Talk to colleagues later regarding your feelings and experiences.
- Each hospital should have its own bereavement programme.

Conclusion

Each neonate in SNCU requires individualized assessment and nursing care. A family centered approach in the SNCU can make a tremendous difference to parents, providing the basis of systematic support. Ensuring that parents have good information on which to base their decisions requires intense effort from staff using innovative communication strategies. Equipping staff to undertake this communication should be a mandatory component of their training and assessment, and its practice should be a compulsory component of care. Good communication with the family brings confidence and faith in health care providers and avoids emotional harassment and unnecessary litigation.

CHAPTER 19

QUALITY IMPROVEMENT IN HEALTH CARE

WHO defines quality of care as "the extent to which healthcare services provided to individuals and patient populations improve desired health outcomes. In order to achieve this, health care must be safe, effective, timely, efficient, equitable and people-centred".

Improving the quality of healthcare, especially in the low- and middle-income countries (LMICs) is essential to meet the health-related targets of the Sustainable Development Goals especially for improving maternal, fetal, neonatal and child survival. This improvement is not feasible without optimal resources and clinical skills which are necessary to ensure a satisfactory quality of clinical care.

Approaches to ensure that patients receive high quality care can be divided into two general categories: quality assurance (QA) and quality improvement (QI). The terms QA and QI are often used interchangeably, but they are two sides of the same coin, and both are essential to ensure optimal functioning of health systems.

1. **Quality Assurance (QA)** ensures basic functions of a healthcare delivery system by periodic audits (typically by external evaluators). QA focuses on ensuring that requisite infrastructure, policy, supplies, equipment and trained staff is in place as per predefined standards to facilitate delivery of quality care. QA must ensure that clinical procedures and protocols are in place and are being implemented.
2. **Quality Improvement (QI)**, focuses on equipping front-line healthcare workers and managers with skills to identify and solve problems at their level with the existing resources by improving systems and processes of care. It is about changing behaviors, approaches and systems to maximize the quality of care that patients receive. QI seeks to transform the culture within which healthcare is delivered.

The science of QI looks at opportunities for improvement within the available resources and aims to improve patient experience by bringing in efficiency. Doctors and nurses who are responsible for the delivery of care, are often aware of challenges in healthcare delivery and may offer solutions within their area of work. The QI approach helps them to identify, prioritize, and solve problems by working as teams. The feasible solutions are tested by them in small PDSA cycles and adopted or adapted to bring in sustained improvement. It is important to document sustainable change by collecting the data over time, the results of which motivate them and other team members.

Approach to Quality improvement

A four step simplified approach, point of care QI (POCQI available on www.pocqi.org) has been used extensively to bring about quality improvement.

Steps of QI Methodology: The four steps of QI, to be followed are-

1. Identify a problem, form a team and write an aim statement to improve the quality.
2. Analyze and measure quality of care.
3. Develop changes and test these to learn what works.
4. Sustain improvements.

A. STEP 1 : Identify a problem, form a team & write an aim statement

- Use existing local data to identify a problem to be solved. Usually a system has multiple problems that need to be solved. Prioritization should depend on the impact on patient outcomes, how easily it can be solved and need for resources. A problem should be simple, easy to fix and amenable to change. It should value patient outcomes, without requiring new resources and should have a short turn- around time. Avoid long term projects initially.

Select Your Team:

- Involve members who are *enthusiastic* (want to make changes), *involved* (already doing the work that needs change) & *Influential* (who can get things done, involve and influence other people).
- Involve people at all levels so as to reduce the resistance to change. Assign key roles of team leader (lead meetings, direct activities to achieve goals), recorder (record meeting notes) & communicator (communicates and liaison among members).

Form a Aim Statement:

1. Prepare **SMART** Aim which is Specific, Measurable, Achievable, Relevant and Timely.
2. It should include **Who** (which patients), **What** (the process), **How much** (the amount of desired improvement) and **By when** (time period over which change will occur).

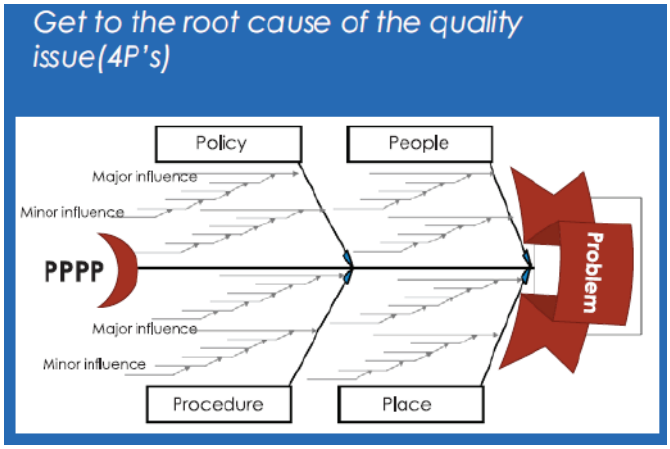
B. STEP 2: Analyzing and Measuring quality of care

Analyzing quality of care

Understand why the problem is happening and get to the root cause. Various tools used to identify problem include.

a. Fish bone analysis: Identify root-cause using 4 P's (People, Place, Procedures and Policies). In general, there are four broad categories of causes for any observed problem.

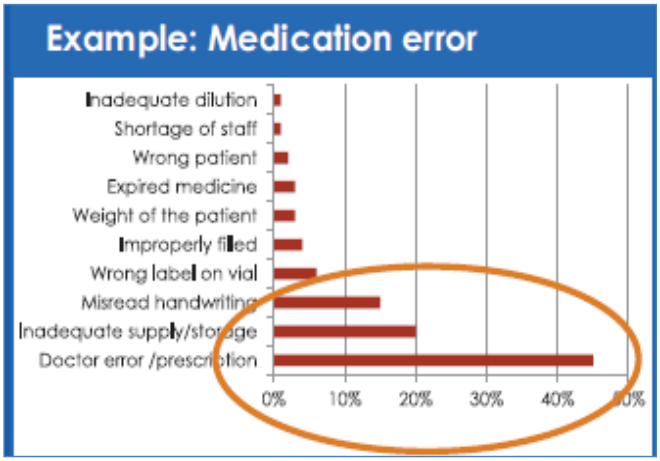
- **PEOPLE:** People may not know what to do or how to do it.
- **PLACE:** The place you are doing the work may make it hard to do the work. For example, there may be no equipment or equipment is kept too far from where it is needed.
- **PROCEDURE:** The way work is done may be contributing to the problem.
- **POLICY:** There may be no policies, or policies may be wrong or non-specific.



Fishbone Analysis

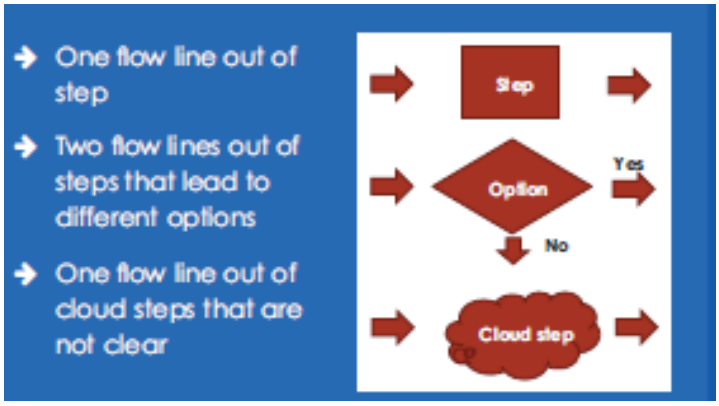
b. **Five Whys:** Ask Why a problem exists and continue to ask why after each answer till a way to fix problem is identified.

c. **Pareto Charts:** Helps to look for the causes that account for most of problem and to prioritize the ones that can be addressed effectively.



Pareto Charts

d. **Process Flow Chart:** Describes all steps in a process so that steps which are done in wrong manner, are easy to modify, redundant steps and those contributing to maximize the problem can be identified.



Measure Quality of Care

Review background data and information and determine indicators which help in knowing whether improvements have been made. An indicator should be clear, unambiguous and linked to aim. Identify Process & Outcome indicators and use clear, well defined numerator & denominator.

1. **Process indicators** measure actions that health workers or others carry out to achieve something. Process measures let you know if you are putting into practice the new process or not.
2. **Outcome indicators** measure what health workers are trying to achieve (clinical outcome). Outcome measures let you know if you are actually getting the result that you want that matters to patients.

Indicators allow us to compare our performance with other health facilities that are working on similar problems. This can help to identify lessons that we can take from other facilities.

C. STEP 3: Developing & Testing Changes

Develop Changes

- Hypothesize about what changes will improve the problem.
- Organize changes according to importance & practicality & test one change at one time.
- In order to develop changes; ask the team: What changes to make? Why this change will result in improvement? How will it work? And, what improvement will be expected as a result of the change?
- Ask and document the details of 'What needs to be done? Who will do it? When will it be started? Who will measure indicators? and When will results be reviewed?'
- Some Categories of changes include:

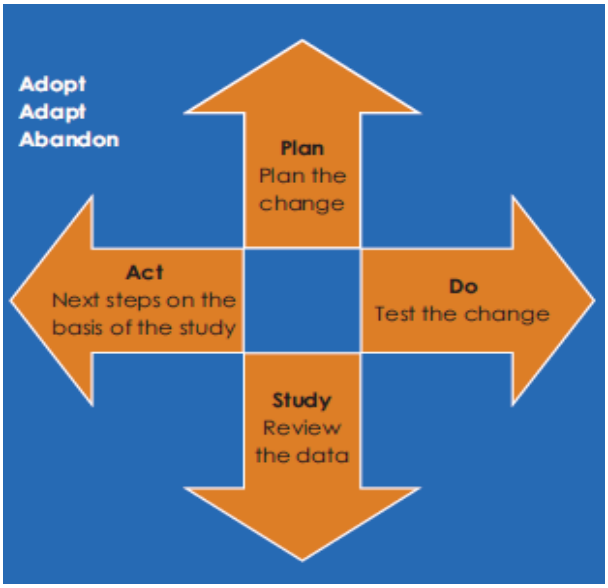
    1. Improving knowledge or skills of the healthcare providers – training.
    2. Eliminate waste by stopping unnecessary treatments or steps of care – stop doing harmful or useless (even if harmless) practices.
    3. Reassign & reorganize tasks.
    4. Improve the patient relationship and communication - listen to what patients want.
    5. Manage variation in the existing treatment and care practices – make work (process of care) more standard and predictable.

The rationale of testing things initially at a small scale is that it allows us to know if it succeeds and gives the confidence to practice at a larger scale and adopt more innovative changes in future. As much as possible, it is good to test each change idea individually.

It is also important to highlight that some of your changes/ideas will not work. Failure also provides opportunity for learning. It is good to test the change/idea in different working conditions to learn if the change always works, for example, testing on weekends or night time will let you know if changes will work when there are fewer staff.

Test & Implement Change: Test the hypothesized solution to see if it yields improvement. Based on the results, decide whether to **Adopt, Adapt & Abandon** solution. A PDSA cycle is very useful for this:

- **Plan:** Plan the change and how it will be implemented.
- **Do:** Test the change.
- **Study:** Review the data, and determine if it is a success /failure, based on data.
- **Act:** Perform next steps on basis of the experiences and results of study (ADOPT, ADAPT & ABANDON).



Plan –Do-Study-Act Cycle

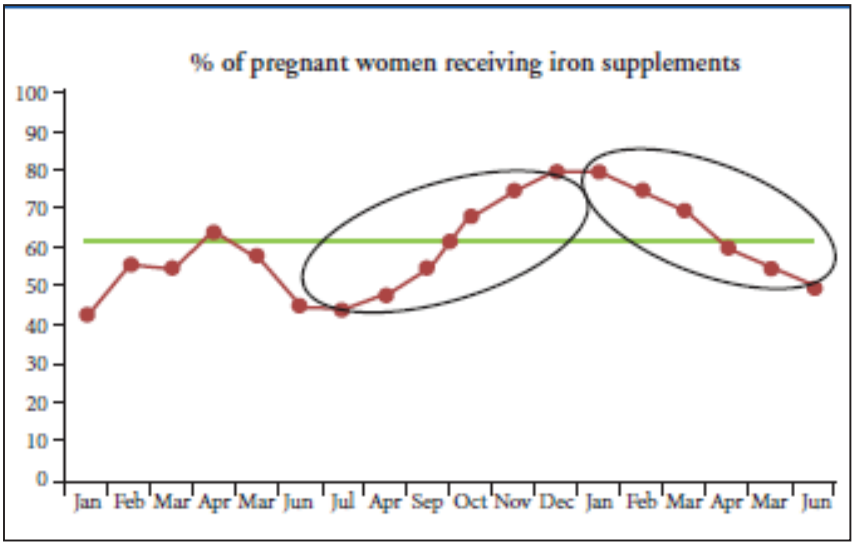
D. STEP 4: Sustaining Improvements

- Determine how to embed successful changes into your system and sustain the quality level over time and how to engage and motivate teams to view QI as an important tool for providing better care.
- This requires framing guidelines, standard operating procedures or job responsibilities.
- Involve new members of the hospital to join and build multiple teams so that they can learn & support each other. Spread best practices among colleagues in hospital, keep higher authorities informed and reward successful teams. Manager of the health facility should continuously encourage the healthcare team to incrementally improve quality of care.

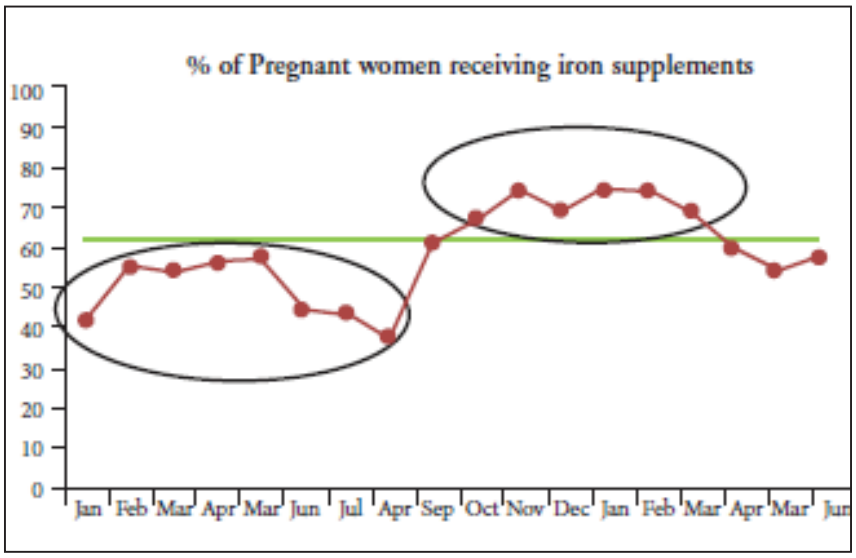
Interpreting RUN Charts

A run chart displays data over time. First thing is to draw a median for the baseline values. Primary purpose of a run chart is to determine whether the change has led to any improvement.

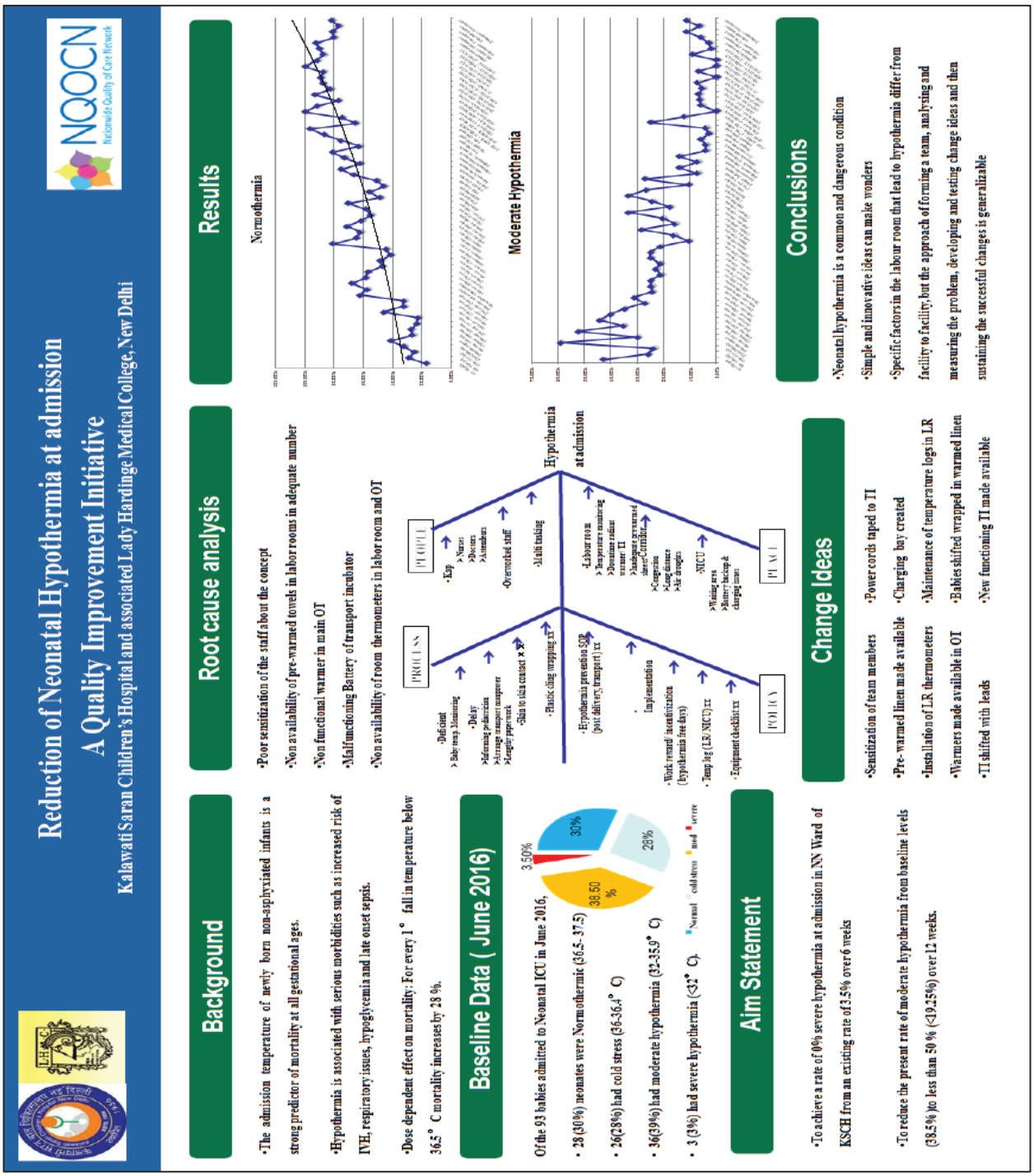
1. **A Trend:** Continued movement in a single direction, either up or down. A trend on a run chart is 5 or more consecutive points going up or all going down.



2. **A Shift:** Pattern indicating that a process/ outcome has moved to a different level of performance. A shift on a run chart is 6 or more consecutive points either all above or all below the median.



Example of QI Project: A Quality Improvement initiative to decrease the incidence of hypothermia at the time of admission in NICU, Lady Hardinge Medical College, New Delhi



CLINICAL SKILLS

1 TEMPERATURE RECORDING & THERMAL CONTROL

Objective

Upon completion of this session each participant

- Should be able to record axillary temperature in a newborn
- Should be able to clinically assess hypothermia, cold stress and normal temperature
- Should be well versed with ways to achieve thermal control during domiciliary care, institutional care & transport
- Should be able to counsel and help mother to initiate skin to skin care

Rationale

Temperature recording is a simple bedside tool to assess the baby's temperature and ascertain the degree of "hypothermia."

Equipment & Other Requirements

i. Digital thermometer
ii. A manikin
iii. Cotton Swabs & 70% isopropyl alcohol
iv. Cotton sheet
v. A wrist watch
vi. Mother or other caregiver to demonstrate kangaroo care

Skills

1. Drying
2. Wrapping & covering the baby
3. Recording temperature
4. Tactile assessment of temperature (Cold stress assessment)
5. Kangaroo mother care

Procedure

1. Drying

Dry baby from head to toe, back, front, axillae & groin and discard wet linen.

2. *Wrapping*

Wrap the baby using a baby sheet. Spread the square sheet and fold one corner on itself- place baby's head on the infolded corner so as to cover the head till the hairline on forehead. Cover over the right shoulder & tuck on left side. Fold from the foot end & tuck beneath the chin & finally cover over the left shoulder and tuck on the right side.

3. *Record temperature*

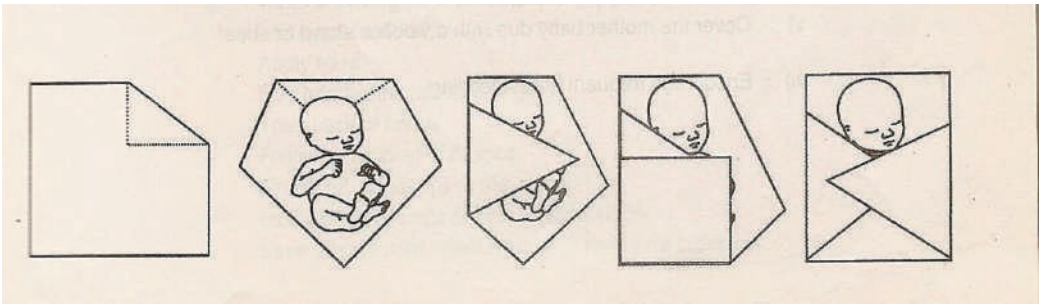
i. Place the baby supine or on the side
ii. Switch on the digital thermometer
iii. Abduct arm at shoulder. Place the bulb of the digital thermometer in the apex of the axilla
iv. Hold arm in adduction at shoulder & flexion at the elbow till you hear a beep
v. Remove thermometer & read temperature.

4. *Tactile assessment of temperature*

i. Wash hands
ii. Allow them to dry
iii. Rub together & warm them
iv. Touch the baby's soles & palms with the dorsum of your hands
v. Now touch the baby's chest using the dorsum of your hands
vi. If both are warm- baby is normothermic, if periphery is cold but chest is warm- cold stress, if both are cold – baby is hypothermic

5. *Kangaroo mother care, and developmentally supportive care*

i. Counsel mother for KMC and developmentally supportive care and take her consent for initiating KMC
ii. Ask mother or caretaker to wear a front open loose shirt or blouse
iiii. She should sit in a semi reclining position in a chair or a bed
iv. Unbutton top 2-3 buttons & slip baby with only the napkin, socks and cap on, into the shirt
v. Ensure skin to skin contact between baby & caretaker
vi. Baby should be in a frog like position with the head turned to one side and is placed between the mother's breasts
vii. Tie a belt or string at the belt level to prevent the baby from slipping down
viii. Cover the mother baby duo with a woolen shawl or sheet
ix. Encourage frequent breastfeeding
x. Demonstrate positioning including nesting, swaddling and holding the baby



2 INFECTION PREVENTION

Objective

Upon completion of this session each participant:

- Should be able to demonstrate steps of hand washing
- Should be able to clean and disinfect newborn care equipment and environment
- Should be able to provide routine eye & cord care and be able to advise mother regarding maternal & baby hygiene

Rationale

Prevention of infection in newborns is easily achievable by simple measures like hand-washing and keeping baby's environment clean. Prevention is much more rewarding as therapy for neonatal sepsis is not always "successful."

Equipment & Other Requirements

i. Soap
ii. Running water
iii. Hand washing chart
vi. Cord tie
v. Cord stump
vi. Spirit
vii. Sterile Cotton
viii. Sterile blade
ix. Manikin
x. Disinfectant solution
xi. Newborn care equipment
    - Bag & mask
    - Laryngoscope
    - Thermometer
    - Oxygen hood
    - Skin probe
    - Cots/mattresses
    - Sheet
    - Suction machine

Skills

1. Hand Washing
2. Equipment disinfection
3. Eye & cord care

Procedure

1. Hand washing

i. Remove watch, bangles and rings
ii. Fold sleeves up till the elbows
iii. Wet hands till elbows
iv. Apply soap
v. First rub hands with both palms facing each other
vi. Then rub palm of right hand over the left dorsum and left palm over the right dorsum
vii. Rub palm to palm with fingers interlocked to clean the web spaces
viii. Then interlock both the palms with rotational movements for cleaning the knuckles
ix. Rub both the thumbs with the palm of the opposite side
x. Rub fingers over the opposite palm on both sides
xi. Keep elbows dependent during the entire procedure so that water drips from palm to elbow
xii. Air dry or wipe with disposable sterile paper/ napkins

2. Equipment disinfection

I. Resuscitation bag & mask

Face mask (Disinfect daily and sterilize weekly)

1. Clean with detergent daily and after each use
2. Immerse in 2% Gluteraldehyde for 20-30 minutes for disinfection and for 4-6 hours for sterilization
3. Rinse with clean water and dry with sterile linen

Resuscitation bag (Disinfect daily and sterilize weekly)

1. Dismantle parts
2. Clean with Detergent
3. Immerse in 2% gluteraldehyde for 20-30 minutes for disinfection and for 4-6 hours for sterilization
4. Rinse with clean water and dry with sterile linen
5. Reassemble the parts

II. Laryngoscope

1. Wipe blade with 70% isopropyl alcohol before and after use
2. Immerse the laryngoscope without batteries and bulb in 2% gluteraldehyde for 20-30 minutes for sterilization

III. Thermometer

1. Ideal to have separate for each baby
2. Wipe with alcohol before and after use

IV. Oxygen hood

1. Clean every day or after each use with detergent

V. Cots and mattresses

1. Clean everyday with surface disinfectant e.g.3% phenol or 5% Lysol
2. Replace mattresses whenever surface covering is damaged

VI. Suction apparatus

1. Suction bottle should be cleaned with detergent daily
2. Change tubing connected to bottle daily
3. Soak in 2% gluteraldehyde for 4-6 hours
4. Flush with water and dry
5. Use disposable suction catheter

VII.Feeding utensils

1. Cup, spoon and paladai should be boiled for at least 15 min before use

VIII. Care of Cord & Eyes

Cord - Keep cord dry

1. Clean cord base and keep dry
2. Do not apply anything

Eyes – No routine eye care is required

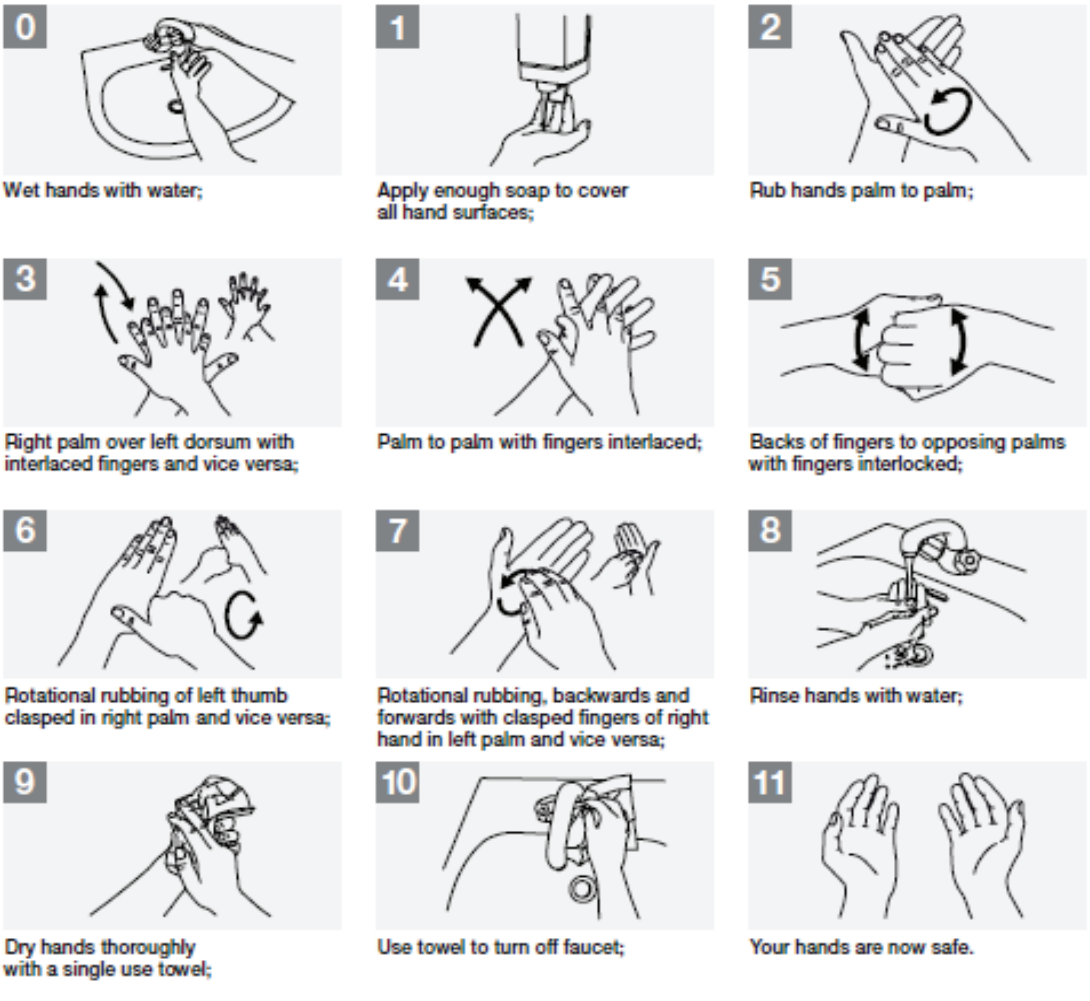
1. Clean eyes from medial to lateral side using separate sterile saline soaked cotton swabs, one for each eye, in case of eye discharge.

Source: Hand Hygiene WHO 2009

HOW TO HANDWASH?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40-60 seconds



Source: Hand Hygiene WHO 2009

3 BREASTFEEDING / ASSISTED FEEDING

Objective

Upon completion of this session each participant should be able to:

- Assess breastfeeding and help mother initiate breastfeeding
- Teach mother the skill of manual expression of breast milk
- Provide gavage feeds to the baby
- Provide katori spoon/paladai feeding to the baby
- Advise mother regarding treatment for retracted nipples
- Allay all fears & anxiety of a lactating mother regarding adequacy & superiority of breastmilk

Rationale

Breast milk is the ideal milk for all neonates and every attempt must be made to ensure establishment of breastfeeding in babies who can feed at the breast. For small and sick neonates expressed breast milk should be provided by alternative feeding methods. Advantages of breast milk are manyfold and mothers of babies in SNCU must be encouraged, counseled and supported to ensure this mode of feeding.

Equipment & Other Requirements

i. Lactating mother
ii. Katori/cup
iii. Spoon/paladai
iv. 5 fr & 6 fr feeding tubes
v. 10 ml & 5 ml syringes
vi. Adhesive tape
vii. Manikin
viii. Blade

Skills

- Assessment of breastfeeding – Attachment, position and effective sucking and swallowing
- Manual Expression of breast milk
- Gavage feeding
- Katori spoon/paladai feeding

Procedure

1. Assessment of breastfeeding

1. Ask mother to feed her baby if she has not fed in the previous one hour
2. Check for signs of good attachment and positioning
3. Observe for effective sucking and swallowing
4. Demonstrate the same to the participants

2. Manual expression of Breast Milk

1. After washing hands ask mother to sit comfortably, lean forward and support the breast over a bowl using both hands
2. Initially massage the breast in all quadrants
3. Position the thumb and the forefinger at the margin of areola on both sides & press the breast tissue into the ribcage
4. Maintaining the backward pressure, start bringing the thumb & the forefinger of the hand towards each other. Do not slide finger and thumb over the breast towards the nipple
5. Repeat the same several times till no further milk can be expressed out

3. Gavage feeding

Take 5 fr or 6 fr catheter depending on the gestation and weight of the baby.

1. Measure length from angle of mouth to tragus to midpoint between umbilicus and xiphisternum
2. Insert the tube from mouth till the desired length has been introduced
3. Check position using a syringe & a stethoscope to auscultate the gush of air
4. Tape the tube to the side of mouth & close outer end after removing the syringe
5. To instill feed-Take a 10 ml syringe barrel without the plunger and insert nozzle into the open end of the feeding tube. Pour milk in to the syringe and wait for it to go down slowly by gravity. After a feed, close the open end
6. Check abdominal girth at next feeding session & proceed to feed if no increase in girth. If the girth increases by 2 cm, do a pre-feed gastric aspirate and analyse the amount and content to decide about continuing/discontinuing feeds
7. Always confirm the position of the tube prior to giving a feed

4. Katori spoon/Paladai feeding

1. Take baby in the lap, hold the baby semi upright with head well supported
2. Stimulate the angle of mouth and rest the spoon/paladai filled with milk at the angle of the mouth
3. Pour milk slowly into open mouth & watch for swallowing. Gently stroke behind the ear or on the sole if the baby goes to sleep
4. Continue feeding in this manner till the desired amount has been fed
5. Burp the baby
6. Place in lateral position with head supported a little higher than the rest of the body

5. *Treatment of Retracted nipples*

Postnatal

- Teach mother to roll out nipple between thumb and forefinger several times a day
- Syringe method (to be done only by the mother):
  i. Take a 10 ml syringe, cut the nozzle end transversely using a new blade
  ii. Take care that the syringe barrel's cut margin is not ragged
  iii. Insert plunger into the barrel from the cut nozzle end
  iv. Place the barrel's open end on the areola including the nipple in the barrel & instruct mother to gently pull back the plunger as far as possible
  v. Repeat this several times & follow it by putting the baby to the breast to encourage suckling
  vi. To release the vacuum press areola towards the chest to let air enter/ push plunger in towards the nipple

4 ASSESSING CAPILLARY FILLING TIME (CFT), OBTAINING VENOUS ACCESS AND PERFORMIMG LUMBAR PUNCTURE

Objective

Upon completion of this session each participant should be able to:

- Assess perfusion by using CFT method
- Catheterize the umbilical vein
- Demonstrate peripheral venous access on an improvised model
- Perform LP on a manikin

Rationale

i. CFT: CFT is simple sign to assess perfusion of a baby. A CFT of >3 seconds denotes poor peripheral perfusion. This can also be prolonged in hypothermia due to peripheral vaso-constriction. If the baby is hypothermic, CFT should be reassessed after temperature normalises.
ii. Umbilical Venous access: It is a quick IV access for infusing volume expanders & drugs during resuscitation.
iii. IV access: To provide parental fluids & medications.
iv. LP: LP should be done in all cases of suspected meningitis.

Equipment & Other Requirements

i. Stop watch/wrist watch
ii. Umbilical cord 1 ft
iii. Blade and Forceps
iv. Normal saline
v. 2ml/5ml syringe
vi. 5fr Feeding tube or umbilical venous cannula No 4,5
vii. Spirit swabs
viii. Iodine swabs
ix. Gloves
x. Soap & Water
xi. Sticking tape

Skills

i. CFT assessment
ii. Umbilical venous cannulation on a cord stump
iii. Peripheral IV access on an improvised model
iv. Lumbar puncture on a manikin

Procedure

1. CFT assessment

1. Wash and dry hands
2. Press the forehead or sternum using index finger/thumb for 5 sec, release and look at the blanched area for return of color. Note the time taken for return of the color. Normal CFT is up to 3 sec
3. CFT>3 secs indicates poor perfusion, however in presence of hypothermia interpretation may be fallacious

2. Umbilical Venous Cannulation

This activity shall be carried out on the umbilical cord provided to the participants. Each participant shall perform this activity and acquire the skill.

1. Wash hands & dry
2. Wear gloves
3. Connect syringe to the catheter, flush the catheter with saline & keep ready
4. Make sure that there is no air bubble in the catheter
5. Take a small piece (about 10 cm long) of fresh umbilical cord in a kidney tray (The procedure in a newborn should be done under all aseptic precautions). Clean the umbilical cord and surrounding skin area with spirit – povidone iodine – spirit, let dry between applications. Cover the area with sterile towel
6. Hold or mount cord
7. Place a purse string suture loosely
8. Cut the umbilical cord transversely with a sterile blade
9. Identify 2 arteries & 1 vein – the umbilical vein is thin walled with patulous large opening in contrast to the arteries which are thick walled and much smaller in caliber. (In the normal position, the umbilical vein is at 11-12 o' clock position and arteries at 4 and 7 o'clock position)
10. Insert the saline filled catheter gently into the vein (Black flow of blood can be appreciated in a live baby by pulling at the plunger)
11. In actual situation the length of the catheter to be inserted is usually 1-2 cm below the skin till there is a free back flow of blood
12. Inject the drug and follow it by flushing it with normal saline
13. Pinch the catheter while removing it
14. Press the cord / tighten the purse string to prevent bleeding

3. IV Access

The training for gaining an intravenous access shall be done on a model which is provided. Each participant shall carry out this skill on this given model.

1. Select the vein (dorsum of hand/foot)
2. Wash hands and dry
3. Wear gloves
4. Prepare skin by cleaning with spirit, povidone iodine and spirit, let dry between applications
5. Hold the limb proximally to make the vein prominent
6. Pierce skin distal to the intended site of puncture
7. Insert needle into the vein (feeling of give way)
8. Ensure free flow; remove the needle and advance the intracath further into the vein
9. Secure the intracath by adhesive tape
10. Flush the cannula with normal saline 0.5ml
11. Inject fluid/medications
12. Check distal limb for adequacy of circulation

4. Lumbar puncture & CSF examination

Equipment needed

22 to 24G spinal needle or 24G/26G needle, sterile bottles/tubes (at least 3 for collecting CSF), spirit swabs, povidone-iodine swabs, and dry cotton.

Precautions

Obtain the specimen under strict aseptic precautions.

Steps

- Wear sterile gloves prior to the procedure
- Place the neonate in the lateral decubitus position or in the sitting position with legs straightened. One assistant should hold the infant firmly at the shoulders and buttocks. AVOID neck flexion while holding the baby
- Prepare the skin over the puncture site by cleansing the area
  i. First with a spirit (70% alcohol) swab; let it dry
  ii. Clean with 10% Povidone iodine swab; let it dry
  iii. Clean again with a fresh spirit (70% alcohol) swab; let it dry

Note: Clean the area in circular motion from midline to periphery with spirit, betadine and spirit allowing drying before initiating the next step.

- Cover the cleaned area with sterile towels
- Insert the needle in the midline between the fourth (L4) and fifth (L5) lumbar spinous processes. Use preferably a spinal needle; if not available use ordinary percutaneous needle
- Gradually advance the needle in the direction of the umbilicus; withdraw the stylet (if using spinal needle) to detect the presence of spinal fluid
- Collect CSF in three sterile bottles/tubes; if it is slightly blood stained, collect in one more bottle and discard the first sample; if grossly traumatic (blood-stained), abandon the procedure and repeat after 48 hours

CSF examination

- Inspect the CSF for turbidity and color; it should be clear without any turbidity.
- Use one of these tubes for examination under microscope; the other two samples are sent to the laboratory.

Parameter	Minimum volume needed	Procedure
Cell count - total and differential	0.5 mL	Load one drop of undiluted CSF fluid onto the Neubauer chamber; count the number of cells in the 4 WBC counting chambers. Multiply the number of cells counted by 2.5 to give the estimated number per cu.mm
Glucose and protein	1.0 mL	Send the second sample to the laboratory for glucose and protein estimation; REMEMBER the samples have to be analyzed IMMEDIATELY
Culture	1-2* mL	Send the third tube to the microbiology laboratory

EQUIPMENT DEMONSTRATION

1 RADIANT WARMER

Upon completion of this section the participant should be able to:

1. Describe the parts of a radiant warmer
2. Demonstrate the working of the warmer
3. List the dangers associated with its usage
4. Identify troubleshoot and take action
5. Manage maintenance

Parts

1. Bassinet (for placing the neonate)
2. Radiant heat source (Quartz/ceramic or similar heating rod)
3. Skin probe (for measuring baby's skin temperature)
4. Air probe
5. Control panel (Display and control knobs)
   i. Mode selector (selects manual or servo mode)
   ii. Heater output control key/knob (to increase or decrease the heater output manually)
   iii. Heater output display (indicates heater output)
   iv. Temperature selection key/knob (select the desired skin temperature)
   v. Temperature display (displays temperature of baby's skin, the set temperature and air temperature)
   vi. Alarm display for power failure, system failure, skin probe failure, skin temp. high/low & heater failure

Working

i. Connect to mains and switch on
ii. Select the manual mode and keep heater output to maximum for 15-20 minutes for pre-warming the bassinet and linen
iii. Select servo mode and set the desired skin temperature to 36.5^{0}C. Heater output adjusts automatically to keep the baby's temperature at the set temperature
iv. Place baby in the bassinet. Cover head with cap, feet with socks and hands with mittens
v. Connect skin probe to baby's abdomen with a skin friendly tape
vi. If baby is hypothermic one may use the manual mode

Cleaning & Disinfection

Bassinet

i. Soap/detergent – daily
ii. Clean using disinfectant like 2% Bacillocid or glutaraldehyde when the bassinet is unoccupied or weekly (move the baby while using disinfectant)

Probe

i. Clean using Isopropyl alcohol swab before and after each use.

Dos & Donts

i. Place skin probe on the right upper abdomen in the supine position and in the flanks if baby is prone
ii. Use skin friendly adhesive tape to secure the probe in place. Do not place probe on bony structures
iii. Ensure that the skin is dry or else prepare using alcohol/spirit swab to ensure good adhesion to the skin
iv. Check repeatedly to ensure that the sensor probe is in position
v. Check temperature manually at least once per shift
vi. Always respond to alarms promptly and take corrective measures
vii. Do not apply probe to bruised skin
viii. Do not reuse disposable probes

Trouble Shooting

Problem	Action
1. No power on turning instrument on	• Check power supply, plug, fuse
	• If above okay, call engineer
2. Power on, heater not on	• Call engineer
3. No skin temperature display	• Faulty skin sensor (replace/call engineer)
4. Display temperature and baby's temperature variation is > 1^0C	• Needs calibration, call engineer
5. Suddenly heater output is higher than usual on servo-control mode	• Check whether the probe is securely attached to the baby's skin • If no – attach it to the proper site • If yes – check baby's temperature manually, if the temperature is higher than display, it is probably due to skin probe failure. Call engineer

Side effects and dangers

i. Hyperthermia (especially in the manual mode if temperature is not monitored or in the servo mode when the probe gets displaced). To prevent hyperthermia, ensure probe is properly attached and the temperature of baby is monitored when the warmer is used in manual mode.
ii. Hypothermia (due to equipment failure). To prevent hypothermia, the equipment should be maintained in good condition and alarms should be attended immediately.
iii. Increased insensible water loss (IWL) (occurs due to exposed skin surface to radiant heat, more so in preterm neonates). To prevent IWL:
    1. Clothe the baby and use caps and socks
    2. Apply coconut oil to the skin
    3. Maintain ambient temperature and humidity

Maintenance

i. Calibration every 4-6 months as per manufacturer's manual.
ii. Comprehensive warranty for 5 years at the time of purchase and thereafter, annual maintenance contract(AMC)
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2 PHOTOTHERAPY UNIT

Objective

Upon completion of this section the participant should be able to:

i. Describe the types and parts of a phototherapy unit
ii. Demonstrate the working of a phototherapy unit
iii. Manage a baby under a phototherapy unit

Types of phototherapy units

All phototherapy units have a designated light source to provide irradiance ranging from 6 – 40 uw/cm^2/nm in the wavelength of 420-460 nm. The various types available are Conventional, CFL & LED units.

Parts

Source of light

1. ***Fluorescent lights (Conventional phototherapy)***
   - 6-8 white fluorescent light OR a combination of 2 special blue and 4-6 white fluorescent lights with a plexiglass shield
   - White tubes (Philips TL 20 W/52)
   - Blue tubes (F 20 T 12/ BB)
   - Tube life is 1000 hours/ 6 months whichever is earlier
   - Irradiance provided -6-8 uw/cm^2/nm (White light)
     8-12 uw/cm^2/nm (Blue + White light)
2. ***Compact Fluorescent lights (CFL)***
   - Compact high intensity bulbs (4 blue and 2 white) enclosed in the unit with reflecting grills
   - Irradiance provided – 12-18 uw/cm^2/nm
   - Lamp life is 2000 – 3000 hours
3. ***Light emitting diode (LED)***
   - Multiple high intensity gallium nitrate LED encased in a unit
   - Irradiance provided – 20-40 uw/cm^2/nm
   - Bulb life is 20000 – 30000 hours

   Other parts
   - Radiator fan (as applicable)
   - Hour meter (as applicable)

Working

i. Connect to mains
ii. Switch on the unit & check that all tubes/lamps are working

Cleaning

i. Soap/Detergent once daily
ii. Clean with disinfectant once a week
iii. Keep the lamps, the covering shield and the grill clean

Dos & Donts

i. Cover eyes with an eye patch and genitalia with a diaper/nappy
ii. Place baby naked under the phototheraphy (with eye cover and diaper)
iii. Place baby as close as possible to the light source, avoiding hyperthermia
iv. Check temperature every 4 hourly to monitor for hypo/hyperthermia
v. Check weight daily
vi. Frequent breastfeeding
vii. Increase in allowance for fluid if there is any evidence of dehydration
viii. Change position frequently (after each feed)
ix. Measure serum bilirubin every 12 hours or earlier, if required
x. Do not put anything on top of the phototherapy unit (this may block the air vents)
xi. Low birth weight babies can have their socks, caps and mittens on while under phototherapy to prevent hypothermia
xii. Use Fluxmeter to check irradiance

Trouble Shooting

Problem	Action
1. No power, on turning instrument on	• Check power supply, plug, fuse
	• If above okay, call engineer
2. Fan not working	• Call engineer
3. Timer not working	• Call engineer
4. Standard Blue units • Tubes not coming on • Blackening/ flickering of tubes	 • Tubes faulty/choke needs chang • Tubes need change

Ineffective Phototherapy

i. Baby covered or frequently removed from phototherapy
ii. Low irradiance (tubes old, flickering, black ends, bulbs covered with dust or reflectors dirty)
iii. Distance between phototherapy lights and baby is more than recommended
iv. Hemolytic conditions can cause bilirubin to rise inspite of phototherapy

Side Effects and Dangers

i. Transient maculopapular rash on the trunk
ii. Hyperthermia/Hypothermia
iii. Increased insensible water loss and dehydration
iv. Loose stools
v. Bronzing of the skin in the presence of direct hyperbilirubinemia

Maintenance

1. Change lights if
    i. Irradiance as measured with fluxmeter < 15 uw/cm2/nm
    ii. Lamp life > 1000 hours of use for fluorescent tubes, for LED > 20000-30000 and for CFL > 2000 – 3000 hours / as per manufacturer's instruction manual
    iii. If Fluxmeter and hour meter are not available, then change fluorescent tubes every 3 months
    iv. Tube ends are black or flickering or not working
2. Comprehensive/Annual maintenance contract

3 SUCTION MACHINE

Objective

Upon completion of this section the participant should be able to:

- Describe the parts of a suction machine
- Use a suction machine
- Clean, disinfect and maintain a suction machine

Parts

i. Suction tubing
ii. Suction bottles
iii. Pressure gauge

Types

i. Electrical
ii. Mechanical: Foot operated
iii. Wall suction

Working

Electrical

i. Connect to the mains
ii. Switch on the unit and occlude the distal end with your thumb to check the suction pressure. Ensure it does not exceed 100 mm of Hg
iii. Use disposable suction catheters
iv. Connect the desired size disposable suction catheter to suction tubing
v. Perform suction gently and intermittently
vi. Switch off the suction machine

Foot operated

i. Pedal to build the desired level of suction pressure
ii. Steps iii to vi are same as above

Wall suction

i. Turn knob to 'ON' position
ii. Check and adjust the pressure gauge
iii. Steps iii to vi are same as above

Cleaning & Disinfection

i. Wash suction bottle and tubings with soap & water daily
ii. After cleaning soak the tubings and the bottle in 2% glutaraldehyde solution for 20 minutes daily. Or use disposable tubings which need to be changed daily
iii. Take out from glutaraldehyde solution and wash under running water
iv. Connect to the machine
v. Flush the suction tubing by suctioning with clean water after each use

Dos & Donts

i. Suction gently. Pinch/occlude the suction catheter while inserting and release occlusion to apply suction pressure only while withdrawing
ii. Monitor vitals while performing suction
iii. Do not perform vigorous & deep suction
iv. Use only disposable suction catheters and discard them after single use
v. Check adequacy of suction pressure prior to use
vi. Use normal saline drops, if secretions are dry

Troubleshooting

Problem	Possible Cause	Action
Machine not starting	Check power supply, fuse, plug & socket	Ensure power supply, change fuse, cord, or socket if needed
No suction Pressure	Check for leakage in the bottle/tubing Issues in manifold room with malfunctioning wall suction	Replace tubes/ bottles, ensure air tight connections Rectify malfunctioning in manifold room

Side Effects & Dangers of suctioning

i. Local trauma
ii. Bradycardia
iii. Apnea
iv. Infection

Maintenance

- i. Check suction pressure daily
- ii. Check tubing for leaks or cracks
- iii. Comprehensive /Annual maintenance contract

4 BAG & MASK

Objective

Upon completion of this section the participant should be able to:

i. Describe the parts of a bag
ii. Describe types of masks
iii. Use the bag
iv. Describe cleaning of a bag & mask

Parts of a Self Inflating Bag

i. Bag
ii. Oxygen inlet
iii. Air inlet
iv. Patient outlet
v. Valve assembly
vi. Oxygen Reservoir

Safety Feature

Pressure release valve (also called the pop-off valve) & pressure gauge.

Types of Mask

Rounded silicone cushioned mask for preterm and term infants.

Working

i. Assemble bag
ii. Check bag (For this, occlude the patient outlet tightly with your palm and then squeeze the bag and look for opening of inspiratory valve & the release of the pop-off valve, the pop-off valve goes up along with a hissing sound- this indicates that the bag is functioning normally)
iii. Connect to oxygen source, if required
iv. Attach the reservoir, if required
v. Fix appropriate size mask (00 for extremely preterm, 0 for preterm and 1 for term, ideally rim of the mask should cover the tip of chin, the mouth and the base of the nose, but not the eyes)
vi. Apply mask. Ensure adequate seal
vii Perform PPV-Check for adequate chest rise

Indication

To provide positive pressure ventilation.

Contraindication

Congenital diaphragmatic hernia.

Disinfection

i. Disassemble all parts, wash thoroughly with warm water and soap after each use
ii. For disinfection, soak in glutaraldehyde 2% for 30 minutes and for sterilization, soak for 6 hrs
iii. After removing from glutaraldehyde rinse with clean water, dry with sterile cloth and reassemble
iv. Clean mask with spirit between patient use

Do's And Don'ts

i. Check bag prior to resuscitation
ii. Choose the appropriate size mask
iii. Don't perform overzealous PPV
iv. Make sure that the airway is patent
v. Ensure adequate seal
vi. Look for adequate chest rise

Problem	Possible Cause	Corrective action
Chest does not rise with Bag & Mask ventilation	Leakage around mask Improper position of neck Blocked airways Mouth closed Needs higher pressure	Ensure tight seal Reposition Resuction Open mouth Use higher pressure
Bag doesn't generate pressure while tested on palm	Leakage/cracked bag Pop-off valve defective	Change bag
Baby doesn't improve despite effective bag & mask ventilation	Needs advanced resuscitation/ alternate airway Needs oxygen	Based on heart rate -Do Chest Compressions and use medications as necessary Ensure O_2 supply Attach reservoir.

Maintenance

i. Replace if damaged or leaking.

5 WEIGHING MACHINE (ELECTRONIC/ MECHANICAL)

Objective

Upon completion of this section the participant should be able to:

i. Demonstrate the use of the weighing machine
ii. Calibrate the machine

Parts

i. Pan or baby tray
ii. Weight scale dial or digital display
iii. Machine proper (base)

Working

i. Clean the pan before each use with spirit
ii. Place a sterile towel or paper (one for each baby and discard after use) on the pan to reduce chances of hypothermia and cross infection
iii. The machine should always display zero every time before weighing
iv. Place baby naked on the middle of the pan and wait till the display stabilizes (Do not record blinking or changing values)
v. Record weight. Clothe the baby after weighing
vi. Switch off the machine

Cleaning and Disinfection

i. Clean with soap and water daily
ii. Wipe with spirit swab before each patient use

Dos & Donts

i. Always look for and adjust zero error, in mechanical machines it is done by adjusting the knob and in electronic machines by using the Zero switch
ii. Regularly (weekly) calibrate using a known weight
iii. Weigh the baby naked
iv. Do not stack up linen or other objects on the weighing pan when not in use.
v. The machine should be placed on a flat stable surface during use

Maintenance

i. Check with a standard known weight at least once a week; request engineer for calibration if incorrect weight is displayed by the machine
ii. Comprehensive/Annual maintenance contract

6 PULSE OXIMETER

Objective

Upon completion of this section the participant should be able to:

i. Describe the parts of a Pulse Oximeter
ii. Demonstrate the working of the pulse oximeter
iii. Interpret Pulse Oximeter readings
iv. Describe daily maintenance, cleaning and troubleshooting

Parts

1. Display panel
   i. Numeric display
   ii. Graphic display
2. Control buttons
   i. Power / standby button
   ii. SpO_2 alarm setting button
   iii. HR alarm setting button
   iv. Set button (alarm, volume, trend)
   v. Alarm silence button
3. Electric cable
4. Extension cable for attachment of the patient sensor
5. Patient sensor which is to be connected to the extension cable

Working

I. Connect to the mains
II. Switch on the machine
III. Set the alarm limits for heart rate 100 – 160 bpm
IV. Set saturation alarm limits—90 - 96%
V. Connect the patient sensor to the patient by wrapping it around the baby's hand/foot and then attach sensor/probe to the pulse oximeter
VI. Pulse oximeter starts detecting signal from the patient and displays heart rate and saturation in a few seconds
   - The values displayed may not be reliable in the presence of shock, cold peripheries, excessive movement, electrical interference and exposure of probe to bright ambient light. Values are reliable when the plethysmographic waveform or bar signal is good
   - Values are reliable when the display is constant and not blinking or repeatedly changing

Cleaning and Disinfection

i. Clean display panel with moist soft cloth
ii. Clean body with soft cloth dampened with soap water followed by moist soft cloth
iii. Clean reusable sensors with spirit after each patient use

Dos & Donts

i. Inspect sensor site every 2 to 4 hours for any erythema or discoloration
ii. Change sensor site every 4 – 6 hourly
iii. Do not apply sensor too tightly
iv. Do not apply probe to edematous or bruised sites

Trouble shooting

Alarm	Possible cause	Corrective action
Ambient light	Excessive light on sensor	Relocate, cover with opaque paper/cloth
Check sensor	Motion, low perfusion, wrong position	Reposition, relocate
Interference detected	Erratic signal with electromagnetic waves in vicinity like TV, mobile phone	Remove interference
Low battery	Low internal battery	Connect to power
Sensor failure	Broken cable, faulty photodiode, sensor damage	Replace sensor
System failure	Internal component failed	Unit needs service/change

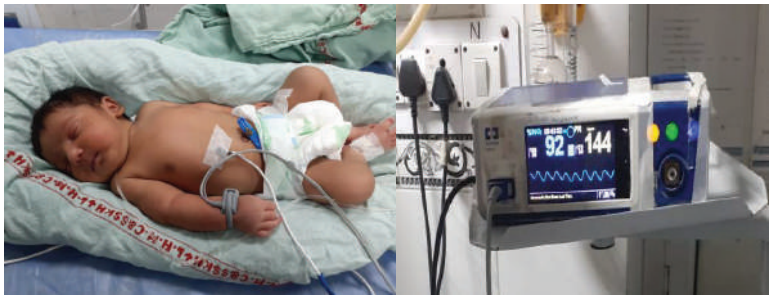
Side Effects & Dangers

i. Failure of operation
ii. Local reddening, blisters, skin discoloration, burn etc. because of the sensor placement

Maintenance

i. Cleaning the Oximeter as necessary
ii. Recharging the battery as necessary
iii. Replacing the fuses in power module as necessary
iv. Comprehensive/Annual maintenance contract

Pulse Oximeter



7 INFUSION PUMP (SYRINGE PUMP)

Objective

Upon completion of this section the participant should be able to:

i. Describe parts of a syringe pump
ii. Demonstrate the working of a syringe pump
iii. Set proper rate for fluid administration
iv. Maintenance of the apparatus

Parts

i. Syringe barrel clamp
ii. Pusher & push guard/ flange guard
iii. Handle assembly bolt
iv. Swing lock clamp
v. On/Off button
vi. Screen
vii. Silence alarm
viii. Bolus OR Prime
ix. Value selection
x. Alarm warning
xi. Stop – Infusion stop
xii. Menu

Working

i. Connect to Mains. Observe indicator light comes on
ii. Press the 'ON' key to turn the pump on. All signals on display panel will glow
iii. Select the appropriate size of syringe 10ml or 20ml or 50ml depending on the infusate to be infused (drug or IV Fluid)
iv. Load syringe with the infusate under aseptic conditions. Take into account the deadspace of the tubing for calculation of drug/fluid
v. Install syringe loaded with desired amount of fluid with intravenous tubing/PMO line attached and primed with the required fluid. Press OK to confirm syringe
vi. Select the flow rate in ml/hour
vii. Connect the tubing to the patient
viii. Start the infusion. Check arrow indicator movement to ensure that the fluid is being delivered
ix. Check IV site regularly to avoid inadvertent extravasations
x. To give a BOLUS, press the bolus key and continue pressing till the desired amount has been infused
xi. Press STOP to stop the infusion
xii. Prime the line with desired fluid every time you change the type of fluid

Cleaning & Disinfection

i. Use a cloth soaked in soap water for cleaning
ii. Use spirit swab for control panel and probe

Do's & Dont's

i. Cross check the flow rate with the prescribed rate
ii. Label the syringe with the drug name
iii. Respond to alarms and take corrective action immediately

Trouble Shooting

Problem	Action
1. No power on turning instrument on	• Check power supply, plug, fuse
	• If above okay, call engineer
2. Alarms	• Check syringe position and clamps
3. Occlusion alarm with no block in line (easy fluid infusion when manually pushed)	• Call engineer

Side Effects & Dangers

i. Inadvertent IV extravasation if IV cannula is displaced

Maintenance

i. Comprehensive/ Annual maintenance contract

8 OXYGEN DELIVERY SYSTEMS

Following oxygen delivery devices are used in neonates.

1. Nasal prongs/canula : Nasal prongs/canula provide FiO_2 between 25 to 45% with flow rates of .5-2 L/min. Among the various types of nasal prongs available, short bi-nasal prongs are most commonly recommended. They come in various sizes and the appropriate neonatal size prongs should be used. These are the most preferred mode of providing oxygen.

2. Oxygen hood: The flow rates in the oxygen hood should be maintained between 2-3L/Kg/min. These are capable of providing FiO_2 between 30 to 90%. They have occludable portholes on the sides. With one port hole opened it provides a FiO_2 close to 40-50%, while with both opened it provides 30-40%. With both port holes closed, 80-90% FiO_2 can be achieved.

Precautions

i. Oxygen saturation should not cross 95% in preterm infants as hyperoxia leads to widespread free radical injury. Set appropriate alarm limits on pulse oximeter.
ii. Use oxygen analyzer to check the FiO_2 when oxygen therapy is initiated and thereafter, whenever a change in the flow rate is made or a change in the respiratory status of the neonates has occurred.

Humidification

Medical air and oxygen have almost no water vapour and is basically cold (15-20^{0}C) and dry (0.3mg/L H_2O). Warm, moist air is essential for maintaining the structural and functional integrity of respiratory tract. Cold and dry air can cause damage to airway epithelium and impair the clearance of secretions and mucus. This effect is particularly seen when the flow rate provided to the infant is above 1L/min.

Hence, it is recommended that heated and humidified air be provided for neonates whenever providing respiratory support. Optimum heat and humidity recommended is 37^{0}C and 44mg/L H_2O (100% relative humidity) for both invasive and non invasive ventilation.

For standard flow oxygen therapy, humidification is not needed.

Oxygen Concentrators

An **oxygen concentrator** is a device providing oxygen therapy to a patient at minimally to substantially higher concentrations than available in ambient air. Oxygen concentrators are less expensive than liquid oxygen and are the most cost-effective source of oxygen and a more convenient alternative to tanks of compressed oxygen.

Room air contains 21% oxygen combined with nitrogen and a mixture of other gases. A miniaturized compressor inside the machine pressurizes this air through a system of chemical filters. This chemical filter is made up of silicate granules called Zeolite. The Zeolite will sieve the nitrogen out of the air, concentrating the oxygen. Through this process, the system is capable of producing medical grade oxygen up to 96% consistently. Most of the portable oxygen concentrator systems available today provide high concentration of oxygen and also maximize the purity of the oxygen.

Safety

The concentrator's instruction manual indicates what maintenance is necessary; here are some general guidelines to follow:

- The concentrator needs good, clean air to operate properly. Hence, operate the concentrator in a well-ventilated area
- Wash the filters periodically (at least once in a week)
- Replace the filters periodically (at least once in a year)
- Ensure examination of the concentrator at least once in a year by the company engineer

There are also some very important safety issues to be kept in mind. Oxygen is dangerous in the presence of fire. Keep flammable materials safely away, and do not allow any heat sources to be near a working oxygen concentrator. In both clinical and emergency-care situations, oxygen concentrators have the advantage of not being as dangerous as oxygen cylinders, which if ruptured or leaking, greatly increase the combustion rate of a fire.

Oxygen concentrators are considered sufficiently foolproof to be used in neonatal units. They can be used for more than one patient by using flow splitters. Oxygen concentrators need a power source to function.

Parts

1. Machine with compressor
2. Flowmeter with/without splitter
3. Humidification bottle

Working

1. Plug on to the power supply
2. Switch on the concentrator using the ON/OFF button
3. Once the concentrator is on, a yellow light will come up
4. Next, adjust the flow to 3-4 liters. This light will be 'on' till the desired concentration of oxygen is achieved, which in most concentrators is nearly 90-93%, after which it goes 'off'
5. Every manufacturer has a specific way of showing the achieved desired concentration, in some concentrators this yellow light will become green after achieving the desired concentration

Maintenance

1. Coarse filter –Ensure it is dust free and washed daily
2. Zeolite granules –Change every 20,000 hrs
3. Bacterial filter –Change every year

Trouble shooting

Alarm	Possible cause	Corrective action
Machine too noisy	Coarse filter blocked by dust	Wash filter daily
Machine gets heated	Machine is near the wall	Keep away from wall for free circulation of air
Yellow light is not going off	Desired oxygen concentration not reached	May be due to high humidity or the flow rate is more, which exceeds the capacity of zeolite material. Decrease the flow rate.
Compressor heats up	Malfunctioning of compressor	Look at the fan, it may be jammed, and hence may need repair.

9 TRANSCUTANEOUS BILIRUBINOMETER(TCB)

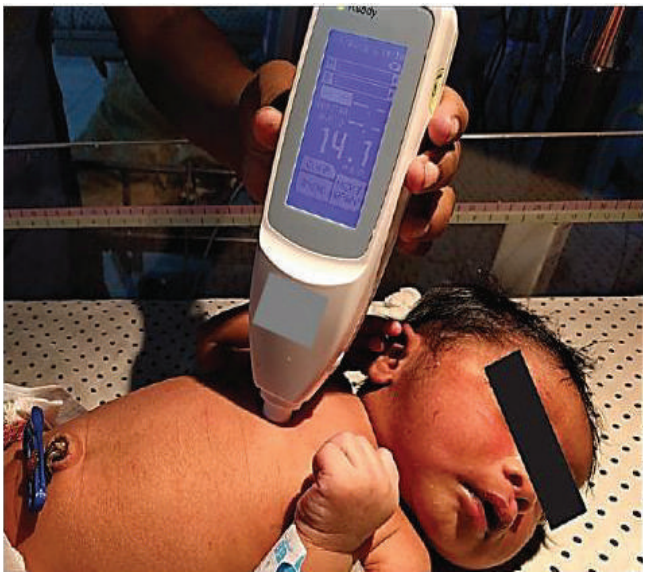
Objective

Upon completion of this section the participant should be able to:

1. Demonstrate the working principle of TCB
2. Describe use of a Transcutaneous Bilirubinometer
3. Enumerate advantages and disadvantages of using TCB

Principle

Good correlation between cutaneous bilirubin and Total serum bilirubin forms the basis of Transcutaneous Bilirubinometry. These meters work by directing light into the skin of the neonate and measuring the intensity of specific wavelength that is returned. The meter analyzes the spectrum of optical signal reflected from the neonate's subcutaneous tissues. "These optical" signals are converted to electrical signals by a photocell. These electrical signals are analyzed by a microprocessor to generate a serum bilirubin value.



The major skin components, which impart the spectral reflectance in neonate, are:

i. Melanin
ii. Dermal maturity
iii. Hemoglobin
iv. Bilirubin

The available meters can be divided into 2 categories:

i. Multi wavelength Spectral Reflectance meters (Bilicheck)™
ii. Two-wavelength (460 nm, 540 nm) Spectral Reflectance meters (Minolta, Bili-test)

How do these meters report the results?

The earlier transcutaneous bilirubinometers reported the result in form of Transcutaneous Bilirubin Index (TcBI). The TcBI can be converted to bilirubin values in mg/dL or umol/lL by using different multiplication factors for different populations. Bilicheck™, however, displays the results in clinically appropriate units: mg/dL or µmol/L.

Basic operating procedure

The optic head of the meter is gently pressed against the neonate's skin (usually forehead or upper part of "sternum)." For correct measurement, the optic head should make full contact with the skin and there should be no gap between the head and the skin. This should be achieved by gentle pressure. 3 - 5 values are recorded at different sites in a neonate and then the result gets displayed.

Site of measurement

The commonly used sites are the forehead and the upper part of sternum.

Hyperemia at the test site may affect the results. Measurements against bruises, birthmarks and subcutaneous hematoma should be avoided.

Advantages

Non invasive screening tool for neonatal jaundice.

Disadvantages

- TCB is not reliable in preterm neonates < 35 weeks.
- Higher readings (≥ 15 mg/dL) on the TCB should always be confirmed by a serum bilirubin value as the reliability decreases at higher level of bilirubin. Once a baby is placed under phototherapy TCB should not be used to assess the bilirubin level as the skin is bleached.

10 CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

Objective

Upon completion of this section the participant should be able to:

i. Enumerate the indications of use of CPAP
ii. Demonstrate the principle of working of CPAP
iii. Set up Bubble CPAP
iv. Monitor a baby on CPAP
v. Identify CPAP failure & wean a baby from CPAP
vi. Outline complications and contraindications of CPAP

Indications

1. Respiratory Distress Syndrome (RDS)
2. Term with RD - if RD score > 4/10 (With grunting/ retraction as one of the parameters)
3. Post extubation in preterm VLBW babies
4. Apnea of prematurity : >2 episodes per hour over 4 hours requiring physical stimulation or one episode requiring bag and mask ventilation after starting methyxanthines

Principle

1. The distending pressure increases lung volumes and establishes functional residual capacity while preventing further alveolar collapse and promoting surfactant release
2. CPAP splints the upper airways thereby reducing obstructive apnea and mixed apnea
3. Increased oxygenation and ventilation/ perfusion matching
4. Improves compliance and stabilizes the compliant chest wall, improving thoraco- abdominal synchrony and reduces the work of breathing

Optimal pressure to be used

1. RDS-
   - Start at 5 cm H_2O with FiO_2 50% (titrate in steps of 5% to a maximum of 70% to maintain a SpO_2 91-95%). The pressure can be increased in increments of 1 cm H_2O every 15-30 min up to a maximum of 8 cm H_2O – if RD worsens or oxygenation is impaired despite titrating FiO_2 to a maximum of 70%
   - Babies with RDS should be given rescue surfactant early in the course of the disease, if the FiO_2 requirement is >30%
2. Apnea of Prematurity - Start at 4-5 cm H_2O with FiO_2 being titrated as required.
3. Post-extubation - Start at 4-6 cm H_2O and FiO_2 5-10% above the pre-extubation FiO_2.

How to set-up a bubble CPAP

1. Connect the air and oxygen tubing
2. Set the flow using flowmeter (usually at 5-8 L/min)
3. Set up the inspiratory limb from the flowmeter to the humidifier and from the humidifier to the patient end (e.g. nasal cannula)
4. Fill water in the humidifier and humidify the gases to 37^0C
5. Set up the expiratory limb - from the patient end to a chamber filled with sterile water. Immerse it under water up to the required depth

Occlude the patient end of the ventilator circuit with your palm and observe if bubbling occurs in the water chamber - If there are no bubbles, look for any leak in the circuit; if no leak is found, increase the flow by 1 L/min and recheck.

Initiation of CPAP

1. Measure for prong/mask size using the nose guide supplied in each packet. While selecting prongs it is important to select appropriate size so as to snugly fit into the nasal cavity and have appropriate inter-nares distance. The biggest nasal prong, that comfortably fits the nostril, should be used
2. Measure the cap size from the middle of the forehead, around the head to the nape of the neck and then back to the middle forehead. DO NOT use a "head circumference" measurement to determine cap size. Place the cap onto the infant's head, checking that the ears are in a normal position. Ensure the cap is pulled well down over the ears and down to the nape of the neck
3. Apply a skin friendly sticking tape such as tegaderm and a piece of cotton on overlying skin of septum
4. The bubbles should be seen both during inspiration and expiration phases of respiration
5. For a given set pressure, increasing the flow rate of the gases will cause an increase in the delivered pressure of CPAP. So while changing the CPAP pressures on a given patient, the flow rate of the gases must be kept constant
6. Attach pulse oximeter
7. Insert the orogastric tube. The open end of orogastric tube should always be above the level of stomach, to constantly deflate it with the excess gas that enters it during CPAP

Monitoring Clinical monitoring

1. Continuous monitoring as per the CPAP monitoring chart
2. X-ray chest - one CXR initially for establishing the diagnosis and to assess lung inflation. 6 to 8 spaces on the CXR is adequate inflation. If <6- increase PEEP and If >8- decrease PEEP
3. In case of sudden deterioration, one needs to rule out pneumothorax
4. ABG – individualised basis
5. PFAG (pre feed abdominal girth) charting q 2 hourly

CPAP failure

- Even on a CPAP of 7-8 cm H2O and 70% FiO_2, if the neonate has excessive work of breathing
- PCO_2 >60mmHg with pH <7 OR PaO_2<50 mmHg
- Recurrent apnea (More than 2 episodes per hour over 4 hours requiring physical stimulation or one episode requiring bag and mask ventilation)

CPAP weaning

If the infant is stable on CPAP for 24 hours, first wean off the FiO_2 to 30% (in steps of 5%) and then wean the pressure to 4 cm H2O (in steps of 1 cm).

Contraindications of nCPAP

- Choanal atresia
- Cleft palate
- Tracheo - esophageal fistula type C
- Congenital diaphragmatic hernia
- Hypotension requiring a second inotrope

Complications

- Pulmonary air leaks (PAL) -PAL tend to occur when oxygen requirements are decreasing and lung compliance is improving
- Cardiac output is believed to decrease due to decrease in venous return, because CPAP causes increase in intrathoracic pressures & decreased right ventricular stroke volume. These effects can be minimized by using optimal CPAP
- CPAP Belly
- Nasal septal injury - divided into 3 stages
    - o Stage I: erythema not blanching, on an otherwise intact skin
    - o Stage II: superficial ulcer or erosion, with partial thickness skin loss
    - o Stage III: necrosis, with full thickness skin loss

BLENDER

Objective

Upon completion of this section the participant should be able to:

i. Describe parts of a Blender
ii. Demonstrate the working of a Blender
iii. Set proper FiO_2
iv. Maintain the apparatus

Parts

- Oxygen source
- Compressed air source
- FiO_2 dial
- Flowmeter

Working

- Blender should be upright and secure
- First connect the oxygen tube of the blender to oxygen port
- Connect the compressed air tube of the blender to its port
- Connect flowmeter to blender outlet
- Adjust the flow rate to 5-10 L/min
- Adjust the FiO_2 dial to select the desired oxygen concentration
- Start with FiO_2 of 30%
- This air-oxygen gas mixture from the blender can be attached to the bag and mask or T-piece resuscitator
- Titre to be achieved as per the minute specific SpO_2 charts/91-95%

Cleaning & Disinfection

Disconnect the equipment before cleaning. Use a damp cloth soaked in soap water for cleaning

Do's & Dont's

Adjust FiO_2 to maintain saturation between 91-95%

Maintenance

Annual maintenance contract

CASE MANAGEMENT

INTRODUCTION

Case Management algorithm is an effective way to ensure timely assessment and management of each and every sick newborn who is born in/brought to the health facility for emergency/ priority/non urgent signs by triaging. Triaging should be done by a staff trained in quick assessment and optimal management of newborn emergencies.

Triaging

Emergency signs	Priority sings	Non urgent signs
• Low body temperature (Temp<35.5^{0}C) • Apnea or gasping respiration • Severe respiratory distress (rate>70, severe retractions, grunting) • Central cyanosis • Shock (cold periphery, CFT • >3secs, weak & fast pulse) • Coma, convulsions or encephalopathy	• Tiny neonate (<1800gms) • Temp 36.4^{0}C - 35.5^{0}C • Respiratory distress (rate>60, no retractions) • Irritable/restless/jittery • Refusal to feed • Abdominal distension • Severe jaundice (appears<24 hours /stains palms and soles/ lasts>2 weeks) • Severe pallor • Bleeding from any site • Major congenital malformations (Tracheo esophageal fistula, Menigomyelocele, Anorectal malformation) • Large baby >3.8 kg or according to the percentile charts, (See Chapter 4: Low Birth Weight Baby)	• Jaundice • Transitional stools • Developmental peculiarities • Minor birth trauma • Possetting • Superficial infections • Minor malformations • All cases not categorized as Emergency/ Priority
Neonates with emergency signs are at high risk and require urgent intervention and emergency measures. These neonates with emergency signs after stabilization are to be admitted in the SNCU (Special Care Newborn Unit).	**Action** Neonates with priority signs are sick and would need immediate assessment. They should be attended to on a priority basis. These will also need to be admitted to SNCU.	In neonates with no emergency or priority signs, proceed with assessment and further treatment according to neonate's requirement

- **Low body temperature (Temp<35.5^{0}C or abdomen cold to touch):** Place under radiant warmer and apply skin probe.
- **Apnea or gasping respiration:** Maintain temperature, position and clear (if needed) airway, stimulate, provide PPV.
- **Severe respiratory distress (rate>70, severe retractions, grunting)** and/or **Central cyanosis:** Stabilize airway (pulse oximeter to be attached.
- **Shock (cold periphery, CFT>3secs, weak & fast pulse):** Maintain temperature, Airway & Circulation (NS bolus @ 10ml/kg over 30 minutes).
- **Coma, convulsions or encephalopathy:** Maintain temperature, Airway. Check & correct hypoglycemia, hypocalcemia & review for anticonvulsant drugs.

Once triaged the neonate needs to be managed based on the **'Newborn Care Checklist'.** The 'Newborn Care Checklist' is a 10-step process where all aspects related to neonatal care are evaluated. If any of the steps in the checklist are found to be abnormal, immediate interventions should be initiated. The 10 parameters can be remembered by the Mnemonic **'TABCFMFMCF'.**

B. Checklist for Newborn Care - T.A.B.C.F.M.F.M.C.F.

1.	**Temperature - Assess**	Hypothermia Cold Stress Normal Hyperthermia	Provide heat Skin to skin contact, Warmer care Cover adequately Uncover
2.	**Airway**	Compromised	Open and maintain airway Position Suction
3.	**Breathing**	None or gasping Normal Respiratory distress	PPV (oxygen if required) No intervention Provide oxygen/CPAP/mechanical ventilation
4.	**Circulation-CFT**	<3 seconds	No intervention
5.	**Fluids**	If CFT >3 sec If Hypoglycema If circulation not compromised	IV NS 10ml/kg IV 10% Dextrose 2ml/kg Normal requirement
6.	**Medications**	Pneumonia Apnea Meningitis Bleeding Convulsions	IV antibiotics - Ampicillin, Gentamycin IV caffeine IV antibiotics Inj Vitamin K 1mg IM Inj Phenobarbitone
7.	**Feeds**	Weight<1200 gm Weight 1200-1800 gms Weight > 1800 gms	Gavage feeds Katori Spoon feeding Breastfeeding
8.	**Monitoring**	i. Temperature ii. Respiration iii. Color iv. Heart rate v. CFT vi. SpO_2 vii. Danger sign Apnea Grunting Severe retraction Abdominal distension Bleeding	Touch method Temperature record 2 hrly Apnea, Gasping, Tachypnea, retractions, grunt Pink Cyanosis Pale Normal Tachycardia Bradycardia Normal <3 secs 91-95% <90% >95% In case of Danger sign 1. Give PPV, if gasping or apnea 2. Give oxygen, if required 3. Keep NPO in abdominal distension 4. Inj Vitamin K 1mg, if bleeding

9.	**Communication**	a. For referral	i. Inform parents/relatives about baby's referral ii. Inform need for referral iii. Communicate place of referral iv. Communicate with the higher centre if possible v. Send a written note about details of birth & care provided vi. Send a health worker with the family if possible vii. Mother to accompany as far as possible
		b. For hospitalized Neonate in SNCU	i. Inform neonate's status to family at least twice daily ii. Report on temperature, colour, perfusion and general activity iii. Report on progress in terms of resolution of RD, requirement of Oxygen, IVF, IV Antibiotics, and Feeding
		c. For home care	i. Exclusive breast feeding ii. Maintain temperature- teach tactile assessment iii. Prevent infection- cord & eye care iv. Danger signs- Early care seeking v. Maternal nutrition, rest, supplements & spacing vi. Developmentally supportive care
10.	**Follow up**		i. Follow up 2 weekly initially for 2-3 visits ii. Check weight, mode of feeding, enquire problems during each visit iii. Follow up every month thereafter iv. Immunization advice v. Complementary feeding advice

CASE STUDY

Example 1

A 8 day old newborn is brought in with complaints of fast breathing and inability to feed at the breast. The weight at admission is 2250 gm as against 2450 at birth. The baby is lethargic, temperature is 36^0C, respiratory rate is 80/min with moderate retractions and grunt but no cyanosis, the H.R.is 150/min, CFT is <3secs.

How would you triage this neonate?
How would you manage this baby?

Category after Triage	Emergency
Signs	RR – 80/min, moderate retractions, grunt

How will you manage the baby?

T-	Provide warmth under radiant warmer
A-	Maintain airway by placing shoulder roll
B-	Provide oxygen, monitor SpO_2. (91-95%)
C-	Normal
F-	Total fluid requirement for the day is 150 ml/kg = 370 ml. Start fluids at 120ml/kg Isolyte – P (294 ml= 98 ml 8 hourly @ 12ml/ hr or 12 Micro drops /min)
M-	Estimate blood sugar and perform sepsis screen Start Ampicillin (50mg/kg/dose= 125 mg 8 hourly) and gentamicin (5 mg/kg/dose = 12.5 mg OD)
F-	Start feeds @ 30 ml/kg/day i.e 6 ml EBM 2 hourly and increase as the baby stabilizes.
M-	Temperature, HR, respiratory score, oxygen saturation
C-	Communicate the infant's condition to parents from time to time and discuss referral if need
F-	Not applicable at this stage

CASE STUDY

Example 2

B. Sunita, 3 Kg, term baby, born through vaginal delivery one hour back has come to you with the c/o not crying at birth. Baby required neonatal resuscitation in the form of initial steps, and bag and mask ventilation for two mins and was referred to SNCU for post resuscitation care.

On admission the baby's temperature is 36°C. Baby is lethargic, hypotonic, and has a respiratory rate of 86/minute and a heart rate of 170/min, CFT is 2 seconds/min. SpO_2 is 80%.

Triage: Emergency

Signs – Seizure, RR – 86/min

Baby is placed in the warmer on servo-control, airway positioned and secretions cleared.

Baby developed generalised tonic and clonic seizures.

How will you manage this baby?

How will you manage the baby?

T Cold stress. Place under radiant warmer

A Position and clear the airway

B Attach Pulse oximeter and provide oxygen to maintain SpO_2 between 91-95%

C Insert Intracath under all aseptic precautions, do a blood glucose and send investigations including calcium and electrolytes

F If blood sugar is <45mg/dL – Give a bolus of 6 ml of 10% dextrose over one minute followed by a GIR 6mg/kg/min{Refer to the table 7.1(a) in chapter 7}

M If blood sugar is normal, Give inj Calcium 6ml over 5-10 minutes under cardiac monitoring. If seizures persists give Inj. Phenobarbitone 60mg IV over 20 minutes. Provide Oxygen to maintain saturation between 91-95%

F NPO till further orders

M Temp., RR, HR, SpO_2,CFT, Blood Sugar, I/O chart, Downe's score, Levene's Score

C Communicate the baby's condition to the parents from time to time and discuss need for referral if condition deteriorates

F Not applicable at this stage

CASE STUDY 1

A 3 days old 39 weeker baby with a birth weight of 3200 gm is brought to the SNCU with yellow palms and soles. The baby has a temperature of 36.2^{0}C. The respiratory rate is 52/min. The CFT is 2 secs.

How would you triage this neonate?

How would you initiate management of this baby?

At the Hospital:

Serum Bilirubin – 24 mg/dL

Mother's Blood Group – B Negative

Baby's Blood Group - B Positive

How would you manage this baby?

CASE STUDY 2

Baby Roma, a 35 weeks gestation baby weighing 2550 gms at birth was feeding well at the breast and on day 5 developed discharge from the umbilicus followed by refusal of feeds and lethargy the next day. He vomited twice, had a feeble cry and on way to the hospital had a convulsion.

At the hospital- Weight - 2400 gm Temperature –37^{0}C. Clinical exam – Drowsy, normal anterior fontanel

RR - 56/mim, no retractions, no grunt

HR 176/min

CFT - 5 sec

Abdominal distention with periumbilical erythema

How would you triage this neonate?

What is your diagnosis?

How will you manage this baby?

ANNEXURES

Annexure 1:

SCHEDULE OF IMMUNIZATION IN INDIA AFTER PHASED INTRODUCTION OF NEWER VACCINES

Schedule of immunization In India (2017) after phased introduction of newer vaccines

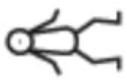
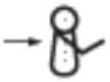
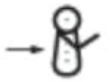
Age	Vaccine
0-7 days	BCG, b OPV-0, HBV-0
6 weeks	bOPV-1, Pentavalent 1, Rota 1*, fIPV 1, PCV 1*
10 weeks	bOPV-2, Pentavalent 2, Rota 2*
14 weeks	bOPV-3, Pentavalent 3, Rota 3*, fIPV 2, PCV 2*
9 -12 months	Measles/MR1*, JE1*, PCV 3 Booster
16-24 months	DPT booster 1, bOPV Booster, JE2*, MR2*
5-6 years	DPT Booster 2
10 years	Td
11- 13 years	HPV1*, HPV2*
16 years	Td

*Wherever implemented

Annexure 2:

EXPANDED NEW BALLARD SCORE FOR GESTATION ASSESSMENT

Neuromuscular Maturity

Score	–1	0	1	2	3	4	5
Posture							
Square window (wrist)	 > 90°	 90°	 60°	 45°	 30°	 0°	
Arm recoil		 180°	 140–180°	 110–140°	 90–110°	 < 90°	
Popliteal angle	 180°	 160°	 140°	 120°	 100°	 90°	 < 90°
Scarf sign							
Heel to ear							

Physical Maturity

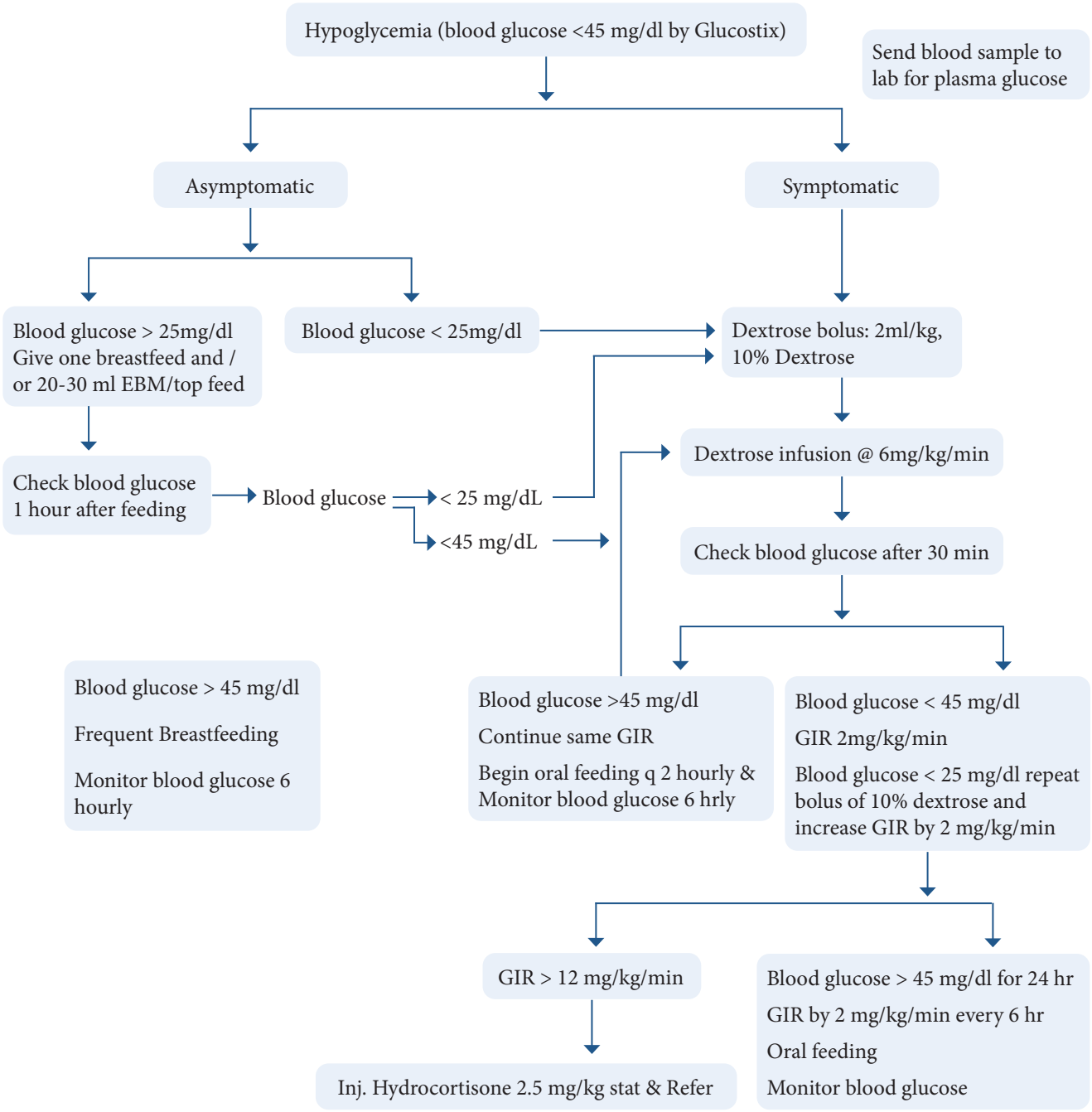
Skin	Sticky, friable, transparent	Gelatinous, red, translucent	Smooth, pink; visible veins	Superficial peeling and/or rash; few veins	Cracking, pale areas; rare veins	Parchment, deep cracking; no vessels	Leathery, cracked, wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	
Plantar surface	Heel-toe 40–50 mm: –1 < 40 mm: –2	> 50 mm, no crease	Faint red marks	Anterior transverse crease only	Creases anterior 2/3	Creases over entire sole	
Breast	Imperceptible	Barely perceptible	Flat areola, no bud	Stippled areola, 1–2 mm bud	Raised areola, 3–4 mm bud	Full areola, 5–10 mm bud	
Eye/Ear	Lids fused loosely: –1 tightly: –2	Lids open; pinna flat; stays folded	Slightly curved pinna; soft; slow recoil	Well curved pinna; soft but ready recoil	Formed and firm, instant recoil	Thick cartilage, ear stiff	
Genitals (male)	Scrotum flat, smooth	Scrotum empty, faint rugae	Testes in upper canal, rare rugae	Testes descending, few rugae	Testes down, good rugae	Testes pendulous, deep rugae	
Genitals (female)	Clitoris prominent, labia flat	Clitoris prominent, small labia minora	Clitoris prominent, enlarging minora	Majora and minora equally prominent	Majora large, minora small	Majora cover clitoris and minora	

Maturity Rating

Score	Weeks
–10	20
–5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

Annexure 3:

MANAGEMENT OF HYPOGLYCEMIA



Annexure 4:

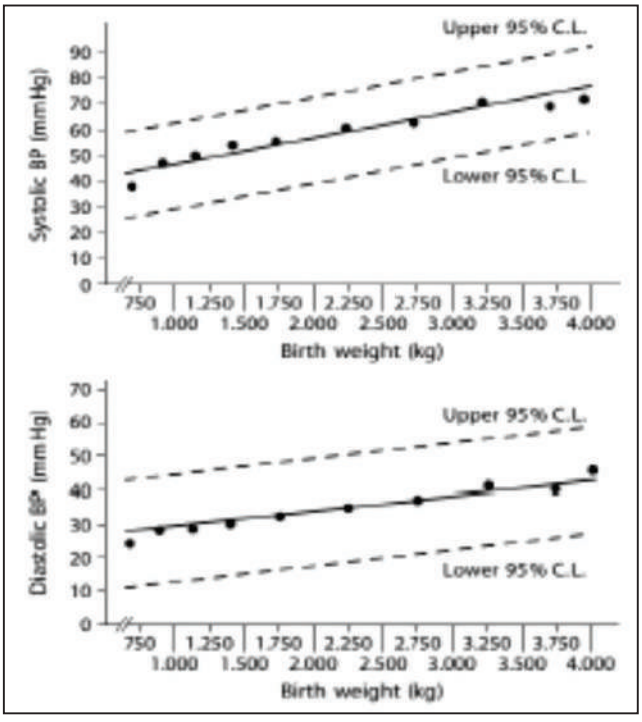
GESTATIONAL AGE AND POSTNATAL AGE DEPENDENT MEAN BLOOD PRESSURE NORMOGRAMS IN NEONATES IN THE FIRST 3 DAYS OF LIFE

Gestation (in Weeks)	Mean BP (mm Hg) in first 72 hours of life						
	0 hrs	12 hrs	24hrs	36hrs	48hrs	60hrs	72hrs
23 - 26	22	24	25	26	27	29	30
27 - 32	30	31	32	33	34	35	37
33 - 36	35	36	37	39	40	41	42
37- 43	42	44	45	46	47	48	50

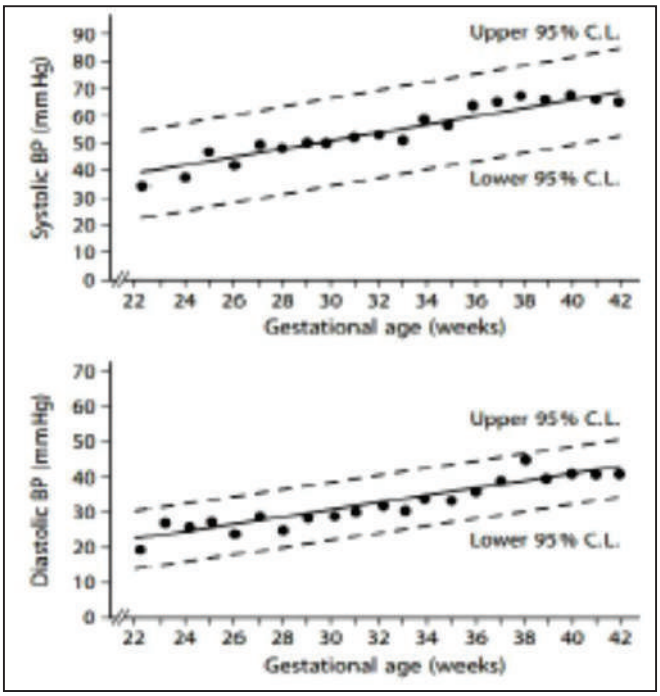
Values represent the lower limit of 80% confidence interval for the gestational group. 90 % neonates areexpected to have mean blood pressure equal to or greater than the values for the particular group. *Averys disease of newborn : 8th edition.*

ZUBROW BLOOD PRESSURE CHARTS

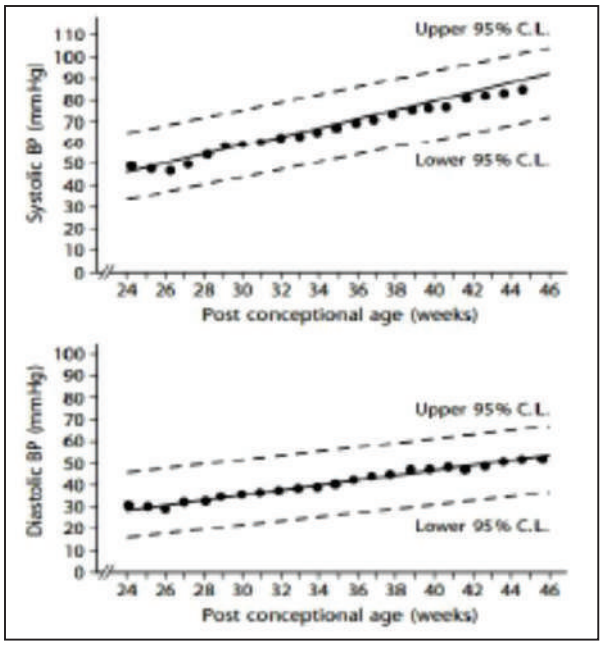
A. Linear Regression of Mean systolic & Diastolic BP by Birth weight on day 1 of life, with 95% CI (upper & lower dashed lines).



B. Linear Regression of Mean systolic & Diastolic BP by Birth weight on day 1 of life, with 95% CI (upper & lower dashed lines).



C. Linear regression of Mean systolic & Diastolic BP by post-conceptual age in weeks with 95% CI (upper and lower dashed line)



Annexure 5:

MONITORING CHART

Parameter/ Time	At Ad m.	2 hrs	4 hrs	6 hrs	8 hrs	10 hrs	12 hrs	16 hrs	20 hrs	24 hrs	28 hrs	32 hrs	36 hrs
Temp													
HR													
RR													
SpO_2													
CRT													
MBP													
Ur Output 8 hrly (mL/kg/hr)													
Downe's Score													
Levene Score													
Blood glucose													
S. Electrolytes													
Serum Calcium													
Bld. Urea and creatinine													

Annexure 6:

RESPIRATORY DISTRESS CHARTING

A. Downe's score and its interpretation (For both PT & Term Neonates)

Score	Respiratory rate	Cyanosis	Air entry	Grunt	Retraction
0	<60/min	Nil	Normal	None	Nil
1	60-80/min	In room air	Mild decrease	Audible with Stethoscope	Mild
2	>80/min	In >40% FiO_2	Marked decrease	Audible with unaided ear	Moderate

Interpretation

Score 1-3 Mild respiratory distress

Score 4-6 = Moderate respiratory distress (may need CPAP)

Score >6 = Impending respiratory failure (May need CPAP or mechanical ventilation)

B. Silverman Anderson Score (For PT Neonates)

Feature	Score O	Score 1	Score 2
Upper Chest Movement	None	Respiratory Lag	See-Saw Respiration
Lower Chest retractions	None	Minimal	Marked
Xiphoid Retarctions	None	Minimal	Marked
Nasal flaring	None	Minimal	Marked
Grunting	None	Audible with stethoscope	Audible without stethoscope

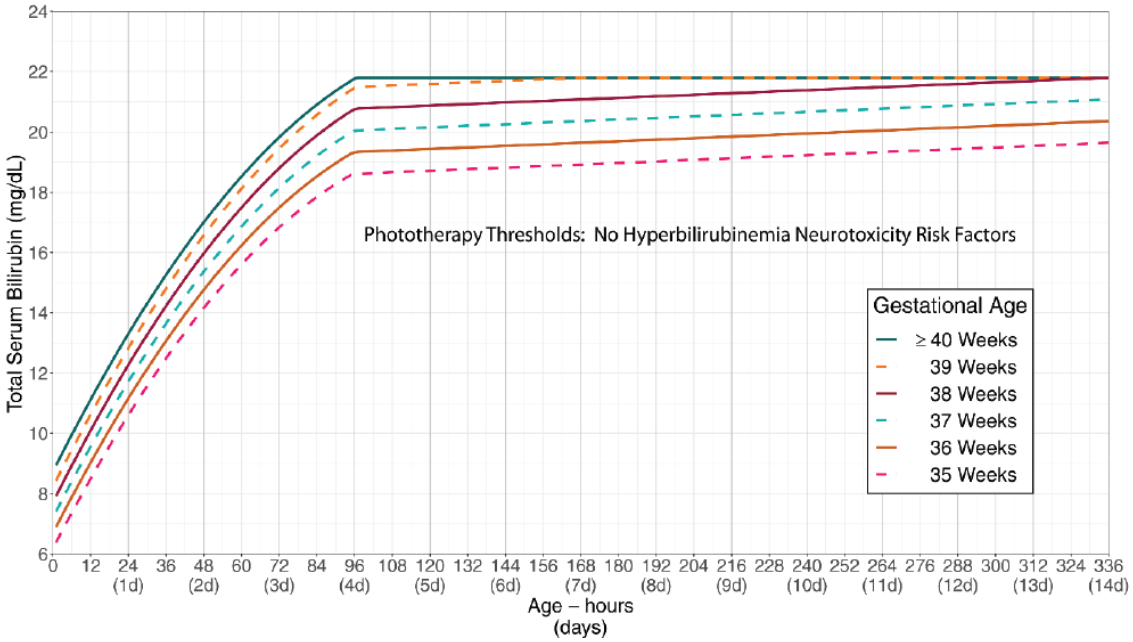
Interpretation

Score 1- 6 = Respiratory distress

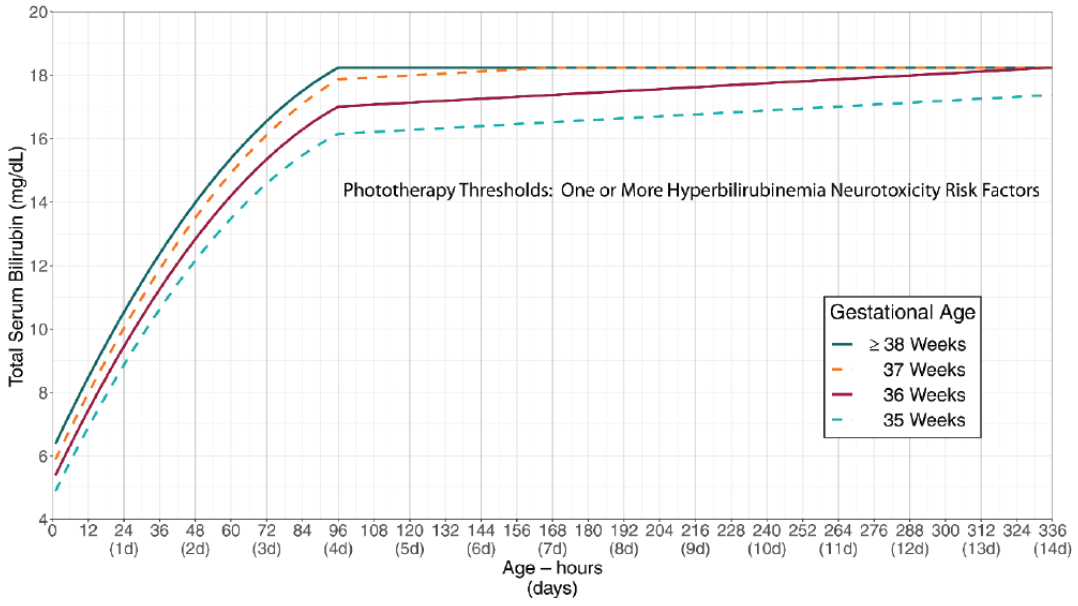
Score > 6 = Impending respiratory failure

Annexure 7:

CHART FOR PHOTOTHERAPY (AAP GUIDELINES 2022)



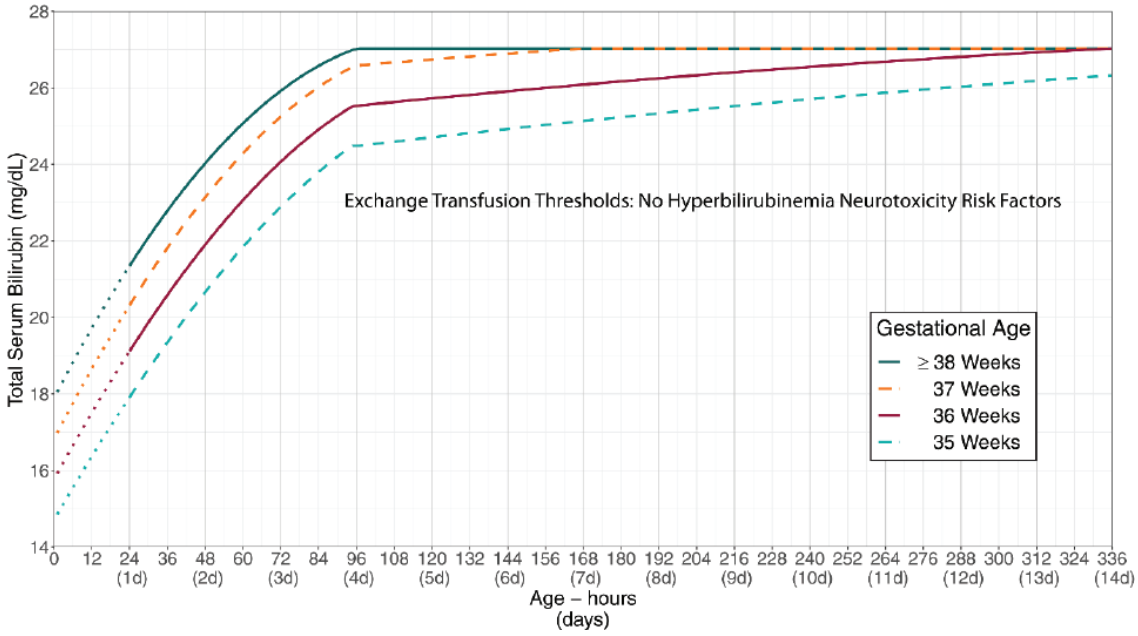
Phototherapy threshold by gestational age and age in hours for infants with no recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age (AAP 2022)



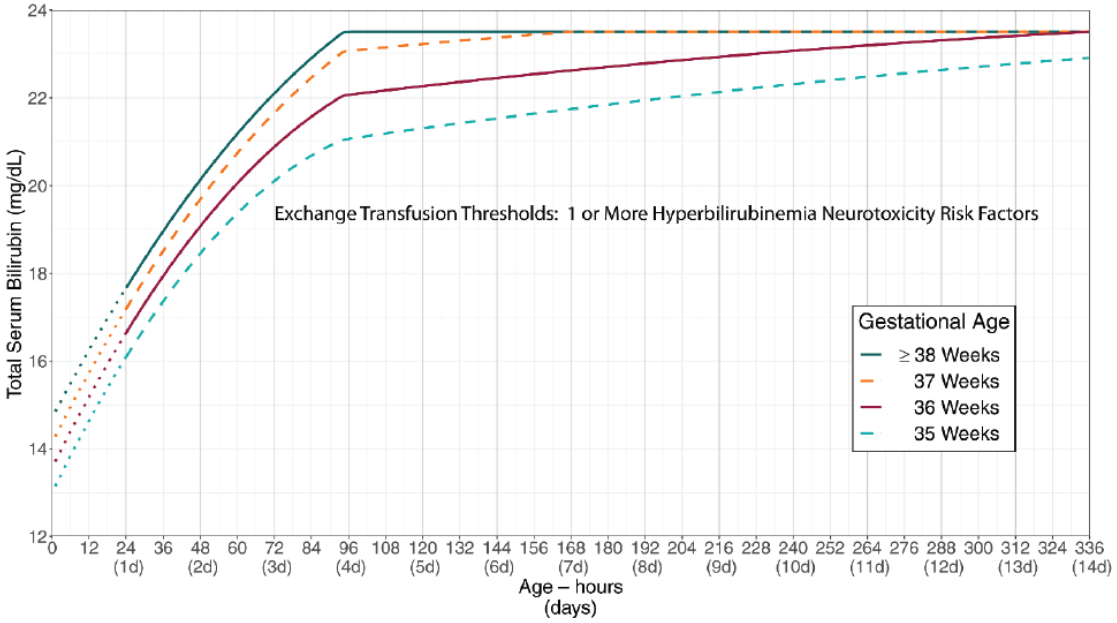
Phototherapy thresholds by gestational age and age in hours for infants with any recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age (AAP 2022)

Annexure 8:

CHART FOR EXCHANGE TRANSFUSION (AAP GUIDELINES 2022)



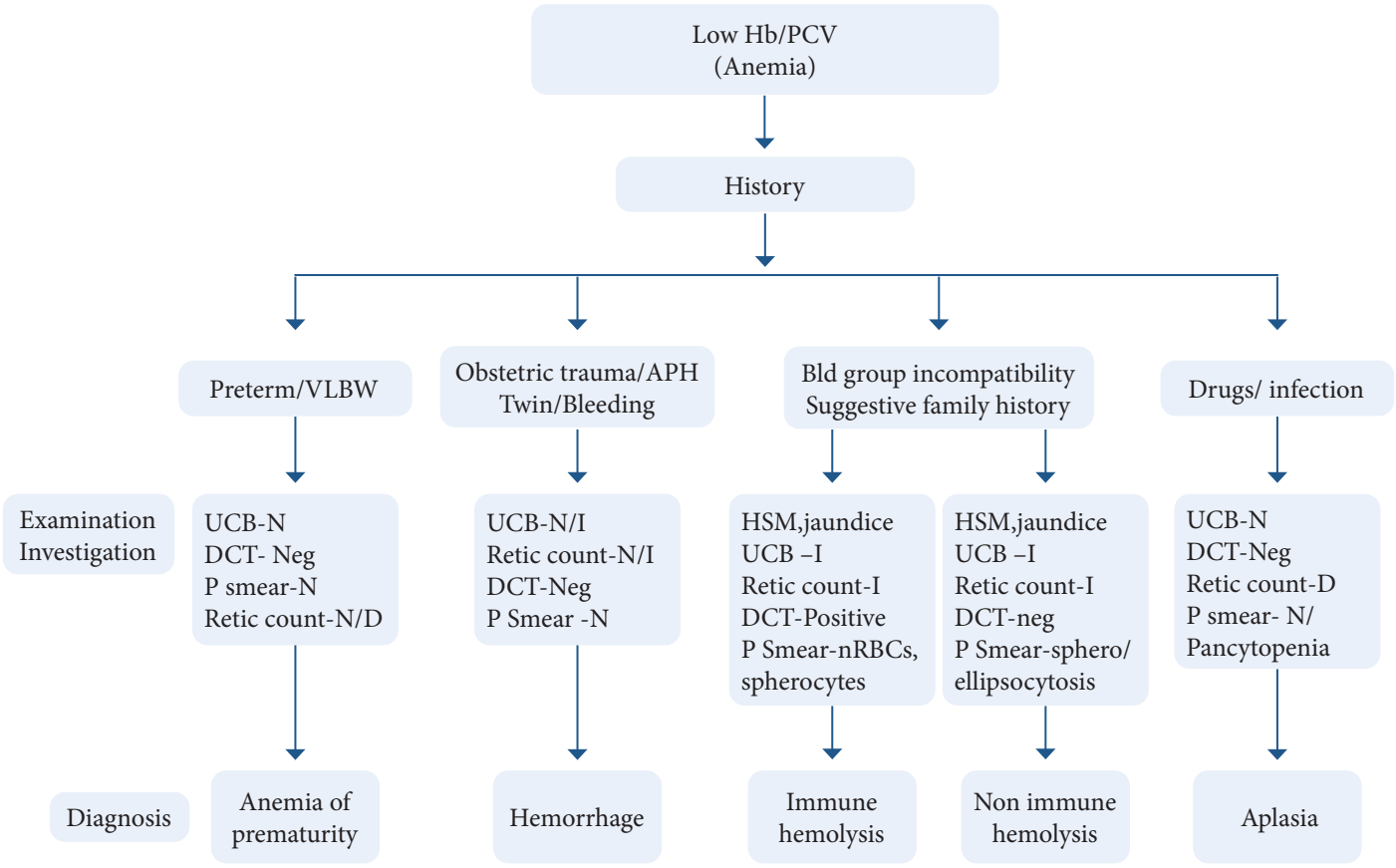
Exchange transfusion thresholds by gestational age for infants with no recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age (AAP 2022)



Exchange transfusion thresholds by gestational age for infants with any recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age (AAP 2022)

Annexure 9:

APPROACH TO ANEMIA



Hb. Haemoglobin, Bld – Blood, Neg-negative, Retic- Reticulocyte, UCB – Unconjugated bilirubin,

HSM - Hepatosplenomegaly, Psmear – Peripheral smear, nRBC- Normal RBC, N/I – not increased, I – increased, D – decreased

N- Normal, P - Peripheral

Annexure 10:

EQUIPMENT AND DRUGS REQUIRED IN SNCU

EQUIPMENT	DRUGS
1. Open care system: radiant warmer – servo controlled with oxygen and suction 2. Self inflating bag (240,500 ml) with masks 3. (size 0,1) 4. Neonatal Laryngoscope with straight blades (size 00,0,1) ET Tubes 2.5, 3, 3.5, Suction catheters size 8,10,12,14F Feeding tubes 5,6F Oxygen tubing, Nasal prongs 5. Suction pump: Portable (manual, electrical), 220 V 6. Suction pump: Foot operated 7. Baby weighing scale : Electronic, 10 kg, error < 5 gm 8. Oxygen concentrator 9. Digital Thermometer 10. Pulse oximeter-bedside with neonatal probes 11. Neonatal Stethoscope 12. Examination Light 13. Multipara Monitor with NIBP, HR,SpO_2, ECG, RR, Temp 14. Transport incubator: basic, with battery and Oxygen 15. Bubble CPAP machine with caps, interface, nasal prongs and circuit	1. I/V-10 % dextrose, 5% Dextrose, Isolyte P, Normal saline, Ringer lactate 2. ACD: Phenobarbitone, phenytoin, midazolam, lorazepam 3. Calcium Gluconate 4. Vasopressors: Inj Adrenaline, Dopamine, Dobutamine 5. Oxygen 6. Hydrocortisone 7. Drugs as per annexure 13

Annexure 11:

HOUSEKEEPING ROUTINES

1. Floor & walls

- Walls and sinks must be cleaned with a surface detergent/ 3% phenol or 5% Lysol at least once a day
- Wet mopping of the room should be done at least 3 times a day
- Sweeping and dry dusting be avoided

2. Disposal of waste and soiled linen

- Closed colour coded bins should be available as per Bio Medical Waste (BMW) rules.
- The bin must be kept closed and emptied at regular intervals.
- Plastic bag can be used in dustbin and these bags should be sealed before they are removed.
- The dustbin should be cleaned and washed properly in running water every day.

3. Cleaning of spills and splashes with suitable disinfectants

- Use 10 gm of bleach in 1 Itr of water. Cover the area with solution for at least 20 minutes and mop with newspaper or cloth.

4. Feeding utensils

- Cup, Spoon and paladai should be boiled for at least 15 min before use.
- Feeding tubes should be preferably disposable.

5. BMW should be segregated at source in specified colour coded bins/bags (as mentioned below) for final disposal as per BMW rules.

Yellow: a) Human Anatomical Waste b) Animal Anatomical Waste c) Soiled Waste d) Expired or Discarded Medicines & Cytotoxic drugs along with glass or plastic ampoules, vials etc. e) Chemical Waste f) Microbiology, Bio-technology and other clinical lab waste g) Chemical Liquid Waste h) Discarded linen, mattresses, beddings contaminated with blood or body fluids. Also routine mask & gown & shoe covers.

Red: Contaminated Waste (Recyclable) Vacutainers, tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles) and gloves.

White: Waste sharps including Metal sharps-Needles, Syringes with fixed needles, Needles from needle tip cutter/ burner, Scalpels & Blades.

Blue: Broken/ discarded glass, Medicine vials & ampoules except those contaminated with cytotoxic wastes & Metallic Body Implants.

Black: Municipal waste.

All individual items like stethoscope, measuring tape and probe tips should be cleaned with 70% isopropyl alcohol daily or whenever being used for another baby.

Disinfection is killing of the live micro-organism and this can be achieved by 20 minutes contact period with 2% glutaraldehyde.

Sterilization is killing of live micro-organism along with spores. This can be done by 4 hour contact period with 2% glutaraldehyde.

Ensure that fumes of glutaraldehyde are aired out or rinsed completely with water from objects before using on infants because these can be damaging to the baby. 2% glutaraldehyde once prepared is active for 14 days provided the container is kept closed.

Annexure 12:

GUIDELINES FOR ENTRY INSIDE THE SNCU

- Overcrowding must be avoided inside the SNCU.
- Every person should enter the unit after hand washing and gowning (as per unit policy).
- **Hand washing before entering SNCU is mandatory. Perform hand hygiene as per WHO guidelines in between babies using Hand rub/ Hand washing.**
- Both parents should be allowed to visit their baby. Hand washing and gowning should be taught to them. They should be allowed to touch, cuddle and care for their baby within the permissible limits.
- There should a "buffer zone" beyond the door of the SNCU into which visitors are not allowed without "permission."
- Separate set of shoes to be used inside the SNCU and outside the unit.
- Doctors and nurses should have special dress for the SNCU
- Nobody should wear bangles, rings, sacred wrist threads, wristwatch, nail polish, socks and woolens inside the unit.
- Any person with infection should not be allowed to enter the SNCU.
- Infected babies can be admitted in the SNCU with adequate isolation and barrier facilities. "Infected baby" with diarrhea, pyoderma and such contagious infections should not be admitted inside the main SNCU, instead they can be housed in a separate room.
- Any hospital personnel, who does not have a valid reason to be in the SNCU, should not be allowed to enter.

Annexure 13:

DRUG LIST

Drug	Dose	Route
Adrenaline 1:10,000	0.2 ml/kg I/V	IV
Aminophylline	5 mg/kg loading,then 2 mg/kg/dose q 8-12 hr	IV
Caffeine	20 mg/kg loading,then 8-10 mg/kg/dose q 24 hr (start after 24 hrs of loading)	IV, Oral
Vitamin K	1 mg	IV/IM
Calcium gluconate 10%	2 ml/kg	IV
Inj. Magnesium sulphate 50%	0.2ml/kg	IM
Phenobarbitone	20 mg/kg loading over 20 min then 3-4 mg/kg q 24 hr	IV
Phenytoin	20 mg/kg loading over 20 min then 5 mg/kg q 24hr	IV
Lorazepam	0.05 -1.0 mg/kg	IV
Dopamine/Dobutamine	5-20 micro g/kg/min	IV continuous
Ampicillin	< 7 days 50 mg/kg/dose, q 12 hr> 7 days 50 mg/kg/dose, q 8 hr	IV
Gentamycin	5 mg/kg/dose, q 24 hr	IV
Amikacin	15 mg/kg/dose, q 24 hr	IV
Cefotaxime	< 7 days 50 mg/kg/dose, q 12 hr> 7 days 50 mg/kg/dose, q 8 hr	IV
Piperacillin	50 mg/kg/dose, q 8 - 12 hr	IV
Meropenem	40 mg/kg/dose, q 8 hr	IV
IV Fluids: 10% Dextrose, 5% Dextrose, 25% Dextrose, Normal saline, Isolyte –P, Ringer Lactate, Distilled water	Fluid requirement as per body weight & day of life	IV
Supplements: Vitamin D Calcium Phosphorus Multivitamin Iron	400 IU/day 120-140 mg/kg/day & 60-90 mg/kg/day 1ml/day 2 mg/kg/day	Oral Oral Oral Oral
Hydrocortisone	1- 2.5 mg/kg (as per the indication – Shock or hypoglycemia)	IV

Annexure 14:

NEWBORN HISTORY AND EXAMINATION

Baby of _____(Mother' name) Age _____ ____ Sex_____

Date of birth_____ Time_____

Maternal history

Age _____ Para _____ Gravida _____

Previous Obstetric History

Present pregnancy LMP ___/___/_____ Expected date of delivery ___/____/_____

Present gestation in weeks _____

Antenatal History

Antenatal check ups : Yes/No If yes where _____ Number _____

BP ___/____ mmHg Urine examination: Albumin + / - tetanus toxoid: ____ doses

Blood group _____Any other investigation _____

Family history of mother: _____

Labor Presentation: Vertex / Breech / Transverse Spontaneous/induced

APH ☐ Placenta previa ☐ PROM ☐ Duration: _____ (hours)

Amniotic fluid : Clear/meconium stained

Drugs in labour

Delivery mode : Normal Vaginal/Forceps/Vacuum/Caesaran

Indication, if not normal vaginal _____

Anesthesia: General / Spinal

Baby

Resuscitation required None/ Initial steps / Free Flow oxygen / PPV / CC / Medications

Apgar scores 1 min. _____ 5 min. _____ 10 min. _____

Presenting Complaints:

1. _____

2. _____

3. _____

General Examination

I. General condition : Alertness/Sensorium – Normal / Drowsy / Comatosed

Activity & Cry: Good / weak / Poor

II. Vital signs :

1 Temperature _____^{0}C (axillary) Perpheries warm/cool

2 Respiration rate _____ (per minute) Retraction ☐ Grunt ☐ Apnea ☐

3 Heart rate _____ (per minute) All pulses palpable Yes/ No.

4. BP/Perfusion : _____ , Capillary refill time (CFT) _____ seconds

III. Anthropometry

Weight _____ (gms) Head circumference _____ (cms) Length _____(cms)

Gestation: Term/Preterm/Post term

IV. Position on intrauterine growth chart: AGA/SGA/LGA

V. Congenital malformations (Head to toe examination) :

_____

VI. Other features Cyanosis ☐ Icterus ☐ Seizures ☐ Fontanel: Level / Bulging ☐

Systemic Examination

Diagnosis

Single or multiple/Term-preterm-postterm/Gestation in wk/Wt in gms/ AGA or SGA/ Sex/ add problem

Management Plan

1. _____

2. _____

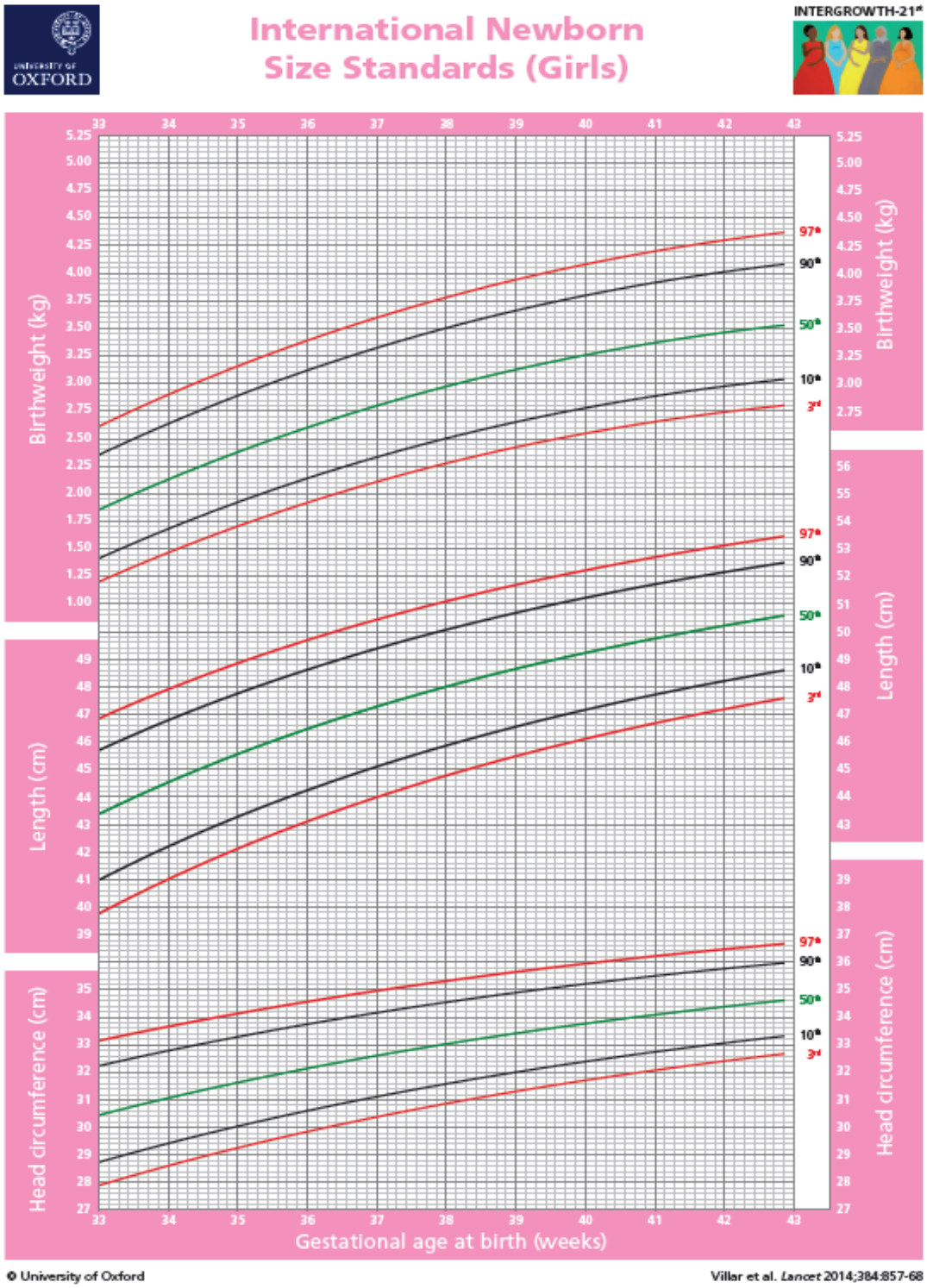
3. _____

4. _____

5. _____

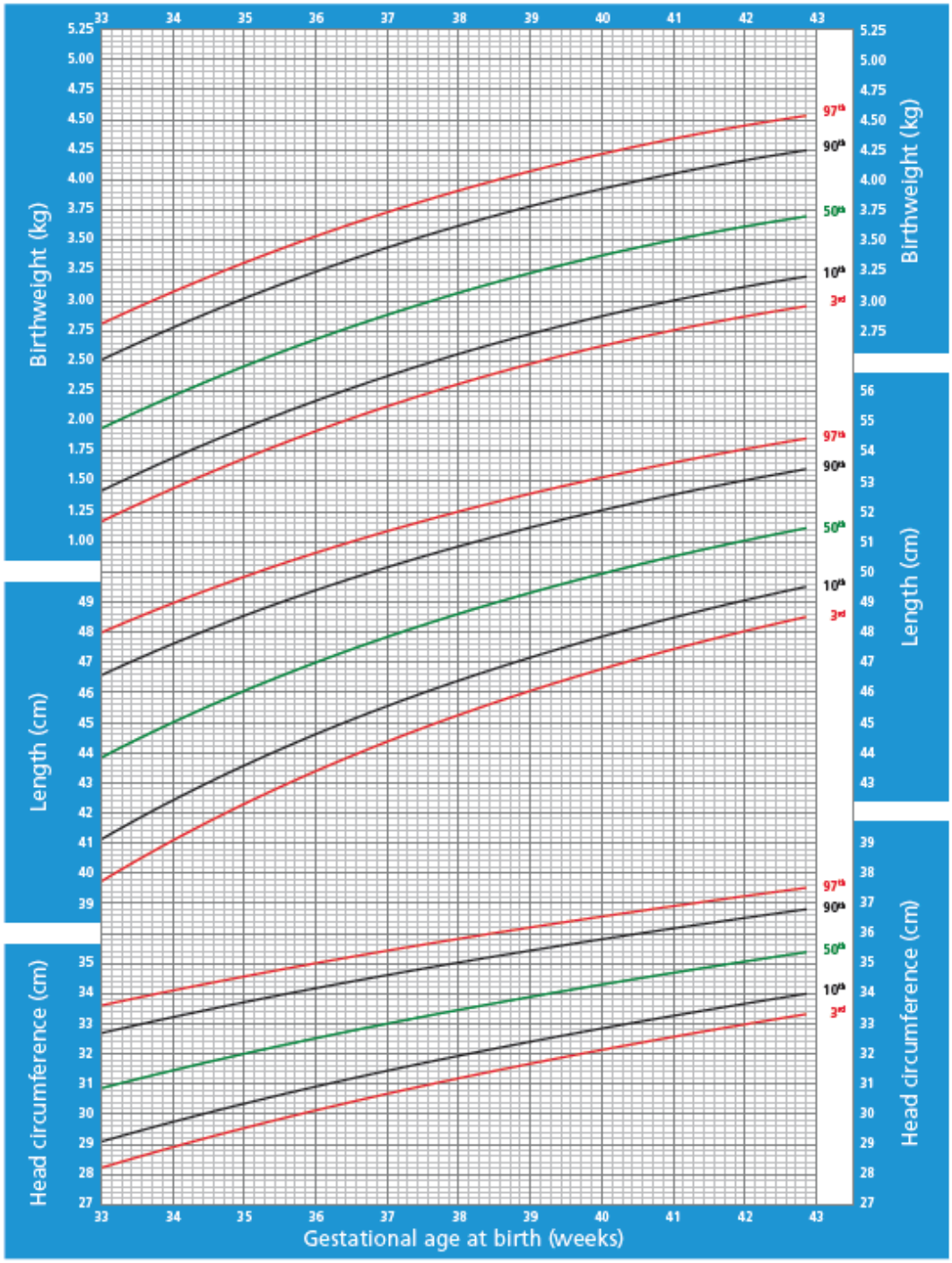
Annexure 15:

INTERGROWTH 21 CHARTS

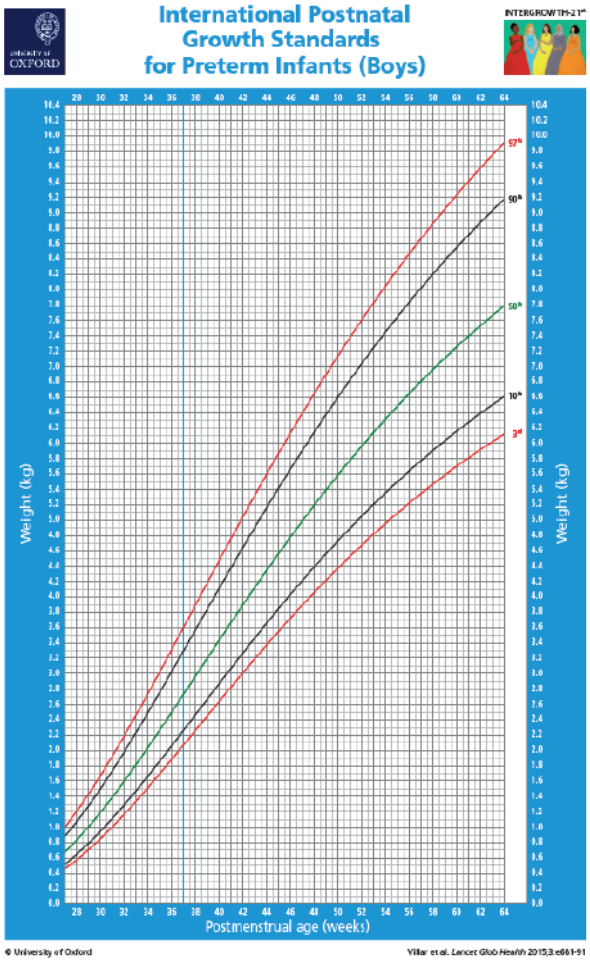


International Newborn Size Standards (Boys)

INTERGROWTH-21st



Villar et al. *Lancet* 2014;384:857-68


International Postnatal Growth Standards for Preterm Infants (Boys)
INTERGROWTH-21st
Weight (kg)
Postmenstrual age (weeks)
97th
90th
50th
10th
3rd
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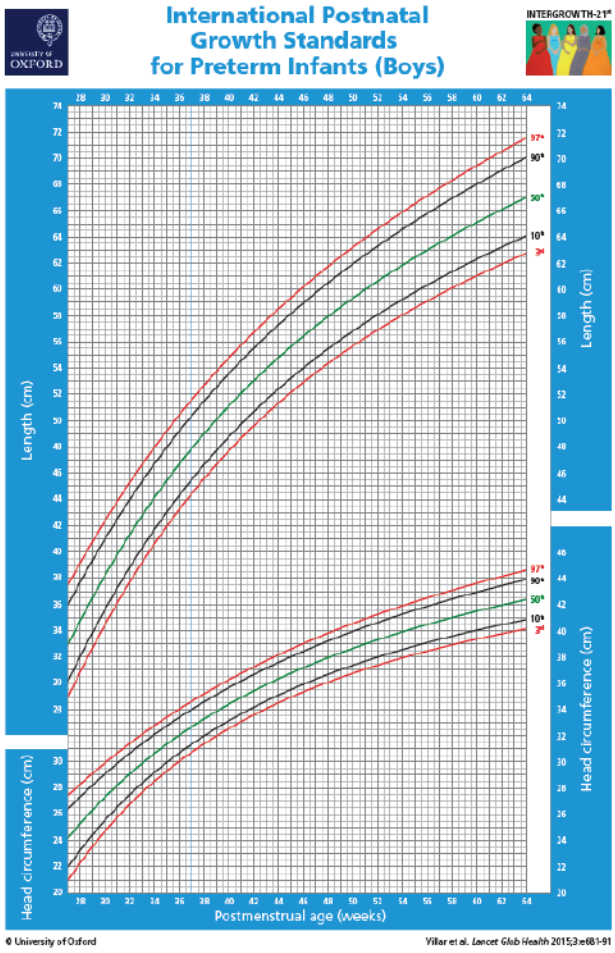
Villar et al. Lancet Glob Health 2015;3:e681-91


International Postnatal Growth Standards for Preterm Infants (Boys)
INTERGROWTH-21st
Length (cm)
Head circumference (cm)
Postmenstrual age (weeks)
97th
90th
50th
10th
3rd
© University of Oxford
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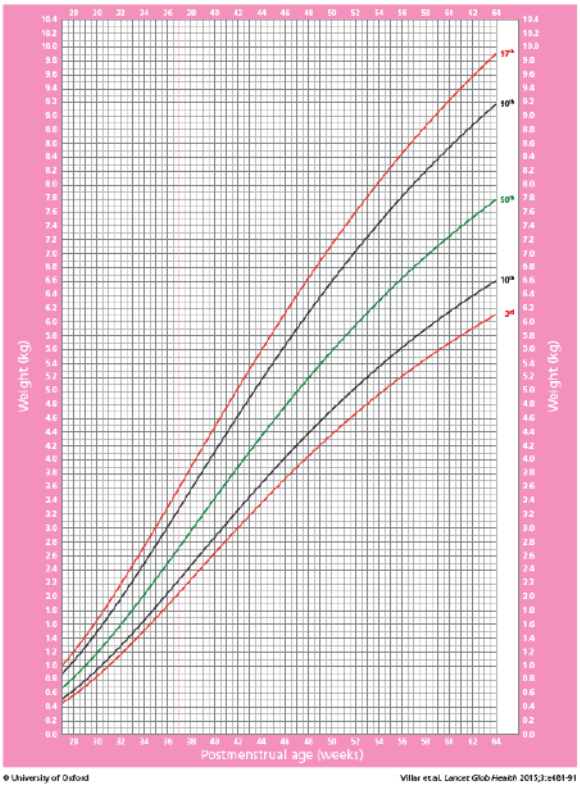
International Postnatal
Growth Standards
for Preterm Infants (Girls)
INTERGROWTH-21st
Weight (kg)
Postmenstrual age (weeks)
97th
90th
50th
10th
3rd
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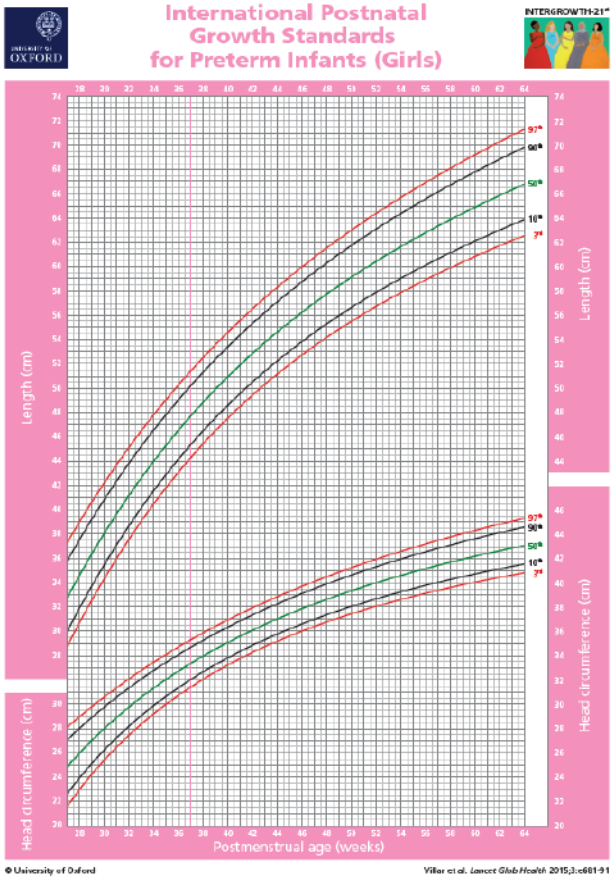
International Postnatal
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Length (cm)
Head circumference (cm)
Postmenstrual age (weeks)
97th
90th
50th
10th
3rd
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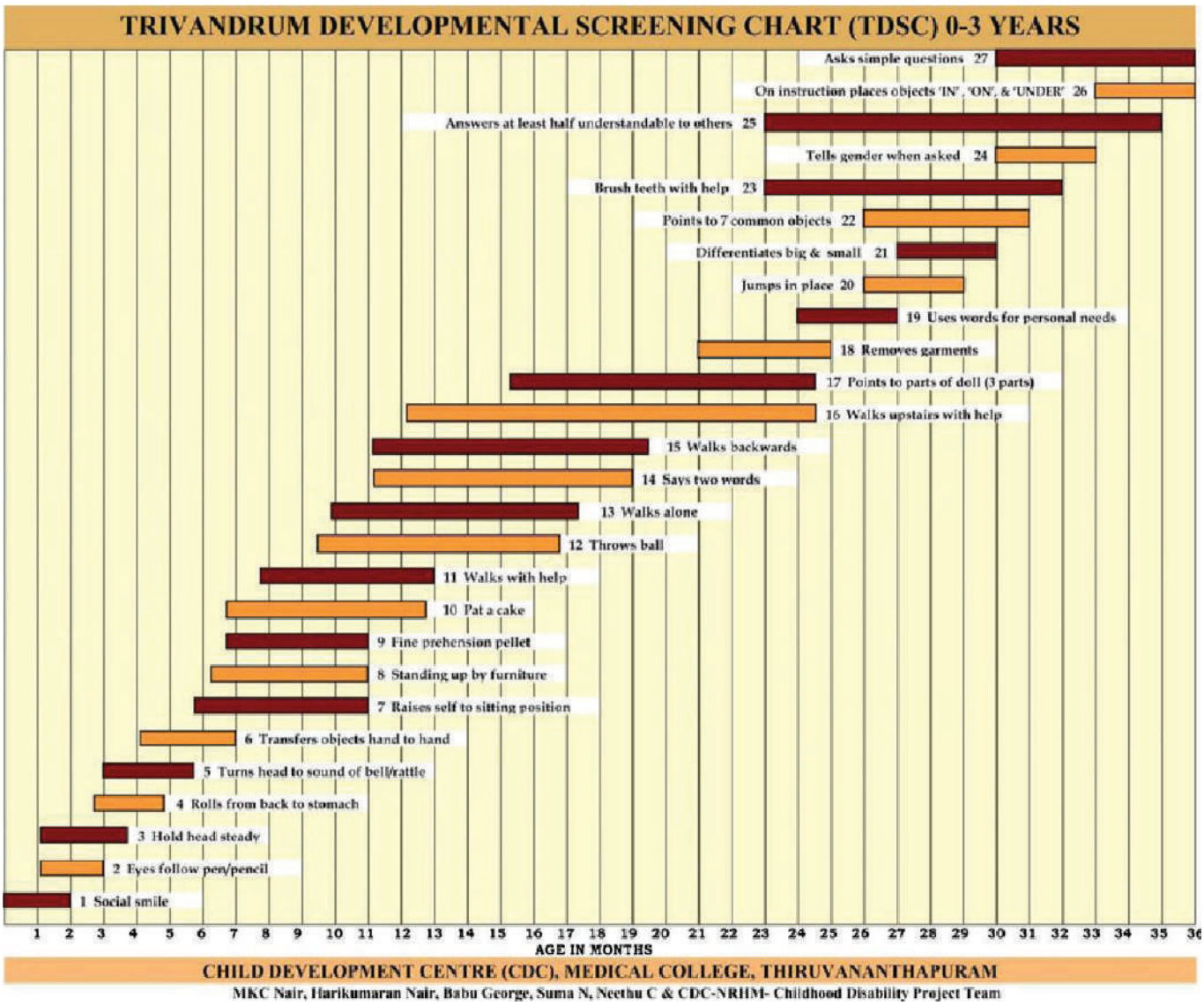
Villar et al. Lancet Glob Health 2015;3:e681-91

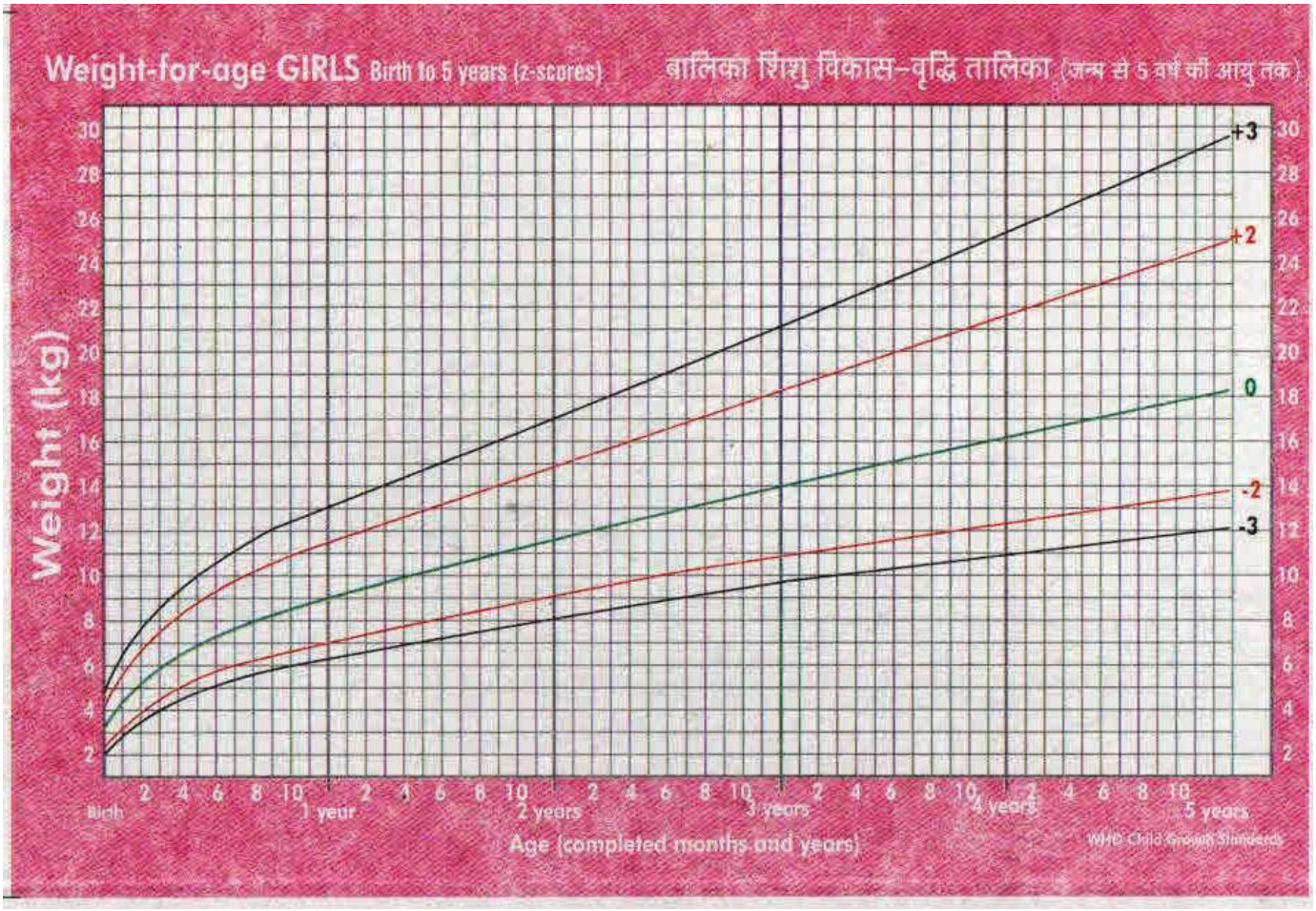
Annexure 16:

TDS CHART



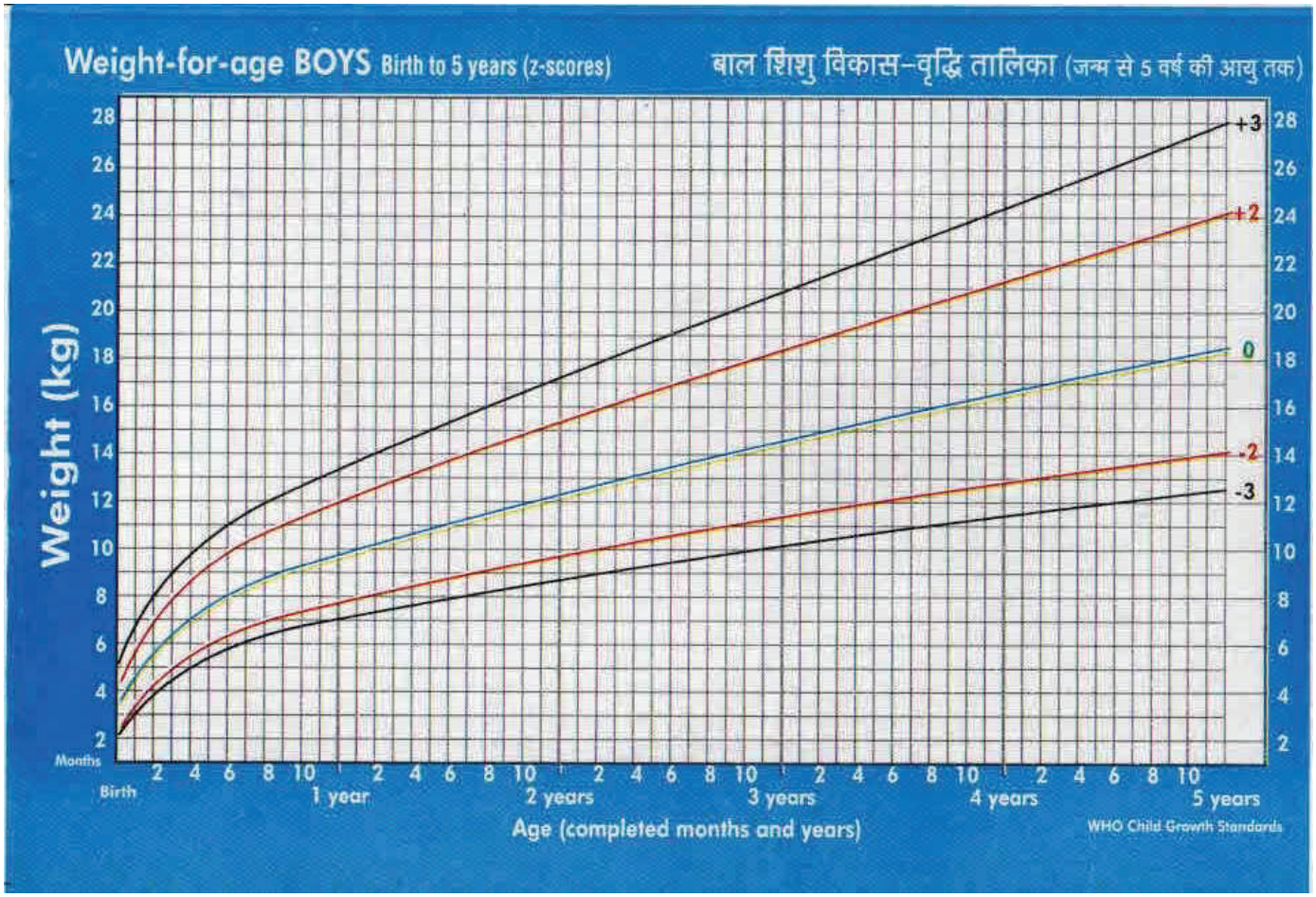
Annexure 17:

WHO GROWTH CHART FOR GIRLS



Annexure 18:

WHO GROWTH CHART FOR BOYS



Annexure 19:

NORMAL HAEMATOLOGICAL AND BIOCHEMICAL VALUES IN NEWBORN

Parameter	Normal values	Parameter	Normal values
Hemoglobin	15-24 g/dL	GGT	37-193 U/L
TLC	9.1-34000 cells/mm3	Calcium (Total)	9-11 mg/dL
Differential		Calcium (Ionic)	Cord blood- 5-6 mg/dL Day 1- 4.3-5.1 Day 2 onwards- 4-4.92 mg/dL
Bands	150-400/mm3 (3-5%)	Phosphate (inorganic)	4.8-8.2 mg/dL (1.55-2.65 mmol/L)
Segmented neutrophils	3000-5800 (54-62%)	Serum Magnesium	1.2-2.6 mg/dL
Lymphocytes	1500-3000 (25-33%)	Total protein	4.3-7.6 mg/dL
Platelets	84000-4.78 lakh in first week 1.5-4 lakh thereafter	Creatine kinast (total), CK-T	Upto 48 hours- 130-1200 U/L Day 2-4- 87-725 U/L
Reticulocyte count	1 day- 0.4-6% 7 days- <0.1-1.3 1-4 wks- <1.0-1.2	Creatine kinase MB (CK-MB)	1.8-5 U/L
CRP	0.08-1.58 mg/dL	pH	7.35-7.45
Blood urea	3-12 mg/dL	Pco2	35-45 mm Hg (permissive hypercapnia- upto 55 as long as pH>7.2)
Serum creatinine	0.03-0.5 mg/dL	Hco3	Arterial- 21-28 mmol/L Venous- 22-29 mmol/L
Serum potassium	3.2-6.0 mg/dL (mmol/L)	BE	(-10) to (-2) mmol/L
Serum sodium	133-146 mg/dL (mmol/L)	Serum chloride	97-110 mmol/L
BUN	3-12 mg/dL	Serum glucose	50-90 mg/dL
Uric acid	1.8-5.0 mg/dL	TSH	0-3 days – 1-20 micro IU/L 3-30 days – 0.5-6.5 micro IU/L 1-5 months- 0.5-6 micro IU/L
Direct bilirubin	>1 mg/dL	T3 total	60-300 n g/dL (till 1 year of life)
AST	22-71 U/L	Free T3	cord blood- 20-240 p g/dL 1-3 days- 200-610 p g/dL
ALT	10-40 U/L	T4	0-3 days- 8-20 microgram per dl. After 3 days- 5-15 microgram/dl (newborn)
ALP	150-800 IU/L		

Annexure 20:

ANTIBIOTIC POLICY

Antibiotic therapy should cover the common causative bacteria, namely, *Escherichia coli, Staphylococcus aureus and Klebsiella pneumonia*.

Antibiotic Therapy for Neonatal Sepsis

I. Septicemia or Pneumonia

B wt < 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0-14 days age	0-14 days age		
Inj Ampicillin* or	50 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj cloxacillin#	50 mg/kg/ dose	12 hrly	8 hrly	IV	7-10 days
AND					
Inj Gentamicin	5 mg/kg/dose	24 hrly	24 hrly	IV	7-10 days

B wt ≥ 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0-7 days age	0-7 days age		
Inj Ampicillin* or	50 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj cloxacillin#	50 mg/kg/ dose	12 hrly	8 hrly	IV	7-10 days
AND					
Inj Gentamicin	5 mg/kg/dose	24 hrly	24 hrly	IV	7-10 days

II. Septicemia IInd Line Drugs

B wt < 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		14 days age	>14 days age		
Inj Piperacillin+ Tazobactum***	100 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

B wt ≥ 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Piperacillin+ Tazobactum***	100 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

III. Meningitis (For confirmed meningitis)

B wt < 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Cefotaxime*	50 mg/kg/dose	12 hrly	8 hrly	IV	3 weeks
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks

B wt ≥ 2 Kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Cefotaxime*	50 mg/kg/dose	8 hrly	6 hrly	IV	3 weeks
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks

IV. Meningitis – IInd Line

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Meropenem****	40 mg/kg/dose	8 hrly	8 hrly	IV	3 weeks
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks

Start if pustules/umbilical sepsis.

* Infuse as an IV infusion using syringe infusion pump over 30 minutes or longer.
Use a concentration not higher than 100 mg/ml for infusion.

** Infuse as an IV infusion using syringe infusion pump over 30 minutes or longer.
Use a concentration not higher than 5mg/ml for infusion.

*** Infuse as an IV infusion using syringe infusion pump over 30 minutes or longer.
Use a concentration not higher than 50 mg/ml for infusion.

**** Infuse as an IV infusion using syringe infusion pump over 30 minutes or longer.
Use a concentration not higher than 10mg/ml for infusion.

The above tables are suggested guidelines to begin with as it is not possible to advocate a single antibiotic policy for use in all newborn units.

- **Every newborn unit must have its own antibiotic policy based on the profile of pathogens and local sensitivity patterns.**
- Preferably choose Penicillin plus an Aminoglycoside combination for sepsis and not cephalosporins as they rapidly induce the production of extended spectrum ß-lactamases (ESBL), cephalosporinases and fungal colonization leading to increased resistance and fungal sepsis.
- IIIrd generation Cephalosporins like cefotaxime should be reserved for meningitis in view of good CSF penetration. Avoid using ceftriaxone in neonates as it may displace bilirubin from albumin binding sites and may also induce cholestasis.

Change of Antibiotics

- Empirical up gradation can be considered if there is no clinical improvement by 48 hours of institution of antibiotics or there are signs of deterioration earlier than that.
- In such circumstances (presence of signs of deterioration) one must look for alternate explanation (hypoglycemia, hypothermia, MAS, TTNB, RDS, Perinatal asphyxia) for the clinical signs and augment supportive care. However, despite this, if improvement does not occur in 48-72 hrs one may consider changing to IInd line antibiotics. Current evidence does not support the use of serial CRP as a guide for deciding whether or not antibiotics should be upgraded empirically.

Following conditions do not require antibiotics for their management (unless workup for sepsis is positive)

- Meconium Stained Amniotic Fluid.
- Meconium Aspiration Syndrome.
- Mild Respiratory Distress.
- Perinatal Asphyxia.
- Asymptomatic neonates with presence of 1-2 risk factors for EOS.
- Jaundice.
- Prematurity.

When to Stop Antibiotics

Culture negative sepsis: If the blood culture is reported sterile at 48 hours, the following guidelines must be adhered to:

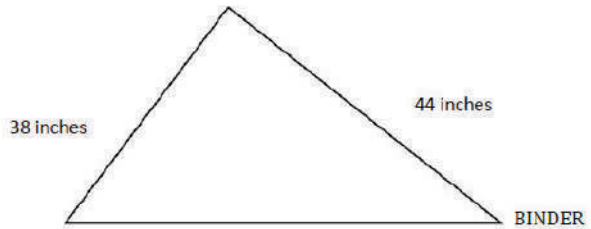
- Asymptomatic neonate at risk of EOS: stop antibiotics.
- Suspected EOS or LOS and the neonate becomes completely asymptomatic: stop antibiotics by 5-7 days.

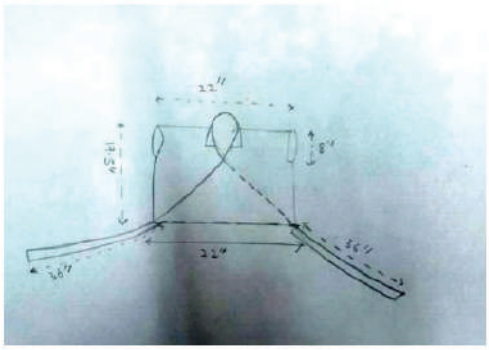
Annexure 21:

KMC GARMENTS

Specifications of the KMC binder and shirt

1. Binder should be triangular in shape with dimensions of 60" x 44" x 38".
2. The shirt should be front open with two flaps overlapping each other with belt attached to both the flaps. The dimensions are 19.5" X 22" with the belt measuring 36".
3. Fabric should preferably be cotton, non stretch and light in colour.





SHIRT

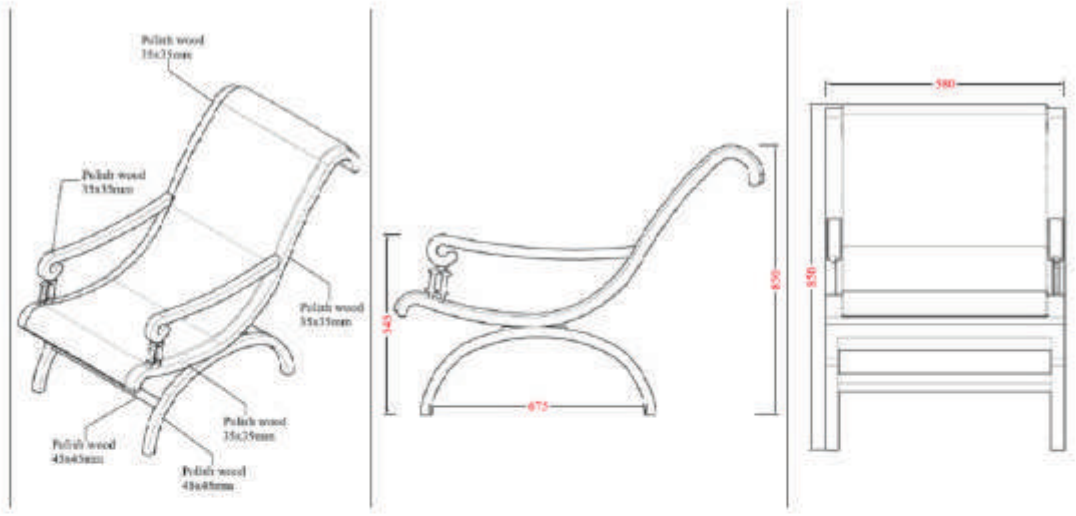
Annexure 22:

KMC CHAIR

Polished wooden kangaroo mother chair with PU foam padding and leatherite upholestry may be procured as per drawing and image appended below.

The chair should preferably be made from good quality and strong wood with sections of 45mm x 45mm and 35mm x 35 mm along with armrests as indicated in the drawing with reclining angle as per the sample photo shown below.

The leatherite wood joint needs to be well fixed and covered with thread chord as depicted.



Annexure 23:

LIST OF VIDEOS FOR FBNC MODULES

1. Emergency signs
2. Kangaroo Mother Care Counselling
3. Kangaroo Mother Care technique
4. Breastfeeding techniques
5. Manual Expression of breast milk
6. Enteral feeding using paladi
7. Orogastric tube insertion and feeding
8. Glucose monitoring
9. Intravenous access
10. Preparation Of Intravenous infusions & drugs
11. Hand hygiene
12. Infection control & Equipment cleaning protocols
13. Neonatal seizures
14. Respiratory distress
15. Oxygen Therapy in neonates
16. Pulse oximeter
17. Continuous positive airway pressure (CPAP)
18. Developmentally Supportive Care
19. Anthropometry
20. Waste Management
21. Routine care
22. Bag and mask
23. Radiant warmer
24. Newborn examination at
    a) Birth
    b) 24 hours of life
    c) Discharge
    d) Admission and management in SNCU
25. Discharge planning
26. Human milk banking

Child Health Division
Ministry of Health & Family Welfare
Government of India
Nirman Bhawan
New Delhi - 110011