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Standard Operating Procedures for

Management of Sick Newborn and Setting Up Newborn Services at Different Level of Health Facilities in Sierra Leone

August 2024

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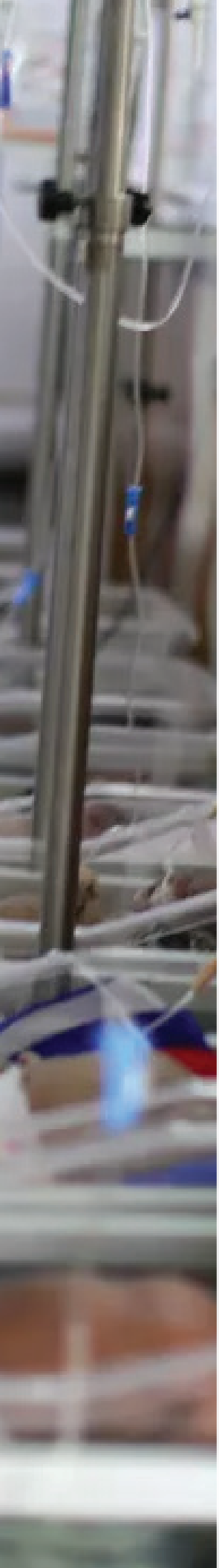

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Foreword

The first 28 days of life (the neonatal period) is the most vulnerable time for a child' s survival. Globally, about 2.6 million children die in the first month of life, with approximately 7,000 newborns dying every day, most of which occur within the first week of life. Neonatal mortality contributes significantly to under-five deaths (WHO, 2016). Each of these deaths is a tragedy, particularly because many are preventable.

Sierra Leone is making progress towards reducing maternal and neonatal mortality, however despite the numerous advances in improving child health, neonatal mortality remains a significant contributor to the under-five mortality in Sierra Leone. Given this situation, the country requires focused and prioritized high-impact interventions to accelerate the reduction of newborn deaths.. Seventy per cent of these deaths among newborns are caused by complications related to prematurity, birth asphyxia, and infections, most of which are preventable and treatable.

The Ministry of Health has prioritized newborn health in the reproductive maternal, newborn, child and adolescents' health (RMNCAH) strategy (2017-2021), and the Sierra Leone Every Newborn Action Plan (2017-2021). These documents are aligned to global commitments to newborn health including the SDGs, "Every Newborn Action Plan," and the new "Global Strategy for Women's, Children's, and Adolescents' Health 2016–2030. These strategies among other priorities contain high impact newborn intervention area across the continuum of care to improve newborn survival.

The Sierra Leone Every Newborn Action Plan (SLENAP) has a clear strategy which spells out the establishment of different levels of services for newborn and building the capacity of service providers to enhance competency in managing sick newborns. This is a unique opportunity to develop and implement best practices in providing newborn care. The need to ensure quality standard care for newborn babies has led to creation of standard operation procedures (SOPs). This edition is the second and revised edition in an attempt to nationally harmonies and standardise newborn care and practice in the Sierra Leone. Currently, the country has 16 Special Care Baby Units (SCBUs).

I do believe that, just as we were able to reach zero cases with Ebola, we can achieve zero preventable deaths among newborns, ensuring that each live birth thrives to its fullest potential (mentally and physically). I believe these standards will be instrumental in providing quality neonatal healthcare. I urge partners supporting newborn interventions to adhere to these SOPs, as the document seeks to standardise newborn services provided throughout the country.

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Acknowledgement

These reviewed (second edition) Standard Operating Procedures (SOPs) for the management of sick newborns are the result of a consultative process with the key stakeholders and partners of the Ministry of Health (MoH). The guidelines have been formulated from various global sources and tailored to the needs and health practices of the country. They are designed to serve as a guide to all healthcare providers in the country to provide standardised quality neonatal care.

I would like to congratulate the team that worked with zeal and commitment to ensure this initiative was a success. I hope the guidelines will offer great learning and will be a useful resource to all healthcare workers caring for neonates.

We would like to express our sincere gratitude to all the paediatricians (national and international), midwives, nurses, partners, institutions, and individuals who contributed to the development of this document with their professional knowledge, personal enthusiasm, and commitment to ensure that newborns survive, develop, and thrive in Sierra Leone.

The MoH would particularly like to acknowledge the technical and financial support from UNICEF, as well as the financial support from UK Aid.

We look forward to the continued support from our partners during the implementation of the SOPs in health facilities and request that partners supporting newborn interventions to adhere to the SOPs as we seek to standardise newborn care throughout the country. We are hopeful and believe that these efforts will lead to a reduction of neonatal deaths and improve the quality of life for our newborns.

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ACRONYMS

AAP	American Academy of Pediatrics
ABC	Airway, Breathing, Circulation
ABCD	Airway, Breathing, Circulation and Drugs
ABG	Arterial Blood Gas
AGA	Appropriate for Gestational Age
ANC	Antenatal Care
AP	Antero-posterior
ART	Antiretroviral Therapy
ARV	Antiretroviral
AZT	Zidovudine
BCG	Bacille Calmette-Guérin
bCPAP	Bubble Continuous Positive Airway Pressure
BCS	Blantyre Coma Scale
BD	Bis in Die, which means 'twice a day'
BIND	Bilirubin Induced Neurological Dysfunction
BPD	Bronchopulmonary Dysplasia
BP	Blood Pressure
BW	Birth Weight
CBC	Complete Blood Count with Differentials
CH	Congenital Hypothyroidism
CCH	Central Congenital Hypothyroidism
CHC	Community health center
CHD	Congenital Heart Defect
CHEWs	Community Health Extension Workers
CHO	Community Health Officer
CHP	Community Health Post
CFL	Compact Fluorescent Light
CLD	Chronic Lung Disease
CMV	Cytomegalovirus

CO2	Carbondioxide
COVID-19	Coronavirus Disease 2019
CPAP	Continuous Positive Airway Pressure
CRP C-	Reactive Protein
CRT	Capillary Refill Time
C/S	Caesarean Section
CSF	Cerebrospinal Fluid
CTG	Cardiotocography
CVP	Central Venous Pressure
CXR	Chest X-ray
DCT	Direct Coomb's Test
DDH	Developmental Dysplasia of the Hip
DIC	Disseminated Intravascular Coagulopathy
DL	Decilitre
DOL	Day of Life
D/W	Dextrose Water
EBM	Expressed Breastmilk
EBT	Exchange Blood Transfusion
ECEB	Essential Care for Every Baby
ECG	Electrocardiography
ECHO	Echocardiography
ECSB	Essential Care for Small Babies
EEG	Electroencephalography
EID	Early Infant Diagnosis
ELBW	Extreme Low Birth Weight
ENC	Essential Newborn Care
ENCC	Essential Newborn Care Course
EOS	Early Onset Sepsis
EPI	Expanded Programme on Immunization
ESR	Erythrocyte Sedimentation Rate

ET	Endotracheal Tube
E/U/Cr	Electrolyte, Urea, Creatinine
FBC	Full Blood Count
FFP	Fresh Frozen Plasma
FiO2	Fraction of Inspired Oxygen
FMOH	Federal Ministry of Health
GA	Gestational Age
GBS	Group B Streptococcus
GCS	Glasgow Coma Scale
G6PD	Glucose-6-Phosphate Dehydrogenase Deficiency
GIR	Glucose Infusion Rate
HAI	Healthcare Associated Infection (Hospital Acquired Infections)
HAART	Highly Active Antiretroviral Therapy
HBB	Helping Babies Breath
HBIG	Hepatitis B Immunoglobulin
HBsAg	Hepatitis B Surface Antigen
HCP	Healthcare Practitioner
HCWs	Healthcare Workers
HFNC	High Flow Nasal Cannula
HFOV	High Frequency Oscillatory Ventilation
HIE	Hypoxic Ischaemic Encephalopathy
HIV	Human Immunodeficiency Virus
HMD	Hyaline Membrane Disease
HPA	Human Platelet Antigen
HPLC	High Performance Liquid Chromatography
HR	Heart Rate
Hr	Hour
HSV	Herpes Simplex Virus
IEF	Isoelectric Focusing
IM	Intramuscular

IPPV	Intermittent Positive Pressure Ventilation
IU	International Unit
IUGR	Intrauterine Growth Restriction/Retardation
IV	Intravenous
IVF	Intravenous Fluid
IVH	Intraventricular Haemorrhage
KG	Kilogramme
KMC	Kangaroo Mother Care
L	Litre
LBW	Low Birth Weight
LED	Light Emitting Diode
LGA	Large for Gestational Age
LMP	Last Menstrual Period
LNMP	Last Normal Menstrual Period
LOS	Late Onset Sepsis
LP	Lumbar Puncture
MAP	Mean Airway Pressure
MAS	Meconium Aspiration Syndrome
MCG	Microgramme
M/C/S	Microscopy, Culture and Sensitivity
MEq	Milliequivalent
MG	Milligramme
MIN	Minutes
ML	Millilitre
MMOL	Millimole
MOsm	MilliOsmole
MPDSR	Maternal and Perinatal Death Surveillance and Response
MRI	Magnetic Resonance Imaging
MTCT	Mother to Child Transmission
NAITP	Neonatal Alloimmune Thrombocytopaenia

NCPAP	Nasal Continuous Positive Airway Pressure
NEC	Necrotizing Enterocolitis
NG	Nasogastric
NGT	Nasogastric Tube
NICU	Neonatal Intensive Care Unit
NiENAP	Nigeria Every Newborn Action Plan
NNJ	Neonatal Jaundice
NNU	Neonatal Unit
NPI	National Programme on Immunization
NPO	Nil per Os
NRP	Neonatal Resuscitation Program
NRT	Neonatal Resuscitation Training
NVP	Nevirapine
NYI	Newborn and Young Infant
ODCH	Ola During Children's Hospital
OFC	Occipitofrontal Circumference
OG	Orogastric
OGT	Orogastric tube
O2	Oxygen
OT	Operating Theater
PaCO2	Partial Pressure of Carbon dioxide
PaO2	Partial Pressure of Oxygen
PCR	Polymerase Chain Reaction
PCV	Packed Cell Volume
PEEP	Positive End Expiratory Pressure
PGE	Prostaglandin E
PIP	Peak Inspiratory Pressure
PO	Per Oral
PPE	Personal Protective Equipment
PPHN	Persistent Pulmonary Hypertension

PPV	Positive Pressure Ventilation
PROM	Prolonged Rupture of Membranes
PSBI	Possible Severe Bacterial Infection
PT	Prothrombin Time
PTT	Prothrombin Time Thromboplastin
QI	Quality Improvement
QoC	Quality of Care
RBS	Random Blood Sugar
RDS	Respiratory Distress Syndrome
Rh	Rhesus
RMNCH	Reproductive, Maternal, Newborn and Child Health
ROP	Retinopathy of Prematurity
RR	Respiratory Rate
RSS	Respiratory Severity Score
SARS	Severe Acute Respiratory Syndrome
SB	Serum Bilirubin
SCBU	Special Care Baby Unit
SEUC	Serum Electrolytes, Urea and Creatinine
SGA	Small for Gestational Age
SIADH	Syndrome of Inappropriate Anti-diuretic Hormone
SLENAP	Sierra Leone Every Newborn Action Plan
SPA	Suprapubic Aspiration
SPO2	Oxygen Saturation
SRT	Surfactant Replacement Therapy
Te	Expiratory Time
Ti	Inspiratory Time
TB	Tuberculosis
TFT	Thyroid Function Test
TPN	Total Parenteral Nutrition
TSH	Thyroid Stimulating Hormone

UAC	Umbilical Artery Catheter
UNICEF	United Nation Children Emergency Fund
UTI	Urinary Tract Infection
UVC	Umbilical Vein Catheter
VT	Tidal Volume
VLBW	Very Low Birth Weight
WHO	World Health Organization

CHAPTER 1:
STANDARD OPERATING PROCEDURE FOR ESTABLISHMENT OF DIFFERENT LEVEL OF NEWBORN SERVICES

1. Introduction

Newborn mortality remains high in Sierra Leone with an estimated rate (for 2015) of 35 per 1,000 live births, which represents 29% of under-five mortality (UN IGME, 2015). There is a significant disparity in neonatal mortality across different districts and regions in Sierra Leone as shown in the DHS 2013 with mortality rates ranging from 24 to 66 (national 39 per 1,000 live births). The leading causes of neonatal mortality in Sierra Leone are prematurity (30%), neonatal infections (30%) and asphyxia (26%) (Countdown, 2015). 19% of newborns die on the first day of life, while 81% die in the first six days of Life (DHS, 2013), indicating the need for immediate and essential newborn care especially in the first day and week of life. Currently, the neonatal mortality rate in Sierra Leone stands at 31 per 1,000 live births. The Sierra Leone Every Newborn Action Plan (SLENAP) aims to reduce the neonatal mortality rate to 12 or fewer per 1,000 live births by 2030 as per the Sustainable Development Goals (SLENAP, 2017). The SLENAP outlines the further development and establishment of newborn care services in Sierra Leone.

RATIONALE FOR THE GUIDELINE

The major need for this guideline is to standardise national neonatal care in the country's health facilities at primary, secondary and tertiary centers where basic, comprehensive and advanced newborn care services are provided. It is a step beyond the ENCC package and guideline for use in primary health centres that address only basic newborn care.

This guideline seeks to strengthen comprehensive newborn care in all secondary and tertiary institutions, and advanced newborn care.

The essence of this guideline is to help the user address common neonatal conditions with the aim of reducing neonatal morbidity and mortality. This includes users to:

- Provide care at birth for all newborns, including those of low birth weight.
- Provide neonatal resuscitation for all those who need it.
- Provide emergency assessment and treatment for small and sick newborns.
- Understand which newborn requires referral and safe transport.
- Understand common clinical problems of the sick and small newborns especially prematurity and its complications, asphyxia, sepsis and neonatal jaundice.
- Counsel families on common problems arising in this age group.
- To introduce quality improvement in their facilities.
- Know how to use and maintain equipment necessary for the care of newborns.

TARGET AUDIENCE/USERS

The guideline is designed for use primarily by health workers in secondary and tertiary health facilities across the nation (and to some extent the primary health facilities). Target users include health workers at public, private hospitals and faith- based institutions that have the capability and expertise to offer comprehensive and advanced newborn care.

STRUCTURE OF THE GUIDELINE

The guideline is structured to address major areas of newborn care and is presented in sections. The initial sections are centred on the status of newborn care in the country, triaging and transportation of the newborn; and some basic physiological processes in the newborn. This is followed by sections on specific clinical guidelines on asphyxia, prematurity, oxygen use, respiratory support with the bubble CPAP, neonatal jaundice, neonatal sepsis; with guidance on newborn technologies and equipment use integrated; while the later sections are on common procedures in the newborn; congenital/surgical newborn emergencies; guidance for discharge/follow-up; and appendices.

2. Newborn Care Corner (NBCC) and Newborn Stabilisation Unit (NSU): Set-up, Requirements and Clinical Protocols

Table 1 outlines the different newborn care facilities by health care level. Newborn Care Corners are to be established at all labour rooms and obstetric operating theatres of PHUs and hospitals conducting deliveries.

Newborn Stabilisation Units (NSUs), Special Care Baby Units (SCBU) and Newborn Intensive Care Units (NICUs) will be established over a period of 10 years with advancement of care over the years as shown in the table, aiming to reach Level III advanced care (NICU including mechanical ventilation) in the long term at national and regional hospitals. The country now has 16 functional SCBUs across the country (I tertiary facility, 3 regional hospitals and 12 district hospitals).

Table 1, Newborn Care Facilities at Different Healthcare Levels Including Timeline (2017-2027)

Facility	Targeted in Sierra Leone	Services for All Newborn / Newborn at Birth (0-3 year): All these have been achieved
PHU (MCHP, CHP, CHC)	All 1,184 PHUs	Newborn Care Corner (labour room)
District Hospital	All district hospitals (n=13)	Newborn Care Corner (labour rooms and obstetric operating theatre)
Regional Hospital	Bo, Makeni, Kenema (n=3)	Newborn Care Corner (labour rooms and obstetric operating theatre)
National Hospital	Princess Christian Maternity Hospital (PCMH)	Newborn Care Corner (labour rooms and obstetric operating theatre)
	Ola During Children's Hospital (ODCH)	In cooperated into SCBU
Private and mission clinics and hospitals (for profit, not for profit) conducting deliveries		Newborn Care Corner (labour rooms and obstetric operating theatre)

All PHUs and hospitals (district, regional, national) that conduct deliveries should have a Newborn Care Corner (NBCC) in each labour room and obstetric operating theatre. A Newborn Care Corner is a space where essential equipment and supplies are available for providing immediate and essential care to newborns, including resuscitation. Chapter 1 provides details on services provided in, configuration, requirements, human resources and clinical protocols for NBCCs.

2.1. Newborn Care Corner Services

Services provided in the NBCC include:

- Immediate Care at birth:
  - Drying thoroughly and wrapping with a clean, dry cloth.
  - Keeping warm (skin-to-skin).
  - Clamping/tying and cutting the cord.
  - Initiation of breastfeeding within the first hour.
  - Resuscitation with bag and mask when required.
- Essential Newborn Care at birth:
  - Prevent Disease: Eye Care with tetracycline ointment, Cord Care applying 7% Chlorhexidine, Inj. Vitamin K.

  - Assessment/Examination: Monitoring of vital signs, breathing, temperature, breastfeeding, cord stump for bleeding, skin colour, activity and body movement, weight, inspection for abnormalities, aspiration of meconium, blood or mucus in the airway.
  - Immunisations,

- Referral to higher-level-care including pre-referral treatment and care SBCU or NICU (in the same or other hospital).

2.2. Configuration Newborn Care Corner

The configuration of the newborn care corner should be as follows:

- A clear floor area of about 20-30 square feet should be provided in the room for newborn care corner inside the labour room and operating theatre.
- The resuscitation kit should be made ready for each delivery. If not required, then keep it in a safe place where it is easily found. If there is a radiant warmer, the resuscitation kit should be placed inside the drawers.
- Maintain the temperature of the room at 28°C. The area should be away from doors and windows to prevent draughts of air. Fans should be turned off.
- Availability of an oxygen source is desirable but not essential, however, it is recommended for newborn care corners at hospital level.
- An appropriate power connection should be available for a radiant warmer, which is recommended for newborn care corners at hospital level.

2.3. Equipment and Renewables for Newborn Care Corner

Table 2, Equipment and Renewables Required for the Newborn Care Corner

S No.	Item description	PHU & Other primary level facilities	Hospital, Other secondary/ tertiary level facilities	Minimal Quantity
1	Resuscitation table with radiant warmer	E (without oxygen)	E (With Oxygen)	1
2	Resuscitation Bag and Mask, 250-500 ml including both term and preterm masks (0 and 1 size)	E	E	1
3	Digital weighing scale-pan, preferably 10 kg type	E	E	1
4	Stethoscope for neonatal	E	E	1
5	Digital clinical thermometer	E	E	1
6	Measuring tape	E	E	2
7	Room thermometer	E	E	1
8	Wall clock with second-hand needle or digital wall clock	E	E	1
9	Penguin suction	E	E	3
10	Clean and warm cotton cloths/towels for drying and wrapping the baby, and cap for baby	E	E	At least 3
11	Sterile equipment for clamping/tying and cutting the cord	E	E	1 set
12	Sterile gloves	E	E	5 pairs
13	Identification tag for baby and mother to match	E	E	6
14	7% Chlorhexidine gel for cord care	E	E	5
15	Oxygen cylinder 8 F (alternative: oxygen concentrator)	D	E	1
16	Pump suction, foot-operated	D	E	1
17	Light examination, mobile, 220-120 V	D	E	1

A nurse should be assigned the responsibility of establishing and maintaining the newborn care corners to ensure, on a daily basis that all equipment is present, clean, and functional. Staff should receive regular training on how to use and maintain equipment to control sepsis.

2.4. Human Resources for the Newborn Care Corner

The following human resources are needed for the newborn care corner:

- **Staffing**

If possible, one nurse is required to provide immediate newborn care, in addition to the nurse conducting the delivery, to provide appropriate care at birth. Both the nurse handling the newborn and the nurse conducting the delivery need to have the appropriate skills and competencies to attend a birth and provide immediate and essential newborn care, including resuscitation.

- **Training**

All health workers (including gynaecologists, medical doctors, midwives, SRNs, CHOs, SECHNs, and MCH Assistants) posted at the labour rooms and obstetric operating theatres should have followed the skilled based ENC training or EmONC training, where ENC has been included, on providing immediate and essential newborn care at birth, including neonatal resuscitation and selected care of sick newborns. Doctors and nurses posted in the unit must undergo skill-based training on Emergency Triage Assessment and Treatment (ETAT) and Sick Newborn Care. This training should be followed by on-the-job training at a facility with SBCU/NICU, as per the requirement of the training package.

3. Special Care Baby Unit (SCBU): Set-up, Requirements, and Clinical Protocols

Table 3, Newborn Care Facilities at Different Health Care Levels Including Timeline (2017-2027)

Facility	Targeted in Sierra Leone	Services for All Newborn/Newborn at Birth (0-3 years) Short term (0-2 years) Mid-term (2-5 years): GOAL ACHIEVED
District Hospital	All district hospitals (n=13)	Special Care Baby Unit (SCBU)*
Regional Hospital	Bo, Makeni, Kenema (n=3)	Special Care Baby Unit (SCBU)*
National Hospital	Princess Christian Maternity Hospital (PCMH)	Referral to ODCH
	Ola During Children's Hospital (ODCH)	Special Care Baby Unit (SCBU)*
Private and Mission clinics and hospitals (for-profit, not-for-profit) conducting deliveries		Quick identification of problems/danger signs and prompt referral
* Referral from NSU to SCBU, from SCBU to NICU as needed		

All district and regional hospitals have now established a Special Care Baby Unit (SCBU) close to the labour ward. An SCBU is a neonatal unit that provides care to all sick newborns (except for those requiring assisted ventilation or major surgery). An SBCU with the additional services of assisted (mechanical) ventilation is a Neonatal Intensive Care Unit (NICU). Achieving the advanced level of NICU is foreseen for Sierra Leone only in the long(er) term. The details on services provided, configuration, requirements, human resources, and clinical protocols for SCBU/NICUs are given below:

3.1. Special Care Baby Unit Services

Services provided in the SBCU include:

- Management of low-birth-weight infants over 1800 grams, with complications requiring SBCU care.
- Management of sick newborns (except for those requiring mechanical ventilation or major surgical intervention).
    - Fluid management, shock
    - Hypocalcaemia
    - Perinatal asphyxia

- Neonatal seizures
- Phototherapy for newborns with hyperbilirubinaemia
- Respiratory distress
- Neonatal sepsis
- Anemia and bleeding disorders
- KMC
- Immediate and Essential Newborn Care for all newborns including resuscitation.
- Stabilisation and referral of sick newborns: to SBCU/NICU in the same or another hospital; e.g. from district to regional, or regional to national).
- Follow-up of high-risk newborns.
- Training of health workers on newborn care (with a focus on staff designated to work in SBCU).

3.2. Location and Size of an SCBU

An SBCU at r0egional and national level should have such a configuration that there is possibility for expansion in relation to increased demand for SCBU/NICU services.

The location of the SCBU should be as follows:

- Distinct areas in the hospital, with controlled access and environment.
- Close proximity to the labour room.
- If obstetric and neonatal service units are on different floors, quick access such as a ramp or elevator should be available.
- Transport of newborns within the hospital should be possible without using public corridors. Effective movement should be possible for staff, family, and equipment.

The size of the SCBU will be determined as follows:

Bed capacity:

- 3 beds for every 1,000 annual deliveries occurring within the hospital.
- 50% additional beds to allow for newborns delivered outside the hospital.
- For example: a hospital conducting 3,000 deliveries per year will need 3/1,000 x 3,000 = 9 beds for in hospital deliveries and 9 x 0.5 = 4.5 beds for outside hospital deliveries, making a total of 13.5 beds required.
- Special care units usually have 8-16 beds, consideration of factors such as availability of resource management capacity, technology and maintenance of minimum level clinical experience point towards a minimum capacity of 10-12 beds.

Space:

- Per bed, the following clear floor space is needed:
  - 50 square feet (4.6 m2) for baby care.
  - 50 square feet (4.6 m2) for general support and ancillary areas.
- Additional space is required for handwashing stations and columns.

3.3. Configuration of an SCBU

The SBCU design will be determined by a systematic plan of space utilisation, the projected bed space demand, related staffing requirements, and other basic information. The ideal design provides constant surveillance of each bed area form the nurse's station, with minimal walking distance for the staff. A washbasin for handwashing should be present in each room and easily accessible.

The design of the SBCU should consider inborn and out-born baby care area(s), a stepdown area (rooming facility), and space for ancillary (supplementary) services, general support, and staff support. Each needs outlets for: O2 concentrator, warmer, monitor, bili-light, and IV pump.

3.4. Electrical, Mechanical and Environmental Needs of a SBCU

Electrical, mechanical and environmental requirements of each newborn bed should be organised keeping in mind the safety, easy access and ease of maintenance.

3.4.1. Electrical and Mechanical Needs

- **Power supply-** The unit should have 24-hour uninterrupted established power supply. Backup power supply is a must, 2-4 /bed. To ensure this, a generator with 25-50KVA capacity and voltage stabiliser (3 Phase) of the same rating is needed. Monitors must have UPS.
- **Electrical outlet for individual beds-** To handle equipment, 6-8 central voltage stabilised outlets are required per bed: 4 of them should be of 5 amperes and another 4 of them should be of alternate sockets for mobile bed-side X ray equipment or USG machine need to be planned.
- **Lighting of the unit-** The unit should be well illuminated with adequate daylight. Panel of lights with cool white, fluorescent tubes, preferably CFL (compact fluorescent light) or LED (light-emitting diodes) will be required for adequate illumination.
- **Floor surfaces-** Floor surfaces should be easily cleanable and should minimise the growth of microorganisms. Materials should permit cleaning without the use of chemicals. At the same time, floors should be highly durable to withstand frequent

cleaning and heavy traffic. Vitrified tiles (ceramic tiles with low porosity) are preferred. Large sized tiles should be used to minimize junctions.

- **Walls-** Ease of cleaning, durability and acoustical properties of wall surfaces must be considered. Walls should be glazed-tiled up to a height of at least seven feet. Large sized tiles should be used to minimize junctions.
- **Water Supply-** The unit should have 24-hour uninterrupted running water supply. To ensure water supply it is useful to have a separate overhead tank with a capacity of 1,000 to 2,000 litres.
- **Oxygen supply-** If possible, the unit should have a centrally supplied oxygen system. Alternatively, oxygen concentrators or oxygen cylinders may be used.

3.4.2. Environmental Needs

Ambient lighting

- Perception of skin tones is critical in an SCBU, light sources should provide accurate skin-tone recognition. Light sources should be as free as possible of glare or veiling reflections.
- No direct view of the electric light source or sun shall be permitted in newborn spaces; this does not exclude direct procedure lighting, as described below.
- Any lighting used outside the baby area shall be located to prevent any newborn's direct line of sight to the fixture. Lighting fixtures should be easily cleaned.

Procedure lighting in baby care areas

- Temporary increases in illumination necessary for baby evaluations or procedures should be possible without increasing lighting levels for other babies in the room. Procedure lights with adjustable intensity, field size and direction can help protect an infant's eyes from direct exposure and provide the best visual support to staff. Eye protection must be provided for infants during phototherapy and procedures. Also provide dimmed lighting for quiet times to improve rest.
- Procedure light that comes inbuilt with radiant warmers is often sufficient for procedures and occasionally separate lights may be required.

Illumination of support areas

- Illumination of support areas within the SBCU, including the charting area, medication preparation area, reception desk, and handwashing area should be adequate. In locations where these functions overlap infant care areas (such as close proximity of the staff charting area to infant beds), the design should nevertheless permit separate light sources with independent controls, ensuring that the different needs of sleeping infants and working staff can be accommodated to the greatest possible extent. Care must be

taken, however, to ensure that bright light from these locations does not reach an infant's eyes.

Day lighting

- At least one source of daylight be visible from baby care areas, either from each room itself or from an adjacent staff work area. When provided, external windows in the rooms should be glazed to minimise heat gain or loss, and should be situated at least two feet (0.6 metres) away from any part of a newborn's bed to minimize radiant heat loss. Positioning newborns too close to external windows due to radiant heat loss or gain, as well as glare. Therefore, provision of windows in the unit requires careful planning and design.

Ambient temperature and ventilation

- The unit should be designed to provide an air temperature of 78.8-82.4° (26-30°C).
- Ventilation in the unit should inhibit particulate matter from moving freely in the space and to minimise draughts on or near the newborn beds. General ventilation can be provided in two ways:
- **Exhaust-only.** Exhaust fans pull stale air out of the unit while drawing fresh air in through cracks, windows or fresh air intakes. Exhaust-only ventilation is a good choice for units that do not have existing ductwork to distribute heated or cooled air.
- **Supply-and-exhaust.** Supply-and-exhaust ventilation is a good choice for units with heating or cooling ducts, as it is a cost-effective way of providing fresh air.

Acoustic environment

- The acoustic conditions of the unit should promote speech intelligibility for staff and parents. The ideal sound level in SCBUs should not exceed 45 decibels.

3.5. Equipment and Renewables for an SCBU

Table 4 and Table 5 show the equipment and renewables for the SCBU. The equipments are calculated for 10 bedded SCBU, and should be increased as per the increment of the beds.

Table 4, Equipment and Renewables for SBCU *

SN	Item description	Essential (E) or Desirable (D)	Minimum Quantity for 10 Bed SBCU
1	Open care system: radiant warmer, fixed height, with trolley, drawers	E	6
2	Radiant warmer, fixed height stand	E	4
3	Basinet on trolley, neonatal, with mattress	E	4
4	Phototherapy unit, single head, high intensity	E	4
5	Bag and mask for neonates, 250–500 ml, with masks 0–1 and a Penguin sucker	E	6
6	Suction pump, portable, 220 V, with accessories	E	10 (Each bed side)
7	Infusion syringe pump (10, 20, 50 ml, single phase)	E	6
8	Infusion syringe pump, 10, 20, 50 ml, single phase	E	2
9	Digital clinical thermometer (32–43°C)	E	10
10	Electronic baby scale, 10 kg <5g>	E	2
11	Pulse oximeter, bedside, neonatal	E	6
12	Stethoscope, neonate	E	10 (Each bed side)
13	Sphygmomanometer, neonate, electronic	E	4
14	Oxygen concentrator	E	8
15	Light, examination, mobile, 220-12V	E	4
16	Bed-side monitor (multifunctional)	E	6
17	CPAP system with air oxygen blender	E	4
18	Bilirubinometer	E	1
19	Micro Centrifuge machine including rotor	E	1 Outside care area
20	Photometer, HemoCue Glucose 201+/SET (glucometer)	E	1 per room
21	Microcuvette, for Glucose 201+/BOX-100 (glucose strip)	E	2
22	Photometer, HemoCue haemoglobin 201+/SET	E	2

Item No.	Item description	Essential (E) or Desirable (D)	Minimum Quantity for 10 Bed SBCU
23	Microcuvette, for Glucose 201+/BOX-100 (Hb strip)	E	2
24	Measuring tape, vinyl-coated, 1.5 m	E	10
25	Kidney tray, stainless steel, 825 ml	E	10
26	Dressing tray, stainless steel, 300 x 200 x 30 mm	E	10
27	Infusion stands, double hook, on castors	E	4
28	Computer with printer, including accessories	E	1
29	Wall clock with secondhand	E	2
30	Reusable gowns, caps and mask for staff and mothers	E	20 (at the end of each room).
31	Washable slippers/shoe rack	E	20 pairs/1

Table 5, Renewables for SCBU

SN	Item description	Essential (E) or Desirable (D)	Minimum Quantity for 10 Bed SBCU
1	Adaptor/connector, Meconium aspirator, disposable (for suction pump)	E	40
2	Cord clamp, disposable, set of 10	E	40
3	Tube, suction, CH10, L50cm, sterile, disposable	E	30
4	Tube, feeding, CH05, 06, 07, 08, sterile, disposable	E	30
5	Syringe, disposable, 1 ml, sterile	E	50
6	Syringe, disposable, 2 ml, sterile	E	50
7	Syringe, disposable, 5 ml, sterile	E	50
8	Syringe, disposable, 10 ml, sterile	E	30
9	Syringe, disposable, 20 ml, sterile, box 80	E	30
10	Syringe, disposable, 50 ml, sterile	E	10
11	Needle, disposable, 21, 23 and 25G (0.6 x 25 mm), sterile	E	50 each
12	Needle, disposable, 25G (0.5 x 16 mm), sterile	E	50
13	Cannula, 24G, 26G, sterile, disposable	E	50
14	Gloves, examination, latex, medium, disposable	E	Many Boxes: Based on IPC guidelines
15	Gloves, surgical, 6, 7, 8 sterile, disposable, pair	E	1 box each
16	Infusion set, pediatric, with chamber, 100 ml, sterile, disposable	E	30
17	Identification bracelets for newborn	E	50
18	Disinfectant, hand soap	E	5
19	Antiseptic, betadine, chlorhexidine, alcohol swabs, sterile gauze	E	1 box
20	Tape, adhesive, micropore, 2.0, 2.5 cm x 5 m	E	
31	Blood transfusion, set	E	3
32	Nasal prongs, disposable, neonate	E	20
33	Capillary tubes (for the bilirubinometer)	E	50

3.6. Technical Specifications of the Equipment

Generic specifications of the medical devices need to be standardised, taking into consideration the following perspectives:

- Functional services available in the unit.
- Capacity of the user in handling the equipment.
- Capacity of the facility for civil, mechanical and electrical implications.
- Capacity for maintenance.
- And above all technical integrity and safety of the equipment as per defined standard.

3.7. Asepsis and Housekeeping Protocols

Maintaining asepsis is extremely critical in newborn care units. This requires the establishment of clear housekeeping protocols and their strict adherence. Asepsis and housekeeping protocols are provided in the annex.

3.8. Annual Maintenance Requirement for Critical Equipment

A mechanism for the maintenance of critical newborn care equipment is essential to ensure the effective functioning of the medical devices, their longevity and best possible services. The maintenance starts right from the time of installation. Training of the users is as important as maintenance. Thus, on-site user level training should include user training, technical training and basics of the clinical application of the device.

The technical training should enable hospital technicians to undertake first-line corrective intervention that do not require specific spare parts. They should also be able to recognize and report correctly the technical malfunctions requiring on-site services of the supplier. Annual maintenance covers both preventive maintenance and on-call corrective interventions.

The objective of preventive maintenance is to ensure maximum uptime of the medical equipment, assuring accuracy, efficiency and clinical efficacy. Preventive maintenance consists of at least two planned technical visits per year, and includes and covers:

- Exchange of information with the end-user and technical staff about the status of the device.
- Function and performance check-up of the device.
- Technical check-up of device based on the manufacturer's technical checklist.
- Assessment of wear and tear of the device with notification if incorrect use of the device is noted.
- Cleaning parts beyond reach, or capability, of the end-user.
- Adjustment and calibration of the device.

- All necessary materials to complete the preventive maintenance.
- Repetition of user and technical training for current and new hospital staff.
- All parts to be replaced; those which are most likely to break down within the next 6 months.

The objective of on-call corrective intervention is to intervene immediately and repair, limiting the downtime to the minimum. Hence, it includes and covers:

- On-site visit of service engineer/technician(s) with necessary spare parts, within a specified period of notification of the malfunction.
- All necessary materials and spare parts to complete the repair.
- Availability of spare parts for the technical lifetime of the device, approximately five years.
- In case the device cannot be repaired on-site, and the device is to be evacuated, a similar replacement model should be provided for the period of the repair.

It is recommended that the procurement should include installation, commissioning, training and maintenance contract for a reasonable period (not less than 2 years) as well.

3.9. Human Resources

The following human resources are needed for the SBCU:

Staffing for SCBU

The SBCU should have the required number of appropriately trained and qualified doctors, nurses, and support staff. There should be a designated consultant paediatrician responsible for the clinical standards of the care of newborn babies.

While the available manpower for SCBU will differ by level of care, the basic principles are:

- At least two dedicated staff nurses per shift are necessary for a 10-bedded unit. Thirty per cent extra staffing is recommended to account the staff off duty.
- There should be an adequate number of doctors to take rounds of the newborns once during each shift (every eight hours) and be on call round the clock.
- Dedicated support staff should be present to clean the unit at least once every shift and more often, depending on the need.
- For a 10-bed unit, the recommended staffing is: 1 paediatrician, 2 medical officers, 8 staff nurses, and 2 support staff. The number of staff should be increased as the number of beds in the unit increases.

Training

It is suggested that the medical and paramedical staff working in an SCBU undergo:

- A n initial skill-based training on Emergency Triage Assessment and Treatment (ETAT) and Essential Newborn Care training program for 5 days.
- On-the-job training at SCBUs in regional hospitals, following the National Newborn Training Package. ENC training should be provided to all service providers working in the delivery room and OT.

3.10. Referral Services

Each SBCU accepting sick newborns and required to make neonatal referrals (to a higher level SCBU/NICU) should have (access to) an appropriately staffed and equipped ambulance transport service.

4. Neonatal Intensive Care Unit (NICU): Set-up, Requirements, and Clinical Protocols

Table 6, Newborn Care Facilities at Different Health Care Levels Including Timeline (2017-2027)

Facility	Targeted in Sierra Leone	Services for Sick Newborns		
		Short term	Mid-term	Long-term
		(0-2 years) >>	(2-5 years) >>	(5-10 years)
District Hospital	All district hospitals (n=18)		Special Care Baby Unit (SCBU)*	Newborn Intensive Care Unit (NICU)*
Regional Hospital	Bo, Makeni, Kenema (n=3)	Special Care Baby Unit (SCBU)*	Newborn Intensive Care Unit (NICU)*	
National Hospital	Princess Christian Maternity Hospital (PCMH)	Referral to ODCH		
	Ola During Children's Hospital (ODCH)	Special Care Baby Unit (SCBU)*	Newborn Intensive Care Unit (NICU)*	
Private and mission clinics and hospitals (for-profit, not-for-profit) conducting deliveries		Quick identification of problems/danger signs and prompt referral		

* Referral from NSU to SCBU, from SBCU to NICU as needed.

All district and regional hospitals should work towards upgrading the Special Care Baby Unit (SCBU) into Neonatal Intensive Care Unit (NICU). In addition to SCBU services NICU will provide assisted (mechanical) ventilation. All the NICUs should also have the SCBU services. Achieving the advanced level of NICU is foreseen for Sierra Leone only in the long(er) term. The details on services provided in, configuration, requirements, human resources and clinical protocols for SCBU/NICUs as given below:

4.1. Neonatal Intensive Care Unit Services

Services provided in a NICU:

- Management of low-birth-weight infants (<1000 grams).
- All the services available at Special Baby Care Unit (SCBUs).
- Management all sick newborns those that need assisted mechanical ventilation.
- Management of babies needing total parenteral nutrition.

4.2. Location and Size of a NICU

A NICU at the regional and national levels should be designed with flexibility for expansion, in response to increased demand for NICU services.

The location of the NICU should have the following chraracteristics:

- Distinct areas in the hospital, with controlled access and environment.
- Close proximity to the labour room and within the SCBU.
- If obstetric and neonatal service units are on different floors, quick access, such as a ramp or elevator should be available.
- Transport of newborns within the hospital should be possible without using public corridors. Effective movement should be possible for staff, family, and equipment.

The size of the SCBU/NICU will be determined as follows:

Bed capacity:

- 1 bed for every 1,000 annual deliveries occurring within the hospital.
- 50% additional beds to allow for newborns delivered outside the hospital.
- F or example, a hospital conducting 3,000 deliveries per year will need 1/1000 x 3000 = 3 beds for in-hospital deliveries, and 3 x 0.5 = 1.5 beds for deliveries outside the hospital, making total of 4-5 beds requiered.
- Special care units usually have 8-16 beds; however, consideration of factors such as availability of resource management capacity, technology and maintenance of minimum level clinical experience points towards a minimum capacity of 10-12 beds.

Space:

- For each bed, the following clear floor space is needed:
    - 50 square feet (4.6 m2) for baby care.
    - 50 square feet (4.6 m2) for general support and ancillary areas.
- Additional space is required for handwashing stations and columns.
- Minimum space between two baby beds/cots should be 120 cm^2 and the maximum of 240 cm^2.

4.3. Configuration of a NICU

The design of the NICU will be determined by a systematic plan for space utilisation, projected bed space demand, related staffing requirements, and other essential factors. The

ideal design allows for constant surveillance of each bed area from the nurse's station, with minimal walking distance for the staff.

4.4. Electrical, Mechanical and Environmental Needs of a NICU

The electrical, mechanical, and environmental requirements of each newborn bed should be organised with a focus on safety, easy access, and ease of maintenance.

4.4.1. Electrical and mechanical needs

- **Power supply-** The unit should have 24-hour uninterrupted established power supply. A backup power supply is essential, with one or two outlets. To ensure this, a generator with 25-50 KVA capacity and a voltage stabiliser (3-phase) of the same rating is needed. Monitors must be equipped with an uninterruptible power supply (UPS).
- **Electrical outlet for individual beds-** To handle equipment, 6-8 central voltage stabilised outlets are required per bed. Four of these outlets should be of 5 amperes, and the remaining four should be alternate sockets for mobile bedside X-ray equipment or USG machines.
- **Lighting of the unit-** The unit should be well-illuminated with adequate daylight. A panel of lights with cool white fluorescent tubes, preferably compact fluorescent lights (CFL) or light-emitting diodes (LED), should be provided for sufficient illumination.
- **Floor surfaces-** Floor surfaces should be easily cleanable and minimise the growth of microorganisms. Materials should allow cleaning without the use of harsh chemicals. At the same time, floors should be highly durable to withstand frequent cleaning and heavy traffic. Vitrified tiles (ceramic tiles with low porosity) are preferred. Large-sized tiles should be used to minimise junctions.
- **Walls-** The ease of cleaning, durability, and acoustical properties of wall surfaces must be considered. Walls should be glazed and tiled up to a height of at least seven feet. Large-sized tiles should be used to minimise junctions.
- **Water Supply-** The unit should have 24-hour uninterrupted running water supply. To ensure continuous water supply, a separate overhead tank with a capacity of 1,000 to 2,000 liters is recommended.
- **Oxygen supply-** If possible, a centrally supplied oxygen system should be installed. For alternative use, oxygen concentrators or oxygen cylinders can be used.

4.4.2. Environmental Needs

Ambient lighting

- Perception of skin tones is critical in a SBCU; light sources should provide accurate skin-tone recognition. Light sources should be as free as possible from glare or veiling reflections.

- No direct view of the electric light source or sun shall be permitted in the newborn spaces. This does not exclude direct procedure lighting, as described below.
- Any lighting used outside the baby area should be located so that no newborn has a direct line of sight to the fixture. The lighting fixtures should be easy to clean.

Procedure lighting in baby care areas

- Temporary increases in illumination necessary to evaluate a baby or to perform a procedure should be possible without increasing lighting levels for other babies in the room. Since intense light may be unpleasant and harmful to the developing retina, every effort shout be made to prevent direct light from reaching an infant's eyes. Procedure lights with adjustable intensity, field size, and direction can help protect an infant's eyes from direct exposure and provide the best visual support to staff.
- Procedure lights that come inbuilt with radiant warmers are often sufficient for procedures, and no separate lights are required.

Illumination of support areas

- Illumination of support areas within the SBCU, including the charting area, medication preparation area, reception desk and handwashing area should be adequate. In locations where these functions overlap with infant care areas (such as the proximity of the staff charting area to infant beds), the design should permit separate light sources with independent controls. This allows for the very different needs of sleeping infants and working staff to be accommodated to the greatest extent possible. Care must be taken, however, to ensure that bright light from these locations does not reach an infant's eyes.

Day lighting

- At least one source of daylight should be visible from the baby care areas, either from each room itself or from an adjacent staff work area. When provided, external windows in the rooms should be glazed to minimize heat gain or loss and should be situated at least two feet (0.6 metres) away from any part of a newborn's bed to minimize radiant heat loss. Placing newborns too close to external windows can cause serious problems with radiant heat loss or gain and glare. Therefore, the provision of windows in the unit requires careful planning and design.

Ambient temperature and ventilation

- The unit should be designed to provide an air temperature of 26-28ºC (78.8-82.4ºF).
- Ventilation in the unit should inhibit particulate matter from moving freely in the space and minimise drafts on or near the newborn beds. General ventilation can be provided in two ways:

- **Exhaust-only:** Exhaust fans pull stale air out of the unit while drawing fresh air in through cracks, windows, or fresh air intakes. Exhaust-only ventilation is a good choice for units that do not have existing ductwork to distribute heated or cooled air.
- **Supply-and-exhaust:** Supply-and-exhaust ventilation is a good choice for units with heating or cooling ducts, as it is an inexpensive way of providing fresh air.

Acoustic environment

- The acoustic conditions of the unit should favour speech indelibility intelligibility, normal or relaxed vocal effort, speech privacy for staff and parents, and physiological stability. This includes uninterrupted sleep and freedom from acoustic distraction for the newborn and the staff.
- Noise-generating activities and gadgets (such as telephone sounds, staff areas, and equipment) should be acoustically isolated.

4.5. Equipment and Renewables for a NICU

Table 7 shows the equipment and renewables for the NICU.

Table 7, Equipment and Renewables for NICU*

SN	Item description	Essential (E) or Desirable (D)	Minimum Quantity for 6 Bed NICU
1	Open care system: radiant warmer, fixed height, with trolley, drawers	E	3
2	Ventilators	E	3
3	Blood exchange machine	E	2
4	Incubator	E	2
5	Bag and mask, neonate, 250-500 ml with masks 0-1 + Penguin sucker	E	6
6	Pump, suction, portable, 220 V, with access	E	6
7	Infusion pump	E	6
8	Infusion syringe pump, 10, 20, 50 ml, single phase	E	6
9	Thermometer, clinical, digital, 32-43°C	E	6
10	Scale, baby, electronic, 10 kg <5g>	E	1
11	Pulse oximeter, bedside, neonatal	E	2
12	Stethoscope, neonate	E	6
13	Mobile X-ray machine	E	1
14	Laryngoscope	E	2
15	Oxygen concentrator	E	6
16	Light, examination, mobile, 220-12 V	E	2
17	Bedside monitor (multifunctional)	E	6
18	Bilirubinometer (transcutaneous)	E	1
19	Photometer, HemoCue Glucose201+/SET (Glucometer)	E	1
20	Microcuvette, for Glucose 201+/BOX-100 (glucose strip)	Pkt	1
21	Photometer, HemoCue haemoglobin 201+/SET	E	1
22	Microcuvette, for Hemoglobin 201+/BOX-100 (Hb strip)	Pkt	1
23	Wall clock with second hands	E	1
24	Syringe, disposable, 2 ml, sterile	E	50

SN	Item description	Essential (E) or Desirable (D)	Minimum Quantity for 6 Bed NICU
25	Syringe, disposable, 5 ml, sterile	E	50
26	Syringe, disposable, 10 ml, sterile	E	50
27	Syringe, disposable, 20 ml, sterile, box of 80	E	50
28	Syringe, disposable, 50 ml, sterile	E	30
29	Needle, disposable, 21, 23 G (0.6x25mm), sterile	E	50 each
30	Needle, disposable, 25 G (0.5x16mm), sterile	E	50
31	Cannula, 24G, 26G sterile, disposable	E	50 each
32	Gloves, examination, latex, medium, disposable	E	2 box
33	Gloves, surgical, 6, 7, sterile, disposable, pair	E	2 box each
34	Infusion set, pediatric, with chamber, 100 ml, sterile, disposable	E	30
35	Bracelet, identification, newborn	E	20
36	Disinfectant, hand soap	E	2
37	Antiseptic, betadine, chlorhexidine	E	
38	Tape, adhesive, micropore, 2.0, 2.5cm x 5m	E	2
39	Blood transfusion, set	E	5
40	Nasal prongs, disposable, neonate, set of 3	E	20
41	Antiseptic, betadine, chlorhexidine	E	
42	Tape, adhesive, micropore, 2.0, 2.5cm x 5m	E	2
43	Blood transfusion, set	E	5
44	Nasal prongs, disposable, neonate, set of 3	E	20

4.5.1. Technical Specifications of the Equipment

Generic specifications of the medical devices need to be standardized, taking into consideration the following perspectives:

- Functional services available in the unit.
- Capacity of the user in handling the equipment.

- Capacity of the facility for civil, mechanical and electrical implications.
- Cpacity for maintenance.
- And, above all, technical integrity and safety of the equipment as per defined standard.

4.6. Asepsis and Housekeeping Protocols

Maintenance of asepsis is extremely critical in newborn care units. It requires establishing clear housekeeping protocols and following them stringently. Asepsis and housekeeping protocols are provided in the annex.

4.7. Annual Maintenance Requirement for Critical Equipment

A mechanism for maintenance of critical newborn care equipment is essential to ensure effective functioning of the medical devices, their longevity and best possible services. The maintenance starts right from the time of installation. Training of the users is as important as maintenance. Thus, on-site user-level training should include user training, technical training, and basics of the clinical application of the device.

The technical training should enable hospital technicians to undertake first-line corrective interventions that do not require specific spare parts. They should also be able to recognize and report correctly the technical malfunctions requiring on-site services of the supplier. Annual maintenance covers both preventive maintenance and on-call corrective interventions.

The objective of preventive maintenance is to ensure maximum uptime of the medical equipment, assuring accuracy, efficiency and clinical efficacy. Preventive maintenance consists of at least two planned technical visits per year and includes and covers:

- Exchange of information with the end-user and technical staff about the status of the device.
- Function and performance check-up of the device.
- Technical check-up of device based on the manufacturer's technical checklist.
- Assessment of wear and tear of the device with notification if incorrect use of the device is noted.
- Cleaning parts beyond reach or capability of the end-user.
- Adjustment and calibration of the device.
- All necessary materials to complete the preventive maintenance.
- Repetition of user and technical training for current and new hospital staff.
- All parts to be replaced, those which are most likely to break down within the next 6 months.

The objective of on-call corrective intervention is to intervene immediately and repair, limiting the downtime to the minimum. Hence, it includes and covers:

- On-site visit of service engineer/technician (s) with necessary spare parts, within a specified period of notification of the malfunction.
- All necessary materials and spare parts to complete the repair.
- Availability of spare parts for the technical lifetime of the device, approximately five years.
- In case the device cannot be repaired on-site, and the device is to be evacuated, a similar replacement model should be provided for the period of the repair.
- It is recommended that the procurement should include installation, commissioning, training and maintenance contract for a reasonable period (not less than 2 years) as well.

4.8. Human Resources

The following human resources are needed for the NICU:

Staffing for NICU

The NICU should have the required number of appropriately trained and qualified doctors, nurses and supporting staff. There should be a designated consultant paediatrician responsible for the clinical standards of the care of newborn babies.

While the available manpower for NICUs will differ by level of care, the basic principles are:

- A t least 4 dedicated staff nurses per shift are necessary for a 10-bedded unit. Thirty per cent extra staffing is recommended to account the off duty.
- There should be an adequate number of doctors to be able to take a round of the newborns once in each shift (every eight hours) and to be on call round-the-clock.
- Dedicated support staff should be available to clean the unit at least once every shift and more often, depending on the need.

For a 10-bed unit, the recommended staffing is: 1 consultant, 2 medical officers, 12 staff nurses and 2 support staff.

Training

It is suggested that the medical and paramedical staff working in an NICU should undergo:

- On-the-job training at NICUs of Regional Hospitals.

4.9. Referral Services

Each NICU accepting sick newborns and required to make neonatal referrals (to another hospital for surgery should have (access to) an appropriately staffed and equipped ambulance transport service.

LEVELS OF NEONATAL CARE IN SIERRA LEONE

Classification of newborn care services is key to improving neonatal survival, as this offers the opportunity of enhanced referral of high-risk patients to higher-level centres, with the appropriate resources for complexity of care. Each level of care reflects the minimal capabilities, functional criteria, human resource, expertise and provider type required.

Table 8, WHO's Levels of Newborn Care with Interventions

Level 1 Immediate and essential newborn care	Immediate newborn care Neonatal resuscitation (for those who need it) Early initiation and support for exclusive breastfeeding Routine newborn care? Prevention of mother-to-child transmission of HIV Assessment, management, and referral of complicationst Pre-discharge advice on mother and baby care and follow-up
Level 2 Newborn special care	Thermal care (e.g., incubators, radiant heaters) Kangaroo mother care Assisted feeding (e.g., nasogastric tube, cup, syringe) Safe administration of oxygen Prevention of apnea for preterm neonates Detection and management of neonatal infection Detection and management of hypoglycaemia, jaundice, and anaemia Management of neonatal seizures Safe administration of intravenous fluids Detection and referral management of birth defects
Transition to intensive care	Continuous positive airway pressure (CPAP)* Exchange transfusion* Detection and management of necrotising enterocolitis# Specialised follow-up of high-risk infants+
Level 3 Neonatal intensive care	Advanced feeding support (e.g., parenteral nutrition) Mechanical/assisted ventilation, including intubation Screening and treatment for retinopathy of prematurity Surfactant treatment Investigation and management of birth defects Paediatric surgery Genetics services

THE CLASSIFICATION OF LEVELS OF NEWBORN CARE IN SIERRA LEONE:

1. Level 1: Basic care available at Primary Health Care facilities.
2. Level II: Speciality care available at Secondary Health Care facilities (General Hospitals, some Faith-based mission hospitals, and some Private health facilities).

3. Level IIIa: Subspeciality intensive care available at Tertiary Health Care facilities (University Teaching Hospitals and some Private facilities that offer specialist residency training and tertiary care services).
4. Level IIIb: Subspecialty intensive care, same as IIIa, but Regionalised with further specialisations; and often more expensive equipment to offer highly specialised care.

Level I:

Level I facilities entail care at the Primary Health Centre level, and should have:

- A newborn resuscitation corner, a well-newborn nursery, and a postnatal ward where basic resuscitation such as Helping Babies Breathe and immediate postnatal care (Essential Newborn Care) can be provided to neonates who are low risk.
- They should have the capacity to perform neonatal resuscitation at every delivery and to evaluate and provide routine postnatal care for healthy newborns.
- Delivery of intermittent positive pressure ventilation using a bag and mask should be available by skilled personnel who have undergone the modified ENCC training.
- Care for preterms ≥ 1800 g who are physiologically stable.
- Stabilisation of newborns who are less than 1800g prior to referral.
- Identify danger signs in ill babies and offer the first ENCC-recommended care and refer for advanced care.
- Have a KMC corner or to have dedicated postnatal beds for KMC for care of preterms weighing 1800-2000 g.
- Human resource: Personnel include skilled birth attendants like CHEWs, nurses, midwives, medical officers, and supervisory specialist. At least one skilled nurse must be available round-the-clock for neonatal care per shift.

One clinician, skilled in neonatal care, is required to oversee the clinical care.

Doctors and nurses posted in maternity unit, newborn, and postnatal should be trained prior to starting the unit and then receive ongoing training and mentorship.

Level II:

Care in a speciality-level facility such as district and regional hospitals should:

- Be reserved for stable or moderately ill newborn who are born at ≥30 weeks' gestation or who weigh ≥ 1500 g at birth, with problems that are expected to resolve rapidly (baby is not anticipated to need subspecialty-level services on an urgent basis).
- Have a warm, well-lit delivery room, with well-equipped newborn resuscitation table, pulse oximeters, standard special care newborn unit, and a KMC room.
- Have skilled birth attendants capable of providing neonatal resuscitation with needed additional persons at every delivery.
- Have the capacity to manage a sick newborn on an interim basis until a newborn's condition improves, or the newborn can be transferred to a higher-level facility.

- Have facility for newborn-transfer, such as minibuses or ambulances to safely receive and transfer newborns.
- Be able to identify which danger signs cannot be managed at that level for quick transfer to a tertiary centre.
- Be able to deliver intermittent positive pressure ventilation using appropriate-sized bag and mask by experienced personnel who have undergone the full ENCC training.
- Be able to deliver continuous positive airway pressure ventilation.
- Have personnel such as paediatrician, nurses, midwives, biomedical engineers or technician.
- Have laboratory facilities and personnel available to support ongoing care as well as to address laboratory emergencies, including blood-transfusions.
- Care provided at this level includes:
    - Monitoring of sick newborns
    - Kangaroo mothercare
    - Administration of oxygen
    - Management of hypothermia or KMC
    - Management of hypoglycaemia
    - Phototherapy for jaundiced newborns
    - Feeding babies via alternate feeding methods
    - Provide non-invasive respiratory support with CPAP
- Human resource: Availability of round-the-clock clinical expertise is very crucial. Well-trained nurses and clinicians form the backbone of the service. The unit should have the required number of appropriately trained and qualified nurses. Where available, there should be a designated consultant paediatrician/neonatologist responsible for the clinical standards of the care of neonates. There should be at least two skilled nurses per shift and there should be an adequate number of clinicians to be able to do a ward round twice daily and to be on call. Support staff should be available to clean the ward at least once per shift or more depending on the need, clean equipment, and to do other allocated duties depending on the need. There should be routine training and ongoing mentorship.

Level IIIa:

Designation of level IIIa care should be based on clinical experience, increasing complexity of care, availability of paediatric medical subspecialists, paediatric surgical specialists and Perinatologists. The subspecialty care services should include expertise in neonatology and feto-maternal medicine who can manage mothers referred for the management for potential preterm, multiple pregnancy births and diverse perinatal maternal complications. It should have specialized neonatal nurses per shift, with a ratio of at least 1:4 babies, depending on

the level of severity and gestation. (WHO: Roadmap human resources for newborn health 2020).

Regular trainings and mentoring should be incorporated for capacity building of clinicians, nurses and biomedical engineers.

Level IIIa facilities are to:

- Provide care for newborns who are born at <30 weeks' gestation or weigh <1500 g at birth.
- Provide care for newborns with complex medical or surgical conditions, regardless of gestational age.
- Should have a designated Special Care Baby Unit (SCBU) close to the labour ward, a Neonatal Intensive Care Unit, a well-equipped KMC room that can take many mothers at the same time.
- Should have personnel (neonatologists, neonatal nurses, biomedical engineers and technicians) and equipment to provide life support for as long as necessary.
- Should have facilities for phototherapy and exchange blood transfusion if needed for jaundiced neonates.
- Facilities should have advanced respiratory support, including CPAP and physiological monitoring equipment (pulse oximeters, multi-parameter monitors, arterial blood gases - ABG), laboratory and imaging facilities, nutrition and pharmacy support with paediatric expertise and social services.
- Provide specialized newborn diagnostic services e.g. CT scan, MRI.
- Should be able to provide ongoing assisted ventilation for 24 hours or more, including conventional and high-frequency ventilation.
- Should have transport services capable of receiving and safely transferring newborns.
- Collection of data to assess outcome within the facility and with other facilities at same level of care.
- Provision of clinical support, training and mentorship to the lower levels of care to improve quality of newborn care.

Level IIIb:

Level IIIb or Regional subspecialty units should include: The capabilities of level IIIa

- Additional capabilities and considerable experience in the care of the most complex and critically ill newborn, including a subspecialists' team.
- Diverse specialized newborn diagnostic and interventional capacities should be available at this level e.g. CT scan, MRI.
- Concentrating the care of complex and critically ill newborn at designated level IIIb centres will allow these centres to develop the expertise needed to achieve optimal outcomes.

CHAPTER 2:
CRITERIA FOR ADMISSION, TRANSFER AND DISCHARGE

The Special Newborn Care Units are receiving sick newborns from the labour room, operating theatre, and postpartum ward within the hospital, as well as from the peripheral health facilities, communities, and self-referred cases. To ensure that the babies who truly require special care receive admission, it is important to have criteria for admission in the SBCU. This process will minimise unnecessary admissions in the SBCU.

1. Criteria for Admission to Special Care Baby Unit (SBCU)

- Birth weight < 2 kg
- Large baby > 4 kg
- Gestational age < 36 weeks
- Perinatal asphyxia
- Hypoglycaemia: Random blood sugar < 2.7 mmol/L
- Refusal of feeds
- Respiratory distress
    - Central cyanosis
    - Respiratory rate > 60 c/min or < 30 c/min
    - Chest indrawing
    - Grunting
    - SpO_2 < 90%
    - Apnoea or gasping
- Severe jaundice
    - Severe/pathological jaundice appearing within 24 hours of life
    - Jaundice extending to palms and soles at any time
- Hypothermia < 36°C or hyperthermia > 38°C
- Shock
    - Capillary refill time (CRT) > 3 seconds
    - Weak or rapid pulse
    - Cool peripheries
    - Heart rate (HR) > 180 bpm

- Sepsis / Suspected sepsis
- Abdominal distension
- Convulsions
- Altered consciousness / Lethargy

2. Criteria for Transfer from SCBU to the Step-Down Unit

- Babies who are no longer in respiratory distress:
  - Respiration rate between 30–60 c/m
  - No retraction
  - No flaring
  - SpO_2 > 90% without oxygen
- Babies who are waiting to complete antibiotics
- Low birth babies < 1.8 kg with normal vital signs
- Babies with jaundice with normal vital signs
- Babies admitted for any condition but now have normal vital signs and are not in any distress

3. Criteria for Discharge from SBCU

The discharge of these babies must be planned, and the following points should be considered prior to discharge:

- Babies able to maintain their temperature at room temperature between 36.5°–37.5°C
- Babies with normal vital signs and not in distress
- Respiratory rate: 30–60 c/min
- CRT < 3 seconds
- Heart rate: < 180 b/min
- Strong pulses
- Babies are breastfeeding or the mother can feed through alternative means (e.g. cup feeding)
- Low birth weight babies with documented appropriate weight gain for 3 consecutive days and weighing > 1.6 kg
- Primary illness has resolved
- The mother/caregiver is able to take care of the baby at home
- The weight, head circumference, and length should always be recorded at the time of discharge

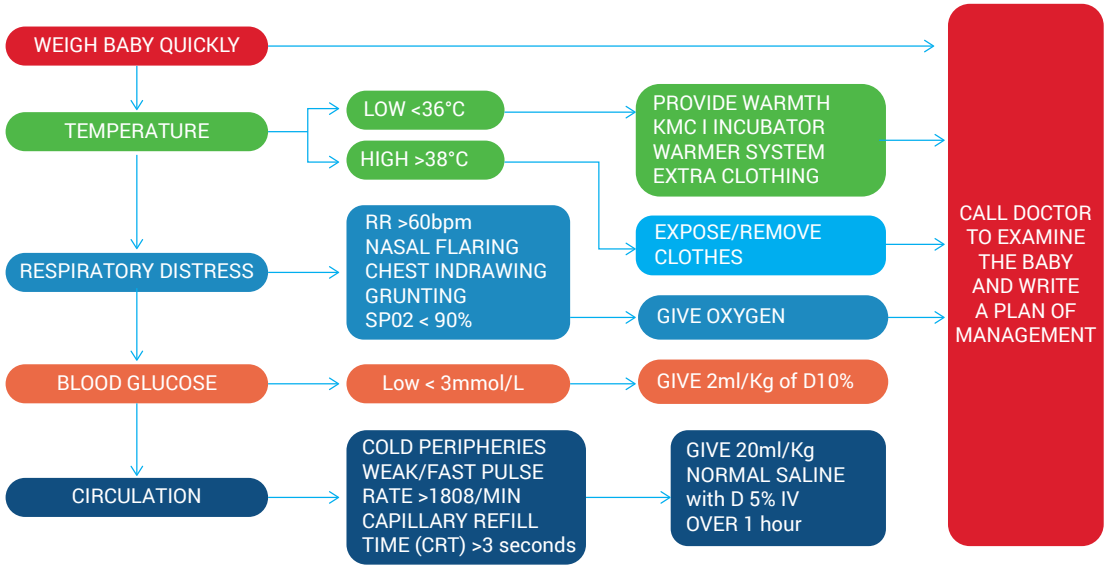
- The required nutritional supplements should have been started prior to discharge or scheduled for the follow-up visit
- The baby should have received immunisations prior to discharge
- Methods of temperature regulation like KMC, and any other necessary skills, should have been explained and practised adequately by the mother under supervision in the hospital
- All danger signs should be explained in detail to the parents and provided in writing, with information regarding whom and where to contact clearly mentioned on the discharge slip.

Follow up visit:

- First follow-up: 3 days after discharge.
- Second follow-up: 7 days after discharge.
- Third follow-up: 14 to 21 days after discharge.
- Fourth follow-up: 28 days after discharge.
- Fifth follow-up: 42 days (6 weeks) after discharge.

Figure A, Guidelines of General Neonatal Care at Admission

ASSESS



CHRONOLOGICAL AGE: Age since birth
POST MENSTRUAL AGE= GESTATIONAL AGE + CHRONOLOGICAL AGE

NOTE: If unconscious, convulsing and no glucometer, give 2-4 mls/kg of D10%

NEONATAL REFERRAL AND TRANSPORT

(Comprehensive Newborn Care, November 2021, Neonatal Care guidelines, 2018)

Neonatal referral is an integral part of perinatal care programmes. The goal is to reduce neonatal mortality and morbidity when the management of a sick infant exceeds the ability of the level of care provided in a health facility. All hospitals with established maternity services and level I or II neonatal care units should have agreements with higher perinatal care centres for perinatal consultations and neonatal transfer.

Level I: Health Centre Level *(PHUs: Newborn Care corner/stabilization unit)*

Level II: Secondary Hospital Level *(District and Regional hospital: SCBU)*

Level III: Referral Hospital/Tertiary *(SCBU/ Neonatal Intensive Care Unit (NICU))*

Arranging for Transport

Communication with the referral centre should be made prior to transport to ensure the availability of a bed and availability of the services required for the baby (e.g. surfactant, surgery, etc.).

Information that should be available at the time of the consultation call:

- Parent's consent for referral, documented in the patient's medical record.
- Patient's name and date of birth.
- Names of the patient's mother and father.
- Prenatal history.
- Labour and delivery record.
- Neonatal resuscitation record.
- Apgar scores.
- Gestational age and birth weight.
- Vital signs (temperature, heart rate, respiratory rate, BP).
- Oxygen/ventilatory support requirements.
- Laboratory data obtained (glucose, calcium, haematocrit, blood gas value).
- Vascular access.
- Role of the referring hospital.

Preparation

Personnel

Transport teams should consist of preferably two fully skilled personnel trained in the care of the high-risk neonates to ensure adequate stabilisation before and effective management during transportation.

Vehicle and Equipment

An ambulance should be prepared with the following:

- Transport incubator.
- Monitors for heart rate, respiratory rate, temperature, arterial BP, with different sizes of neonatal blood pressure cuff.
- Inspired oxygen concentration.

Record All Findings and Treatments

Make sure the birth is recorded to facilitate issuance of birth certificate and appropriate follow up if required.

STABILISATION, REFERRAL AND TRANSPORT OF THE SICK NEWBORN

Transportation of sick or preterm babies to a centre with expertise and facilities for advanced and specialised care has been shown to improve outcomes.

In-utero transfer is the safest method of transfer; however, this is not always feasible. Thus, the need for a standardised national transport protocol across all levels of care to improve neonatal outcomes. This protocol should include facilities for communication and emergency transport to and from the referral centres and referring facilities.

TYPES OF TRANSFER

- **Inter-Facility Transfer:** Movement of newborn from one facility to another, usually following a referral from a lower-level health facility to a higher one for advanced care.
- **Intra-Facility Transfer:** Movement of newborn within the same health facility, usually from one section to another e. g., from the ward to radiology department.

Steps in Inter-Facility Transfer

1. Decision to Transfer

This shall be taken by the managing consultant or, in their absence, the most senior doctor on site.

2. Communication

Once the decision to refer a newborn has been made:

- The parents or caregiver should be duly informed about the baby's status, the indication for the referral, the referral hospital, the transfer benefits and risk, and the formal referral letter should be written. Referral is permitted only if consent is given.
- The referral hospital should be contacted by phone to enable them to prepare appropriately to receive the baby. If possible, aim to communicate directly with the receiving health workers.
- Ensure continuous communication troughout the transport system.

3. Pre-Transport Stabilisation

Transfer should not be undertaken until the baby has been resuscitated and stabilised. This stabilisation before the transport is done by the health workers in the referring hospital. The essence of this stabilisation is to ensure and maintain:

i. Temperature Equilibrium Assurance
ii. Respiratory Stability
iii. Cardio-vascular Equilibrium
iv. Metabolic Equilibrium and to Administer Fluids
v. Antibiotics Administration

i. Temperature Equilibrium Assurance

Normal newborn temperature (axillary) is 36.5-37.5 °C. If the baby's temperature is normal, measures will be taken to keep it normal while hypothermia or hyperthermia should be addressed using the appropriate thermal control measures (see Chapter 17: Thermoregulation).

ii. Respiratory Stability

Airway management:

- Airway positioning.
- Remove secretions and foreign body.
- Oropharyngeal airway may be used as indicated.

Breathing:

- Ensure normal breathing pattern.
- Oxygen administration as indicated.

- Bubble CPAP should be commenced as indicated for respiratory support.
- Babies with irregular or gasping breathing will require bag and mask ventilation.
- Babies who require prolonged bag and mask ventilation should be intubated with appropriately sized endotracheal tube.
- Instillation of artificial surfactant.

iii. Cardiovascular Equilibrium

The baby should have an intravenous access and intravenous fluid commenced as indicated and as appropriate for the age and weight of the baby. Assess perfusion for warm peripheries, capillary refill time of ≤ 3 seconds, normal tone, activity, and blood pressure with oxygen saturation of > 90%.

iv. Metabolic Stabilisation

Check the blood glucose. If there is hypoglycaemia, correct appropriately and monitor blood glucose. Evaluate for other metabolic derangements (such as metabolic acidosis) and correct as appropriate.

v. Antibiotics Administration

Many babies referred for advance care have danger signs and may require prereferral antibiotics.

SPECIAL CONSIDERATIONS REGARDING PRE-TRANSPORT STABILISATION FOR SOME PATHOLOGIES

a. Abdominal Wall Defects (Omphalocele, Gastroschisis)

- Pass a naso- or orogastric tube for gastric decompression.
- For omphalocele, cover the abdominal defect with soft, sterile sheets or gauze.
- The sheets may be wetted intermittently with warm normal saline.
- For gastroschisis, place a plastic bag over the exposed bowel loops.
- Provide intravenous fluids to replace fluid loss.

b. Neural Tube Defects

- Position the baby on the side or in the prone position to avoid pressure on the defect.
- Cover the defect with soft, sterile sheets or gauze. These may be wetted intermittently with warm normal saline.

c. Diaphragmatic Hernia

- Pass a naso- or orogastric tube for gastric decompression.

d. Other Malformations of the Gastrointestinal Tract (e.g. Tracheoesophageal Fistula, Duodenal Web or Atresia)

- Pass a naso- or orogastric tube for oesophageal or gastric decompression.
- Provide intravenous fluids.
- Initiate plans for referral.

4. Documentation

The referring hospital should complete the 2-way referral form giving details of presenting complaints, examination findings, diagnosis, interventions and reason for referral. Available investigation results should be attached. If blood samples have been taken but not yet analysed send them with the transport team. Informed consent obtained from parents to be documented and filed as appropriate.

All documentation must be well dated, timed and the name of the responsible officer clearly written

5. Transporting the Baby

i. Mode of Transport – The choice of vehicle depends on what is available in the facility, the topography of the area, and clinical urgency, among other factors. Babies are best transported in the Kangaroo Mother Care (KMC) position, unless the clinical condition does not permit this.

a. Ambulance – This is the most commonly used means of transportation. The ambulance is expected to have facilities for resuscitation, including oxygen and intravenous fluid administration.

b. Other vehicles – Such as private or hired cars, tricycles, etc., can be used in areas where there is no ambulance or where the road network is poor.

c. Boats, ferries – In areas where water transport is the only available means of transportation.

ii. Accompanying the Baby

a. It is best to transport the baby with the mother, except in situations where this is not possible.

b. The precise requirement for accompanying medical personnel depends on the clinical status of the baby.

c. Babies whose needs can be met by routine care alone usually do not require a medical escort.

d. The following categories of babies must be accompanied by one or two trained medical personnel, usually a nurse and/or a doctor:

i. Babies at risk of deterioration during transfer

ii. Babies who require detailed observation, specific interventions, or post-operative care
iii. Babies on any form of respiratory support or support for at least two organ systems

iii. Care of the Baby During Transport

The health worker accompanying the baby must ensure they have the following essential resuscitative equipment:

- Emergency drugs, fluids, endotracheal tubes, and other necessary consumables
- Portable suction apparatus
- Adequate oxygen supply to last the duration of the journey
- Note: Do not attempt resuscitation in a moving vehicle — the vehicle should stop for resuscitative efforts.

a. Temperature Maintenance:

- Use a transport incubator if available, or
- Kangaroo Mother Care (KMC) position by the mother or attendant, or
- Other methods such as adequately covering the baby (e.g., with a cap, socks, and securely wrapped)

b. Airway and Breathing:

- Maintain the baby's neck in a slightly extended (neutral) position
- If intubation is not feasible, provide bag-and-mask ventilation or bubble CPAP (bCPAP)

c. Circulation:

- Assess perfusion by checking for warm peripheries, capillary refill time < 3 seconds, tone, and activity
- If the baby is on intravenous fluids, monitor and maintain the prescribed rate

d. Check Oxygenation:

- Continuous pulse oximetry is preferable (target SpO > 90%)
- Observe for signs of central cyanosis; if possible, perform blood gas analysis before and during transport

e. Feeds:

- Babies with altered consciousness or severe respiratory distress may be fed expressed breast milk (EBM) via orogastric (OGT) or nasogastric tube (NGT)
- Otherwise, initiate intravenous fluids appropriate for age and weight
- A stable baby at risk of hypoglycaemia may be given oral feeds in addition to IV fluids. If the baby can suckle, provide breastfeeds; if not, give EBM via cup or tube feeding (OGT/NGT).

6. What To Do If the Neonate Deteriorates During Transport?

The most appropriate action depends on the level of skills of transport team in resuscitation; space and equipment available in the ambulance; and the distance from the receiving hospital. Two major strategies can be used in case of acute deterioration:

- Resuscitate as appropriate.
- If there is a health facility along the way, stop over to stabilise the baby before moving on.

Maintain communication with the referral hospital throughout the transportation procedure.

7. Arrival and Handover

Upon arrival at the receiving hospital, there should be a formal handover between the transport team and the receiving medical and nursing staff, who will assume responsibility for the baby's care.

- The handover should include both a verbal and written account of the baby's history, vital signs, therapies, and any significant clinical events during transport.
- The referral for m and other relevant documents should also be handed over.

Steps in Intra-facility Transport

Whenever possible, the transport of newborns within the facility should be avoided. It is preferable to provide services at the baby's bedside. Where this is not feasible, consider the following steps:

1. Decision to Transport

The decision to transport should be made by the managing consultant or, in their absence, the most senior health worker on duty.

2. Communication

Once the decision to transport a newborn has been made:

- The parents or caregiver must be fully informed about the baby's condition, the reasons for the transfer, the required services, and the risks and benefits of transport.
- Consent must be obtained before proceeding with transport.
- The receiving unit should be contacted to ensure they are properly prepared to receive the baby.

3. Pre-transport Stabilisation

The transfer should not take place until the baby has been resuscitated and stabilised.

4. Documentation

The transferring unit must appropriately document:

- The reason for the transfer
- The date and time of transfer
- The parental consent
- The treatment given so far

Transporting the Baby

i. Mode of Transport

It is recommended that babies be transported in the Kangaroo Mother Care (KMC) position. If this is not feasible (for example, due to the baby's clinical condition), transport incubators should be used. Mobile oxygen trolleys and a resuscitation bag device should also be available in case the baby deteriorates during transport.

ii. Accompanying the Baby

- It is best to transport the baby with the mother, except in situations where this is not possible.
- Medical personnel must accompany all babies requiring intra-facility transport services.

What To Do If the Neonate Deteriorates During Transport?

If the baby's condition deteriorates during transport, initiate resuscitation immediately and return the baby to the newborn unit.

CHAPTER 3:
NEONATAL RESUSCITATION, PERINATAL ASPHYXIA AND SEIZURES

1. Neonatal Resuscitation

When a baby is not breathing, urgent management is required. For most babies, breathing begins spontaneously at birth. However, some babies need assistance to start or continue breathing; this assistance is known as resuscitation.

Preparation for Resuscitation:

- The clinician should be properly prepared before resuscitation.
- Each newborn must be delivered by a qualified health worker.
- High-risk mothers should be identified prior to childbirth.
- At least two competent health workers should be available at delivery to provide immediate newborn care (including resuscitation for babies with no spontaneous respiration) and care for the mother.
- Resuscitation equipment should always be checked and ready when indicated.
- Take a detailed history, specifically asking about antepartum and intrapartum risk factors in the mother.
- Ensure clean surfaces for newborn care.
- Close windows and doors to prevent drafts and maintain a warm environment.
- Wash hands and follow standard precautions to prevent infections.

High-Risk Deliveries Include:

- Preterm births (less than 37 weeks)
- Meconium staining
- Fetal distress or all cesarean sections
- Known congenital malformations
- Multiple births
- Malpresentation (abnormal presentation of the baby)
- Maternal complications such as pre-eclampsia, eclampsia, maternal diabetes, or maternal bleeding

Important Note:

- Neonatal resuscitation is NOT recommended for extremely low birth weight (ELBW) babies weighing less than 600g or those with a gestational age (GA) less than 26 weeks.

Initial Newborn Care:

- A newborn should be placed in a warm environment (under a radiant warmer).
- The baby should be dried, suctioned, and stimulated.
- The newborn should then be assessed to determine the need for resuscitation based on three key signs:
    - Respiration or crying
    - Heart rate
    - Colour

Preterm newborns are at increased risk of needing resuscitation.

Golden Minute Assessment:

Review the newborn within the first 60 seconds (the golden minute). If the newborn has:

- Adequate respiratory effort (good regular breathing or crying)
- A heart rate (HR) > 100 beats/minute
- Transitioned to a pink colour (check mucous membranes)

Then no further resuscitation is necessary, and APGAR scores can be assigned.

Table 9, The Apgar Score Used to Assess the Newborn's Condition During the First Few Minutes of Life.

0	1		2
Heart rate	Absent	<100 beats/min	>100 beats/min
Respiration	Absent	Slow, irregular	Good, crying
Muscle tone	Limp	Some flexions of extremities	Active motion
Reflex/irritability (response to stimulation)	No response	Grimace	Cough
Colour	Blue or pale	Body pink, blue extremities	Pink
	INTERPRETATION	Severely depressed	0-3
		Moderately depressed	4-6
		Excellent condition	7-10

The Apgar score at 1,5 (10, 20) minutes after delivery gives you a retrospective idea on the effectiveness of the resuscitation. The Apgar scores should be recorded in the neonate's birth record. Complete documentation of the events during resuscitation must include a description of interventions performed and their timing. The Apgar score is not a tool to determine the initiation or decisions about the course of resuscitation.

If the newborn has inadequate respiratory effort (gasping, apnoea, slow irregular breathing), HR < 100 or remains cyanotic, neonatal resuscitation is required, with further assessments of the Apgar score at 5-minute intervals.

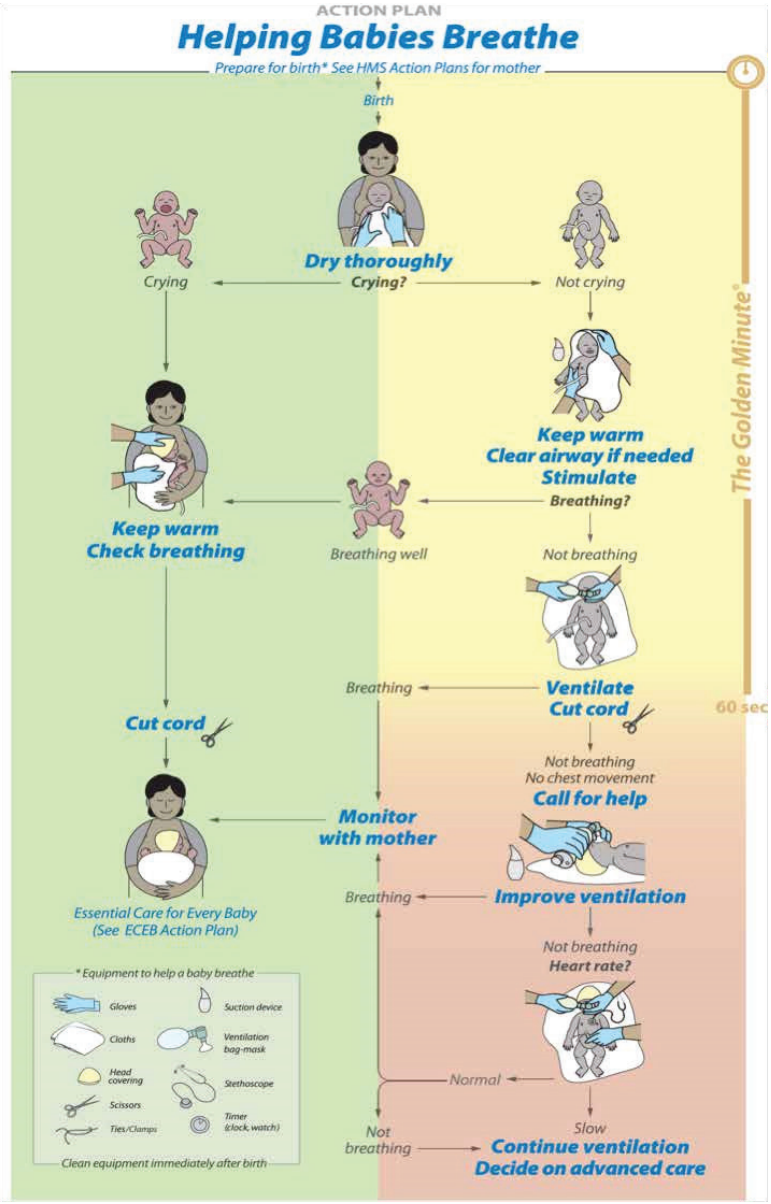
Neonatal resuscitation is a rapid sequence of steps to be initiated if a baby's breathing or circulation is impaired. The aim is to optimise the airway, breathing, and circulation as quickly as possible. The effectiveness of resuscitation is assessed every thirty seconds based on improvement in breathing, HR, and colour.

GENERAL STEPS FOR NEONATAL RESUSCITATION

A) THE HELPING BABIES BREATHE (HBB) CHART

This outlines the basic resuscitation steps that all health workers in all facilities in the country should be proficient in from Level 1 to Level 3. It is taught in detail during the Essential Newborn Care Course (ENCC), and the Action Plan Chart is shown in Figure B. It emphasises the crucial need to commence breathing for the baby using the bag and mask within the first minute of birth (The Golden Minute).

Figure B, Action Plan

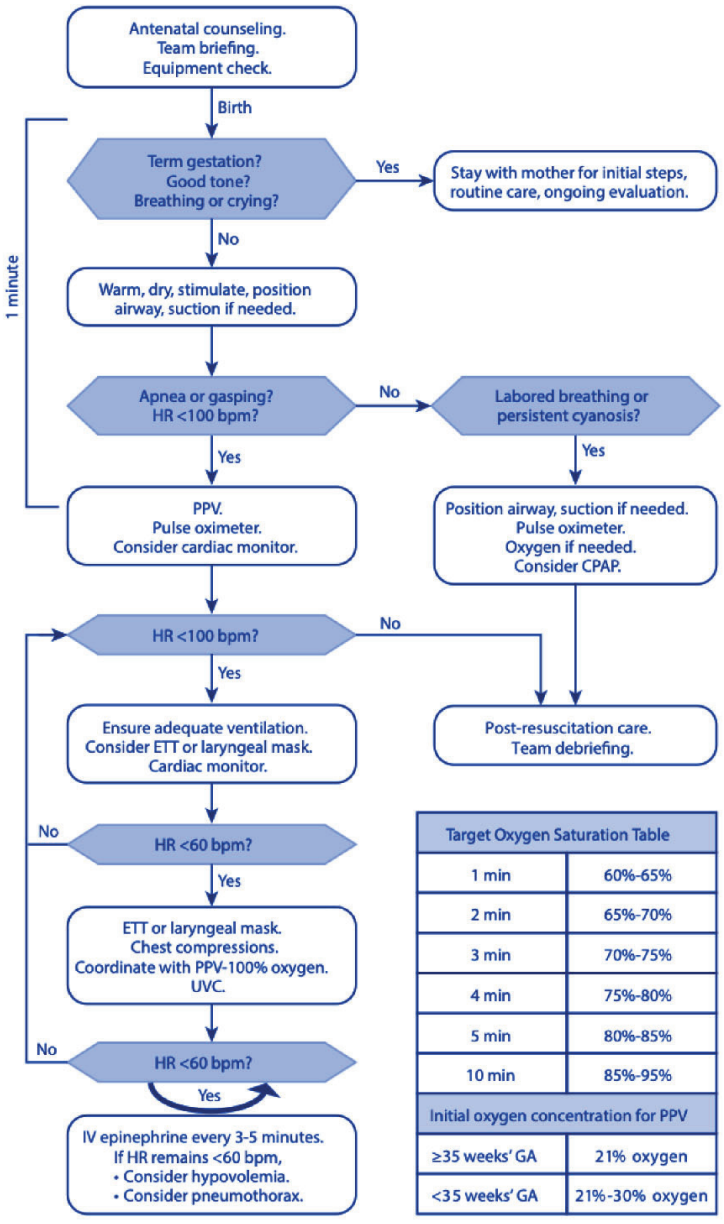


THE NEONATAL RESUSCITATION PROGRAMME (NRP) FLOW DIAGRAM:

This flow diagram describes the steps to be followed to evaluate and resuscitate a newborn and integrates chest compression and endotracheal intubation steps. It is divided into five blocks beginning with preparation for birth and the initial assessment.

Throughout the diagram (Figure C), diamond-shaped steps indicate assessments, and rectangles show actions that may be required.

Figure C, The NRP Flow Diagram



Post-resuscitation Care

An infant who has required resuscitation must be closely monitored and managed of oxygenation, infection, blood pressure (BP), fluids, apnoea, blood sugar, feeding and temperature. Take care not to overheat the infant during or following resuscitation.

Withdrawal of Resuscitation

- Discontinuation of resuscitation efforts may be appropriate if there are no signs of life in an infant after 15–20 minutes of complete and adequate resuscitation efforts.

Table 10, Medications and Dosages for Discontinuation of Neonatal Resuscitation

Drugs	Concentration	Route/Dosage
Adrenaline	1:10000	IV: 0.1-0.3 ml/kg
Volume expander	Normal saline (SS 0.9%)	IV: 10 ml/kg
Dextrose	10%	IV: 2ml/kg (200 mg/kg)

2. Perinatal Asphyxia

Perinatal asphyxia is defined as the inadequate delivery of oxygen to tissues to meet metabolic demands. This can occur perinatally due to fetal, maternal, and/or placental etiology.

Table 11, Risk Factors and Conditions Associated with Neonatal Asphyxia

Fetal	Maternal	Placental
■ Preterm and post-dates ■ Multiple births ■ Forceps or vacuum–assisted delivery ■ Abnormal presentation ■ Emergency caesarean section ■ Intrauterine growth restriction (IUGR) ■ Meconium–stained amniotic fluid ■ Abnormal fetal heart rate trace ■ Congenital malformations ■ Anemia ■ Infection	■ General anaesthetic ■ Maternal drug therapy ■ Pregnancy-induced hypertension ■ Chronic hypertension ■ Maternal infection ■ Maternal diabetes mellitus ■ Hemorrhage ■ Preeclampsia ■ Eclampsia	■ Chorioamnionitis ■ Placenta previa ■ Placentalabruption ■ Cord prolapses ■ Polyhydramnios ■ Oligohydramnios

Assessment of Newborns with Perinatal Asphyxia

1. Always obtain a history of pregnancy, labour, fetal heart monitoring, medications in the mother and/or infant, sepsis and intrapartum events, duration of stages of labour, presentation, method, and indication for delivery.
2. Resuscitation and evidence for intrapartum hypoxia, viz:

- Blood gas from cord blood (umbilical artery or vein) as soon as possible after birth if available (or acidotic breathing [deep respirations with prolonged expiration]),
- Apgar scores at 1, 5, and 10 minutes,
- Mode of resuscitation and need for intubation,
- Time of first gasp and onset of heart rate > 100 bpm,
- Time of onset of regular (non-gasping) respirations,
- Drugs/fluids administered to the infant.

3. It may be necessary to check placental tissue—appearance, surface, weight, and size—and send for histology if any anomaly is suspected.
4. Consider the diagnosis of HIE if low Apgar scores (< 5 at 5 minutes), delayed first breath, absence of cry at 5 minutes of life, need for neonatal resuscitation, neurological examination, abnormal tone, and seizures.
5. Note that every organ may be affected by asphyxia, even in the absence of HIE.

Hypoxic Ischaemic Encephalopathy (HIE)

Is due to inadequate pre-, intra- and/or post-partum oxygen delivery and blood flow. Consider this diagnosis if low Apgar scores (< 4 at 5 minutes), delayed first breath, absence of cry at birth, need for neonatal resuscitation, abnormal neurologic exam, abnormal tone, and seizures. Assess by Sarnat staging:

Table 12, Sarnat and Sarnat Staging Chart

	Stage 1	Stage 2	Stage 3
Level of consciousness	Hyperalert		
		Neuromuscular control	
Muscle tone	Normal	Mild hypotonia	Flaccid
Posture	Mild distal flexion	Strong distal flexion	Intermittent decerebration
Stretch reflexes	Overactive	Overactive	Decreased or absent
Segmental myoclonus	Present	Present	Absent
		Complex reflexes	
Suck	Weak	Weak or absent	Absent
Moro	Strong, low threshold	Weak, incomplete, high threshold	Absent
Oculo vestibular	Normal		Weak or absent
Tonic neck	Slight	Overactive	Absent
Autonomic function	Generalized sympathetic	Strong	Both systems depressed
Pupils	Mydriasis	Generalized parasympathetic	Variable, often unequal,
Heart rate	| Tachycardia	Miosis	poor light reflex
Bronchial and salivary secretions	Sparse	Bradycardia	Variable
Gastrointestinal motility	Normal or decreased	Profuse	Variable
Seizures	None	Increased, diarrhoea	Variable
Electroencephalogram findings	Normal (awake)	Common, focal or multifocal	Uncommon (excluding decerebration)
Duration	Less than 24 nours	Early: low-voltage continuous delta and t/heta Later: periodic pattern (awake) Seizures: focal 1-to 1-Hz spike-and-wave	Early: periodic pattern with Isopotential phases Later: totally isopotential
		2 - 14 days	Hours to weeks

CLINICAL SYMPTOMS AND SIGNS OF HIE

Clinical signs vary over time. Moderately or severely affected infants typically develop increasingly obvious signs within the first 48-72 hours. Seizures are often subtle. There are three stages of encephalopathy (refer to Table 12 Sarnat and Sarnat Staging Chart).

- Stage 1 (mild): Hyperalertness, irritability, increased tone, poor suck, and exaggerated Moro reflex. No seizures.
- Stage 2 (moderate): Lethargy, decreased tone and primitive reflexes. Often accompanied by seizures.
- Stage 3 (severe): Stupor or Coma, flaccid tone and seizures often clinically less apparent. Unable to sustain adequate, regular spontaneous respiration.

Table 13, Multiorgan Systemic Effects of Asphyxia

SYSTEM	EFFECTS
Central nervous	Hypoxic-ischemic encephalopathy, infarction, intracranial hemorrhage, seizures, cerebral edema, hypotonia, hypertonia
Cardiovascular	Myocardial ischemia. poor contractility, cardiac stunning, tricuspid insufficiency, hypotension
Pulmonary	Pulmonary hypertension, pulmonary hemorrhage, respiratory distress syndrome
Renal	Acute tubular or cortical necrosis
Adrenal	Adrenal hemorrhage
Gastrointestinal	Perforation, ulceration with hemorrhage, necrosis
Metabolic	Inappropriate secretion of antidiuretic hormone, hyponatremia, hypoglycemia, hypocalcemia, myoglobinuria
Integumentary	Subcutaneous fat necrosis
Hematologic	Disseminated intravascular coagulation

Investigations

- Blood gas analysis, including lactate,
- Blood glucose,
- Full blood count (FBC), blood culture,
- Serum electrolytes/urea/creatinine (EU/Cr), calcium, magnesium,
- Clotting profile,
    - Urine test,
    - Cranial ultrasound,
    - Magnetic resonance imaging (MRI),
    - Electroencephalogram (EEG).

PRINCIPLES OF TREATMENT OF ASPHYXIA

IMMEDIATE MANAGEMENT ON ADMISSION

- Prompt and effective resuscitation. Manage airway, breathing and circulation (refer to newborn resuscitation algorithm).
- If respiratory support is needed and respiratory effort is good, nasal CPAP or nasal cannula is often adequate.
- Oxygen administration using appropriate methods. Avoid hypoxaemia. Maintain SpO2 at 92-95%.
- Maintain body temperature within the normal range (36.5oC – 37.5oC). Avoid hyperthermia.
- Perform a general and neurological examination as outlined above.
- Keep Nil by mouth for 24 – 48hrs and monitor bowel sounds.
- Set IV access and commence D10 infusion promptly.
- Monitor glucose, and if hypoglycaemia, treat accordingly and prevent hyperglyceamia.
- Monitor cardiac function and circulation.
- Fluid restriction (40 mls/kg/24hrs) in first few hours till good urinary output is established.
- Fluid challenge if oliguric (Urinary Output (UO) <1 ml/kg/hr) Give 10ml/kg Bolus and reassess.
- Strict monitoring of fluid input/output. Weigh the diapers. (1g=1ml after noting weight of dry diaper.
- Remember to palpate for bladder and massage if distended. Catheterization should only be done by skilled personnel and when absolutely necessary for adequate monitoring of urinary output.
- Avoid hypothermia except therapeutic cooling is available within 6 hours.
- Therapeutic hypothermia within 6 hours of birth for 72 hours if facilities available.
- Observe for signs of hypovolaemia and hypoperfusion (blood pressure/capillary refill time).
- Give fluid bolus of normal saline in aliquots of 10mls/kg if suspected circulatory collapse.
- Use inotropes if hypotension is not corrected by fluid bolus. Usually, start with dobutamine at 5 mcg/kg/min as the first line. If not available, give dopamine at 7.5mcg/kg/min and increase as necessary.
- An echocardiogram can assess cardiac function to guide fluid and inotrope management.
- Assess the baby for fluid overload, if features of fluid retention are seen (e.g., facial puffiness, bloating and sacral oedema).
- Acidosis will normally correct itself once adequate respiratory and circulatory support provided.

- Regular blood glucose monitoring at least 4-6hrly. Target levels >49mg/dL (>2.7 mmol/L). Maintain RBG levels at < 150mg/dl (<8 mmol/L).
- Monitor electrolytes. Serum EU/Cr/Calcium/Phosphates: Hypocalcaemia and hypomagnesemia should be anticipated and treated.
- Treat hypocalcaemia with calcium gluconate when total serum calcium <8 mg/dL (2 mmol/L) or with presence of signs and symptoms such as spasms.
- Treat hyponatraemia < 130 mmol/L.

Seizures

- Prophylactic anticonvulsants are not indicated.
- Watch out for seizures, which may set in 6 – 36 hours after insult.

Keep a Seizure Chart. (Refer to guideline on seizure Mgt)

Gastrointestinal System

Keep NPO

- Some babies with severe HIE are unable to suck for several weeks and require tube feeding.
- Introduce enteral feeds slowly due to the risk of necrotizing enterocolitis (NEC).
- If NEC develops, follow guideline for management of NEC.

Monitor Haemoglobin and Coagulation Profile

- Treat active bleeding with vitamin K1 (1-5mg IV) and fresh frozen plasma (FFP) (15mls/kg over 30 minutes) – consider fresh whole blood if no FFP.

COMMUNICATION WITH PARENTS

- Explain the clinical conditions and the potential for other causes of encephalopathy.
- Explain the management of the condition.
- Document the parent's version of events and document all counselling process in the baby's case note.
- Prepare them for a potential poor outcome if investigations and signs are suggestive.
- The mother and family will require counselling and support.
- Encourage the mother to hold her baby.

DOCUMENTATION, DISCHARGE, AND FOLLOW-UP

- Document in case records whether HIE as mild, moderate, or severe.
- Document parental counselling, occipitofrontal circumference (OFC), and seizures.
- Arrange a clinic follow-up 1 week after discharge.
- Arrange for supportive care as indicated, such as physiotherapy, audiometry, ophthalmology, speech therapy, neurology, and nutritional support, among others.

PROGNOSIS

- The risk of long-term problems increases with the degree of encephalopathy

3. Seizures

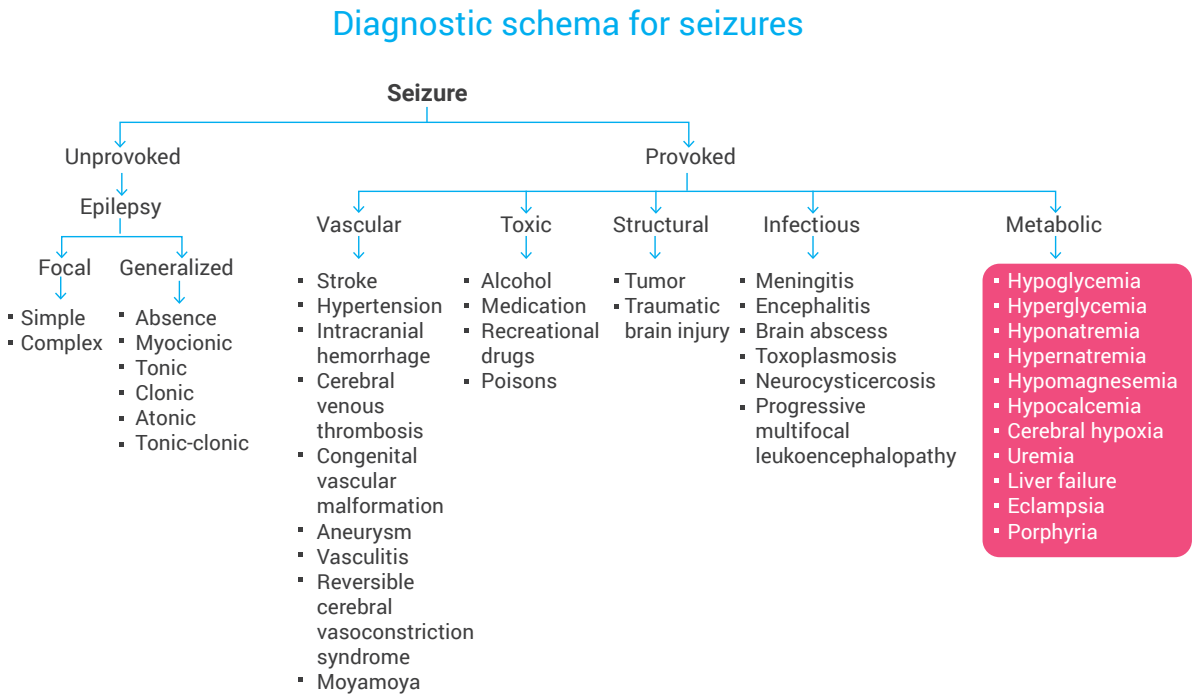
Neonatal seizures are manifestation of neurological dysfunction and are the most common manifestation of all neonatal encephalopathies. Status epilepticus refers to continuous seizures lasting for 5 minutes or recurrent seizures.

Clinical Manifestation of Neonatal Seizures May Be:

- **Subtle**: Eye deviations, eyelid fluttering, staring, blinking; Oro-facial movements such as chewing, sucking, tongue thrusting, lip smacking; Limb movements such as cycling, fisting, or pedalling.
- **Tonic**
- **Clonic**: Focal or multifocal
- **Myoclonic**

Autonomic changes can occur, including apnoea, tachycardia, unstable blood pressure, colour changes (blanching), and a high-pitched cry.

Figure D, Diagnostic Schema for Seizures



PRINCIPLES OF MANAGEMENT

- Evaluate ABCDE & call for HELP!
- Maintain head and neck in neutral position to keep airway patent.
- Clear secretions (if seen in the baby)
- Commence oxygen via nasal prongs and monitor oxygen saturations (aim 90- 95%).

Treat underlying cause:

- **Hypoglycaemia**: Give 10% Dextrose (D10) 2-4 mL/kg IV bolus, followed by a maintenance infusion at 6-8mg/kg/min.
- **Hypocalcaemia** (see section on perinatal asphyxia): Give 10% calcium gluconate 1mL/kg IV over ≥10 minutes with ECG monitoring if possible.
- **Hypomagnesaemia** (serum magnesium <0.68 mmol/L): Give magnesium sulphate 100 mg/kg IV or deep IM (also use for refractory hypocalcemic fit).
- **Infection**: Treat accordingly (refer to Treatment of Meningitis).
- **Seizures**.

1st Line AED

PHENOBARBITAL IV (drug of choice):

- 20 mg/kg slow infusion over 20 to 30 minutes.
- If seizures persist, give repeat dose of 10 mg/kg over 15 to 30 minutes (max loading dose = 40 mg/kg).
- Maintenance: 5 mg/kg IV divided 12 hourly (BD). Start maintenance dose 24 hours after the last loading dose.

2nd Line AED

PHENYTOIN IV:

- 20 mg/kg slow infusion over 20 to 30 minutes.
- Note: Never give phenytoin through IM route. It is recommended to use separate IV line, not to use the infusion with glucose containing fluids as there is risk of crystallization and purple glove syndrome, and it should be given in a setting with cardiac monitoring (when available)

3rd Line AED

LEVETIRACETAM IV:

- 40 mg/kg slow infusion over 10 minutes.
- If seizures persist at the end of infusion give a further LEVETIRACETAM IV: 20 mg/kg slow infusion over 10 minutes.
- Maximum loading dose: 60 mg/kg or 2500mg.

If seizure persists:

- IV Midazolam 0.2 mg/kg (loading dose).
- Maintenance 0.2 mg-0.6 mg/kg/hr.

Caution:

Anticonvulsants can cause respiratory depression and apnoea. Patients must be admitted to a neonatal unit for careful monitoring. Basic resuscitation equipment must be kept at the bedside, including Ambu- bag & mask and suction.

If seizures persist despite the above measures, consider treating for possible pyridoxine (Vitamin B6) deficiency, particularly if the mother is on isoniazid therapy:

- PYRIDOXINE (Vitamin B6) IV or IM: 100 mg single dose.
- Alternatively, PO or via O/NGT (if IV or IM not possible): Pyridoxine (50-100 mg) or seek neurologist opinion.

Ongoing Monitoring:

Table 14, Maintain a Seizure Chart (see example table below)

Name: Hospital No:			
Date	**Time**	**Type of seizure**	**Duration**

Discontinue anticonvulsant 48 hours after the last seizure and observe for at least 48 hours after the last dose of anticonvulsant to ensure that seizures do not recur. All newborns with HIE should be followed up after discharge. Frequency and duration of follow up depends on severity of HIE.

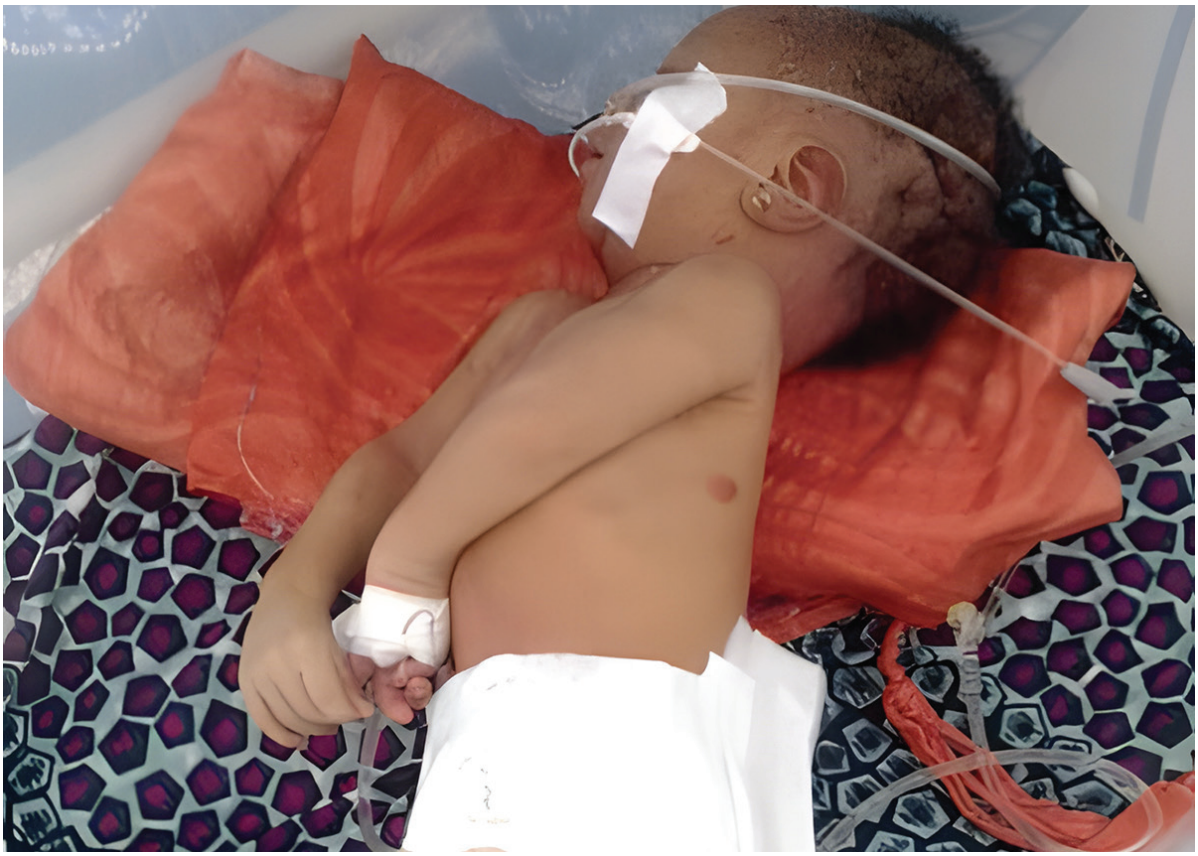


Figure E, Flow for Easily Correctable Causes

CHECK FOR EASILY CORRECTABLE CAUSES: BLOOD GLUCOSE, ELECTROLYTES

If no immediate correctable cause:

- Start IV Phenobarbital 20mg/kg over 15-20 minutes.
- May repeat IV Phenobarbital at 10mg/kg after 20-30 minutes if seizures continue up to a total dose of 40mg/kg.
- Start maintenance Phenobarbital 5mg/kg divided BD to be
- commenced 24hrs after the last loading dose.

If seizures persist after giving Phenobarbital:

- Consider IV Phenytoin 15-20 mg/kg over 15-20 minutes
- Maintenance dose of 5mg/kg IV daily to be commenced 24hrs after loading dose.
- Note:
  - Use a separate line for Phenytoin and do not use with glucose containing fluids
  - If a separate line is not available, flush the existing line until free
  - flowing, then administer the Phenytoin and flush the line again.

- Observe for at least 48 hours after the last anticonvulsant dose to ensure seizures do not recur.
- Start antibiotics if febrile or high-risk for Central Nervous System infection.
- Do a lumbar puncture for CSF analysis as soon as seizure stabilized and no signs of raised ICP

CHAPTER 4:
RESPIRATORY DISTRESS IN NEWBORNS

Introduction

Respiratory distress accounts for significant morbidity and mortality in neonates, occuring in 4 to 6 percent of neonates. Preterm neonates are at higher risk of developing respiratory distress. Many conditions causing respiratory distress are preventable, and early recognition and prompt management are required. Delayed or inappropriate management may result in hypoxic respiratory failure, which carries high mortality and morbidity rates.

Definition:

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

- **Abnormal respiratory rate:**
- **Tachypnoea**: RR >60 breaths/minute
- **Bradypnoea**: RR < 30 breaths/minute
- **Chest indrawing**
- **Grunting**
- **Apnoea**: Cessation of breathing for > 20 seconds or any duration associated with bradycardia and cyanosis
- **Gasping**
- **Increased work of breathing**
- **Grunting on respiration**
- **Flaring of alae nasi (Nasal flaring)**
- **Retractions (severe chest indrawing)**
- **See-saw breathing**
- **Hypoxia features**
- **Oxygen saturation < 90%**
- **Central cyanosis (blue tongue and lips)**
- **Altered level of consciousness**

May progress to respiratory failure, if not promptly managed. **If the baby is apnoeic or gasping, immediately resuscitate the baby.**

Common Causes of Respiratory Distress

Medical Causes:

- Preterm infants
- Infants born to mothers with fever, prolonged rupture of membranes, foul-smelling amniotic fluid
- Infants with birth asphyxia
- Infants of diabetic mothers
- Respiratory Distress Syndrome (RDS): Common in preterm babies and infants of diabetic mothers
- Perinatal Asphyxia
- Transient tachypnoea of newborn (TTNB): Common in term babies especially after elective caesarean section or rapid delivery
- Congenital Pneumonia
- Miscellaneous Causes: Hypothermia, hypoglycaemia
- Meconium aspiration syndrome (MAS)

Surgical Causes: Infants with congenital abnormalities

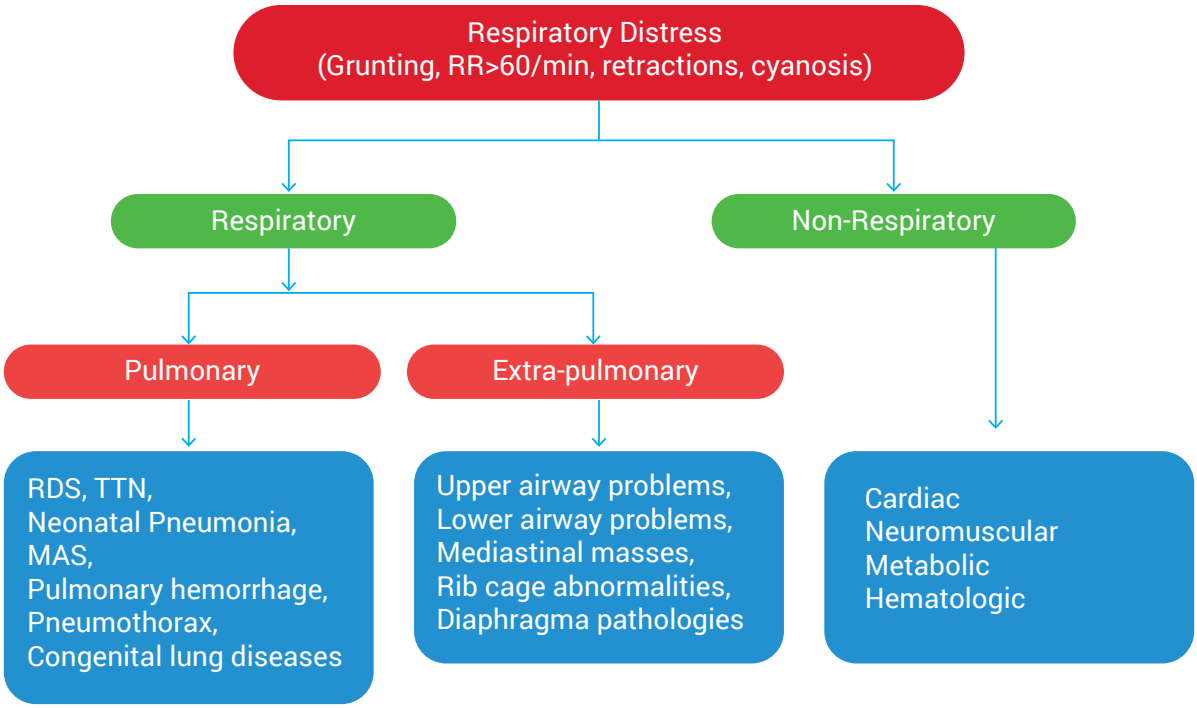
- Diaphragmatic hernia
- Tracheo-oesophageal fistula
- Bilateral Choanal atresia

Other Causes:

- Congenital Heart Disease
- Persistent Pulmonary Hypertension of the Newborn (PPHN)

Causes of respiratory distress can vary and may be respiratory or non-respiratory (central, cardiac, metabolic, or mixed) in origin.

Figure F, Causes of Respiratory Distress in the Newborn



Source: Respiratory Distress and Management Strategies in the Newborn http://dx.doi.org/10.5772/64397

Approach to Respiratory Distress

History taking:

A detailed and relevant antenatal and perinatal history should be taken based on the common causes:

- Gestation
- Antenatal history of poly/ oligohydramnios
- Age of onset of distress / breathing difficulty
- Rupture of Membranes > 18 hours, intrapartum fever, chorioamnionitis
- Meconium-stained amniotic fluid
- Perinatal asphyxia: Delayed crying with need for resuscitation
- Maternal diabetes mellitus

Examination:

- Severity of respiratory distress as assessed by Downe's score given below:
- Neurological status: Activity, Altered sensorium
- Central cyanosis or low oxygen saturations on pulse oximeter
- Full ABCD assessment

Table 15, Modified Downe's Score

Feature	Score 0	Score 1	Score 2
Cyanosis	None	No Cyanosis with Oxygen Support	Cyanosis despite Oxygen Support
Retractions	None	Mild	Severe
Grunting	None	Audible with stethoscope	Audible without stethoscope
Air entry	Normal	Decreased	Barely audible
Respiratory rate	<60	60--80	80 or apnea

Scoring the severity of respiratory distress:

The severity of respiratory distress is assessed by Downes' Score, which is more comprehensive and can be applied to any gestational age and condition. Scoring should be done at half-hourly intervals, and a chart should be maintained.

Score Interpretation:

- <4 = No respiratory distress
- 4-7 = Mild to moderate respiratory distress
- 7= Severe respiratory distress - monitor arterial blood gases

Investigations:

- Full blood count and differentials
- Sepsis screen/ work-up should be done when there are risk factors for sepsis
- Chest X-ray
- Oxygen saturation with oximetry
- Blood gas analysis (where available)
- ECG and Echocardiography (if congenital cardiac defect is suspected)

Table 16, Common Causes of Respiratory Distress and Their Typical Presentations

	Transient Tachypnoea of the newborn	Respiratory distress syndrome	Meconium aspiration syndrome	Neonatal pneumonia	Pneumothorax
Birth history	Near term or term Short labour/CS delivery No risk factor for sepsis	Preterm, <35weeks GA	Term or post-term Meconium stained amniotic fluid	Perinatal risk factors for sepsis	Received bag & mask ventilation +/- meconium stained liquor, Can occur spontaneously
Laboratory investigation results	Usually not suggestive of sepsis	May be negative for sepsis	May be suggestive of sepsis	Usually suggestive of sepsis	Usually negativefor sepsis
Chest X-ray	Fluid in fissure, usually on theright side	Early CXR may be normal, Ground glass appearance, air bronchograms extending to the periphery, features of complication maybe apparent (air leaks)	Hyper inflated lungs, Diffuse patchy opacities, features of complications maybe apparent (air leaks, focal emphysema, etc.)	Diffuse patchy opacities	Maybe unilateral hyperluscency +/- mediastinal shift
Course of distress	Mild distress Resolves spontaneously over 24-72 hours	Natural history: 3-4 hours onset time, 72-96 hours peak and resolves about the 7th day of life. Complicared by BPD	Depends on severity and ± complications	Depends on severity, Moderate to severe distress: Usually >48hours	Maybe of sudden onset, moderate to severe distress depending on size.

Management of Respiratory Distress in Newborns

Aims of treatment:

- Resuscitation of the neonate
- Optimising tissue oxygenation
- Decreasing the work of breathing
- Preventing hypoxia, hypercapnia and acidosis.

These can be achieved by:

i. Providing respiratory support
ii. General supportive/specific care
iii. Proper nursing care

A. Supportive Care:

- Thermal care (ensure temperature is between 36.5-37.5ºC).
- Management of fluids and electrolytes.
- Monitoring vital signs.

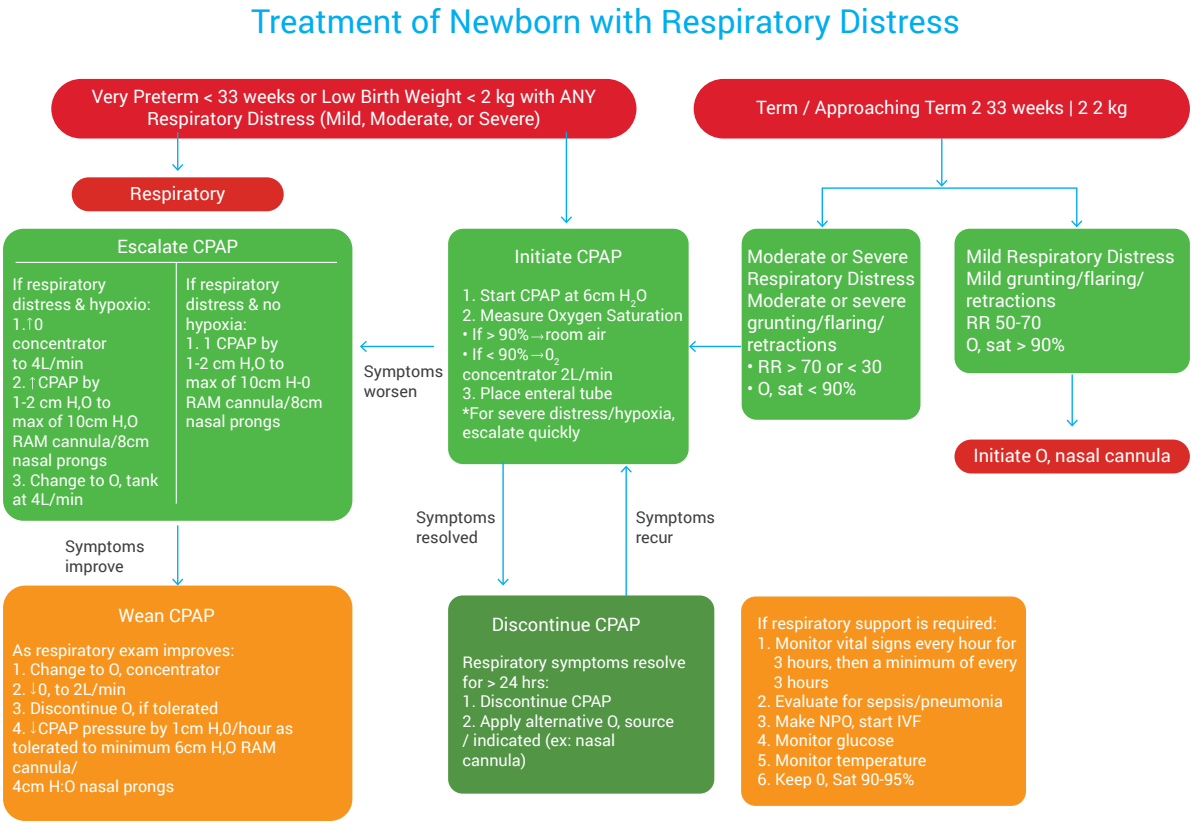
B. Respiratory Support:

- The objective is to ensure adequate oxygenation and ventilation and thereby decrease work of breathing.
- Respiratory support can be provided through.
- Supplemental oxygen – Warm, humidified oxygen should be given at 1-2 L/min via nasal cannula and pulse oximeter monitoring if possible.
- Continuous Positive Airway Pressure (CPAP).

Indications for starting CPAP are:

- Failure to maintain adequate oxygenation and ventilation on supplemental oxygen (SP02 <90% at 5L/min).
- Significant respiratory distress Downe's score >4.
- Persistent grunting.

Figure G, Algorithm for Evaluation and Treatment of a Baby with Respiratory Distress



Respiratory Distress Syndrome (RDS)

Respiratory Distress Syndrome (RDS) occurs primarily in premature infants; its incidence is inversely related to gestational age and birth weight.

- There is reduced risk with antenatal steroid use (Dexamethasone or Betamethasone).
- Increased risk in premature babies < 34weeks GA, maternal diabetes, male infants, multiple births, Caesarean section, precipitous delivery, asphyxia, cold stress, and a history of previously affected infants.

What are the clinical features?

- Neonates with RDS present within 4 hours of birth with tachypnoea and signs of respiratory distress.
- A neonate with RDS will get worse before they get better.
- The respiratory distress gets worse over the next 24 – 36 hours due to the disappearance of the small amount of surfactant present.

- At 36 – 48 hours of age, the infant starts to produce its own surfactant and symptoms will improve. If a baby is hypothermic, this further reduces the production of endogenous surfactant.

Treatment

- Put the baby in neutral (sniffing) position.
- Give oxygen via nasal cannula 0.5-1 litre per minute (escalate as needed but consider early CPAP).
- Give antibiotics if persistent respiratory distress after 4 hours of age, or if the working diagnosis includes sepsis, pneumonia, or meconium aspiration syndrome.
- Trophic Feeds via NGT if the baby is in severe respiratory distress.
- Treat extremely preterm neonates primarily (< 28 weeks GA) and < 32weeks showing clinical features of RDS with surfactant therapy, if available.
- Early CPAP (starting in the delivery room) is recommended for the treatment of preterm newborns with RDS as soon as possible after birth. Mechanical ventilators can be utilised if equipment and expertise are available.
- By third day, there is usually production of endogenous surfactant following appropriate supportive care and respiratory therapy.
- Maintain warmth, stabilise glucose, correct electrolytes and acid base balance –as adverse factors reduce endogenous surfactant production.
    - **Surfactant Replacement Therapy (SRT),** if available: Exogenous surfactant has been shown to reduce neonatal mortality, death or bronchopulmonary dysplasia (BPD) and air leaks in at risk babies.
    - **Indication for administration of surfactant include**: The principle of administration is to deliver surfactant as early as possible to those infants with a high probability of surfactant deficiency, such as:

- Neonates < 28 weeks GA
- Neonates with clinical and radiographic evidence of RDS
- Neonates with RDS on CPAP requiring FiO2 >30-40%
- Preterm neonates (< 30 weeks) needing IPPV, intubation and needing mechanical ventilation at birth
- Severe meconium aspiration syndrome with severe respiratory failure
- Late preterm infants of diabetic mothers with RDS
- Pulmonary haemorrhage after the acute phase
- Respiratory failure - may improve gas exchange and respiratory mechanics and shorten the duration of invasive mechanical ventilation

Key messages:

- Respiratory distress is a common occurrence in neonates.
- Early identification and timely appropriate management are the key to good outcomes.
- Use oxygen judiciously.
- Maintain oxygen saturations in the range of 88-92% for preterm and 92-95% for term baby.
- Perform sepsis screen and commence antibiotics if you suspect sepsis.
- Do not use antibiotics in all cases of respiratory distress.

MANAGEMENT OF APNOEA

Definitions:

Apnoea: Apnoea **is** the cessation of breathing lasting > 15 to 20 secs or any duration associated with bradycardia and/or oxygen desaturation/cyanosis.

Bradycardia: Bradycardia is defined as an abnormally slow heart rate of less than 100 beats per minute in a newborn.

Apnoea may be due to prematurity or secondary to other causes. It is most common among preterms due to immaturity of the respiratory centre and is called **Apnoea of Prematurity.**

Apnoea occurs in > 50% of neonates born < 30 weeks and occurrence reduce with advancing gestational age.

- Apnoea of prematurity is a diagnosis of exclusion because apnoea may be associated with other diagnoses including:
- Hypothermia- sepsis, hyperthermia, hypoglycemia, hypocalcemia, anaemia, birth asphyxia, seizures, hyperbilirubinaemia, intraventricular, haemorrhage, necrotizing enterocolitis, gastro oesophageal reflux, patent ductus arteriosus.
- **IMPORTANT**: **Any neonate with apnoea should be evaluated thoroughly!**
- Pharmacological therapy with a methylxanthine stimulant (caffeine or aminophylline) decreases the episodes of apnea and bradycardia of prematurity and is a crucial intervention to improve the outcome of preterm newborns

Management:

- Maintain normal temperature.
- Provide tactile stimulation.
- Check blood glucose.

- Work up for apnea: -FBC, CRP, blood culture, RBS, serum electrolytes, serum aminophylline level if possible and cranial ultrasound scan to rule out intraventricular haemorrage.
- Check haemoglobin concentration.
- It is important that preterm neonates ≤ 34 weeks of gestational age are commenced on continuous oxygen saturation monitor with alarm set at < 90% and time lag for alarm to go off at 20 seconds.
- If no monitor, close observation neonate for cyanosis, mottling, and not breathing.

- Give bag and mask ventilation to restore breathing.

a. When to start caffeine/aminophylline:

About 25% of neonates < 34 weeks have apnoea of prematurity. Therefore, it is reasonable to start caffeine/aminophylline prophylactically to all premature infants of gestational age <34 weeks or weight <1500g. If caffeine is available this would be the first choice over aminophylline.

- Very low birthweight (< 1500g) babies should receive prophylactic caffeine/ aminophylline orally until they reach 1.5kg or 34 weeks GA, whichever comes first.
- Caffeine (or aminophylline if oral caffeine citrate is not available) may be given orally or via NG tube (usually reconstituted into liquid form by the hospital pharmacist) to stable preterm neonates at the same dosing as the IV dose. Stop once infant has good suckling and swallowing coordination.

(Therapeutic serum level of aminophylline is 9-14mg/L if facility can check serum levels).

b. Dosages of caffeine citrate and aminophylline

- **Caffeine Dose:**
  - Loading dose: 20mg/kg caffeine citrate IV mainly or NG/PO (depending on the circumstances) stat on from birth on Day 1
  - Then maintenance: 10mg/kg/day caffeine citrate IV or NG/PO given as once daily dose in the morning.
  - Can be given orally even if baby is still on IV fluids.

- **Aminophylline dose (if caffeine citrate is not available)**
  - Loading dose: 6mg/kg aminophylline IV (or PO) given slowly over 20min.
  - Then maintenance: 2.5mg/kg/per dose twice daily (IV or per oral PO) starting 24hours after loading.

- Neonates with recurrent apnoeic spells may require CPAP.
    - Discontinue caffeine or aminophylline at 33 weeks corrected age or 3 days prior to anticipated discharge to home if there are no signs or symptoms of apnoea or bradycardia. After discontinuation, it takes 1 day for the serum level to fall below the therapeutic range. The newborn must then be observed closely for an additional 2 days to monitor for recurrence of apnoea and bradycardia.

Note: Newborn should NOT be discharged on caffeine or aminophylline, because it is difficult to safely discontinue the medication in the outpatient setting.

Treating an apnoea episode

- Resuscitate patient first:
    - Stimulate the baby by rubbing his chest or feet for 10 seconds.
    - Suction mouth and nose.
    - If the baby does not begin to breathe immediately, position head in a neutral/ sniffing position and ventilate using a bag and mask.
    - If oxygen saturations <90%, commence oxygen.
    - Check glucose level with glucometer and correct as indicated.
- Establish cause and start treatment for suspected cause.
- Immediate investigations are blood sugar, temperature, PCV, sepsis screening, electrolytes.
- Commence CPAP with close monitoring especially if recurrent apnoea.
- Treat for sepsis if other signs. Change to second line antibiotics if already on 1st line antibiotics.
- KMC should be continued or started if baby is stable.

NOTE: If Apoea is seen in a preterm baby who did not have apnoea before or is already on caffeine/aminophylline you MUST consider sepsis. First rule out hypoglycaemia.

Meconium Aspiration Syndrome (MAS)

Acute or chronic hypoxia and/or infection can result in the passage of meconium in utero. In this setting, gasping by the fetus or newly born infant can cause aspiration of amniotic fluid stained with meconium.

Meconium aspiration before or during birth can obstruct airways, cause severe lung inflammation resulting in interference with gas exchange, and lead to severe respiratory distress.

Airway management at delivery may reduce the risk of aspiration in depressed infants.

Management of MAS

A. Observation:

Infants who are depressed at birth and have had meconium suctioned from the trachea are at risk for meconium aspiration pneumonia and should be observed closely for respiratory distress.

1. CXR – Findings include diffuse, asymmetric patchy infiltrates, areas of consolidation (often worse on the right), and hyperinflation.
2. Oxygen saturation monitoring aids the assessment of the severity of the condition and avoids hypoxaemia.

B. Care of Neonate with MAS

1. Minimal handling to prevent agitation.
2. Correct hypoglycaemia.
3. Pay particular attention to electrolytes, particularly calcium, and monitor blood gases (likely metabolic acidosis).
4. Cautious fluid management to avoid cerebral and pulmonary oedema or dehydration from hyperventilation.
5. Monitor blood pressure – may require inotropes.
6. Maintain haemoglobin levels above 15g/dl (improves oxygenation).
7. Monitor renal function (urinary output).

C. Oxygen Therapy

Management of hypoxaemia should be accompanied by increasing FiO2 and monitoring blood gases and pH.

D. Assisted Ventilation

1. CPAP – Considered when saturation is less than 90%, with a maximum CPAP pressure of 8 cm, and if the child is in distress or if FiO2 > 0.40 (40%).

However, CPAP may sometimes aggravate air trapping and should be instituted with caution if hyperinflation is apparent clinically or radiologically.

2. Mechanical Ventilation – When available and if the baby is not improving on CPAP.

E. Medications

1. Antibiotics: Use broad-spectrum antibiotics (e.g. Penicillin and Gentamicin), which can be guided by blood cultures.
2. Surfactant: Though not routinely used, it may be of benefit in those with clinical deterioration and who require escalation of support.
3. Sedatives: May be warranted if requiring mechanical ventilation.

Complications of MAS

a. **Air Leak**: Pneumothorax and pneumomediastinum occur in 15 to 33% of cases. This is common with mechanical ventilation, especially in the setting of air trapping.

- Treatment involves chest tube insertion for drainage.
- Paediatric surgical consult.

b. **Persistent Pulmonary Hypertension of the Newborn:** Treatment options include:

- Inhaled nitric oxide
- Phosphodiesterase inhibitors, e.g., Sildenafil and Milrinone
- Cardiologist consult

c. **Pulmonary Sequelae:** Approximately 5% of survivors require oxygen supplementation at 1 month. They may have abnormal pulmonary function, including increased FRC, airway reactivity, and a higher incidence of pneumonia.

CHAPTER 5:
BACTERIAL INFECTION AND SEPSIS

Definition

Neonatal sepsis is a clinical syndrome of systemic illness accompanied by bacteraemia occurring in the first 28 days of life. A bacterial infection such as septicaemia, meningitis, pneumonia, urinary tract infection, or meningitis can have serious consequences for newborns. Unfortunately, even serious infections can be difficult to detect in newborns. One must have a high degree of suspicion and a low threshold for treating newborns with antibiotics.

1. Classification and Risk Factors of Neonatal Sepsis

Neonatal sepsis can be classified into two major categories depending on the onset of symptoms.

1. Early onset sepsis (EOS):

Presents within the first 72 hours of life. In severe cases, the neonate may be symptomatic at birth. Infants with EOS usually present with respiratory distress. The source of infection is generally the maternal genital tract. Risk factors for EOS are:

- Prolonged rupture of membranes > 18 hours.
- Febrile illness in the mother with evidence of bacterial infection within 2 weeks prior to delivery.
- Foul-smelling liquor.
- Perinatal asphyxia (APGAR score < 4 at 1 minute) requiring resuscitation at birth.
- Prematurity (<37 weeks' gestation).
- Low birth weight.
- Mother given parenteral antibiotics for confirmed or suspected invasive bacterial infection (such as septicaemia) at any time during labour, or in the 48-hour period before and after birth.
- Suspected or confirmed infection in a co-twin.

2. Late onset sepsis (LOS):

Usually presents after 72 hours of age. The source of infection in LOS is either nosocomial (hospital-acquired) or community-acquired, and neonates usually present with septicaemia, pneumonia, or meningitis.

Risk factors for nosocomial (hospital-acquired) LOS are:

- Not washing hands prior to handling each baby.
- Admission to the intensive care unit.
- Administration of parenteral fluids.
- Invasive procedures (e.g., lumbar puncture).
- Mechanical ventilation (e.g., CPAP).
- Use of stock solutions.
- Prolonged hospital stays.

3. Risk factors for community-acquired LOS are:

- Poor hygiene.
- Poor cord care.
- Pre-lacteal feeds (any food given to neonates except breast milk before initiating breastfeeding).
- Bottle-feeding.

2. Suspect Bacterial Infection, If:

The newborn has one or more of the following danger signs:

- Fever (temperature >38ºC), hypothermia (temperature <36ºC)
- Abnormal breathing: grunting, severe chest indrawing, nasal flaring, or apnoea
- Cyanosis
- Tachycardia (heart rate >180) or bradycardia (heart rate <80)
- Tachypnoea (respiratory rate >60) or bradypnoea (respiratory rate <30)
- Poor perfusion: capillary refill time >3 seconds
- Abnormal activity: lethargy, floppiness, irritability, stiffness, or minimal response to stimulation
- Abnormal feeding: poor feeding, otherwise unexplained hypo- or hyperglycaemia
- History of convulsions

Localising signs:

- Severe jaundice
- Multiple or severe skin pustules
- Umbilical redness extending to periumbilical skin
- Umbilicus draining pus
- Bulging fontanelle
- Painful or swollen joints with reduced movement and irritability if these parts are handled

- Abdominal distension
- The baby is premature (<37 weeks' gestation) or low birth weight (<2.5 kg)
- There are maternal risk factors for infection:
    - Maternal fever (temperature >38ºC) during labour or within 24 hours after delivery
    - Rupture of membranes >18 hours before delivery
    - Foul-smelling amniotic fluid
    - Obstetric diagnosis of chorioamnionitis

3. Laboratory Studies

- CBC (Complete Blood Count) with differential
- PBF (Peripheral Blood Film) with:
    - I:T Ratio (Immature Neutrophils [Bands] / Total Neutrophils)
    - ANC (Absolute Neutrophil Count)

Concern for sepsis if:

- Total WBC is abnormal (<5000/mm³ or >20,000/mm³)
- Differential with granulocytes >70%
- Neutrophil count <2 or >15x10/L
- Absolute neutrophil count: <1500/mm³
- Toxic granulation in neutrophils [or if measured, an immature: total (I:T) neutrophil ratio > 0.2].
- PBF: Nucleated or fragmented RBC, toxic granules
- PLT (Platelet) count: <100,000/mm³

Full blood count

- C-Reactive Protein (CRP) – if CRP is elevated
    - Acute phase protein synthesised in the liver in response to inflammatory cytokines.
    - Generally, a delay of 24 hours between the onset of symptoms and the rise in serum CRP
    - Take a sample at presentation and a further sample 18–24 hours after the first CRP sample
    - A rise may support the diagnosis of infection, but failure to rise does not exclude it where other findings are supportive

- If blood culture is negative and clinical condition is satisfactory, failure of CRP to rise during the first 48 hours is a useful indicator that antibiotics may be safely stopped

Microbiology

- If available, best practice is to take a sample for blood culture before the first dose of antibiotics.

Urine microscopy, culture and sensitivity

- Clean-catch or supra-pubic aspiration (SPA). Use ultrasound scan to check urine in the bladder before SPA.
- Do not send urine collected in a bag for bacterial culture.
- If available, consider urinalysis and gram stain.
- If available, consider lumbar puncture (LP) when concerned about meningitis (lethargy, irritability, convulsions, bulging fontanelle).

Lumbar puncture (LP)

- If baby is unstable, has deranged clotting, or thrombocytopenia (inform the managing consultant)
- Send CSF for urgent Gram stain and culture (MC&S), protein, and glucose
- PCR for bacteria and viruses if available

Imaging

- Consider chest x-ray if respiratory distress or oxygen desaturation (SpO_2 < 90%)
- If abdominal distension noted, consider abdominal X-ray

Management of Neonatal Sepsis

The management of neonatal sepsis has two components: Supportive therapy and specific (antimicrobial) therapy.

- **Supportive therapy**
  - Thermal care
  - Maintenance of oxygen saturation
  - Maintenance of intravenous fluids (in hemodynamically unstable baby)
  - Maintain normal blood glucose level
  - Adequate nutrition

- **Specific/Antimicrobial therapy**
  - Decision to start antibiotics is based upon presence/absence of risk factors, clinical features and/ or a positive septic screen.
  - Duration of antibiotic therapy is also dependent upon clinical features and any available laboratory and microbiological results.
- **The indications for starting antibiotics in EOS include one or more of:**
  - Presence of risk factors for early onset sepsis (see above)
  - Strong clinical suspicion of sepsis
- **The indications for starting antibiotics in LOS include one or more of:**
  - Presence of nosocomial or external risk factors for late onset sepsis (see above)
  - Strong clinical suspicion of sepsis

Recommended Antibiotic Therapy (Adapted from WHO Guidelines)

Risk of Sepsis

- **First line:** Ampicillin PLUS Gentamicin
- **Second line:** 3rd generation Cephalosporin such as Ceftriaxone/Cefotaxime PLUS Gentamicin

Neonatal Meningitis

- **First line:** High dose Ampicillin PLUS Gentamicin
- **Second line:** 3rd generation Cephalosporin such as Ceftriaxone/Cefotaxime PLUS Gentamicin

Severe Infection with Localising Signs

- Risk of Staphylococcal infection (extensive skin pustules/abscess/omphalitis) Ampiclox (IV) PLUS Gentamicin
- Severe conjunctivitis:
- Ceftriaxone 50mg/kg once (max 150mg) PLUS Tetracycline eye ointment (see below)
- Abdominal distension and concerns about necrotizing enterocolitis:
- 3rd generation Cephalosporin such as Ceftriaxone/Cefotaxime PLUS Metronidazole

Table 17, Antibiotic and Antimicrobial Dosing by Postnatal Age and Postmenstrual Age (PMA) in Neonates

Medication	Dose/Frequency			Comments
	< 7 days	7 -21 days	> 21 days	
	< 35 weeks PMA* (if PMA not known use current weight < 2.0 kg)	> 35 weeks PMA* (if PMA not known use current weight > 2.0 kg)		
Ampicillin or Cloxacillin	50 mg/kg IV every 12 hours For Meningitis: 100 mg/kg IV every 12 hours	50 mg/kg IV every 8 hours For Meningitis: 100 mg/kg IV every 8 hours	50 mg/kg IV every 6 hours for For Meningitis: 100 mg/kg IV every 6hr.	-
Gentamicin1	3 mg/kg IV once a day (BW <2kg) 5mg/kg (BW >2kg) For Meningitis: 7.5 mg/kg once a day	7.5 mg/kg IV once a day For Meningitis: 7.5 mg/kg once a day	7.5 mg/kg IV once a day For Meningitis: 7.5 mg/kg once a day	Use newborn dose through 0-28 days
Cefotaxime2	50 mg/kg IV every 12 hours	50 mg/kg IV every 8 hours	50 mg/kg every 6 hours	Preferred over Ceftriaxone for Jaundiced babies
Ceftriaxone3	100 mg/kg IV every 24 hours for sepsis 100 mg/kg IV every 24 hours for meningitis	100 mg/kg IV every 24 hours for sepsis 100 mg/kg IV every 24 hours for meningitis	100 mg/kg IV every 24 hours for sepsis 100 mg/kg IV every 24 hours for meningitis:	Contraindicated in setting of jaundice or within 48 hours of IV calcium administration
Metronidazole	7.5 mg/kg IV every 24 hours	7.5 mg/kg IV every 12 hours	7.5 mg/kg IV every 8 hours	Anaerobic coverage including treatment of necrotizing enterocolitis

Note: See next notes about PMA, gentamicin, cefotaxime and ceftriaxone

*PMA: Post Menstrual Age

4. GENTAMICIN: Gentamicin has been proven to be safe and effective with therapeutic peaks and troughs, and without renal complications in neonates with normal renal function at the prescribed once-daily doses. If there are any concerns about renal impairment review the choice of antibiotics.
5. CEFOTAXIME: Preferred to Ceftriaxone for treatment of presumed meningitis in the context of severe jaundice or prematurity (due to increased risk of jaundice), to replace gentamicin in the treatment of sepsis in the setting of renal dysfunction, or to treat presumed meningitis due to poor CNS penetration of gentamicin.
6. CEFTRIAXONE: Do not use in setting of hyperbilirubinemia because displaces bilirubin from albumin, do not administer within 48 hours of IV calcium in newborns < 28 days of age due to risk of lethal precipitation.

Duration of Antibiotic Therapy:

Duration of antibiotics is determined by review of risk factors, clinical condition and response to treatment and laboratory results.

1. Low risk

- Few perinatal risk factors for sepsis
- Clinical course mild with newborn asymptomatic at 48 hours
- Laboratory testing reassuring with total WBC between 5,000 and 20,000, granulocyte <70% and/or CRP normal
- If available –> blood cultures negative at 48 hours
- The baby should be re-evaluated after 48 hours, and antibiotic therapy should be discontinued. If there are residual concerns – the newborn should be observed for 1-2 days off antibiotics to monitor for signs and symptoms of partially treated sepsis.

2. Moderate risk

- Multiple perinatal risk factors for sepsis
- Symptomatic at presentation
- Laboratory testing abnormal with total WBC < 5,000 or > 20,000, granulocyte >70% and/or CRP is elevated
- If available – CXR showing changes compatible with pneumonia
- The baby should be re-evaluated after 48 hours.
- If there is some clinical improvement then continue the first line antibiotics for a minimum of 7 days.
- If there is little or no clinical improvement then change to second line antibiotics for 7-14 days.

3. High risk

- Multiple perinatal risk factors for sepsis
- Clinical signs and symptoms suggestive of meningitis
- If available – positive blood culture
- If available – positive CSF findings - Cerebrospinal fluid (CSF) with >30 WBC or positive CSF culture
- If available and blood culture positive, treat for a minimum of 14 days
- If clinical or laboratory diagnosis of meningitis, treat for 14 to 21 days
- If gram positive organism isolated, treat for 14 days
- If gram negative organism isolated, treat for 21 days
- If unable to culture/identify organism – assess clinical condition and available laboratory parameters to decide on duration between 14-21 days.

Table 18, Empiric Antibiotic Therapy by Condition for Neonates < 1 Month of Age

Antibiotic Coverage Summary by Condition for newborns < 1 month of age					
Condition	**Clinical Condition**	**Laboratory Results**	**Treatment recommends**	**Therapy Duration**	**Comments**
Sepsis Evaluation: negative	Normal vital signs, well appearing	Normal WBC, differential, CRP, CXR	Ampicillin Gentamicin	48 hours	
Sepsis/ Pneumonia	Abnormal vital signs, ill appearing	Abnormal WBC, differential, CRP, CXR	Ampicillin Gentamicin	7 days	
Sepsis/ Pneumonia: Not improving	Abnormal vital signs, ill appearing, poor response to antibiotics after 48 hrs	Abnormal WBC, differential, CRP, CXR	Ampicillin Cephalosporin	7- 14 days	Cefotaxime preferred over ceftriaxone
Meningitis	Abnormal vital signs, ill appearing, abnormal neurological exam	Abnormal WBC, differential, CRP, CXR, CSF	Ampicillin Cephalosporin	14 days if gram + and 21 days if gram -	Cefotaxime preferred over ceftriaxone
Urinary Tract Infection	Abnormal vital signs, ill appearing	Urinalysis result concerning for urinary tract infection	Ampicillin Gentamicin	7 days	Generally considered in newborns ≥ 7 days

Mild Localised Infection

Local skin infection:

Few pustules **without danger signs** are treated with oral amoxicillin (refer to IMNCI chart booklet for doses). The mother / care giver should give 2 oral doses of oral amoxicillin and do treatment of the infected area(s) as follows twice daily for 5 days:

- Wash hands
- Gently wash of pus and crusts with soap and water
- Dry the area(s)
- Paint the skin or umbilicus/cord with full strength gentian violet (0.5%)
- Wash hands again

Oral thrush

Oral thrush (ulcers or white patches in the mouth) without danger signs are treated by the mother / caregiver as follows 4 times daily for 7 days:

- Wash hands
- Paint the mouth with half-strength gentian violet (0.25%) using a clean, soft cloth wrapped around the finger
- Wash hands again

Eye infection

Pus draining from the eye/eyes **without danger signs** is treated by the mother / caregiver with **tetracycline eye ointment** as follows:

- Clean both eyes
- Wash hands
- Use clean cloth and water to gently wipe away pus
- Then apply tetracycline eye ointment in both eyes 4 times daily
- Squirt a small amount of ointment on the inside of the lower lid
- Wash hands again
- Treat until there is no pus discharge
- Do NOT put anything else in the eye

For all local infections: the baby is referred to higher level of care if there is no improvement in 2-4 days.

The baby is closely followed up by Community Health Worker and PHU during the treatment.

PREVENTION OF SEPSIS

- Health workers in the neonatal unit to be bare below elbow, wear short sleeves.
- Remove jewelry including wedding rings, watches, bracelets.
- Strict hand washing with liquid soap and strict hand hygiene (refer to section on IPC and hand washing) starting from the entrance of the SCBU.
- Minimize frequency of opening incubator doors or touching any part of baby's cots.
- Do not lean on incubators or other patient equipment.
- Wear apron and sterile gloves when carrying out any procedure on a baby e.g. heel prick, re-siting IV cannula.
- Health workers MUST NOT wear same pair of gloves for feeding and taking vital signs of more than one baby at a time. Recommended to use washed hands.
- Initiate enteral feeds with maternal breast milk within 24 hours of birth.
- Aim to initiate skin -skin with mother /KMC within 24 hours of birth for all babies.
- Institute buccal colostrum swabbing within 6hours of birth for the ill and small newborns if breastfeeds not yet feasible.
- Remove all IV cannulae for the baby once no more needed.
- Do not use phones in the neonatal unit.

CHAPTER 6:
NEONATAL SHOCK AND HYPOTENSION

Identification of shock

The term shock denotes a clinical state of poor perfusion of the body in which the body's demand of oxygen and nutrients are not met with accumulation of the metabolic end products. This results in tissue hypoxia and metabolic acidosis leading to irreversible tissue damage.

Shock and hypotension are not synonyms. Hypotension (a blood pressure that is lower than that of the expected reference range) is a late sign of shock.

Table 19, Shock Identification

Cold peripheries
And
Capillary refill time > 3 seconds
And
Weak or fast pulse (>180 beats/min)
Must have all 3 signs to be in Shock

Other features that might be present:

- Pallor
- Mottling of skin
- Lethargy/unconscious
- Decreased urine output
- Low blood pressure (a late sign)

Note that mottled skin and prolonged CRT are commonly seen in hypothermia with or without sepsis Hence hypothermia must be identified and corrected.

Prolonged capillary refill time (CRT):

- Time taken by capillaries to refill after their emptying by pressure. It indicates adequacy of blood circulation/perfusion.
- In small babies CRT is checked over the sternum (breastbone).

Checking CRT:

- Apply steady gentle pressure over the sternum with a fingertip. Applying just enough pressure to empty the underlying capillaries.
- Continue to apply pressure for 5 seconds.
- Count: "one and two and three and four and five"
- Then do the following three things AT THE SAME TIME:
- Lift up your finger from the point of application.
- Restart counting "one and two and three...."
- Watch for the time needed for the blanched capillaries to refill.
- Stop counting right the moment the capillaries fill-up.
- A CRT of ≤ 3 seconds is considered normal.

Causes and types of shock

- Hypovolaemia
- Septic shock has multiple mechanisms:
- Cardiogenic resulting from myocardial depression
- Peripheral vasodilatation resulting in reduced afterload leading to distributive shock.
- Cardiogenic shock occurs due to low cardiac output, as in perinatal asphyxia, PDA (Patent Ductus Arteriosis) and other congenital heart diseases, arrhythmia, hypoglycaemia, acidosis and sepsis.

Hypovolemic shock results from:

  - Fluid loss as happens in vomiting, diarrhoea, polyuria, excessive insensible water loss, poor fluid intake, and pathological renal losses.
  - Blood loss in situations like feto-maternal, feto-fetal transfusion, traumatic and pulmonary blood loss, IVH (Intra-ventricular Haemorrhage)

Other less common causes include:

- Obstructive shock occurs in aortic stenosis, coarctation of aorta, tension pneumothorax, pericardial tamponade.
- Distributive shock also occurs in anaphylactic, neurogenic (loss of sympathetic vascular tone), and with drugs.

Note that multiple mechanisms play a role in development of shock in sepsis and perinatal asphyxia.

Management of shock – fluids

Aim of management: Correct shock, treat underlying cause (if known) and prevent irreversible shock/ complications.

The outcome of shock depends on the promptness of its detection and timely initiation of appropriate management. The aim is restoration of tissue perfusion promptly and is the cornerstone of management. TABC (Temperature, Airway, Breathing and Blood Glucose, Circulation) should be maintained:

- Maintain temperature 36.5-37.5ºC (97.5-99.5ºF).
- Ensure airway is patent and secured.
- Give oxygen to maintain saturation 90-94%.
- Maintain blood glucose ≥ 2.2 mmol/L (> 45mg/dl).
- **Fluid management:**

IF THERE IS HISTORY OF BLOOD LOSS

- Give 20ml/kg of fresh whole blood over 1 hour or,
- If no blood available give 10ml/kg of Normal Saline or Ringer's Lactate over 30 minutes.

IF THERE IS NO HISTORY OF BLOOD LOSS

- Give 20 ml/kg of Normal Saline or Ringer's Lactate over 1hour.
- Assess for improvement (Reduction in CRT towards <3 seconds and decrease in heart rate by at least.
- 10 beats/min)
- If shock persists (HR >180 bpm, CRT >3s, cold peripheries) give another dose 10ml/kg of Normal saline over 30 minutes.

- **Treat underlying cause of shock.**
- Give blood transfusion if hypovolaemic due to blood loss.
- Give antibiotics for septic shock.
- Once shock resolved, start maintenance fluids appropriate for age and weight.

Improvement is assessed as follows:

- Reduction of CRT towards normal (< 3 seconds)
- Decrease in heart rate at least by 10 beats/min

If signs of poor perfusion persist despite giving 2 boluses, vasopressors should be started. Vasopressors and ionotropes are drugs that improve myocardial contractility and thereby

cardiac output. Some degree of myocardial depression is present in all types of shock and vasopressors are helpful. The most used vasopressors are Dopamine and Dobutamine.

Dobutamine improves cardiac output and decreases vascular resistance. It is mostly used in combination with Dopamine to boost up its efficacy.

Hydrocortisone may be considered in those who do not respond to maximal doses of both Dopamine and Dobutamine (>20 πgram/kg/min).

Table 20, Neonatal Shock – Medication Dosing Protocols

Drug		Start dose Continuation	Maximum dose
Dopamine (1 ml = 40 mg)	10 µgram/kg/min	Increase with an increment of 5 µgram/kg/min every 20-30 minutes as needed to improve perfusion	20 µgram/kg/min.
Dobutamine (1 ml = 50 mg)	10 µgram/kg/min	Increase with an increment of 5 µgram/kg/min every 20-30 Minutes	20 µgram/kg/min.
Hydrocortisone	1mg/kg/dose every 8-12 hours depending on response for 2-3 days		

Preparation of Dopamine for Infusion

- Use Insulin syringe for loading the Dopamine.
- One ml of Dopamine injection contains 40 mg Dopamine.
- **Example:** To start Dopamine at a rate of 7.5µ/kg/min in a baby weighing 2.5 kg
- 10X2.5 = 25µgram/min
- 25X60X24 = 36000 µgram/day= 36mg/day (1X36÷40= 0.9)
- 36mg (0.9ml) of Dopamine in 24 hours, in other words it means 12 mg (0.3ml) of Dopamine in 8 hours.

This means that adding 0.9ml of Dopamine to 23.1 ml of fluid (0.9ml = 36 mg of Dopamine in 24 ml), so by giving 1ml/hour of this preparation will deliver the desired 0.9ml (36mg) per 24 hour.

- In situations where infusion pumps are not available, adding 12mg (0.3 ml) of Dopamine to 8 hours maintenance fluid will serve the purpose.

After starting Dopamine drip, the status of the neonate's perfusion must be assessed carefully by serial monitoring of CRT and heart rate. If available, a non-invasive blood pressure monitor should be used to check the BP (blood pressure).

Re-check after 20-30 minutes if the response is inappropriate, increase Dopamine by 5 µgram/kg/min gradually to reach up to 2ml/hour (20µgram/kg/min). With improvement in

perfusion the rate should be decreased by 5 µgram/kg/min. As long as the infant remains on Dopamine, the status of circulation must be monitored frequently, at least hourly.

If the baby continues to be in shock despite Dopamine at 20µgram/kg/min, Dobutamine should be added similarly as Dopamine. The dosage schedule of dobutamine is similar to Dopamine. One ml of injection contains 50 mg Dobutamine.

Hydrocortisone (1mg/kg 12 hrly x 2days) may be considered in those who do not respond to maximal doses of both Dopamine and Dobutamine (>20 πgram/kg/min).

Targets of treatment

Treatment should be tailored as per assessment and response to achieve:

- CRT <3 seconds
- Normal HR for age
- Normal volume of pulses
- Warm extremities
- Normal BP for age
- Urine output >1ml/kg/hour

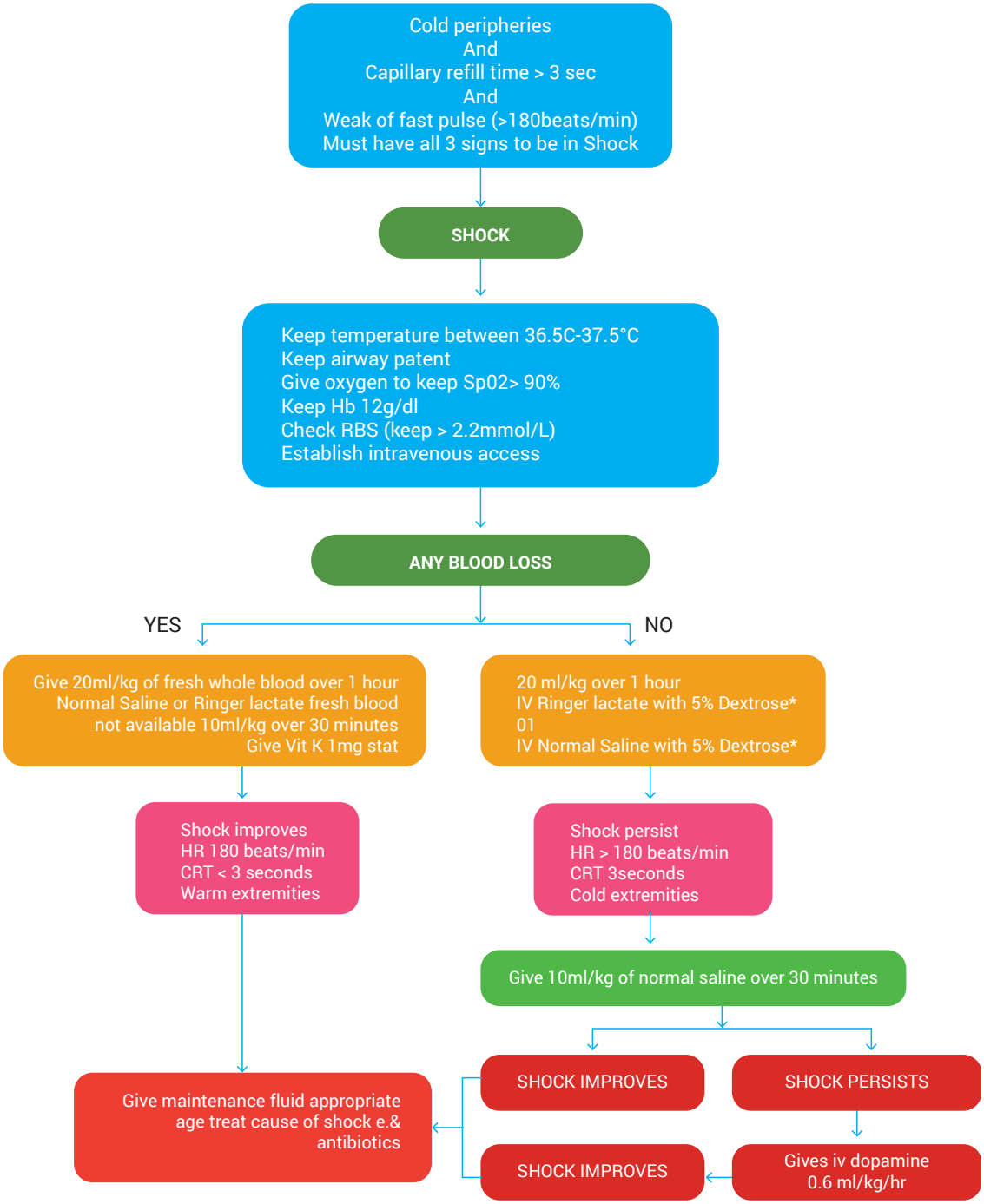
Weaning from ionotropes/vasopressors

Once hypotension improves and maintained for 4-6 hours and tissue perfusion is adequate (as clinically indicated by adequate urine output) the doses of the ionotropes /vasopressors should be tapered slowly at a rate of 5µ/kg/min every 1-2 hours, provided the therapeutic goals are maintained.

When neonates with shock do not respond to the above treatments for example in presence of hypoglycaemia, hypoxia, hypothermia, hyperkalaemia, anaemia, sepsis etc., consider giving blood transfusion if Hb is < 12 gram/dl.

- Consider blood transfusion 20ml/kg over 3-4 hours

Figure H, Shock in Neonates



CHAPTER 7:
LOW BIRTH WEIGHT AND PREMATURE BABIES

Identification and Causes of Low Birth Weight

Low birth weight babies (LBW) are defined as babies with birth weight of <2500 gram (2.5kg) irrespective of the gestational age.

LBW is generally associated with increased morbidity, mortality and impaired immune function. Morbidities of low-birth-weight babies during the neonatal period are usually due to the physiological immaturity of the different organ systems and low reserves thereby creating a greater stress on them for extra uterine adaptation and hence higher mortality. Even after recovering from neonatal complications, some LBW babies may remain more prone to malnutrition, recurrent infections and poor cognitive development. Therefore, low birth weight is a key risk factor of adverse outcome in early life.

Table 21, Birth Weight Categories

Normal birth weight:	2500-< 4000grams
Low Birth Weight (LBW):	1500-< 2500grams
Very Low Birth Weight (VLBW):	1000-<1500 grams
Extremely Low Birth Weight (ELBW):	< 1000 grams
Macrosomia (Big babies)	≥ 4000 grams

Causes of LBW among newborns:

4. Preterm birth (less than 37 weeks completed gestation).
5. Intrauterine growth restriction (IUGR): The babies are defined as small for gestational age (SGA), if their weight is below the 10th percentile on the chart, for that gestational age. The majority of our LBW neonates fall into this category.

Classification of a low-birth-weight baby:

It is important to classify the babies to determine the risk of problems. The babies who are preterm as well as SGA are more at risk than the baby who is only preterm. All babies should be classified as soon as they are admitted to SCBU for appropriate management, monitoring and prognosis.

Preterm babies can be classified into these different categories:

1. **Based on gestational age**

i. Extremely preterm: Less than 28 weeks GA
ii. Very preterm: 28 weeks to less than 32 weeks GA
iii. Moderate: 32 weeks to less than 34 WEEKS GA
iv. Late preterm: 34 weeks to less than 37 weeks GA

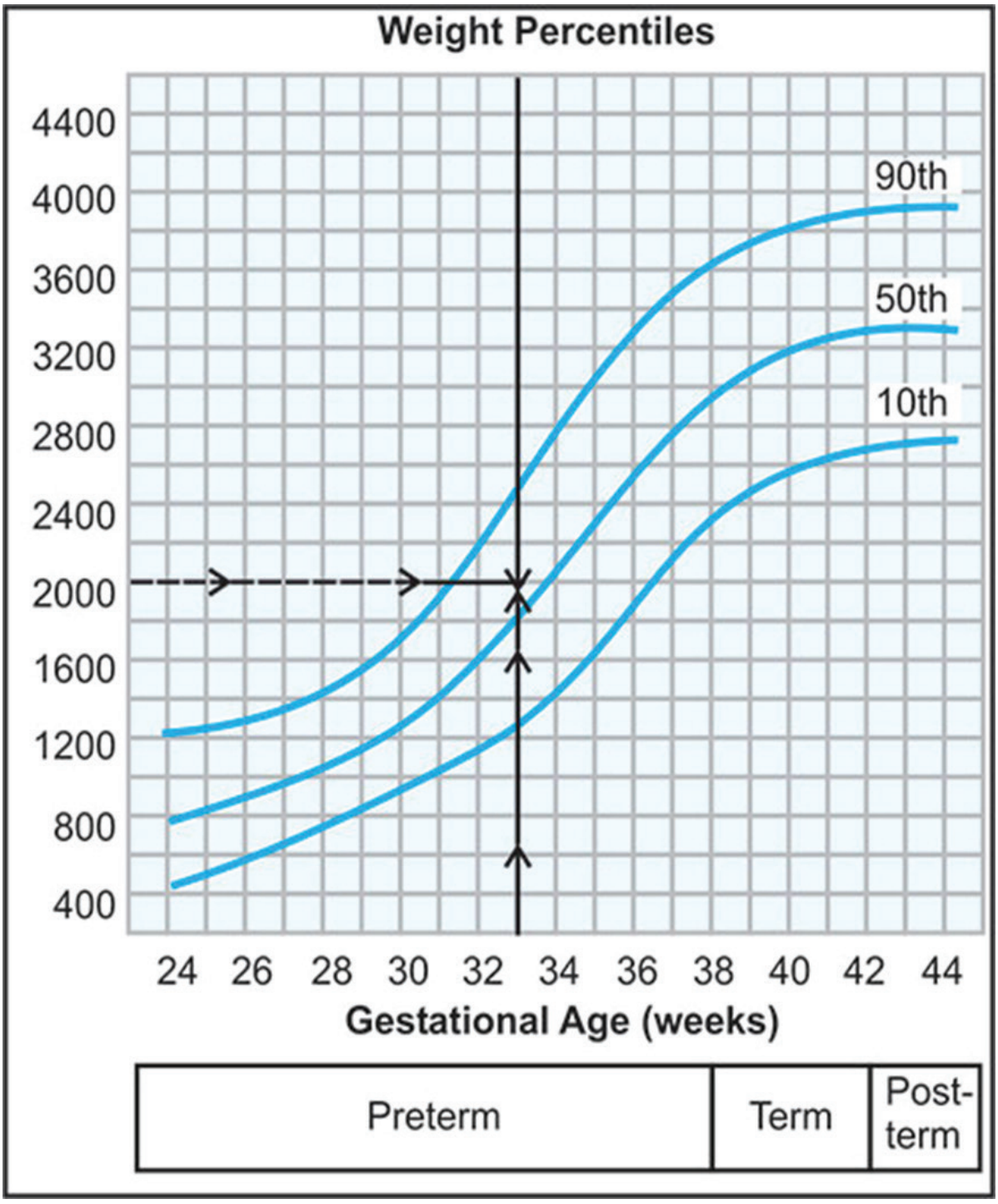
2. **Based on weight percentile (see figure I of Lubchenco chart below)**

v. Large for gestational age (LGA) – Babies above 90th percentile of their gestational age
vi. Appropriate for gestational age (AGA) – Babies between the 10th and 90th percentile
vii. Small for gestational age (SGA) – Babies less than 10th percentile
viii. Low birth weight babies can be preterm babies or small for gestational age or both

3. **Based on clinical status:**

i. Well small baby
ii. Sick small baby

Figure I, Lubchenco Chart (Intrauterine growth chart)



COMMON PROBLEMS OF PRETERM BABIES

Preterm babies are prone to complications and the smaller the baby, the higher the risk of developing immediate and long-term problems. Some of the common problems are highlighted in table 22 and discussed in detail in relevant aspects of this guideline.

Table 22, Problems of Preterm Babies and Different Ways of Managing Them

PROBLEM	POSSIBLE CAUSE	MANAGEMENT
Respiratory Distress Syndrome	Lack of surfactant in alveoli; lung immaturity	■ Ensure IM Dexamethasone injection 6 mg 12-hourly × 48 hrs (12-hourly × 4 doses) for mothers with GA <34 weeks before delivery ■ Early delivery room bubble CPAP/ mechanical ventilation ■ Surfactant administration ■ Aim to use T-piece resuscitator (use bag and mask if unavailable)
Apnoea	Immaturity of respiratory centre	■ Close monitoring ■ Bag and mask ventilation ■ Investigate for any metabolic causes ■ Use of medications such as caffeine citrate or aminophylline
Hypothermia	Lack of stored subcutaneous fat/ brown fat	■ Keep warm. See section on thermoregulation (Chapter ?)
Hypoglycaemia	Inadequate glycogen stores Impaired glycogenolysis due to immature liver	■ Early initiation and maintenance of breastfeeding ■ Intravenous glucose infusion/ partial parenteral nutrition
Feeding Difficulties	Uncoordinated sucking and swallowing process	■ Feed with EBM via naso/ orogastric tube or using a Nifty cup ■ Total/partial parenteral nutrition as indicated
Jaundice	Impaired bilirubin metabolism due to liver immaturity	■ Adequate fluid/feeds ■ Phototherapy ■ Exchange blood transfusion

PROBLEM	POSSIBLE CAUSE	MANAGEMENT
Anaemia	■ Depleted iron stores ■ Bone marrow immaturity ■ Iatrogenic (repeated phlebotomy)	■ Prompt initiation of iron, folic acid, and other supplements (start iron at 2 weeks; start others when baby is receiving >100 ml/kg/day of enteral feeds and parenteral lipid provision is ≤5 ml/kg/day) ■ Minimise volume of blood per phlebotomy session ■ Blood transfusion as indicated
Infections	Immature immune system	■ Hand washing/universal precautions ■ Antibiotics
Necrotising Enterocolitis	Immature GI tract	■ Modify feeding protocol ■ NPO ■ Nasogastric tube to decompress ■ Antibiotics as per guideline
Intraventricular Haemorrhage	Immaturity of the germinal matrix of the lateral ventricles Risk factors: acidosis, asphyxia, shock, and BP fluctuations	■ Prevent risk factors ■ Cranial USS and serial OFC measurements ■ IM Vitamin K ■ Careful resuscitation and minimal handling
Retinopathy of Prematurity	Abnormal proliferation of retinal vessels Worsened by prolonged unblended 100% oxygen use	■ Follow guidelines for ROP screening ■ Use blended oxygen therapy and strict monitoring with pulse oximeter ■ Referral to paediatric ophthalmologist for early detection and treatment
Congenital Conditions	Congenital heart disease (e.g. PDA), other congenital anomalies	■ Oral NSAIDs (Ibuprofen) ■ Anti-failure drugs ■ Review by paediatric cardiologist
Hypocalcaemia	Poor placental transfer Immature parathyroid gland	■ Prophylactic calcium supplementation

Identification of a preterm baby

1. The newborn's due date can be calculated from the date of the last menstrual period (LMP) by subtracting 3 months and adding one week (eg an LMP of October 21st = due date of July 28th).
2. Determine the gestational age for all LBW newborns

- Use LMP if known
- Assess ballard score (appendix A) if LMP not known
- If both LMP and Ballard known, use LMP unless differs from Ballard by >2 weeks

Physical maturity

- Skin: The skin of a preterm neonate is thin, transparent and gelatinous whereas that of a term neonate is thick non-gelatinous and keratinized.
- Ear Cartilage: The external ear or the pinna is soft and lacks 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 5mm 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
- External Genitalia: In males, the scrotum does not have rugae (folds, ridges) and testes may not be descended into the scrotum. In female infants, the labia majora are widely separated, not covering the labia minora, resulting in the prominent appearance of the clitoris.

3. Early antenatal ultrasound scan

Problems of SGA Babies

The basic underlying problem among them is in-utero under nutrition and hypoxia. They are more prone to:

- Fetal distress and birth asphyxia
- Polycythemia
- Hypothermia
- Hypoglycemia
- Congenital malformations

Management of Low-Birth-Weight Baby

Ideally, the delivery of an anticipated LBW baby must be conducted in a hospital with established newborn care facilities. The transfer of the pregnant woman with low birth foetus is far more desirable, convenient and safe than the transport of LBW newborn after birth.

PRETERM RESUSCITATION

Preterm babies are at additional risk for requiring resuscitation because of their:

- Excessive heat loss.
- Vulnerability to hyperoxic injury.
- Immature lungs and diminished respiratory drive.
- Vulnerability to infection.
- Low blood volume, increasing the implications of blood loss.

Additional resources needed to prepare for an anticipated preterm birth include:

- Additional trained personnel, including intubation expertise
- Careful attention for maintaining temperature.
- Pulse oximetry.
- Compressed air/oxygen blender.

Premature babies are more vulnerable to hyperoxia; use an oximeter and blender to gradually achieve oxygen saturations in the 88-92% range during and immediately following resuscitation. Decrease the risk of brain injury by:

- Handling the infant gently.
- Avoiding the Trendelenburg position (baby is supine, and the head is lowered below the feet).
- Avoiding high airway pressures, when possible.
- Adjusting ventilation gradually, based on physical examination, oximetry and blood gases
- Avoiding rapid intravenous fluid boluses and hypertonic solutions (saline) because of the risk of IVH.

After resuscitation:

- Monitor and control blood glucose level.
- Monitor for apnoea, bradycardia or desaturations, and intervene promptly.
- Monitor and control oxygenation and ventilation.
- Consider delaying feeding if perinatal compromise was significant.

- Increase your suspicion for infection.

CARE FOR STABLE PRETERMS OF VARIOUS WEIGHT CATEGORIES

Infants with a birth weight of 2000g – less than 2500g

This category of preterms is usually mature enough to breastfeed and maintain their body temperature. They should be brought to the SCBU for assessment. They can be nursed on the mother's side in the postnatal ward if they are stable.

- Initiate breastfeeding within 1-hour minutes of delivery (their mothers usually need additional support for exclusive breastfeeding or expression of breastmilk).
- Follow the guidelines for routine care of newborns.
- Before discharge assess ability to feed, check temperature and assess for signs of sepsis.
- Arrange neonatal follow-up within 1 week to monitor growth, feeding and temperature.

Mother should be trained on the following- assess temperature by touch technique, kmc, breast feeding positions and attachment, milk expression, kmc, identification of danger signs. Once the mother and the family are confident and the health worker has assessed the knowledge and practice personally, the baby can be discharged and managed at home.

Infants with a birth weight 1500g – less than 2000g

All babies in this category should be admitted in the SCBU and assessed for further management.

- Follow the guideline for routine care of newborns.
- Commence early breastfeeding within an hour of delivery.
- Keep baby warm and commence KMC immediately. Monitor temperature ever 1 hour.
- Review the infants at least twice a day to assess feeding or the presence of any danger signs. If any of these signs is present, baby should be treated promptly.
- Check blood glucose, oxygen saturation and prevent infections.

Infants with a birth weight of <1500g

Most of the babies in this category will require more support. Aim to treat them in Level 3 centres, if there is no adequate expertise in the Level 2 centre. In addition to basic care, the following should be done as indicated:

- Early commencement of bubble CPAP preferably from birth.
- Keep the baby warm. Nurse in an incubator and commence early intermittent KMC even with the incubator.

- Check blood glucose and correct if < 2.7mmol/l.

Set up an IV line and put up a glucose infusion (5% (for less than 1000g) or 10% Dextrose/ water.

- Keep on NPO for the first 24 hours and longer if indicated.
- Commence intravenous antibiotics empirically using the sepsis protocols after a blood culture has been taken and pending the results.
- Cluster care.
- Minimal handling except when necessary.
- Ensure close monitoring for the following:
- Temperature,
- Respiratory difficulties,
- Apnoea,
- Jaundice,
- Feeding,
- Oxygen saturation,
- Blood glucose,
- Signs of infection,
- Fluid input and output monitoring.

The following should also be considered:

- Use of early prophylactic theophylline (caffeine citrate) or aminophylline (if caffeine is not available) for apnoea of prematurity from birth.
- Early initiation of enteral feeding (trophic feeds).
- Psychosocial support for the mother and her family (family centered newborn care).
- Promote developmentally supportive care to maximise baby's neurological development.
- Prompt management of specific medical conditions.

All low birth weight babies of this range should be admitted for assessment by a physician and if needed referred to a higher centre in kangaroo mother care position.

NUTRITION AND FLUIDS

Breast milk feeds are recommended and should be initiated as soon as the baby is stabilised. The following aspects regarding the feeds should be addressed:

- Quantity of feeds.
- Frequency of feeding.

- Mode of feeding that is appropriate for the baby.

More details can be found in chapter (FLUID AND NUTRITION).

Nutritional supplements

1. VITAMIN D

- All LBW infants should receive 400 IU daily of vitamin D once they accept full feeds. This supplementation should continue until 6 months of age.
- Larger doses (800-1000) may benefit the smaller babies (<1500g).

2. VITAMIN A

- A dose of 400- 1000µg/kg/day is recommended for preterm infants. Multivitamin drops 0.3ml/day from the time the baby receives full enteral feeds.

3. CALCIUM AND PHOSPHOROUS

- All VLBW (1500g) should receive calcium 100-220mg/kg/day and phosphorus at 60-140mg/kg/day3 (ostocalcium syrup 5ml = 81mg Ca and 42mg PO4) in divided into 2 doses. This may be continued till 40 weeks post conceptual age or 3.5 to 4 kg.

4. IRON SUPPLEMENTATION

- <37 weeks and/or <2.5kg – give iron supplementation (can start at 2 weeks of age in babies on full feeds) » 3mg elemental iron/kg/day single dose drops up to 2 years. » If discharged prior to 2 weeks, start at the 2-week follow up clinic.

Discharge planning of LBW babies

- Stable baby shows normal vital signs.
- Mother is confident in feeding the newborn and can take care of her at home. (Breast feeding & expressed breastmilk feeding with cup / cup and spoon).
- Consistent weight gain for 3 consecutive days. (Weight daily, head circumference weekly and weekly length should be always recorded at the time of discharge).
- The baby can maintain their temperature in the normal range (36.5°C–37.5°C) in an open cot and the mother knows how to keep the baby warm.
- The required nutritional supplements should be started prior to discharge.
- Ensure that the baby has received BCG and OPV 0 prior to discharge.
- KMC and any other skills are well known to mother and adequately practiced in the hospital under medical supervision.
- Mother has been counselled appropriately about care of baby at home.

- Screening has been done (if facilities are available).

Counselling at Discharge

The mother and the family must be counselled before discharging the LBW neonate from hospital on the following:

- Exclusive breastfeeding
- Thermal protection at home
- When to seek care ("DANGER signs"), and whom and where to contact
- Personal hygiene for prevention of infections
- Scheduled visits for assessing growth monitoring, detecting illness and providing immunization
- Mother's nutrition and healthz Advise for a screen for retinopathy of prematurity (ROP) and hearing evaluation for the babies who are at a very low birth weight 32 weeks/<1500 grams)

Vaccinations for LBW babies

If the LBW baby is not sick, the vaccinations schedule is the same for as the normal babies. Hence, BCG and OPV-0 should be given at the earliest. A sick LBW baby, however, should receive these vaccines only at the time of discharge.

Growth monitoring in LBW infants

All LBW infants should be checked for weight (daily), head circumference (weekly) and length (weekly or fort-nightly) during their SCBU stay. Serial growth monitoring allows early identification of growth faltering.

Prognosis

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

APPENDIX A: BALLARD SCORE

Figure J, 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							

Figure K, 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 ⅔	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

CHAPTER 8:
THERMOREGULATION AND KANGAROO MOTHERCARE

Maintaining a neutral thermal environment is one of the key physiologic challenges that a newborn must face from immediately after delivery. They must be kept warm from the moment of birth, during their time in the labour ward and when transferred to the nursery to maintain the "warm chain".

Even minimal drops in temperature increase the likelihood of mortality. It has been noted that mortality increased by approximately 80% for every degree Celsius decrease in observed axillary temperature, and that relative risk of death ranged from 2 to 30 times for moderate hypothermia, increasing with greater severity of hypothermia.

- Normal axillary temperature range in the newborn is 36.5–37.5°C.

HYPOTHERMIA

This is defined by WHO as axillary temperature that is lower than the normal temperature of 36.5°C.

Grading of hypothermia

WHO temperature grading

- Normal:---------- 36.5oC-37.5oC
- Mild hypothermia (cold stress): ---------- 36°C - 36.4°C
- Moderate hypothermia: ---------- 32°C - 35.9°C
- Severe hypothermia (neonatal cold injury) -------- <32°C

ENCC GRADING

- Normal range (green zone) ---------- 36.5°C – 37.5°C
- Cautionary range (yellow zone)----------35.5°C - 36.4°C
- Danger sign (Red Zone) ---------- <35.5°C or >37.5°C

Four main ways newborns lose heat

Heat loss in newborn is rapid; newborns lose heat through four main mechanisms as shown in figure L and table 23.

Figure L, Mechanisms of Heat Loss in the Newborn

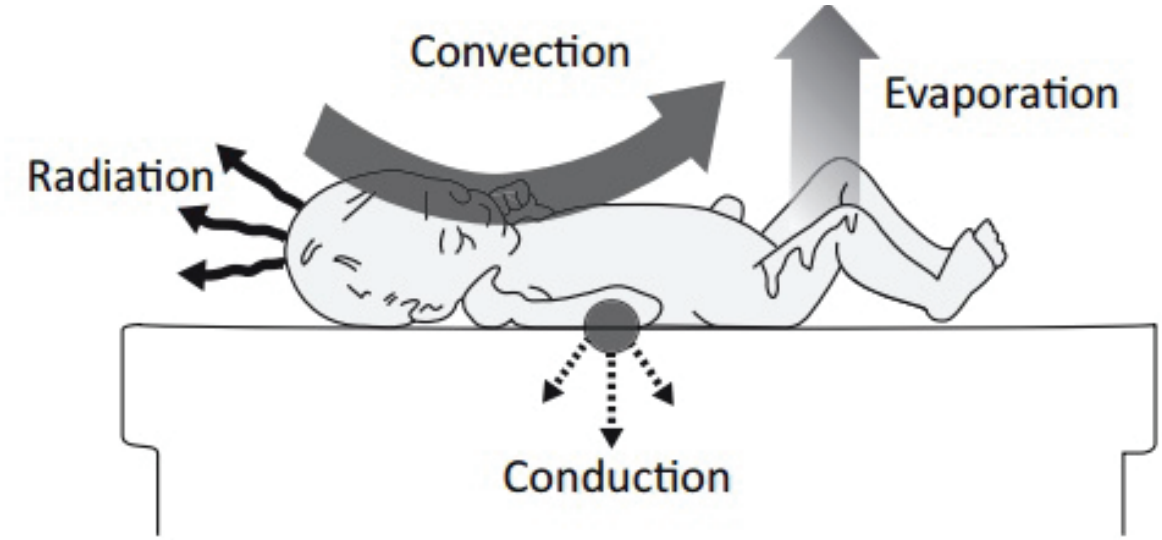


Table 23, Four Mechanisms of Heat Loss in Newborns

Method of Heat Loss	Prevention
Evaporation: Heat loss when water evaporates from the newborn's wet skin (e.g. wet baby)	Immediately after birth dry baby with a clean, pre-warmed, dry cloth and then wrap in another dry warm cloth. Always remember to change the wet cloth!
Conduction: Direct heat loss to solid surfaces on which the patient lies/ come in contact (e.g cold mattresses, weighing scale)	Put the baby on the mother's abdomen for the first 30 min or on a warm surface, delay weighing if room too cold. Place a light, dry material in the weighing scale and zero the scale
Convection: Heat loss due to air currents (drafts) moving heat away from the skin/body. (e.g., exposure to draught)	Close the windows, switch off fans and air conditioners and, if circumstances permit, ■ wait for the room to warm up to 25ºC before performing a Caesarean section; ■ or receive and resuscitate baby in an adjourning room if possible
Radiation: Heat loss via electromagnetic waves from skin to surrounding cooler surfaces (e.g. cold surroundings windows or walls)	Provide a warm, draught free room for delivery or neonatal ward; at least 25ºC.

Common Causes of hypothermia in the SCBU:

- Cold environment/room
- Wet or naked baby
- Cold linen
- Transportation without proper precaution
- Procedures without thermal protection
- Early bath (delay bathing for 24 hours)
- Early weighing (before 60-90 mins)
- Sepsis
- Prematurity
- Hypoglycaemia
- Hypoxia
- Major congenital defects (for example-gastroschisis, omphalocele, neural tube defects)

Symptoms and signs of hypothermia

Hypothermia can cause increased oxygen demand and high energy consumption resulting in diverse complications based on severity.

Symptoms and signs include:

- Bluish discoloration of extremities (acrocyanosis)
- Cold extremities and mottled skin
- Reduced activity/lethargy/weak cry
- Sluggish and inactive neonate
- Poor feeding, failure to gain weight
- Irregular and slow breathing
- Respiratory distress, hypoxia, metabolic acidosis, apnoea,
- Hypoglycaemia, intraventricular haemorrhage, DIC, shock
- Pulmonary haemorrhage, severe bradycardia, neonatal cold injury, and death.

Place all very premature babies <32 weeks' gestation age in a plastic bag immediately after birth without drying, and ensure the radiant warmer is already on. Baby can also be nursed in KMC or in an incubator.

Table 24, Methods Used to Treat Hypothermia

SEVERITY OF HYPOTHERMIA	METHODS USED
Mild Hypothermia	■ Skin-to-skin contact, in a warm room (at least 25°C). ■ Place cap on newborn head. ■ Cover mother and newborn with warm blankets.
Moderate Hypothermia	■ Under a radiant heater. ■ In a pre-warmed incubator. ■ if the newborn is clinically stable, skin-to-skin contact with the mother can be used in a warm room (at least 25°C).
Severe Hypothermia	■ Using a pre-warmed incubator (temperature should be set at 1 to 1.5°C higher than the body temperature) and should be adjusted as the newborn's temperature increases. Warm IV fluid, warm gastric lavage and bladder irrigation. ■ Aim to rewarm at rate of 0.5oC per hour. ■ If no equipment is available, skin-to-skin contact or a warm room or cot can be used.

Prevention of Hypothermia

A. The 10 Steps of Warm Chain:

The newborn baby, particularly premature infant loses heat more easily as they cannot regulate body temperature efficiently. The WHO recommended a set of interlinked procedures to be taken at birth and during few hours after birth to minimize heat loss; this is called the "warm chain":

Table 25, Ten Steps of the "Warm Chain" (adapted from WHO, 1997)

S.NO	Steps	Procedures
1.	Warm Delivery Environment	■ The temperature of the delivery room should be at least 25°C, free from the drafts from open windows, doors, or fans. ■ Supplies needed to keep the newborn warm should be prepared ahead of time. ■ Adults should never determine the temperature of the delivery room according to their comfort.
2.	Immediate Drying	■ Immediately dry the newborn after birth with a dry towel or cloth to prevent heat loss from evaporation. ■ For very preterm babies <32 weeks GA, use the clear plastic wrap from birth.
3.	Skin-to-Skin Contact	■ While the newborn is being dried, place on the mother's abdomen (skin to-skin contact) to prevent heat loss. ○ Cover the newborn with a second towel and put a cap on the head to prevent heat loss. ○ Leave the newborn skin-to-skin on the mother and keep covered.
4.	Breastfeeding	■ Initiate as soon as possible, preferably within 30 minutes of birth.
5.	Postpone Weighing and Bathing	■ Weighing can be done following the period of uninterrupted skin-to-skin contact and the first feed. Place a warm blanket on the scale. ○ Bathing the newborn soon after birth causes a drop in the body temperature and may propagate hypothermia and hypoglycemia. ○ Bathing should be delayed for at least 24 hours after birth.
6.	Appropriate Clothing/Blanket	■ Newborns should be well wrapped with a cap and appropriate clothing.
7.	Mother and Newborn Together	■ Keep mother and newborn together 24 hours a day (rooming-in), in a warm room (at least 25°C). ○ Newborn should be fed on demand. ○ Skin-to-skin (KMC) can be used to rewarm a newborn experiencing mild to moderate hypothermia.

S.NO	Steps	Procedures
8.	Warm Transportation	■ Keep newborn warm while waiting for transportation (unless otherwise advised). ○ Dress the newborn and wrap in blankets if a transport device is used. ○ WHO advocates babies be transported in KMC position once feasible.
9.	Warm Assessment (if newborn is not skin-to-skin with mother)	■ Lay on a warm surface in a warm room. ○ Put under an additional heat source as necessary (i.e. radiant warmer). ○ Utilize servo control if on radiant warmer for >10 minutes.
10.	Training and Raising Awareness	■ Alert health care providers and families to the risks of hypothermia and hyperthermia. ○ Teach the principle of thermal protection of the newborn. ○ Provide on the job training and supervised practice to ensure that the 10 steps of the warm chain become part of the routine care of the newborn. ○ Demonstrate and provide supervised practice on the appropriate use of equipment for low birth weight/preterm newborns.

Supportive care while treating hypothermic newborn

- Continue breast feeding.
- If infant too weak give expressed breast milk by cup or oro/nasogastric tube.
- Assess for infection.
- Monitor oxygen saturation and heart rate.
- Monitor glucose.
- Measure axillary temperature every 30 mins till it reaches 36.5°C.
- Watch for apnoea.

Kangaroo Mother Care

Kangaroo Mother Care (KMC) is “the early, prolonged, and continuous skin-to skin contact between the mother (or substitute) and her low birthweight/premature infant, both in hospital and after discharge, until at least the 40th week of postnatal gestation age, ideally with exclusive breastfeeding and proper follow-up”.

KMC transfers heat from mother to newborn by conduction. Some of the advantages of KMC are prevention of hypothermia, promotion of exclusive breastfeeding, reduction of neonatal infections and early hospital discharge.

Figure M, A Mother with a Baby in KMC Position

1. Kangaroo Mother Care (KMC) for Low Birth Weight (LBW) Newborns (Babies <2.5 kg)

- Encourage all mothers with LBW babies to do KMC.
- KMC transfers heat from mother to baby by conduction.
- Advantages: Prevents hypothermia, enables frequent breast feeding and allows earlier hospital discharge.

Eligibility For KMC

a. Mothers/Caregivers

All mothers/caregivers can do KMC. The person should:

- be willing to do KMC,
- be available all the time to provide the care needed,
- be in good health,
- be supported by the family and community.

b. Newborns

- The baby must be stable and able to breathe on its own (for continuous KMC)
- The baby must be free of life-threatening disease. Please note the following;

- The ability to coordinate sucking and swallowing is not essential for KMC; other methods of feeding can be used until the baby can breastfeed.
- KMC can begin at birth, after initial assessment and any basic resuscitation as may be required.
- Babies under phototherapy may be evaluated to receive intermittent KMC.
- KMC can be initiated in a baby who is otherwise stable but may still be on intravenous fluids, tube feeding and/ or oxygen.

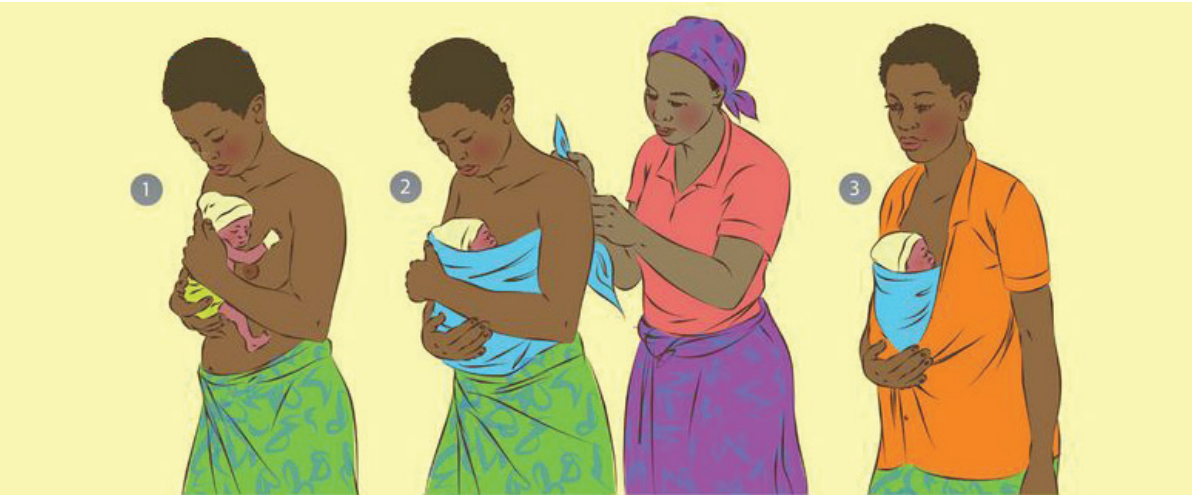
Components of KMC

1. KMC position

To position the baby, ensure that:

- mother's chest is bare
- baby is naked except for hat/cap, socks and diapers
- baby is upright (with skin-to-skin contact with the mother) in between mother's breast and in frog-like posture
- mother support the baby with her hands
- the baby is strapped to the mother using KMC wrap or its alternative.
- the top of the wrap is under the baby's ears while the bottom is tucked under the baby's buttocks.
- the baby's abdomen is not constricted, and baby is breathing freely
- the wrap is securely tied
- the mother wears her top with front opening

Figure N, How to Put a Baby in KMC Position



Monitoring of the baby on KMC

Babies must remain in KMC position throughout the day except when mother is showering, going to the convenience or cooking with firewood. The following should be monitored while on KMC:

- Temperature
- Breathing pattern, heart rate and general wellbeing of the baby
- Weight
- Daily feeds
- Treatment

2. KMC nutrition

Breast milk is the best food for preterm/LBW infants and early, exclusive breastfeeding is the best method of feeding. Breast milk is the food recommended for feeding preterms/LBW (except there is a medical indication for breastmilk substitute).

Mothers should be supported to breast feed exclusively.

Mothers whose babies require feeding by alternative methods should be taught how to express breast milk.

3. KMC support

Mothers of preterm infants need a lot of physical and emotional support, which can be provided through encouragement, reassurance and by listening to their worries and concerns.

It is very important to explain and demonstrate to the mother until she is motivated and confident to try the kangaroo position. Assist the mother with positioning and feeding and give emotional support.

There is a great need to engage early the husbands and other major stakeholders such as – the grandmothers and other relations to ensure optimal physical and psychological support for them.

1.1. Criteria for Admission into the KMC Ward

- Stable low birth weight newborns (<2 kg)

1.2. Contraindications

- Respiratory distress
- Hemodynamic instability
- Systemic signs of sepsis

1.3. Procedure for KMC

- Vital signs per doctor's orders
- If hypothermic at admission to KMC, measure temperature one hour after starting KMC to ensure temperature is normal

1.4. Discharge Criteria

Discharge ONLY when ALL the of the following criteria are met:

1. The baby is exclusively breastfeeding.
2. No danger signs are present, and there are no concerns about sepsis.
3. Re-gaining birth weight plus gaining weight every day for the last 3 days (10-15 gm/day for 3 days).
4. The weight of the baby is at least 1.5 kg.
5. The neonate can maintain body temperature between 36.5-37.5°C at least for 3 days.
6. The mother is confident and able to care for the baby.

1.5. Follow-Up

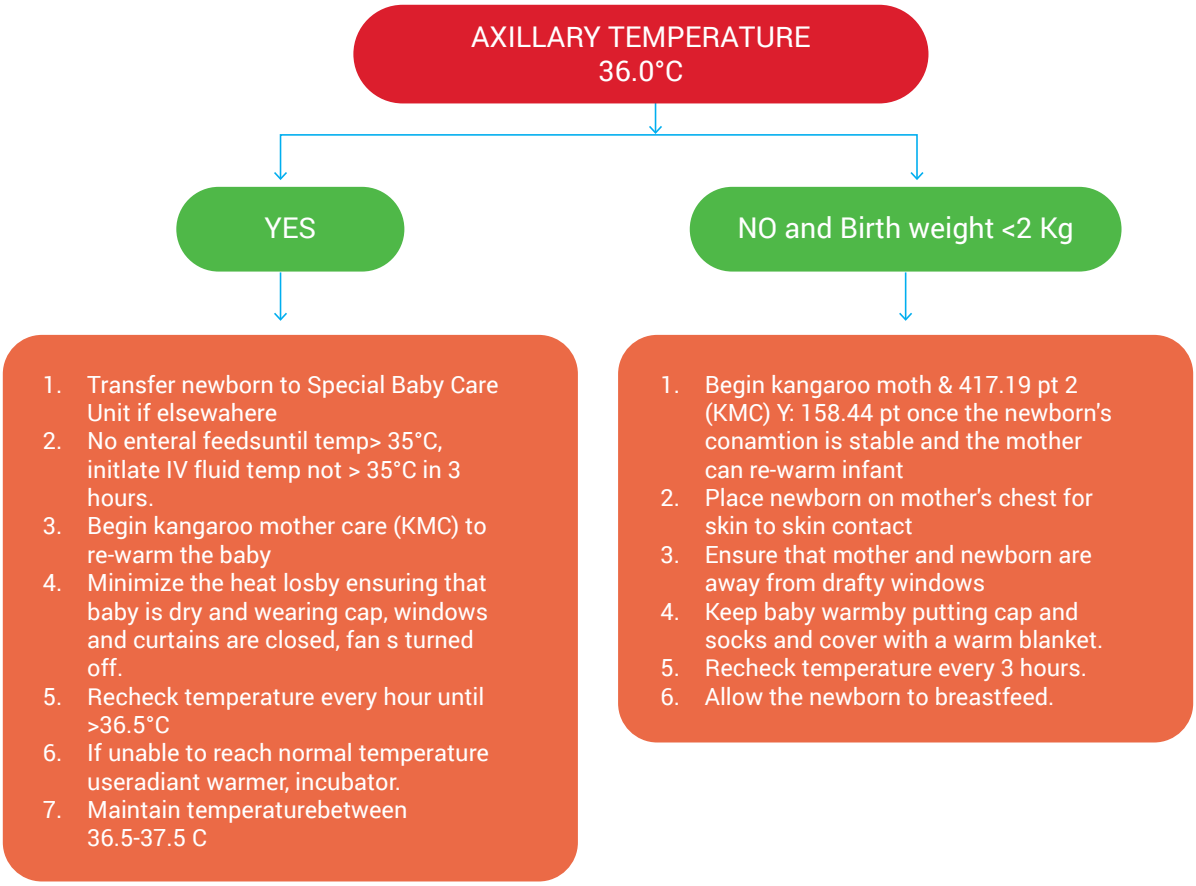
All newborns with Birth weight <2 kg should be followed up:

- Check the temperature and weight gain within the week after discharge.
- Ask to bring the baby for follow up after a week.
- KMC should be continued till the baby reaches term (corrected gestational age ≥ 40 weeks) or weighs 2500g (2.5kg).
- Any baby who develops any danger sign during the follow-up should be readmitted immediately for appropriate treatment.
- Babies should be seen in clinic as follows (unless otherwise indicated):
- Two follow-up visits per week until 37 weeks.
- One follow-up visits per week after 37 weeks till 40 weeks post-conception age.
- If this is not possible, the discharge may need to be delayed until fewer visits are required. Subsequently, once baby attains the weight of 2500g (2.5kg) or 40 weeks post-conception age, the baby shall be seen at the routine well newborn clinic.

1.6. Readmission Criteria

- <10 gm/day weight gain
- Presence of any danger signs

Figure O, Neonatal Hypothermia



2. Use of Radiant Warmer

Radiant warmer is a body warming device commonly used to maintain normal temperature for the newborns. In the delivery room, always provide an area post-delivery to prevent hypothermia. Radiant warmers use artificial overhead heating elements to provide radiating heat ensuring maintenance of normothermia. This minimizes metabolic requirements for heat production, decreasing the risks of hypoglycaemia and respiratory distress associated with hypothermia.

Radiant warmers provide an area where resuscitations, procedures and short-term observation can take place while keeping the baby warm.

The skin temperature of the baby should be monitored continuously by a probe attached to the baby's body. Special attention should be paid to the fluid input and output of the baby while under this device.

Figure P, A Typical Radiant Warmer

Preparing the equipment

- Ensure that the temperature of the room where the radiant warmer is used is at least 25 °C.
- Clean the mattress and platform and cover the mattress with a clean linen sheet.
- Turn on the warmer and set the temperature according to the manufacturer's instructions (usually between 36 °C and 37.5 °C).
- When it is known beforehand that a baby is to arrive in the unit, turn on the warmer to pre-warm the linen and mattress so that the baby does not initially lie on a cold surface.

Monitoring the baby under the radiant warmer

- Place only one baby under each radiant warmer.
- Attach the skin probe for temperature monitoring to the baby's skin. Care should be taken not to overheat the baby as this may lead to very high temperature (hyperthermia). Aim to always set the alarm limits for the radiant warmer.
- Check baby's temperature hourly and act accordingly.
- If the baby is receiving IV fluid or expressed breast milk, increase the volume of fluid and/or milk by 10% of the total daily volume per day for as long as the baby is under the radiant warmer.
- Return the baby to the mother for KMC or to the cot once temperature normalizes and continue monitoring. Do not expose baby under the radiant warmer for very long periods. It is only for short term warming.

3. Incubator Guidelines for Low-Birth-Weight Newborns

If the mother is unable to provide KMC, then use the incubator. The incubator is used to provide a safe/stable environment particularly for the preterm. In addition to maintaining normal temperature, it also shields the preterm baby from "environmental hazards and infections". Hence the humidity of the incubator and temperature settings should be considered in its functionality.

There are 2 types of incubator temperature control:

1. **Servo-controlled skin probe:** The incubator temperature is servo-controlled to maintain a desired set infant temperature. Avoid placing skin probe on bony prominences and excoriated areas.
2. **Air temperature mode:** The incubator temperature is initially set according to birth weight and postnatal age. Adjust according to measured infant temperature. (See table 26). Hypothermic infants may need the incubator temperature raised by 0.5°C every half-to one hour until normothermic.

3.1. Initial incubator management

- Ensure that the incubator is functioning properly, has been cleaned, and is correctly connected to power source with voltage transformer if needed. The humidity and air settings should be adjusted as required and the distilled water in the humidification chamber must be changed every day as it is a potential source of infection.
- Clean the incubator thoroughly between babies, and once a week for the same baby.
- Disassemble the device so that all surfaces and parts can be wiped with disinfectant and thoroughly dried.
- The baby can be receiving intermittent KMC to enable weekly cleaning of the incubator, if no other available one to move to.
- Place newborn with cap and diaper in the incubator if one of the following criteria is met:
- Too unstable to do KMC (because of respiratory distress or another reason)
- Weighs <1.5 kg (very low birth weight).
- Unable to keep temperature >36.5°C using warming lights, KMC, or bundling (because of VLBW or another reason).
- Poor weight gain.
- Set the incubator ambient air temperature according to the following WHO recommendations:

Figure Q, A Typical Infant Incubator

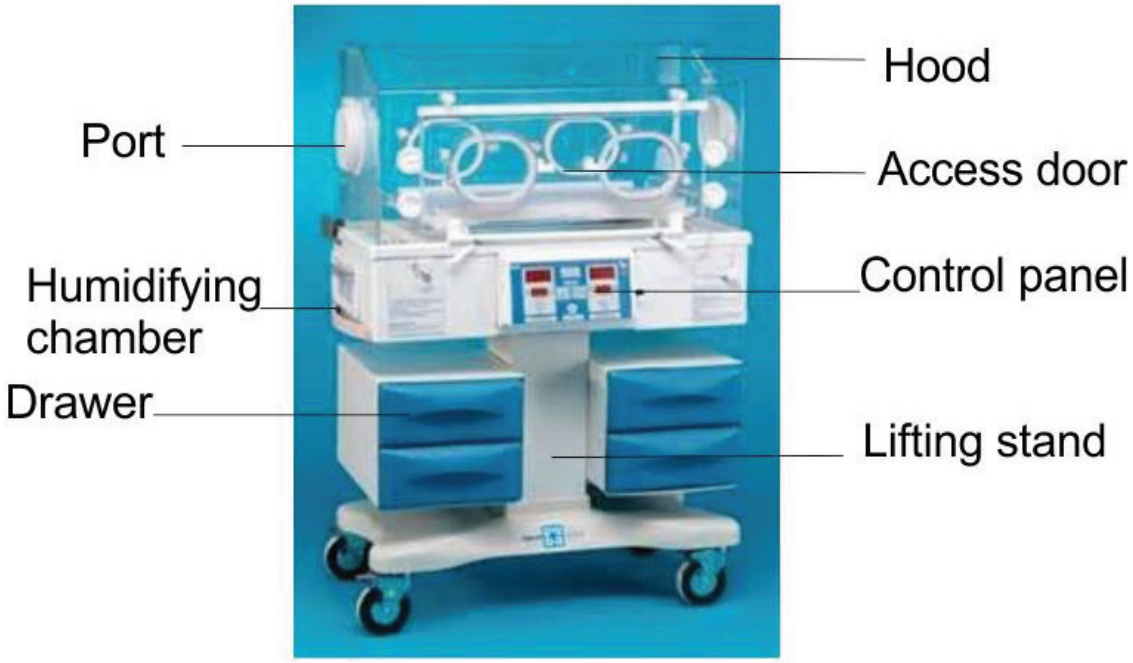


Table 26, Recommended Incubator Ambient Air Temperature

Weight of Newborn	If 0-10 Days Old	If >10 Days Old
<1.5 kg	36°C	35°C
1.5 to 2.0 kg	35°C	34°C

- After placing newborn in incubator, check axillary temperature every hour until > 36.5°C.

- If unable to reach temperature > 36.5°C, then increase the ambient air temperature of the incubator by 1°C increments every hour until the newborn reaches >36.5. Goal temperature is 36.5-37.5.

Table 27, Incubator Temperature Setting by Birth Weight and Postnatal Age

Age	Birth weight and temperature range 1-1.2kg +/-0.5 degree celsius	1.2-1.5kg +/-0.5	1.5-2.5kg +/-1.0	>2.5kg and 36/40 +/-1.5
0-12 hours	35.0	34.0	33.3	32.8
12-24 hours	34.5	33.8	32.8	32.4
24-96 hours	34.5	33.5	32.3	33.0
4-14 days	33.5	33.5	32.1	32.0
2-3 weeks	33.1	33.1	31.7	30.0
3-4 weeks	32.6	32.6	31.4	-
4-5 weeks	30.0	32.0	30.9	-
5-6 weeks	31.4	31.4	30.4	-

HUMIDITY SETTINGS

There is no evidence to support humidity higher than 80% or the continuation of humidity past day 14 of life. Practice outside these parameters should be discussed with the consultant.

After successful staged reductions, environmental humidity can then be ceased after 2 weeks of life, as the epidermis will then have matured to act as an effective barrier. The table below demonstrates the commencing and weaning process for humidification.

Table 28, Recommended Environmental Humidity Weaning Schedule for Neonates

Day of Life	Environmental Humidity (%)
1-7	80%
8	75%
9	70%
10	65%
11	60%
12	55%
13	50%
14	45%
15	CEASE

MONITORING AND DOCUMENTATION

Environmental humidity is an order, and observations are documented in flowsheets.

- Hourly set and actual environmental humidity levels (%).
- Hourly set and actual servo control temperature as well as documentation about location of servo probe.
- Four hourly axillary temperatures.

Nursing care

- Nursing staff should take care to check the position of the probe site at the start of the shift, change the position with care to check for pressure areas. This will ensure that servo control runs without causing problems with temperature instability which can be due to incorrect or invalid temperatures being monitored.
- Take care to avoid excess rain-out by wiping the inside of the incubator with a dry cloth.
- On the hybrid cots there is a clear view button which can be utilised to reduce condensation on the inside of the hood.
- All hybrid cots providing humidity should be changed every 7days as humidification significantly increases microbial growth.
- Change linen every 24-48 hours.
- Once humidification has been discontinued, change hybrid cot, to prevent microbial build up.
- Cleaning staff need to know whether humidification has been run when using the hybrid cot. Nursing staff should put a sign on the incubator when moving to the cleaning room so that additional cleaning can be undertaken appropriately.

Special considerations

- Minimise the opening of doors so that humidity inside incubator remains constant.
- The hybrid cots have an “air curtain” which can be enhanced using the ‘touch time’ setting to minimise heat lost while portholes open.
- It is still important to consider clustering cares and minimal handling for all preterm infants.

3.2. Ongoing incubator management

- Any newborn placed in the incubator must have manual axillary temperature checked every 3 hours.
- If newborn’s temperature is < 36.5°C, increase incubator temperature by 1°C and check temperature after 1 hour. Also dress the neonate.

- If newborn's temperature is >37.5°C, decrease incubator temperature by 1°C and check temperature after 1 hour.
- Once newborn is clinically stable, dress or wrap in blanket and hat and turn incubator temperature down by 2°C and recheck temperature in 1 hour. Adjust incubator temperature as above.
- If the newborn temperature reaches >38°C or there is any concern that the incubator is not functioning properly, remove the newborn from the incubator immediately.
- The temperature of the incubator walls depends on the air temperature of the room in which the incubator is placed and whether there are draughts. If the room temperature is below 25°C (77°F), it is often impossible to compensate for radiant heat loss by increasing the air temperature inside the incubator. Extra clothing may be put on the baby as appropriate. Also, placing the incubator under direct sunlight can dangerously overheat the baby. Phototherapy may have the same effect.

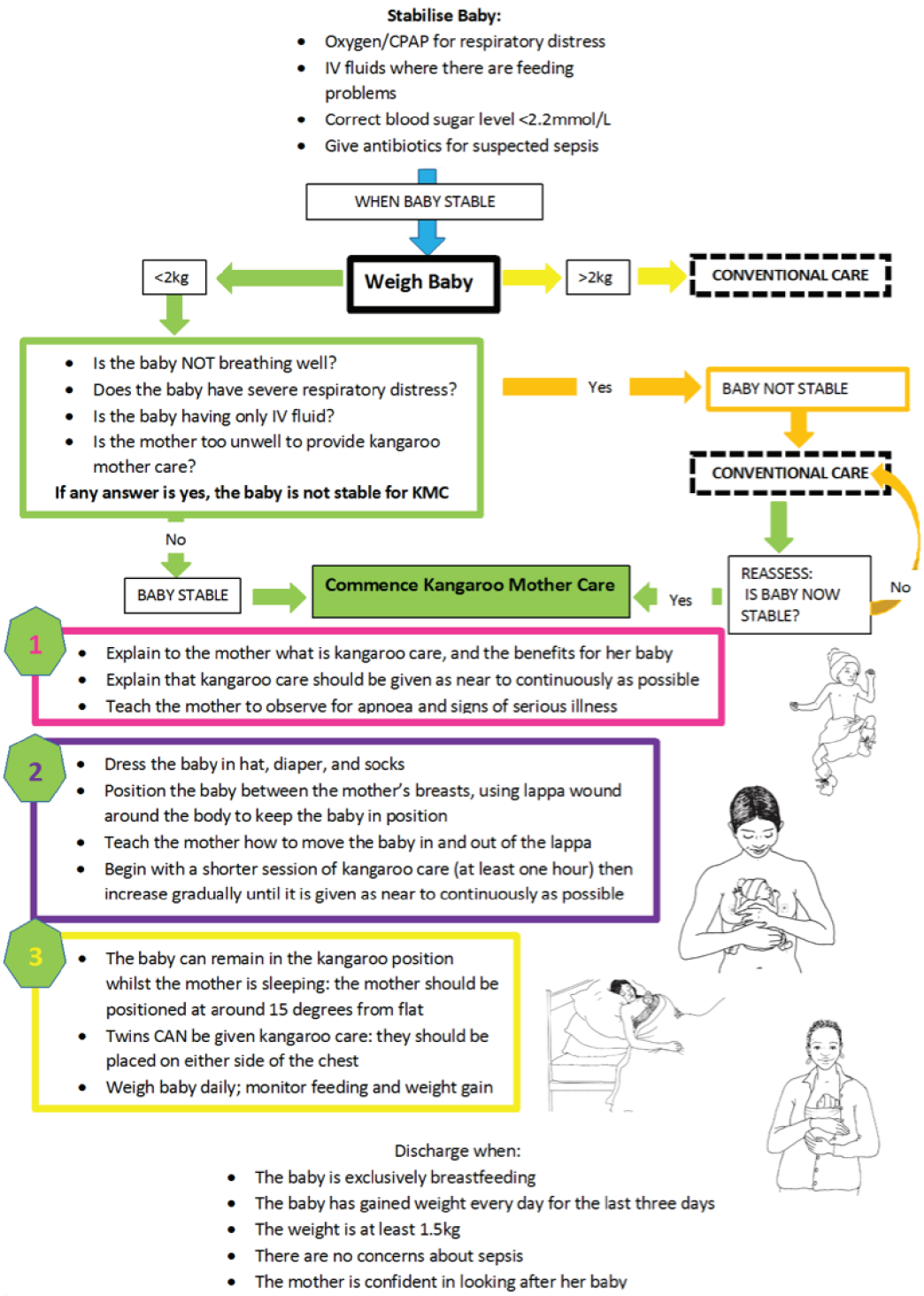
3.3. Weaning incubator

When newborn's temperature rises to > 37.5°C, wean incubator temperature by 0.5°C and recheck axillary temp in 1 hour.

When newborn has stable temperature in normal range with incubator temperature of < 30°C, then transition to

- Kangaroo Mother Care.

Figure R, Kangaroo Mother Care



HYPERTHERMIA IN THE NEWBORN

When the newborn is in an environment that is too hot, the baby's temperature rises above 37.5°C (99.5°F), and it develops hyperthermia. Although less common, hyperthermia can occur just as easily as hypothermia and is equally dangerous.

Effects and signs of hyperthermia

Hyperthermia increases the metabolic rate and the rate of water loss by evaporation, which can cause dehydration. This is a serious complication of hyperthermia. A core temperature above 42°C (107.6°F) can lead to neurological damage. The signs of hyperthermia are not obvious at first. Soon, however, the newborn starts breathing rapidly, the heart rate (if checked) is fast, the skin is hot, the extremities are red due to vasodilation and the face is flushed. When it is beginning to get overheated, the newborn is restless and cries; then, gradually, it becomes lethargic. In severe hyperthermia, shock, convulsions, and coma may occur.

Causes and prevention of hyperthermia

Some of the most common causes of hyperthermia are wrapping the baby in too many layers of clothes, especially in hot, humid climates; leaving a baby in direct sunlight or in a parked car in hot weather; placing a newborn baby too close to a fire or heater; placing the baby close to a hot water bottle; leaving the baby under a radiant warmer or in an incubator that is not functioning properly and/or checked regularly, exposing the baby to the sun's rays. All these practices should be avoided in order to prevent hyperthermia.

Management of hyperthermia

The baby should be moved away from the source of heat, and undressed partially or fully, if necessary. If the baby is in an incubator, the air temperature should be lowered. It is important that the baby be breast-fed more frequently to replace fluids. Every hyperthermic baby should be examined for infection. When hyperthermia is severe i.e. body temperature above 40°C/104°F° the baby can be given a bath. The water should be warm. If it is possible to measure the water temperature, it should be about 2°C (3.6°F) lower than the baby's body temperature.33 Using cooler or cold water is dangerous. It may not achieve the desired effect, and the baby may very quickly become hypothermic. If the baby cannot breast-feed extra fluids should be given intravenously or by tube.

Use of acetaminophen when the temperature is above 38.5oC (5-10mg/kg/dose, orally or rectally every 4hours x 3 doses). Do not use antipyretics as first line treatment.

CHAPTER 9:
NEONATAL HYPOGLYCAEMIA AND HYPERGLYCAEMIA

Definition

Hypoglycaemia is blood glucose level that is less than 47mg/dl (<2.7mmol/L). It is a medical emergency and should be treated promptly to prevent brain damage or death.

It is important to **prevent** it, **recognize** it and **treat** it correctly.

Babies who are at high risk of hypoglycaemia but are well and asymptomatic should be fed early (the first feed must be within the first hour of life), frequently (at least every 2–3 hours), and with adequate volumes. Babies should be breastfed if they are able to. If they are too premature or small to be breastfed adequately, they can be given expressed breast milk via an NG tube. Artificial formula feed should be used only when breast milk is unavailable.

Table 29, Risk Factors for Neonatal Hypoglycaemia

Babies Who are at High Risk of Hypoglycaemia Include:
■ Premature (<35 weeks' gestation)
■ Low birth weight (<2 kg)
■ Large baby
■ Babies of mother with type 1 or 2 or gestational diabetes
■ Sepsis
■ Post maturity
■ Hypothermia/ hyperthermia
■ Feeding difficulties
■ Respiratory distress
■ Birth asphyxia
■ Rhesus iso-immunisation

Table 30, Clinical Signs and Symptoms of Neonatal Hypoglycaemia

Sign and Symptoms of Hypoglycaemia Include:
Sweating
Feeding difficulties, poor suck
Weak or high-pitched cry
Tremors
Hypothermia
Irritability
Lethargy/stupor
Hypotonia
Seizures (lip smacking, eye twitching)
Coma (AVPU- P or U)
Respiratory distress- grunting or tachypnea
Apnoea
Cyanosis
Sleepiness

Note: Hypoglycaemia may have no signs or symptoms and may be an incidental finding when screening at-risk babies.

- If babies are unwell or symptomatic at birth, or become unwell or symptomatic later, the hypoglycaemia protocol should be followed.

Investigations

- Blood tests for monitoring blood glucose (heel prick) < 2.7 mmol/L.
- Newborn screening for metabolic disorders.

Management

Non-pharmaceutical

- Determine and treat the underlying cause.

- Enteral feeding, oral or via oro/nasogastric tube, after exclusion of vomiting, ileus or obstruction.
- For small / premature babies who are unable to breast feed the following volumes of milk should be given by NG tube (Refer to the chapter on fluid and nutrition).

Keeping babies warm also helps prevent hypoglycaemia (see hypothermia guideline).

Treatment

- Early feeding in the first hour of life and glucose monitoring should be initiated if any risk factors are identified within the first two hours of life.
- In an otherwise well baby, give milk feeds and recheck blood glucose levels after 30 minutes.
- If low glucose persists, or the baby is symptomatic, establish an IV line if one is not already in place.
- Administer a bolus of 2 ml/kg body weight of 10% dextrose IV slowly.
- Continue a 10% dextrose infusion at the daily maintenance volume according to the baby's age and weight.
- Maintain the initial glucose infusion rate (GIR) for term neonates at 4–6 mg/kg/min, and for preterm babies at 6–8 mg/kg/min. It is important to maintain a normal GIR after the initial correction of hypoglycaemia. (Refer to the table 31 on calculation of GIR and how to increase the GIR.)
- Measure blood glucose 30 minutes after the bolus of glucose.
- Once blood glucose is ≥2.7 mmol/L (49 mg/dL) for two consecutive measurements, monitor every 8 to 12 hours until 24 hours after IV fluid has been discontinued. (Therapeutic glycaemic goal is between 45 and 150 mg/dL.)
- Allow the baby to begin breastfeeding. If the baby cannot breastfeed, give expressed breast milk using an alternative feeding method.
- As the baby's ability to feed improves, gradually reduce (over one to two days) the volume of IV glucose while increasing the volume of oral feeds. Do not discontinue the glucose infusion abruptly.

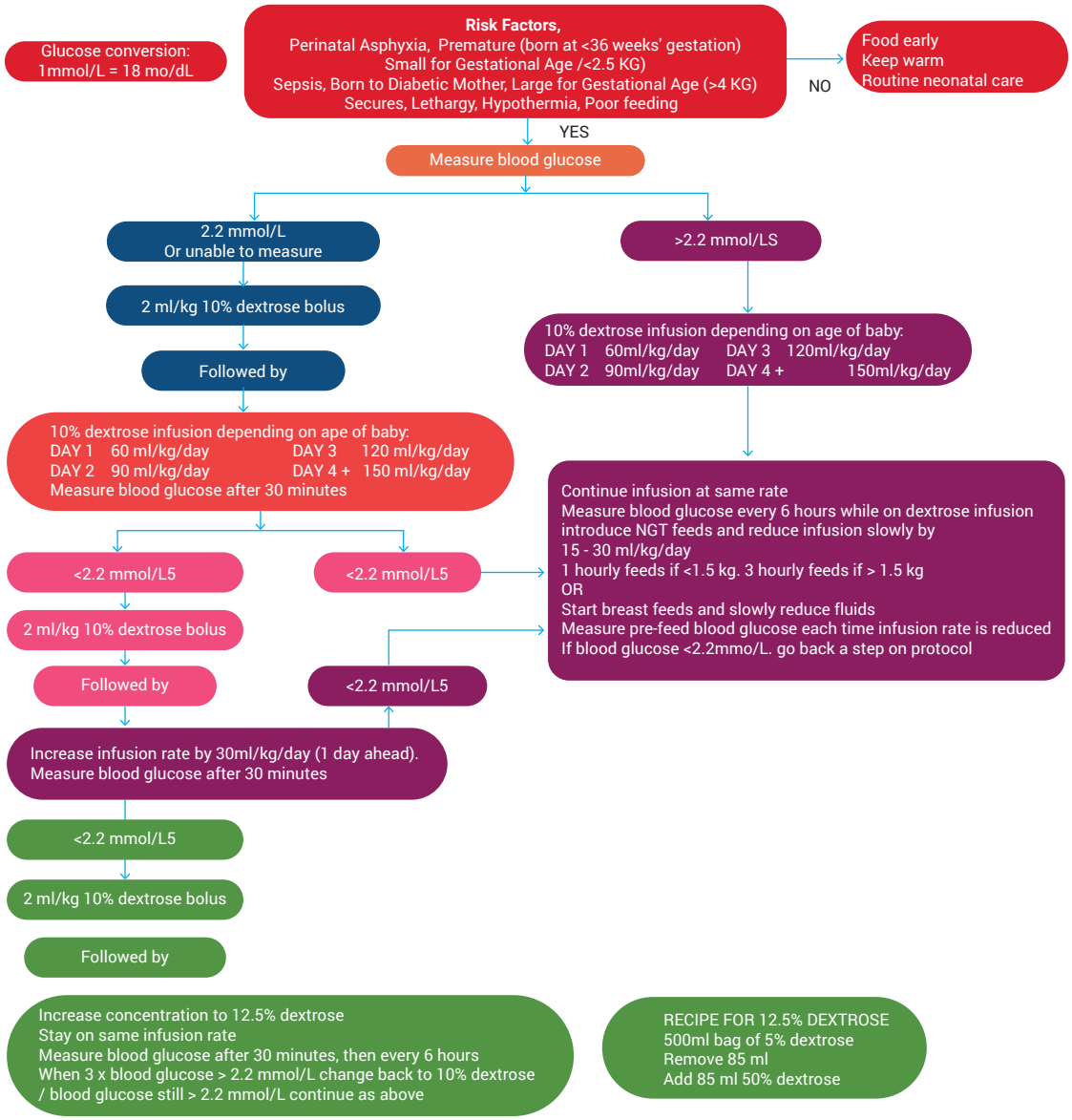
Note: If an IV line cannot be established quickly, pass a nasogastric tube and administer 2 ml/kg of 10% glucose through the tube.

Aim for a glucose infusion rate of 4–8 mg/kg/min depending on the gestational age (GA) of the baby (up to 12 mg/kg/min may be given in cases of intractable hypoglycaemia). Adjust the glucose concentration and rate accordingly.

Table 31, Approximate Glucose Concentration/GIR Based on Volume of IVF

Glucose Concentration	Volume/kg/day	Approximate GIR
10%	100	7 mg/kg/min
10%	160	11 mg/kg/min
7.5%	100	5 mg/kg/min
7.5%	150	7.8 mg/kg/min
7.5%	160	8.3 mg/kg/min
5%	160	5.5 mg/kg/min

Figure S, Neonatal Hypoglycaemia



INFANTS OF DIABETIC MOTHERS

Babies of diabetic mothers are at high risk of developing very low blood glucose from birth and during the first three days of life, even if they are feeding well.

Newborns of diabetic mothers represent the group of neonates with the highest risk of developing symptomatic hypoglycaemia in the immediate hours after birth. This is due to the relative foetal hyperinsulinism in these newborns caused by high glucose levels induced by maternal diabetes.

This risk is worse in babies of mothers with poorly controlled pre-existing diabetes and high levels of glycosylated haemoglobin (HbA1c). If postnatal hypoglycaemia is unrecognised and undiagnosed, it may result in severe neurological damage or death.

It is especially important to screen for postnatal hypoglycaemia in the early hours after birth and implement management strategies to prevent it or its short- or long-term complications, such as convulsions, coma, or death.

Other complications in babies born to diabetic mothers include:

- Polycythaemia,
- Birth trauma,
- Perinatal asphyxia,
- Meconium aspiration,
- Neonatal jaundice,
- Neural tube defects, and
- Congenital cardiac abnormalities, which also contribute to mortality.

These babies need close monitoring, with early feeding and prompt correction of hypoglycaemia if required.

Management

- Measure blood glucose at birth, 30 minutes, 1 hour, 2 hours, 4 hours, 8 hours, 12 hours, and at any time when symptoms suggestive of hypoglycaemia occur. (Refer to hypoglycaemia management.)
- The initiation of enteral feeding immediately after birth is the most important first step.
    - Breastfeeding should be started within one hour of life, with or without assistance, in stable babies.
    - Encourage and support breastfeeding, at least eight to twelve times daily.
- Observe the baby until the third day of life (72 hours):

- Measure blood glucose every six hours for 24 hours (after the first 12 hours of life) and at any time when symptoms suggestive of hypoglycaemia occur, or until the blood glucose has been normal for two consecutive days.
- If blood glucose is less than 49 mg/dL (<2.7 mmol/L) at any measurement, correct the hypoglycaemia.
- Discontinuation of the IV supplementation can occur when the enteral feeding is considered sufficient to maintain a correct glycaemic control.
- If blood glucose has been normal for 2–3 days, the baby is feeding well, and there are no other problems requiring hospitalisation, discharge the baby with follow-up plans.

HYPERGLYCAEMIA

- Neonatal hyperglycaemia is defined as a blood glucose of more than 11mmol/L (200mg/dL) regardless of body weight, gestational or postnatal age. It is desirable to maintain the glucose level below 145mg/dl (8mmol/L).
- The most common cause is iatrogenic, typically due to glucose infusion.
- Hyperglycaemia is one of the most common metabolic abnormalities in preterm infants, especially in the first week of life and during stressful events, due to raised cortisol levels in response to stress.
- A sudden increase in blood glucose may indicate a new stressor such as infection, necrotising enterocolitis (NEC), intraventricular haemorrhage (IVH), hypoxia, or a reaction to medications such as steroids, aminophylline, caffeine, or phenytoin. It may also occur following surgical procedures or in cases of neonatal diabetes.

Risk factors

- Sepsis.
- Intrauterine growth restriction (IUGR).
- Early use and high rate of intravenous dextrose infusion.
- Absence of enteral nutrition.
- Blood glucose should be monitored in all high-risk infants.

Diagnosis

- Symptoms are non – specific.
- Osmotic diuresis, dehydration and intracranial haemorrhage.
- Diagnosis is by evaluating blood glucose with a bedside glucometer and to be confirmed in the laboratory.

Treatment

- Repeat the test to confirm its accuracy (consider using a different glucometer).
- If the infant is on IV fluids, confirm that the fluids were correctly prepared and administered, and ensure that the infusion rate is appropriate for the baby's age and weight (refer to infusion rates on the feeding charts and check the prescription).
- Assess the baby for risk factors and address them.
- If blood glucose is >250 mg/dL (≥12 mmol/L), check urine for glycosuria (≥2+) and assess clinical hydration, including fluid input/output.
- Assess the glucose infusion rate (GIR) in mg/kg/min using the formula provided in the following page.
- If the GIR is >10 mg/kg/min, decrease the glucose in decrements to a GIR of 6–10 mg/kg/min.
- If glycosuria and hyperglycaemia (>250 mg/dL or >12 mmol/L) persist despite a GIR <4 mg/kg/min, commence insulin therapy. The fall in glucose should be slow to prevent rapid fluid shifts in the brain.
- Early introduction of parenteral nutrition, where available (dextrose and amino acids, with or without lipids), and early trophic enteral feeding will help reduce the incidence of hyperglycaemia requiring insulin.
- Insulin therapy is only necessary when other actions to treat or exclude any underlying causes of hyperglycaemia have been carried out.
- Level 2 facilities (District SCBUs) should refer the baby to Level 3 (Regional SCBU and tertiary facilities) if hyperglycaemia persists despite all initial therapy and levels remain >250 mg/dL.

Insulin Therapy (FOR LEVEL 3 CENTRES)

How to Calculate Glucose Infusion Rate (GIR)

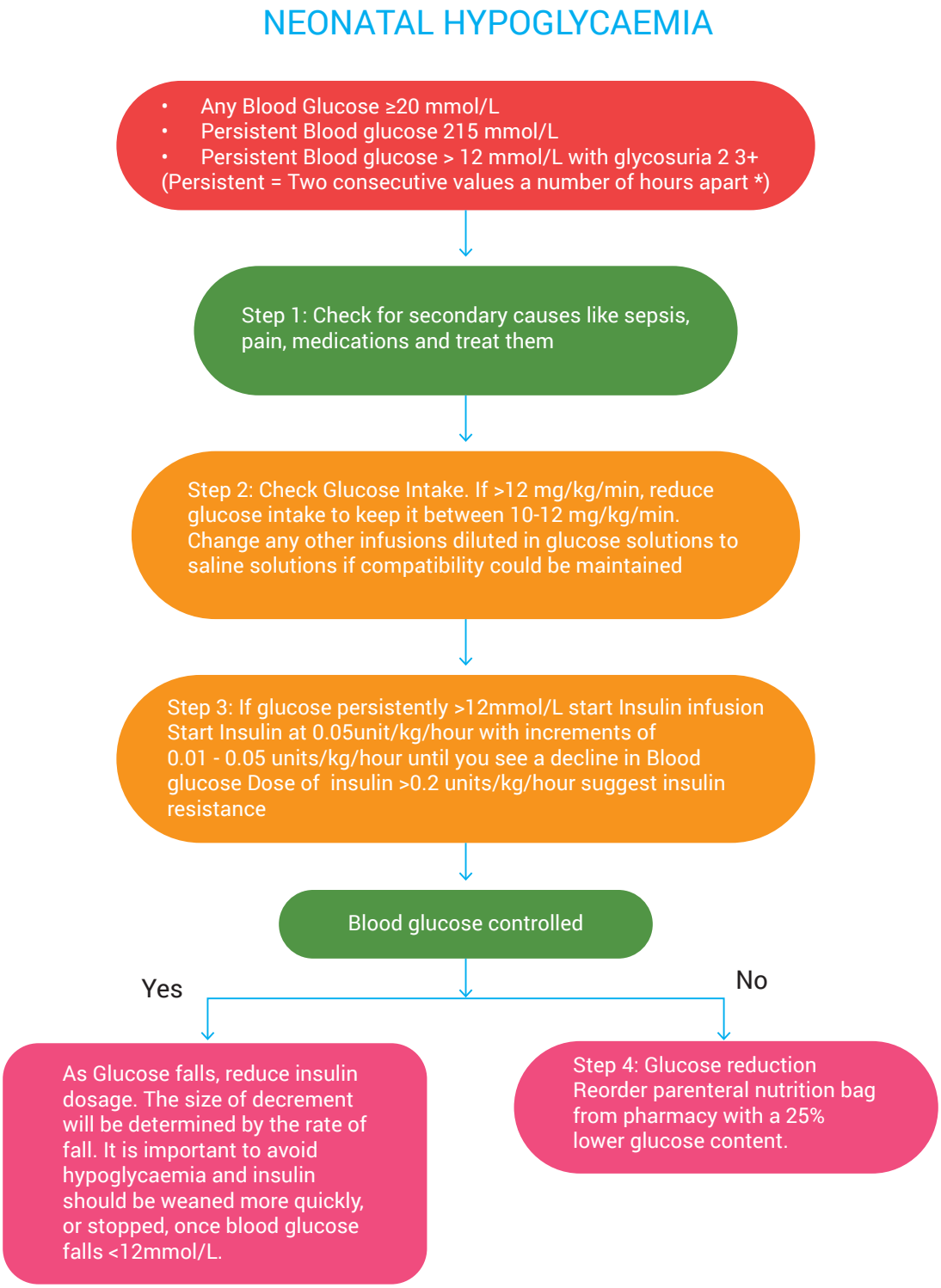
1. Determine the desired fluid intake Calculate the total fluid intake in ml/kg/day.
   Example: 80 ml/kg/day
2. Convert to ml/kg/min
   Divide the daily fluid requirement by 1440 (the number of minutes in 24 hours) to obtain the rate in ml/kg/min.
   Example: 80 ÷ 1440 = 0.055 ml/kg/min
3. Multiply by the glucose concentration of the fluid
   Use the glucose concentration (in mg/ml) of the intravenous fluid to calculate the glucose infusion rate.
4. Glucose concentrations of common solutions:
   - 5% Dextrose = 50 mg/ml
   - 10% Dextrose = 100 mg/ml
   - 50% Dextrose = 500 mg/ml
   - 4.3% Dextrose = 43 mg/ml
5. Final calculation
   Multiply the result from Step 2 by the glucose concentration of the chosen fluid.
   Example: For a baby on 10% Dextrose (100 mg/ml):
   0.055 × 100 = 5.5 mg/kg/min
   This is the Glucose Infusion Rate (GIR).

How to Increase GIR by 1 mg/kg/min

To increase the Glucose Infusion Rate (GIR) by 1 mg/kg/min, follow these steps:

6. Add 1 ml/kg of 50% Dextrose
   Add 1 ml/kg of 50% Dextrose to the total volume of fluid to be infused over 8 hours.
7. Note the glucose concentration
   - 50% Dextrose contains 500 mg of glucose per ml.
8. Calculate the time frame
   - An 8-hour period = 480 minutes (8 × 60).
9. Calculate the GIR increase
   - 500 mg ÷ 480 minutes = 1.04 mg/kg/min (approximately 1 mg/kg/min)

Figure T, Flowchart for the Management of Hyperglycaemia in Neonates



CHAPTER 10: HAEMATOLOGY

- Neonates are born with physiological polycythaemia due to relative hypoxia in utero. Normal haemoglobin for a neonate is 15–18 g/dL.
- Normal haematocrit (packed cell volume) for a neonate is 45–55% (Conversion: Haemoglobin × 3 = Haematocrit).

1. Anaemia

1.1. Physiological Background

Over the first weeks of life, newborns develop physiological anaemia because erythropoietin and fetal haemoglobin production decrease in response to the relatively rich oxygen supply.

- The Hb of a term newborn drops to 9–11 g/dL at 6–12 weeks of age.
- The Hb of a preterm newborn drops more severely and reaches 8–10 g/dL at 5–10 weeks of age.
- This low Hb results in insufficient oxygen delivery to tissues, causing a rise in erythropoietin levels and adult haemoglobin production. Therefore, physiological anaemia rarely requires medical treatment.

1.2. Pathological Anaemia and Aetiology

Anaemia Associated with Jaundice

1. Haemolysis (Increased Red Cell Destruction)

a. Immune Mediated

- Rh Incompatibility
- ABO Incompatibility

b. Enzyme Deficiency

- G6PD Deficiency
- Pyruvate Kinase Deficiency

c. Red Cell Membrane Defects

- Spherocytosis

- Elliptocytosis

d. Acquired

- Sepsis
- Malaria

Anaemia with No Jaundice

1. Blood Loss

a. Foetal

- Foeto-maternal transfusion
- Twin-twin transfusion

b. Obstetric

- Placental abruption
- Placenta praevia
- Vasa praevia
- Cord accidents

c. Neonatal

- Cephalohaematoma
- Subgaleal haemorrhage
- Intracranial haemorrhage
- Bleeding into abdominal organs

2. Diminished Red Cell Production

a. Infections

- Sepsis
- Parvovirus infection

b. Congenital

- Diamond-Blackfan Disease

c. Anaemia of Prematurity

d. Nutritional Deficiency

3. Iron deficiency

Clinical Features

These reflect the physiologic impact of reduced oxygen delivery to the tissues. They include:

1. Pallor with or without jaundice
2. Feeding difficulties
3. Poor weight gain
4. Tachycardia
5. Tachypnoea
6. Signs of decompensation
    a. Increased oxygen requirement
    b. Apnoea
    c. Signs of heart failure (hepatomegaly with tachypnea and tachycardia)

1.3. Diagnosis

Family history of anaemia, neonatal jaundice

Obstetric history: antepartum haemorrhage, foeto-maternal and twin-twin transfusion

Maternal history of blood group (Rh and ABO)

Laboratory testing may include:

- Hb
- Full blood count (FBC)
- Reticulocyte count
- Malaria parasite test
- Blood smear
- Coombs test

1.4. Treatment

The decision regarding the need for a blood transfusion includes the clinical condition of the newborn, the aetiology of anaemia, the haematocrit value, and the trend over time.

Indications for Red Blood Cell Transfusion

1. Hb <7 mg/dL in any preterm neonate
2. Hb <8 mg/dL in any term neonate
3. Hb <10 mg/dL in the following conditions:

a. Persistent tachycardia (>180 beats/min)
b. Persistent tachypnoea (>80 breaths/min)
c. Frequent apnoea requiring mask resuscitation
d. Neonates that require oxygen support to keep SpO2 above 90%

Table 32, Suggested Haemoglobin Threshold for Transfusion in Neonates

Postnatal Age	Respiratory Support	No Respiratory Support
Week 1	11.5g/dl	10.0g/dl
Week 2	10.0g/dl	8.5g/dl
Week 3	8.5g/dl	7.5g/dl

*Respiratory support is defined as FiO2 ≥ 25% (2L/min of Oxygen) or the need for mechanical increase in airway pressure.

Volume of Transfusion Depends On

- Current and target haemoglobin,
- Ongoing blood loss,
- Expected tolerance of transfusion *tolerance is dependent on whether circulating volume is low (acute blood loss) or normal (chronic anaemia).

Transfusion Procedure:

- The typical transfusion volume is 20 mL/kg whole blood, or 10-15 mL/kg packed cells over 3-4 hours.
- There is no indication for routine furosemide. If there is risk for fluid overload, consider giving **1 mg/kg** at the start of the transfusion with whole blood.
- May need second transfusion (preferably from same donor), if anaemia not adequately corrected.
- Wait at least 6 hours after completion of transfusion if post transfusion haematocrit/ haemoglobin needed to allow time for re-equilibration.
- Whole blood should be given to correct the anaemia of rapid blood loss.

1.5. Prevention

- Newborns at risk of iron deficiency should receive supplemental iron (2-4 mg of elemental iron/kg/day) once they are tolerating full enteral feeds.
- Reduce and minimise the frequency of blood sampling in neonates. Take the smallest volume of blood necessary for investigation.
    - Practice delay cord clamping following delivery.

- Ensure that pregnant women receive iron and folic acid supplement during pregnancy to reduce maternal anaemia.

2. Bleeding

2.1. Etiology

- Bleeding can be due to many causes including:
  - Deficiency of clotting factors,
  - Inherited clotting abnormalities,
  - Low or poorly functioning platelets.

It is important to distinguish whether a newborn with a bleeding disorder is otherwise sick or well.

Sick newborns tend to have:

- Disseminated intravascular coagulopathy (DIC)
- Platelet consumption
- Liver dysfunction

Well newborns tend to have:

- Immune thrombocytopenia
- Haemorrhagic disease of the newborn (vitamin K deficiency)
- Hereditary clotting factor deficiencies

2.2. Investigations

1. Coagulation Studies

- Prothrombin time (PT)
- Activated partial thromboplastin time (PTT)

2. Full Blood Count

- HB
- Platelet count
- Wbc

3. **Peripheral Blood Smears**
4. **Fibrinogen Levels**
5. **Fibrin Degradation Products**
6. **Liver Function Test**

2.3. Treatment

1. Correct underlying aetiology, e.g., antibiotics for infections.
2. Give IV vitamin K (1–5 mg) to all bleeding neonates.
3. Platelet transfusion for thrombocytopaenia: 10 mL/kg over 30–60 minutes.
4. Fresh frozen plasma (FFP): 10 mL/kg over 30–60 minutes for neonates with DIC, liver disease.
5. Cryoprecipitate: 10 mL/kg over 30–60 minutes for neonates with inherited bleeding disorders.
6. Fresh whole blood for acute blood loss: 20 mL/kg over 2–4 hours.

NB:

Fresh whole blood (less than 6 hours old) can be used in the absence of platelet concentrates, fresh frozen plasma, and cryoprecipitate.

Reasons for Platelet Transfusion:

1. Neonates with a platelet count <25,000/mm³, even if not bleeding.
2. Neonates with a platelet count <50,000/mm³ with evidence of bleeding (e.g., intracranial bleeding, gastrointestinal bleeding, petechiae, ecchymosis, etc.).

3. Polycythaemia

3.1. Definition

Polycythaemia in the neonate is defined as a venous haemoglobin >22 g/dL or haematocrit >65%. Polycythaemia is seen in up to 5% of neonates.

3.2. Etiology

Table 33, Causes of Neonatal Polycythaemia

Due to Increased Intra-Uterine Erythropoiesis	Erythrocyte Transfusion
Placental Insufficiency: SGA and IUGR neonates	Maternal-fetal transfusion
Post-maturity	Twin-Twin transfusion
Infant of Diabetic Mother	Delayed cord clamping
Maternal Smoking	Holding the baby below the mother at delivery
Maternal Hypertension: Pregnancy induced hypertension, pre-eclampsia and eclampsia	
Beckwith-Wiedemann Syndrome	
Congenital Adrenal Hyperplasia	
Neonatal Thyrotoxicosis	
Congenital Hypothyrodism	

3.3. Clinical Features

The signs and symptoms may be due hyperviscosity or metabolic disturbance or both. The babies are commonly plethoric and asymptomatic:

Table 34, Clinical Features of Neonatal Polycythaemia

Cardio-Respiratory	Respiratory Distress, Persistent Pulmonary Hypertension, Congestive Cardiac Failure.
Central Nervous	Lethargy initially (within 6 hours), Irritability, Jitteriness, Seizures.
Gastro-intestinal	Poor feeding, Vomiting, Necrotizing Enterocolitis.
Metabolic	Hypoglycaemia, HypoCalcaemia.
Haematologic	Hyperbilirubinaemia (Jaundice), Thrombocytopaemia.
Renal	Renal Vein Thrombosis, Renal Failure.

Complications

Due to hyperviscosity leading to sluggish blood flow, impaired tissue perfusion and thrombus formation.

Table 35, Complications of Neonatal Polycythaemia Due to Hyperviscosity

Central Nervous	Cerebral Micro-infarcts, CerebroVascular Accident (Stroke).
Cardio-Respiratory	Persistent Pulmonary Hypertension (PPHN), Myocardial Ischaemia.
Gastro-Intestinal	Necrotizing Enterocolitis (NEC).
Renal	Renal Vein Thrombosis, Renal Failure.

3.4. Management

The goals of the management are:

1. Ensure adequate hydration,
2. Maintain the haemocrit below accepted values,
3. Treat complications.

Haemotocrit > 65% and asymptomatic

- Ensure adequate hydration through oral feed intake or through maintenance IV fluid

Haematocrit > 65% and symptomatic/Haematocrit > 70% and asymptomatic

- Partial Exchange Transfusion with normal saline
- **Volume:** Typically, 15 – 20 mL/kg body weight; depends on observed and desired hematocrit:
- Volume exchanged (ml) = (Desired Hematocrit – Observed Hematocrit) X Weight X Estimated Blood Volume

Observed Hematocrit

For example, for a 2.5 kg newborn with a hematocrit of 70 and goal hematocrit of 50:

$$\textit{Calculation: } \frac{(70-50)x2.5x80}{70} = 57ml$$

- Duration – 60-75 minutes

- Slowly withdraw the calculated volume of blood and replace with equal volume of normal saline, using 20 mls aliquots for term babies a5 mls aliquots for preterm babies.
- One cycle (removing the blood and replacing with equal volume of normal saline) should be completed within 3 minutes.

HAEMATEMESIS AND HAEMATOCHEZIA (VOMITING BLOOD AND BLOOD IN STOOL) IN THE NEWBORN MANAGEMENT

It is important to distinguish between maternal (swallowed blood) and fetal blood using Apts test for fetal haemoglobin. Clinical causes depend on if the baby is ill or stable.

Possible causes in ill babies

- Overwhelming sepsis with DIC
- Severe thrombocytopaenia
- Necrotising enterocolitis (NEC)
- Coagulopathy

Possible causes in stable babies

- Swallowed maternal/placental blood at delivery
- Swallowed maternal blood from cracked nipple
- Local trauma e.g. laryngoscope, NG tube
- Haemorrhagic disease of the newborn (HDN)
- Over vigorous laryngeal suctioning. Always ensure the pressure in the suction machine for suctioning is not more than 80-100mmHg.

Other conditions include

- Steroid use, maternal medications (Aspirin, Phenytoin).
- Rare causes e.g gastritis/stress ulcer, volvulus/malrotation, meckel's diverticulum, portal hypertension, rectal haemangiomas, intussuception, colitis, anal fissure.

Investigations

CBC including absolute platelet count, peripheral blood smear, coagulation studies and test of specific disorders.

Treatment

Same as stated under the bleeding newborn.

In addition:

- For active bleeding secondary to HDN, give Vit. K1 1mg daily IV for 5 days.
- For gastritis, do saline lavage, and give H2 blockers (Ranitidine by IV infusion,500mcg/kg 6- 12hrly) to keep gastric pH>5.
- Surgical conditions may require urgent surgical interventions especially when blood replacement is >50% of blood volume.
- Correct coagulation deficiencies.

CHAPTER 11:
NEONATAL JAUNDICE

Definition:

Yellow staining of the skin and mucous membranes due to increased levels of bilirubin in the blood (hyperbilirubinaemia).

Jaundice is a common problem encountered in neonatal care. It presents in 60% of term neonates and 80% of preterm neonates. Early identification and treatment of jaundice is important to minimize the mortality and morbidity associated with the condition.

**Every neonate should be assessed for jaundice at 48-72 hours of life and at 5-7 days of life using transcutaneous bilirubinometer to check the transcutaneous Bilirubin (TcB) levels (if the TCb is not available, assess with the baby with the Kramer rule as highlighted below).

Jaundice

Types of Jaundice

Physiological Jaundice

- Does not appear before 24 hours after birth
- Rarely lasts more than 10 days in a full term baby and 14 days in a pre-term baby
- Only the unconjugated bilirubin fraction is increased
- Total peak serum bilirubin concentration is usually below 275 micromol/L in a term infant
- Total bilirubin concentration does not rise by more than 85 micromol/L/24 hours
- The baby thrives and shows no signs of illness or anaemia treatment is unnecessary

Pathological Jaundice

- Appears within the first 24 hours of birth but may also appear at any other time after birth
- Persists for longer than 10 days in a full-term babies or 14 days in a pre-term babies
- The unconjugated and/or conjugated fractions of bilirubin are increased
- The conjugated bilirubin level exceeds 10% of the total bilirubin value, or the conjugated bilirubin fraction is 30 micromol/L or more
- Total bilirubin concentration rises by more than 85 micromol/L/24 hours
- The total serum bilirubin level is above physiological level

- There are signs and symptoms of illness in the baby
- Stools are pale in conjugated hyperbilirubinaemia (obstructive jaundice)

Table 36, Causes of Unconjugated Hyperbilirubinaemia

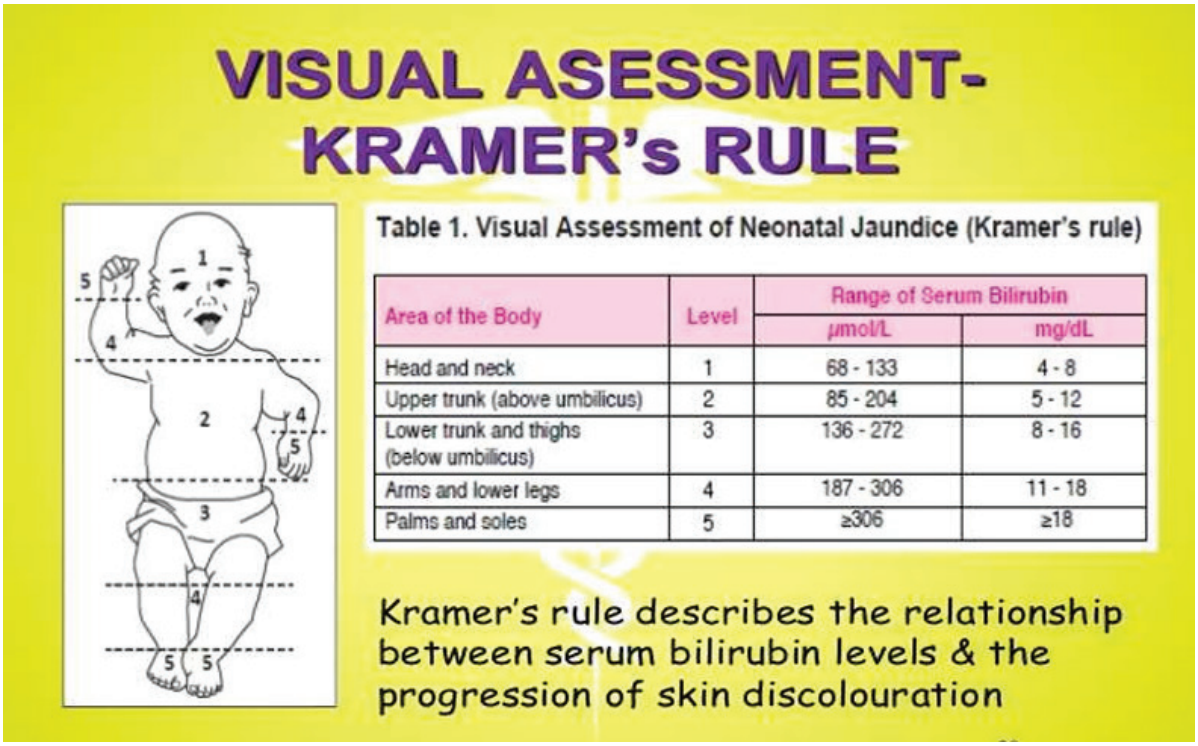
Excessive Haemolysis	Defective Conjugation
■ ABO incompatibility	■ Prematurity Infection
■ Rhesus disease	■ Hypoxia
■ Enclosed haemorrhages	■ Hypoglycaemia
■ Polycythaemia	■ Hypothyroidism
■ Infections	■ Breast milk jaundice
■ Spherocytosis	
■ G6PD deficiency	

Signs and Symptoms

- Yellow color in the eyes and on skin on physical examination
- Changes in muscle tone, seizures, or altered cry characteristics
- Hepatosplenomegaly
- Petechiae
- Hemolytic anemia
- Signs of sepsis

Use the Kramer rule to estimate the approximate serum bilirubin level by the skin discolouration.

Figure U, Visual Asessment - Kramer's Rule



Investigations

1. Serum bilirubin (Total serum bilirubin(TSB) and conjugated fraction)
2. Transcutaneous Bilirubin (TcB) for point of care serum bilirubin estimated

- Blood type and Rh determination in mother and infant
- Direct antiglobulin test (DAT) in the infant (direct Coombs test)
- Hemoglobin and hematocrit values
- Ultrasonography

**Obtain TSB when transcutaneous bilirubin (TcB) if TcB is ≥ 255 micromol/L, or when TcB is ≥ 50 micromol/l above the phototherapy threshold.

Management

The priniciple of managent include:

1. Treat the underlying cause e.g. infection
2. Correct factors known to increase the risk of brain damage in babies with jaundice. e.g.:

- Hypoxia
- Prematurity
- Hypoglycemia
- Hypothermia
- Acidosis
- Hypoalbuminemia

3. Ensure adequate hydration

- Ensure that baby breastfeed 8-12 times each.
- Augment breast feeding with feeding breast milk through cup when necessary.
- IV fluid if baby is unable to breast feed or feed by cup or there is concern about adequate breast milk intake.

4. Treat hyperbilirubinaemia

- This either by: Phototherapy or by Exchange Blood Transfusion.
- The decision to commence phototherapy or exchange blood transfusion should be based on the TSB levels.

Phototherapy

1. Use neonatal jaundice charts (either NICE charts or Limpopo charts) to determine when to start phototherapy.
2. Check TSB every 6-12 hours.

Figure V, Phototherapy

PHOTOTHERAPY

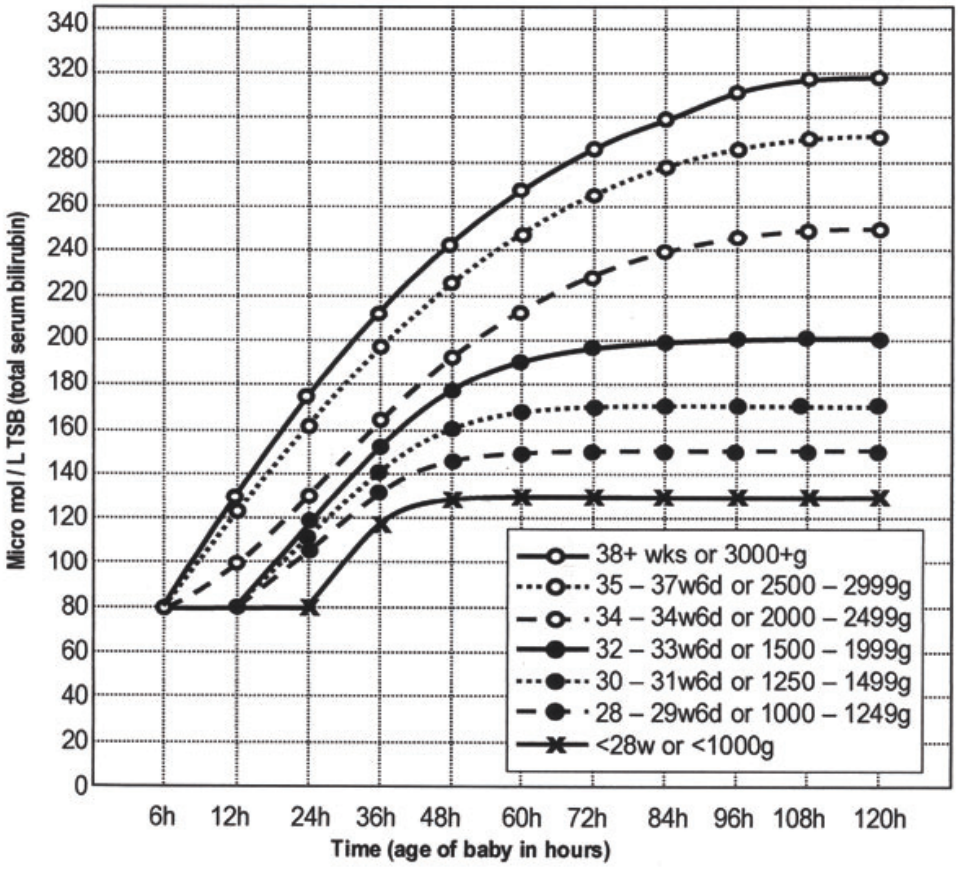
South African Neonatal Academic Hospital Guidelines: 2006

In presence of risk factors use one line lower (the gestation below) until <1000g.

If gestational age is accurate, rather use gestational age (weeks) instead of body weight

Infants > 12 hours old with TSB level below threshold, repeat TSB level as follows:
1- 20µmol/L below line:repeat TSB in 6hrs or start phototherapy and rept TSB in 12- 24hrs,
21 - 50 µmol/L below line: repeat TSB in 12 – 24hrs,
>50 µmol/L below line: rept TSB until it is falling and/or until jaundice is clinically resolving

Infants under phototherapy :
Check the TSB 12 – 24 hly but if TSB >30 µmol/L above the line , check TSB 4 – 6hly.
STOP phototherapy :
If TSB > 50 µmol/L below the line. Recheck TSB in 12 – 24hr.



Start intensive phototherapy when the TSB is ≥ the line according to gestation or weight.

Bilirubin conversion: 1 mg/dL = 17.1 µmol/L.

* Or excessive bruising or anticipated prolonged NPO course in the VLBW (<1500 gm) infant.

Phototherapy

Method:

- Place infant in bassinet, or incubator if available and infant is low birth weight (< 2 kg)
- Ensure that the infant is wearing protective eyewear always
- Infant should otherwise be naked (except for a diaper)
- Position phototherapy source at appropriate distance above infant's body (varies based on type of light source)
- Phototherapy should be continuous without any interruptions, except during feedings
- The distance between the baby and the phototherapy light should be not more than 45cm (or as indicated by the manufacturer)

Monitoring:

Monitor closely during phototherapy:

- Temperature: check temperature every 3 hours to ensure that it stays within the normal range of 36.5- 37.5°C.
- Hydration status:
    - Phototherapy causes increased evaporative fluid losses.
    - Ensure that infant is feeding well (8-12 times per day) or on IV fluids, and that infant is urinating well (at least 6 voids per day).
    - Check TSB every 6-12 hours.

Rising Bilirubin Despite Phototherapy

- Reduce the distance between the baby and the phototherapy light to 25cm.
- Use reflective and fibre-optic blankets.
- Minimize interruptions to phototherapy.

Discontinuation of Phototherapy

Phototherapy should be discontinued once TSB is 50 micromoles/l below the threshold for phototherapy.

After discontinuing phototherapy, recheck total bilirubin level after 24 hours. If bilirubin is above the treatment threshold, restart phototherapy and follow protocol above.

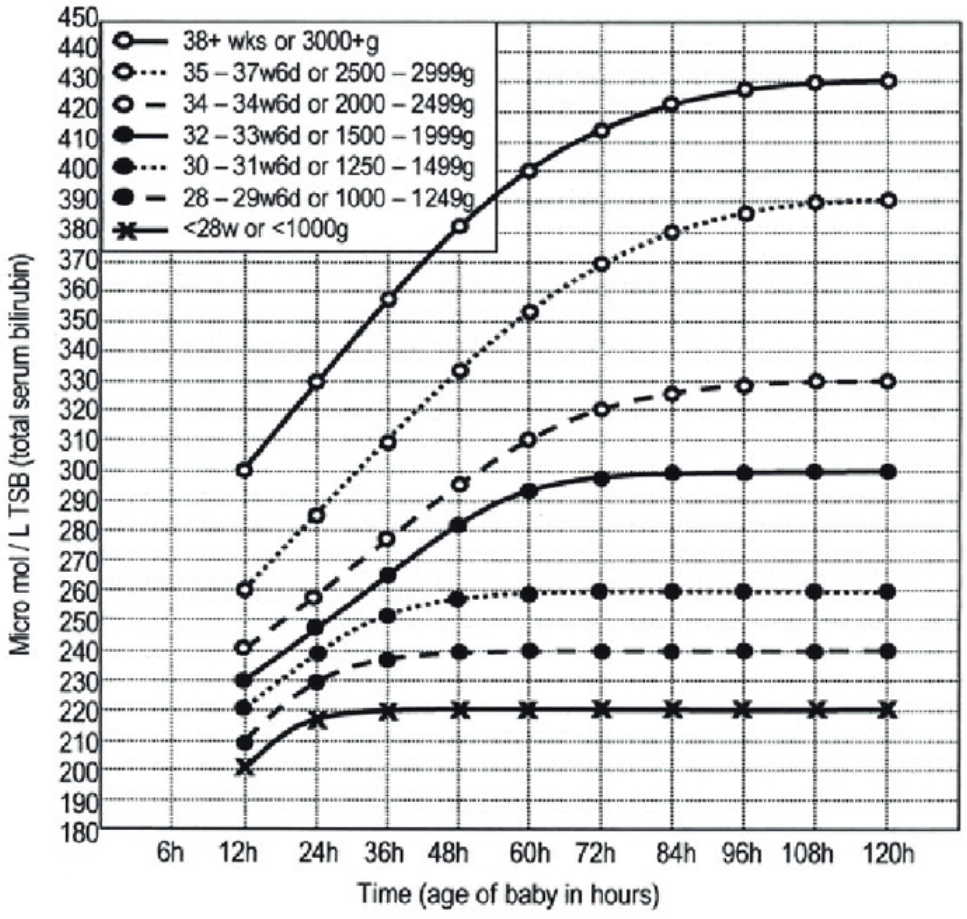
Figure W, Exchange Transfusion

EXCHANGE TRANSFUSION

South African Neonatal Academic Hospital Guidelines: 2006

In presence of sepsis, haemolysis, acidosis, or asphyxia,
use one line lower (gestation below) until <1000g
If gestational age is accurate, rather use gestational age (weeks) than body weight

Note: 1. Infants who present with TSB above threshold should have Exchange done if the TSB is not expected to be below the threshold after 6 hrs of intensive phototherapy.
2. Immediate Exchange is recommended if signs of bilirubin encephalopathy and usually also if TSB is >85 µmol/L above threshold at presentation
3. Exchange if TSB continues to rise >17 µmol/L/hour with intensive phototherapy



Exchange Blood Transfusion

1. Use neonatal jaundice charts (either NICE charts or Limpopo charts) to determine when to perform exchange blood transfusion.
2. Perform EBT on any neonate with clinical signs of acute bilirubin encephalopathy e.g. seizures, neck retraction, lethargy, etc.
3. Consider EBT on neonates with severe anemia that need blood transfusion and jaundice (did not reach the threshold for EBT.)

Intravenous Immunoglobin (IVIg)

Intravenous immunoglobin (IVIg) therapy for coombs positive neonates with jaundice.

Dose 0.5g per kg given over 2 hours.

Exchange blood transfusion

Exchange blood transfusion is the process of removing a baby's blood in aliquots and replacing with a donor's blood or normal saline. This procedure removes abnormal blood component and/or circulating toxins while maintaining adequate circulating blood volume.

Reasons for exchange blood transfusion:

1. Severe Jaundice
2. Haemolytic disease of the newborn

- Cord serum bilirubin >5mg/dl
- Cord PCV <30% (Hb <10g/dl)
- Positive cord blood direct coomb's test

3. Polycythaemia

- PCV >65% with symptoms
- PCV >70% with/without symptoms

4. Disseminated Intravascular Coagulation (DIC)
5. Overwhelming sepsis
6. Antibodies in maternal alloimmune disease

Types of exchange blood transfusion:

1. Double exchange blood transfusion

- 2 X blood volume (80ml per kg) X baby's weight
- Exchanges 85-90% of blood volume and removes 60% of bilirubin

- Used in the treatment of severe jaundice

2. Single volume exchange blood transfusion

- Blood volume X baby's weight
- Exchanges 60-75% of blood volume
- Used in the treatment of sepsis

3. Partial exchange transfusion

- Exchanges blood with normal saline
- Used in treatment of polycythaemia

Materials Required for Exchange Blood Transfusion (EBT)

1. Sterile Pack with Tray Containing:
   - Aprons
   - Sterile gloves
   - Swabs or gauze
   - Syringes
   - Blood giving set
   - Sutures
2. Face mask
3. Eye protection (goggles)
4. Radiant warmer
5. Antiseptic solution
6. Blood for Exchange Transfusion:
   - Must be fresh whole blood (preferably less than 72 hours old)
   - Must be negative for HIV, Hepatitis B, Hepatitis C, and Cytomegalovirus (CMV)
   - Must be crossmatched against both the baby's and mother's blood
   - Donor's PCV (Packed Cell Volume) should be between 40–60%

Procedure

1. The nurse or assistant should wash their hands, place the baby under a radiant warmer, and position the baby in a crucifix position.
2. Wash hands again and wear sterile gloves and a mask.
3. Prepare the skin with an antiseptic solution.
4. Drape the baby, exposing the umbilicus.

5. Cannulate the umbilical vein to a depth of 4–5 cm.
6. Measure the central venous pressure.
7. Attach a three-way tap to the syringe and blood-giving set.
8. Exchange blood in aliquots of 5 mL, 10 mL, or 20 mL, depending on the baby's weight.
9. Withdraw the first aliquot and hand it over to the assistant for FBC, serum EUCr, and serum bilirubin testing.
10. Replace the withdrawn volume of blood.
11. Announce and document the volume in and out for each cycle.
12. Rotate the blood bag every 10–15 minutes.
13. Administer 10% calcium gluconate (1 mL) after every 100 mL of citrated exchange blood. Administer slowly over 10 minutes.
14. Monitor vital signs (HR, RR, temperature, BP, and SpO_2).
15. Measure the central venous pressure at the end of the procedure.
16. The entire procedure takes 60–90 minutes. Do not rush the procedure.
17. Remove the umbilical venous catheter at the end of the procedure if no longer needed.

Post-EBT Monitoring

- Monitor vital signs and abdominal girth every 15 minutes for 1 hour, then every 30 minutes for up to 6 hours.
- Place the baby on nil by mouth one hour before and one hour after the EBT. Continue phototherapy after EBT.

CHAPTER 12:
NEONATAL TETANUS GUIDELINE

Tetanus is a severe infection due to the bacillus Clostridium tetani, found in soil, and human and animal waste. The infection is noncontagious. In neonates, the most common portal of entry for Clostridium tetani is the umbilicus.

Clostridium tetani is introduced into the body through a wound and produces a toxin (tetanospasmin) whose action on the central nervous system is responsible for the symptoms of tetanus.

Tetanus is entirely preventable by vaccination. It occurs in people who have not been fully vaccinated before exposure or have not received adequate post-exposure prophylaxis.

90% of cases present during day 3-14 of life.

Correct management can reduce mortality by up to 50%.

Clinical features include:

- Irritability
- Poor suckling
- Rigidity of lips and trismus
- Generalised rigidity

General measures

- Follow the ABC approach
  Ensure a systematic assessment of Airway, Breathing, and Circulation.
- Support airway and breathing
  Use appropriate positioning, airway adjuncts, and administer oxygen therapy as needed.
- Establish intravenous access
  Open an IV line for hydration and administration of intravenous medications.
- Environmental care
  - Nurse the patient in a dark, quiet room to reduce stimulation.
  - Practise minimal handling to avoid distress.
  - Perform frequent, gentle suctioning of the mouth and oropharynx to maintain a clear airway.
  - Reposition the patient regularly—every 3 to 4 hours—to prevent pressure sores.
- Intensive nursing care
  Ensure close monitoring and responsive nursing support at all times.

- Parental education and involvement Teach the family to recognise danger signs and to alert the nursing staff at the first indication of:
    - Cough
    - Difficulty breathing
    - Apnoea
    - Excessive secretions
    - Cyanosis
- Nutritional and fluid support
    - Insert a nasogastric tube for hydration, feeding, and administration of oral medications.
    - Provide hydration and nutrition by dividing feeds over 24 hours.
    - Administer expressed breast milk every 3 hours to prevent hypoglycaemia.

Neutralisation of the toxin:

- Human Anti-Tetanus Immunoglobulin (HTIG):

Administer 150 units/kg intramuscularly

OR

- Anti-Tetanus Serum (ATS):

Administer 50,000 IU intramuscularly

Control of Rigidity, Spasms, and Sedation

- First-line treatment: Diazepam

Administer 0.1 to 0.3 mg/kg via slow intravenous injection over 3 to 5 minutes, every 1 to 4 hours, depending on the severity and persistence of spasms, provided respiratory rate (RR) is ≥ 30 cycles per minute (CPM).

OR

- Phenobarbitone:
    - Loading dose: 20 mg/kg
    - Maintenance dose: 5 mg/kg daily, gradually tapered
- Important considerations when using diazepam:

- Dosage and frequency must be adjusted according to clinical response and patient tolerance
- High risk of respiratory depression and hypotension
  - → Continuous monitoring of RR and SpO_2 is essential
  - → Ensure availability of:

- Manual ventilation equipment (Ambu bag, face mask)
- Intubation and suction facilities (electric suction preferred)
- Ringer's lactate or normal saline
- IV Infusion of Diazepam:
  - Use a dedicated vein (avoid antecubital fossa if possible)
  - Do not stop treatment abruptly to avoid rebound spasms
- If spasms persist:

Initiate continuous IV infusion of diazepam at 0.1 to 0.5 mg/kg/hour (i.e. 2.4–12 mg/kg per 24 hours).

- Start with 0.1 mg/kg/hour
- If symptoms persist and RR remains ≥ 30, increase by 0.1 mg/kg/hour, up to a maximum of 0.8 mg/kg/hour

- Infusion Preparation Example (Neonate weighing 3 kg):
  - Required dose: 0.1 mg/kg/hr × 3 kg = 0.3 mg/hr
  - Dilution: One 10 mg ampoule of diazepam in 50 ml of 10% glucose = 0.2 mg/ml
  - Administration: 0.3 ÷ 0.2 = 1.5 ml/hour (using an electric syringe)
  - Diazepam is photosensitive – cover the infusion line with dark material
  - Discard diluted diazepam after 6 hours

- Tapering the Infusion:
  - As spasms subside, gradually reduce infusion rate
  - Switch to oral administration: Calculate total daily requirement and give in 4 divided doses
  - After the first oral dose, reduce IV infusion by 50%, then discontinue
  - Taper oral dose gradually with recovery:

→6-hourly →8-hourly →12-hourly →once daily

Inhibition of Toxin Production

Antibiotic Therapy

- Metronidazole:
  - Loading dose: 15 mg/kg on Day 1
  - Then after 24 hours: 7.5 mg/kg every 12 hours for 1 week
- Dosage guidance by age and weight:
  - 0–7 days: As above
  - 8 days to <1 month (<2 kg): Same dosing
  - 8 days to <1 month (≥2 kg): 15 mg/kg every 12 hours
- Broad-spectrum antibiotics (to cover associated sepsis):
  - Ampicillin:
- <7 days old: 50 mg/kg twice daily (BD)
- 7–21 days: 50 mg/kg three times daily (TDS)
- >21 days: 50 mg/kg four times daily (QID)
  - Gentamicin:
- ≤7 days: 5 mg/kg once daily (3 mg/kg if <2 kg)
- >7 days: 7.5 mg/kg once daily

Note: Metronidazole is effective against Clostridium tetani, but due to frequent associated neonatal sepsis, broad-spectrum cover is essential.

Pain relief

> Oral Paracetamol 15 mg/kg 6 hourly (> 1 month), and 10 mg/kg 6 hourly (<1 month)

- Morphine PO (via nasogastric tube), if necessary.
- When morphine is administered with diazepam the risk of respiratory depression is increased, thus closer monitoring is required. When morphine is no longer required, wean the same way as diazepam.

Treatment of the entry point and associated infections

- Search systematically the entry wound.

- Provide local treatment under sedation: cleansing and for deep wounds, irrigation and debridement (where indicated)
- **Cord infection:** do not excise or debride; treat bacterial omphalitis and sepsis, add to metronidazole IV: cloxacillin IV + cefotaxime IV or cloxacillin IV + gentamicin IV (for doses, dosage session).
- Clean the umbilicus with chlorhexidine 7% or, if not available, surgical spirit.

Feeds/Fluids

- Good nutrition is vital, as the muscle spasms consume a lot of energy.
- Feeds should be frequent and small to minimize the risk of hypoglycemia and aspiration.
- Feed according to child's age (preferably expressed breast milk). Refer to feeding protocol.
- If very unstable, keep NPO and start IV fluids at 150 ml/kg/day, but change to feeds as soon as possible.

Monitoring

- Diazepam and Phenobarbital cause respiratory depression, so close monitoring is required.
- Maintain a vitals chart, blood glucose chart, cardiac monitoring chart, spasm chart (both spontaneous and provoked spams), fluid input/output chart.
- Laboratory tests: FBC.

Tetanus Vaccination

- As tetanus infection does not confer immunity, vaccination against tetanus must be administered once the patient has recovered.
- In case of neonatal tetanus, initiate the vaccination of the mother

Table 37, Prognostic Scoring System for Neonatal Tetanus

Factor	Score
Incubation time:	
<48 hours	5
2-5 days	4
5-10 days	3
10-14 days	2
>14 days	1
Site of infection:	
Internal and umbilical	5
Head, neck, and body wall	4
Peripheral proximal	3
Peripheral distal	2
Unknown	1
State of protection:	
None	10
Possibly some or maternal immunisation in	8
neonatal patients	
Protected >10 years ago	4
Protected <10 years ago	2
Complete protection	0
Complicating factors:	
Injury or life threatening illness	10
Severe injury or illness not immediately life	8
threatening	
Injury or non-life threatening illness	4
Minor injury or illness	2
ASA Grade 1	0
Total score	

Interpretation:

- <9 = Mild
- 9-18 = Moderate
- >18 = Severe

CHAPTER 13:
PAIN CONTROL

Pain Assessment and Management

Newborns experience pain: "If it would hurt you, it hurts them!"

- Preterm infants have less ability to demonstrate symptoms of pain.
- Repeated painful procedures have been proven to cause adverse, long term neurologic effects.
- For conducting minor procedures, e.g. blood draws, IV cannula placement, lumbar puncture.

It was commonly believed that premature babies and neonates do not feel pain. It is now known that neonates can feel pain as do children and adults, but due to their immature development they express their feelings of pain differently.

There are many reasons why a neonate in SCBU may experience pain or discomfort:0

Table 38, Causes of Pain in a Neonate

Painful Procedures	Other Causes
Cannulation	Pressure sores
Capillary blood sampling	Gut infection
IM injections	Mishandling/Inappropriate positioning
Nasogastric tube insertion	Hunger
Chest drain insertion	Air in the stomach/bowel
	Hyperthermia/Hypothermia

Repeated or prolonged exposure to pain has long-term effects on the neonate:

- Abnormal brain development
- Increased morbidity and mortality
- Long term effects on brain neurodevelopment with poor cognitive and development outcomes later in life
- Increased length of stay in hospital

It also affects their physiological state, so you may notice an increase in heart rate, raised blood pressure, lower oxygen saturations and more frequent desaturations. It is very

important for clinical staff working with neonates to be aware of signs and to know how to manage pain.

Signs that a neonate is in pain are:

- Increased heart rate
- High temperature
- Hypoglycaemia
- Desaturation
- Crying
- Movement
- Facial expression
- Poor sleep
- Feed intolerance

It is possible to use a tool to assist with the assessment of pain. It indicates to health care workers approximately how severe the pain is and allows them to monitor to check for improvement.

Table 39, Neonatal Infant Pain Scale (NIPS) – Pain Assessment Criteria

	Score	Finding	Details
Facial expression	0	Relaxed muscle	Restful face, neutral expression
	1	Grimace	Tight facial muscles, furrowed brow, chin, jaw
Cry	0	No cry	Quiet, not crying
	1	Whimper	Mild moaning, intermittent
	2	Vigorous cry	Loud scream, rising, shrill, continuous
Breathing patterns	0	Relaxed	Usual pattern for this baby
	1	Changed	Indrawing, irregular, faster, gagging
Arms	0	Relaxed/restrained	No muscular rigidity, occasional movement
	1	Flexed/extended	Tense, straight arms, rigid, extension/flexion
Legs	0	Relaxed/restrained	No muscular rigidity, occasional movement
	1	Flexed/extended	Tense, straight legs, rigid, extension/flexion
State of arousal	0	Sleeping/awake	Quiet, peaceful, sleeping, or alert and settled
	1	Fussy	Alert, restless, and thrashing

The NIPS gives the baby a score out of 7 with 0 being no expression of pain observed and 7 being expression of severe pain observed. Once scored the guide should be followed to decide on management

Figure X, NIPS Tool Used for Assessing Level of Pain in Neonates.

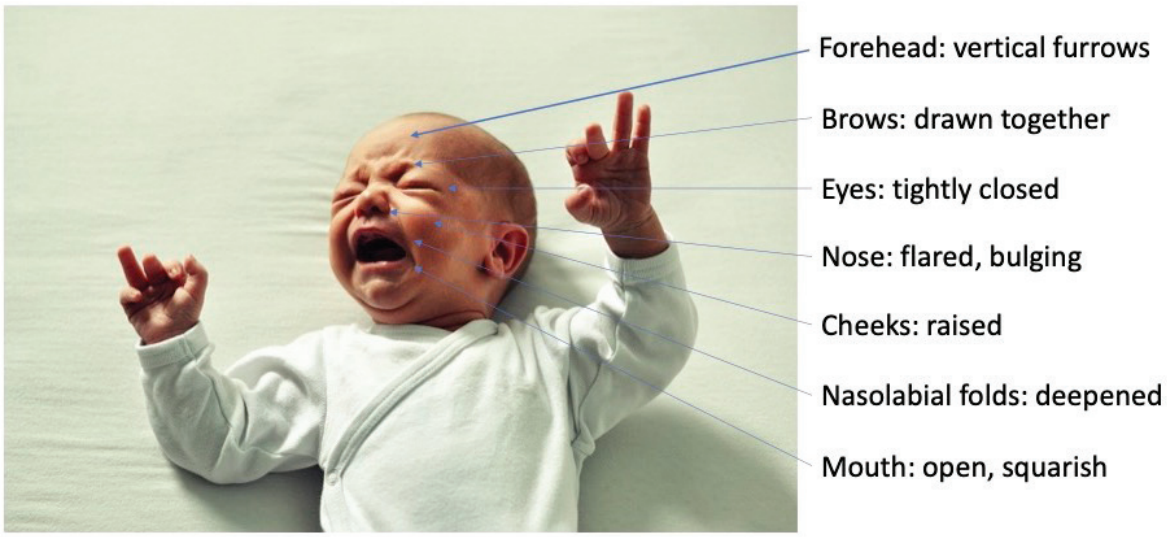


Table 40, Pain Score Interpretation and Recommended Interventions (NIPS Tool)

Pain Level	Intervention
0-2 = mild to no pain 3-4 mild to	None
moderate pain	Non-pharmacological intervention with a reassessment in 30 minutes
>4 = severe pain	Non-pharmacological intervention and possibly pharmacological intervention with reassessment in 30 minutes

Non-pharmacological management of pain

If the baby is experiencing mild to moderate pain and has a NIPS score of 3-4, it is possible that their pain can be treated using non-pharmacological techniques. Non-pharmacological techniques involve calming the baby and relieving their stress without using medication.

Non-pharmacological methods include:

- Kangaroo Care
- Sucrose (sugar water)
- Non-nutritive sucking
- Environment
- Swaddling
- Containment holding

- Cue based interventions
- Parental involvement
- Procedures performed with 2 people

Pharmacological pain management

There are many drugs available that reduce pain; however, due to side effects and the neonate's immature system, not all are suitable for use in neonates.

Paracetamol

Paracetamol can be administered intravenously or orally via a nasogastric tube (NGT). It has no effect on the neonate's breathing, but if given in high doses or over a long period of time, it can damage the liver.

Table 41, Dosage

Route	Dose	Frequency	Max dose/day	Administration
IV	>32 weeks to term corrected 7.5mg/kg	8 hourly	25mg/kg	Infuse over 15 mins
	Neonate 10mg/kg	8 hourly	30mg/kg	
PO/NGT (as suspension)	28-32 weeks 10-15mg/kg	8 hourly	30mg/kg	
	Neonate >32 weeks 10-15mg/kg	6 hourly	60mg/kg	

Morphine

Morphine is an opiate and much stronger than paracetamol. It is the drug of choice for more painful, invasive procedures, such as chest drain insertion. Administering morphine must be done carefully, and the neonate must be under close observation until the effects wear off. It has a sedating effect and can slow the respiratory drive, potentially causing apnoea or respiratory arrest.

Table 42, Dosage

Route	Dose	Frequency	Max dose	Administration
IV	0.025mg/kg	6-8 hourly	N/A	Push over 5 minutes (follow with good flush)
SC	0.025mg/kg	6-8 hourly	N/A	

Infants with a devastating neurological prognosis due to congenital or acquired conditions require special consideration. The severity of the expected outcome must be explained to the family honestly and clearly.

CHAPTER 14:
ENTERAL FEEDING: BREAST FEEDING/ ASSISTED FEEDING

Breast milk is ideal for all neonates, and every effort must be made to establish breastfeeding within the first hour of life. Small and sick babies who are too weak to feed from the breast should be provided with expressed breast milk using alternative feeding methods consistent with national policy. For small and sick neonates who are not too weak to feed from the breast, expressed breast milk should also be provided through alternative feeding methods in line with national policies[1] (e.g. cup and/or spoon instead of baby feeding bottle and artificial teat). The advantages of breast milk are numerous, and mothers of babies in the Special Care Baby Unit (SCBU) must be encouraged, counselled, and supported to ensure this mode of feeding.

Assessment of breastfeeding:

- Ask the mother to feed her baby if she has not fed in the previous one hour.
- Check for signs of good positioning and attachment:

Positioning

- The baby's body should be straight, not bent or twisted, with the head slightly tilted back.
- The baby's body should face the breast, not lie flat against the mother's chest or abdomen, and the baby should be able to look up into the mother's face.
- The baby should be held close to the mother's body.
- The mother should support the baby's whole body (not just the neck and shoulders), with her hand and forearm following the cross-cradle position or underarm position, which is highly recommended for small babies.
- The mother should hold her breast with her fingers in a C shape, with the thumb above the areola and the other fingers below. Fingers should not be in a scissor hold, as this method tends to put pressure on the milk ducts and may cause the nipple to slip out of the baby's mouth.

Attachment

- The baby's mouth is wide open.
- The baby's mouth covers a large part of the areola (with more areola visible above than below the nipple).

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1 Refer to the Infant Friendly Hospital Initiative (BFHI) policy and the National Infant Feeding Policy for Hospitals and Other Health Facilities in Sierra Leone of the Ministry of Health and Sanitation

- The baby's lower lip is turned outwards.
- The baby's chin is touching the mother's breast.

Observe for effective sucking and swallowing:

- The baby takes slow, deep suckles, sometimes pausing.
- You can see or hear the baby swallowing after one or two suckles.
- Suckling is comfortable and pain-free for the mother.
- The baby finishes the feed, releases the breast, and looks contented and relaxed.
- The breast feels softer after the feed.

Effective Breastfeeding

- Slow, deep sucks.
- Cheeks are round while suckling.
- The baby releases the breast when finished.
- The mother notices signs of oxytocin release.

Support for Breast Feeding

Manual Expression of Breast Milk:

Indications for Expressing Breast Milk (EBM):

- Baby cannot breastfeed due to critical condition – can be fed EBM via nasogastric tube or cup.
- Premature baby who is unable to suck – mostly below birth weight of 1500 grams.
- Storage of breast milk.
- To ensure continuous supply of breast milk when baby is not breastfeeding.
- To relieve engorged breasts.
- To boost the breast milk supply.
- To be taught to all mothers during the antenatal period.

Steps to Express Breast Milk:

Step 1: Observe hand hygiene protocol.

Step 2: Obtain a clean, safe container to express and store the milk. The expression container should have a wide opening.

Step 3: Ask the mother to sit comfortably and relax. Massage the breast all around to stimulate letdown.

Step 4: Hold the breast in a 'C' grip with your index finger and thumb near, but not touching, the areola (see figure Y).

Step 5: Push the breast back towards the chest wall. Do not slide your finger and thumb over the breast towards the nipple, or rub the skin, as this can cause bruising, or squeeze the nipple, which stops the flow of milk.

Step 6: Compress the breast between the thumb and the finger without lifting them from the breast. Release without moving your hand from the breast.

Step 7: Repeat this step until the breast is 'empty'. Begin with the next breast until completely drained.

Step 8: Use the expressed breast milk immediately or store it safely for later use.

Figure Y, Steps for Manual Expression of Breast Milk

Steps for Manual Expression of Breast Milk:

- Initially, massage the breast using gentle strokes in all quadrants; a warm cloth may be used to stimulate the flow of milk.
- Position the thumb and forefinger at the margin of the dark area of the nipple (areola) on both sides and press the breast tissue into the ribcage.
- Maintaining the backward pressure, start bringing the thumb and forefinger of the hand towards each other. Do not slide the finger and thumb over the breast towards the nipple, or rub the skin, as this can cause bruising, or squeeze the nipple, which stops the flow of milk.

Repeat the same process several times. Express one breast for at least 3 to 5 minutes until the flow slows, then express the other breast. Afterward, repeat on both sides again (the duration is usually 20-30 minutes). Mothers may change hands when one hand gets tired.

Gavage Feeding (Orogastric/Nasogastric):

Indications for NGT/OGT Insertion:

- Premature babies (usually those with a birth weight below 1500 grams) requiring NGT feeding.
- Baby is on oxygen therapy via nasal catheter – insert in the same nostril as the nasal catheter.
- Baby requires CPAP – insert OGT only.
- Baby requires intensive phototherapy.

Inserting and Using an NGT/OGT:

Step 1: Select the appropriate size of the nasal/oral gastric tube to use. It is advisable to use the smallest-sized tube which is most effective for the purpose (for babies <1500 grams, use size 5-6, and for babies ≥1500 grams, use size 6-8).

Step 2: Size the nasal/oral gastric tube. Measure the length from the angle of the mouth to the tragus, then to the midpoint between the xiphisternum (epigastrium) and umbilicus. Mark the tube at this point.

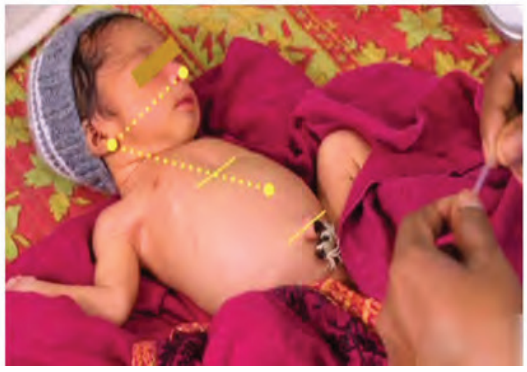
Step 3: Insert the tube from the mouth until the desired length has been introduced.

Step 4: Check the position using a syringe and a stethoscope to auscultate the gush of air. Tape the tube to the side of the mouth and close the distal end after removing the syringe.

To Instil Feed: Take a 10 ml syringe barrel without the plunger and insert the nozzle into the open end of the feeding tube. Pour milk into the syringe and wait for it to go down slowly by gravity. After a feed, close the open end.

Check the abdominal girth at the next feeding session and proceed to feed if there is 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 whether to continue or discontinue feeds.

Always confirm the position of the tube prior to giving a feed. The tube should be changed every 7 days to prevent contamination.



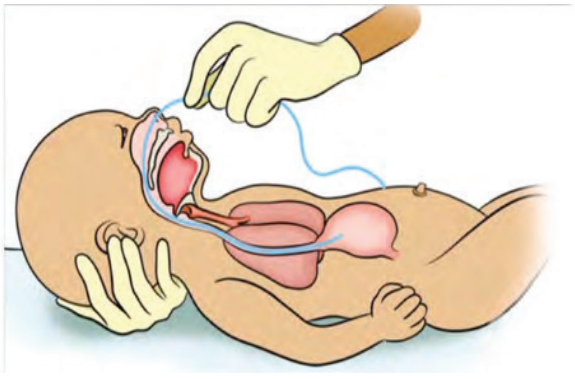


Figure Z, Inserting and Using an NGT/OGT

Cup-spoon Feeding:

Indications for Cup-spoon Feeding:

- Baby is stable, equal to or above 1500 grams, but cannot be breastfed.

Figure AA, Steps to Cup-spoon Feeding

Figure AB, Steps to Cup-Spoon Feeding

Step 1: Observe for hunger cues. Do not wait for crying to feed.

Step 2: Observe hand hygiene protocol.

Step 3: Prepare and place the appropriate volume of milk in a cup.

Step 4: Sit the baby at almost a 90° angle, supporting the baby's head, neck, and back as shown in figure AA above. Do not feed a child that is lying down.

Step 5: Place the cup on the lower lip and tilt it so the milk reaches the baby's lips. Let the baby lick the milk using their tongue (figure AB). Do not pour milk into the baby's mouth.

Step 6: Continue tilting the cup as the baby continues to lick the milk.

Step 7: When the baby has taken enough, they will start closing their mouth and may even fall asleep. Do not feed a sleeping baby.

Management 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.
    - Take a 10 ml syringe, cut the nozzle end transversely using a new blade.
    - Take care that the syringe barrel's cut margin is not ragged.
    - Insert plunger into the barrel from the cut nozzle end.
    - 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.
    - Repeat this several times and follow it by putting the baby to the breast to encourage suckling.

- To release the vacuum, press areola towards the chest to let air enter/push plunger in towards the nipple.

Supplementary Suckling Technique[2]

Use a tube the same size as n°8 NGT (a n°5 tube can be used and is better for the baby, but the milk should be strained through cotton wool to remove any small particles that may block the tube).

Put the appropriate amount of SS-milk (If baby does not have oedema, F100 diluted should be used but if the baby has oedema, F75 should be used)[3][4] in a clean cup and hold it. Put the end of the tube in the cup.

- Put the tip of the tube on the breast at the nipple.

Tell the mother to offer the breast in the normal way -as if breastfeeding- so that the baby attaches properly. At the beginning the mother finds it better to attach the tube to the breast with some tape, later as she gets experience this is not normally necessary.

When the baby suckles on the breast, with the tube in its mouth, the milk from the cup is sucked up through the tube and taken by the baby. It is like taking a drink through a straw.

- Help the mother at first by holding the cup and the tube in place and encourage the mother confidently.

Place the cup at first about 5 cm to 10 cm below the level of the nipple so the SS-milk can be taken with little effort by a weak baby.

- NEVER place the cup above the level of the nipple, or it will flow quickly into the baby's mouth by siphonage with a major risk of aspiration.
- Tell the mother to relax. Excessive or officious instructions about the correct positioning or attachment positions often inhibit the mother and make her think the technique is much more difficult than it is. Any position in which the mother is comfortable and finds the technique is working effectively, is satisfactory.

Note: It may take one or two days for the baby to get used to the tube and the taste of the mixture of milks, but it is important to persevere.

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2 Breast milk output is stimulated by the Supplemental Suckling (SS) technique. Sick newborns are weak and do not suckle strongly enough to stimulate an adequate production of breast milk resulting to low output of milk due to inadequate stimulation by the feeble newborn. The objective of SS technique is to establish breastfeeding, or re-establish breastfeeding when it has been interrupted. A health worker trained in Integrated Management of Acute Malnutrition (IMAM) should be involved in the application of this technique.

3 Preparation of the SS-milk and the amounts to be given are detailed in the IMAM national protocol; Ensure that the IMAM trained health worker is involved in this process

4 Source: IMAM national protocol; This applies to babys who are orphaned or abandoned by the mother and does not have a female caretaker for which SS technique can be applied;

Newborns without the prospect of being breastfed[5]:

The diet of the baby should normally be based upon generic baby formula[6] except those with oedema wherein the IMAM national protocol to provide F75 should be applied. Generic baby formula is preferred, however, F100 diluted can be used (involving an IMAM trained health worker).

Babys should be discharged on generic baby formula.

It is essential that the caretaker has access to adequate amounts of generic baby formula. This has to be supplied by a health facility, orphanage, or foster parents. Commercially produced formula are nearly always unaffordable to many families with babies without mothers. Most caretakers (fathers, siblings) in this situation over-dilute the formula to make it "stretch" and last longer, others use the cheapest milk, which in many occasions will be dried whole milk, evaporated or condensed milk; these are all unsuitable for the growth and development of the baby.

Follow-up for these babies and their caretakers are very important and should be organised by the outreach health worker in conjunction with the community health workers (CHWs) and mother support groups (MSGs).

5 Source: IMAM national protocol; This applies to babys who are orphaned or abandoned by the mother and does not have a female caretaker for which SS technique can be applied;

6 Source: IMAM national protocol; Baby formula may come in liquid or powdered forms. Ready-to-use baby formula (RUIF, liquid form) neither require reconstitution nor dilution with water thus its use may minimize health risks. Powdered baby formula milk is more readily available in local market than the RUIF and careful adherence to instructions on preparing and using it, such as use of clean and safe waster as well as correct water temperature for reconstitution, must be observed.

CHAPTER 15:
PARENTERAL: FLUID AND NUTRITION

Introduction:

Management of fluid and electrolytes is an integral part of neonatal care. Feeding with breast milk in most of the stable neonates should be sufficient to maintain fluid balance. The goal of fluid management in the first few days is to allow normal weight loss simultaneously with ensuring physiological stability.

This section describes feeds and fluids for the small and sick preterm/LBW newborns as well as fluids for the sick normal weight newborn.

FEEDS, FLUIDS AND ELECTROLYTE MANAGEMENT1 FOR THE VERY SMALL AND SICK NEWBORNS

Most sick and very small newborns will need to be commenced on intravenous fluids from day of birth, and if there is a contraindication to oral feeding (including naso/oro-gastric tube and cup feeding) give IV fluids. IV fluid is given to ensure that the baby receives necessary fluid, minimum calories, and electrolytes while aiming at full enteral feed. The gold standard is to mimic the in- utero weight gain rates.

General Rules

- Calculate total fluid using the baby's birth weight until the baby has regained the birth weight and then use the weight on that day.
- Weigh the baby every day.
- Feeds and fluids must be calculated and prescribed EVERY DAY.
- Start breast feeding as soon as possible.

Indications for starting Intravenous (IV) fluids; Possible reasons for not feeding by mouth or gastric tube:

In the presence of the following risk factors, feeds should be withheld and later initiated more cautiously after discussion with a senior clinician.

Table 43, Possible Reasons for not Feeding by Mouth

MEDICAL	SURGICAL
■ Recurrent apnoea ○ Preterm <30 weeks or birth weight < 1500g in the first few days of life ■ Moderate to Severe respiratory distress ○ Any sick baby unable to tolerate enteral feeds ■ Frequent convulsions ■ Neonatal encephalopathy/Severe perinatal asphyxia ■ Cardiorespiratory instability/Shock ■ Unconscious ■ Tense abdominal distension ■ Erythema of the abdominal wall ■ Decreased bowel sounds ■ Gross or occult blood in the stools ■ Abdominal tenderness ■ Heavy bile-stained nasogastric aspirate ■ Vomits after two consecutive feeds with the feeding tube	■ Bowel obstruction (Abdominal infection/ severe abdominal distension/green vomiting) ■ Necrotizing enterocolitis ■ Abdominal wall defects (relative contra-indication) ■ Tracheo-oesophageal fistula ■ Pneumatosis intestinalis on abdominal X-ray

Which IVF fluid to use?

The choice of IV fluid depends on both the postnatal age and gestational age of the newborn.

General Principle:

- Plain glucose infusion (10% dextrose without electrolytes) is recommended during the first 48 hours of life.
- This is due to the immaturity of neonatal kidneys, which:
  - Retain maternal electrolyte status
  - Do not effectively excrete electrolytes

1. Day 1 and Day 2 (First 48 Hours of Life)

- Term newborns:
  Administer 10% dextrose at 60–70 ml/kg/day

- Preterm newborns:
  Administer 10% dextrose at 80–90 ml/kg/day
- Extremely Low Birth Weight (ELBW) infants (<1000 g):
  Use 5% dextrose, as they may not tolerate 10% dextrose due to extreme immaturity
- Fluid Adjustments:
- Daily increase:
  Increase total fluid volume by 10–20 ml/kg/day
- Under phototherapy or radiant warmer:
  Add an additional 20–30 ml/kg/day
  →Monitor fluid status closely
- In cases of severe asphyxia or Hypoxic-Ischaemic Encephalopathy (HIE):
  - Start with 40 ml/kg/day during the first 24 hours (Day 0)
  - Wait for urine output to be established, then switch to normal maintenance fluids

Enteral Support:

- Commence buccal colostrum swabs within 6 hours of birth
- Begin trophic (minimal) oral feeds to prime the gastrointestinal tract:
  - Start with 10–20 ml/kg/day within 24 hours of delivery

2. From Day 3 Onwards (After 48 hours):

- If urine output is well established, add maintenance electrolytes – Sodium, chloride, potassium as indicated to the total amount of fluids. Use birth weight for calculations until the actual weight exceeds the birth weight.
- The duration of IV fluid therapy should be limited to the shortest possible time.
- After two days of IV fluids with Dextrose 10 %, add electrolytes. Take 4 parts of Dextrose 10% and add 1 part of Ringer Lactate (or Normal Saline) to obtain Dextrose with 1/5 RL or NS (e.g. D10 % 80 ml plus RL 20 ml) i.e. 10% Dextrose 80% of total calculated amount plus Ringer's lactate 20% of the total calculated amount.
- Added calcium if baby is preterm, asphyxiated, infant of diabetic mothers or hypocalcemic babies.
- DO NOT give only plain 10% Dextrose infusion after 48 hours of life.
- The aim is to increase the oral portion pending the haemodynamic stability of the baby, while always considering the continuous increase of the total amount of fluid daily.

3. Suggested electrolyte management after the first 48 hours:

- Usually, electrolytes are available in breastmilk if feeding has started. Thus, babies that have commenced effective enteral feeding do not require electrolytes supplementation.
- If feeding is not established by 48 hours of age, newborns requiring prolonged IV fluids need electrolytes (ions):
- Sodium - Start at 2-3 meq/kg and adjusted based on needs to keep serum Na 135-140mmol/L.
- Potassium - Add in the IVF at 48hrs (2-3 meq/kg/day) if urine output is adequate.
- Monitor serum electrolyte levels.

4. Volume of fluids and gradual oral feeds to give:

- Tables below: show approximate volumes of IVF and gradual oral feeds for newborns from <1000g (1kg) to above 3000g (3kg) weight by Day of Life (DOL) with 0 being first day of birth. Babies <1000g should be treated in at SCBUs or NICU (not primary health centers).
- Increase the volume of feeds while decreasing the volume of IV fluid to maintain the total daily fluid volume according to the baby's daily requirement as shown in the tables.
- Monitor blood glucose closely and correct as appropriate.
- Discontinue the infusion of IV fluid when the baby is receiving more than two-thirds of the daily fluid volume by mouth and has no abdominal distension or vomiting.
- Consider adding breast milk fortifier according to guidelines when baby reaches full feeds 150-180mls/kg/day.
- Aim to commence breastmilk/colostrum from day 1; and aim for early enteral nutrition to prevent atrophy of the gut and necrotizing enterocolitis.
- Provide psychosocial and emotional support to the mother; and daily KMC, to enhance breast milk production.

Table 44, IV Fluids and Gradual Feeds for <1000g ELBW

Birth Weight < 1.0 kg (ELBW) (Estimated at 0.9 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO Ml/kg/day	IV		Enteral	
			ml/kg/24hrs	ml/hr	Buccal colostrum/ trophic feeds	Buccal colostrum/ trophic feeds
0	*G5%	80	80	3	0	0
1	*G5%	100	90	3	10	1
2	*G5%	120	90	3	30	3
3	*G5%	140	90	3	50	6
4	*G5%	150	80	3	70	8
5	*G5%	150	60	2	90	10
6	*G5%	150	40	2	110	12
7	*G5%	150	20	1	130	15
8	n/a	160	0	0	150	17
9	n/a	170	0	0	170	19
10	n/a	180	0	0	180	20

For SCBUs and NICUs:

- Primary and secondary facilities should aim to refer in utero all expected deliveries <1000g to tertiary centres for improved chances of survival.
- Calcium – usual maintenance dose is calcium gluconate 200-400mg/kg/day (2-4ml/Kg/day of 10% Calcium Gluconate). Calcium is recommended in the Starter Day 1 fluid in neonates <1500g and asphyxiated neonates.
- Aim for a glucose Infusion rate of 4-8mg/kg/minute depending on the GA of the baby (can give up to GIR 12mg/kg/min in intractable hypoglycaemia). Adjust glucose concentration rate accordingly. See GIR estimates under management of hypoglycaemia.

Table 45, Fluids and Gradual Feeds for Babies 1000g-1500g (VLBW)

Birth Weight 1.0 – 1.5 kg (VLBW) (Estimated at 1.25 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO Ml/kg/day	IV		Enteral	
			ml/kg/24hrs	ml/hr	Buccal colostrum/ trophic feeds	Buccal colostrum/ trophic feeds
0	G10%	80	80	4	0	0
1	G10%	100	75	4	25	4
2	G10%	120	70	4	50	8
3	G10%	140	65	3	75	12
4	G10%	150	50	3	100	16
5	G10%	150	25	1	125	20
6	n/a	150	0	0	150	24
7	n/a	170	0	0	170	26
8	n/a	180	0	0	180	28

Table 46, Fluids and Gradual Feeds for 1.5kg-2.0kg

Birth Weight 1.5 – 2.0 kg (LBW) (Estimated at 1.75 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO Ml/kg/day	IV		Enteral	
			ml/ kg/24hrs	ml/hr	Buccal colostrum/ trophic feeds	Buccal colostrum/ trophic feeds
0	G10%	60	60	4	0	0
1	G10%	80	50	4	30	7
2	G10%	100	40	3	60	13
3	G10%	120	30	2	95	20
4	G10%	140	20	1	120	26
5	n/a	150	0	0	150	33
6	n/a	170	0	0	170	37

Table 47, Fluids and Gradual Feeds for 2.0kg-2.5kg

Birth Weight 2.0 – 2.5 kg (LBW) (Estimated at 2.25 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO Ml/kg/day	IV		Enteral	
			ml/ kg/24hrs	ml/hr	Buccal colostrum/ trophic feeds	Buccal colostrum/ trophic feeds
0	G10%	60	60	6	0	0
1	G10%	90	50	5	40	11
2	G10%	120	40	4	80	23
3	G10%	150	30	3	120	34
4	n/a	150	0	0	150	42

Table 48, Fluids and Gradual Feeds for > 3.0kg

Birth Weight >2.5 kg (Estimated at 3.5 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO Ml/kg/day	IV		Enteral	
			ml/ kg/24hrs	ml/hr	Buccal colostrum/ trophic feeds	Buccal colostrum/ trophic feeds
0	G10%	60	60	9	0	0
1	G10%	90	40	6	50	22
2	G10%	120	20	3	100	44
3	n/a	150	0	30	150	66

NOTE: The birthweight of the baby is used in the calculation of fluid and feed volumes within the first week of life and till the baby regains the birth weight. This is also true for drugs.

- Where the birthweight is not available for referred babies, use the admission weight.
- If newborn is >1.5 kg, has mature suck and demonstrates interest in feeding, start with oral feeds (breastfeeding, cup or syringe). If unable to take full volume enterally, give remainder of volume by NGT.
- NG feeds should be given by gravity, not pushed through syringe.

Important information for giving IV fluids:

- Newborns require higher daily fluid amounts and dextrose concentrations than older children due to high caloric and fluid requirements.
- Low birth weight (LBW) newborns have high fluid requirement due to their large body surface area.

- "Weight for calculations" is the birth weight (BW) until current weight is greater than BW unless oedematous.
- Newborns (DOL 0) should always be started on D10%, never D5%. If a newborn is persistently hyperglycemic on D10% despite minimizing volume of infusion while supporting hydration, change to D5% and monitor glucose closely. This situation occurs most frequently in the ELBW (< 1000 gm) newborn.

Note: Day of birth is "day 0".

- On day of life 0 and 1, newborns do not need supplemental electrolytes due to higher baseline total body sodium content and decreased renal function.
- **By day of life 2, newborns require maintenance Na+ at 3 mmol/kg/day and K+ at 2 mmol/kg/day.**
- Usually, this is in the form of milk if feedings have started. Therefore, newborns can remain on D10% as they transition off IV fluids while increasing their enteral volume.
- If feeding is not established by day of life 2, newborn is requiring prolonged IV fluids and electrolytes (ions). D10% is then mixed with NS or RL to provide necessary electrolytes.
- **Newborns require increased total fluid administration if they have increased losses:**
- Newborns receiving phototherapy should be given an additional 20 mL/kg/day of total fluids to account for increased insensible losses due to evaporation.
- Other reasons for increased losses include fever, vomiting, diarrhea, care under radiant warmer.

Procedure for Administering IV Fluids

Always maintain strict aseptic precautions.

Before infusing IV fluid, ensure the following checks are performed:

a. Verify the expiry date of the fluid.
b. Confirm that the seal of the infusion bottle or bag is intact.
c. Ensure the fluid is clear and free from visible particles or sediment.

- A syringe pump/ infusion giving set or a microburette can be used safely to infuse a calculated volume of fluid over a given time to avoid over hydration or under hydration.
- In the microburette system 1ml of fluid makes 60 µdrops. Approximately 1 µdrop/ minute infuses 1ml/hr. For example, to give 5ml/hr set infusion rate at 5 µdrops/min.
- Calculate fluid requirements for an 8-hour period at a time and reassess every 8 hours to prevent overhydration.
- Take into consideration the volume of medications and IV flushes.
- Strictly maintain intake-output charts, review every 8 hours.
- Properly secure the IV cannula. Splinting should be avoided.

- Discard all constituted fluids and IV drugs after 24 hours due to contamination.
- Infusion sets to be changed preferably after every 24 hours. Label the date and time opened on any open fluid or drugs.
- Change syringe pump/ infusion sets, and fluid bags every 24 hours to avoid contamination and nosocomial infections.
- Calculate the rate of administration:
- The IV flow rate formula is used to calculate the rate or number of drops of IV infusion to be given per minute:
- Drop factor is the number of drops in one milliliter used in IV fluid administration.
- It varies depending on the type of infusion apparatus used.

- Label the infusion set with patients' parameters: Date and time, Patient's name, Type of.
- Fluid, Volume of fluid, Number of drops/minutes. = Volume to be given (in mls) X Drop factor/Total infusion time (in minutes).

How to Calculate Intravenous Fluid (IVF) Rate and Drop Rate

Standard Formula for Calculating Drop Rate (drops per minute):

Drop Rate = (Volume in ml × Drop Factor) ÷ Total Time (in minutes)

- Drop factor for a Soluset = 60 drops/ml
- To convert hours to minutes: multiply by 60

Example 1: 2 kg Baby on Day 4

- Total fluid requirement (Day 4):
  125 ml/kg/day × 2 kg = 250 ml over 24 hours
- Feeds (milk):
  75 ml/kg/day × 2 kg = 150 ml per day

This equates to:

- 12 ml every 2 hours
- or 18 ml every 3 hours, depending on unit protocols

- Remaining fluid to be given intravenously:
  250 ml − 150 ml = 100 ml per day

→This corresponds to 50 ml/kg/day for IV fluids

- Type of IV fluid (Day 4):
  Use a fluid with electrolytes

- Administration method:
  - Administer 25 ml via burette every 6 hours
  - Infuse at a rate of 4 drops per minute

Example 2: 2.6 kg Baby on 60 ml/kg/day IV Fluid

- Total volume required:
  60 ml/kg × 2.6 kg = 156 ml over 24 hours
- Drop factor (Soluset): 60 drops/ml
- Total infusion time:
  24 hours = 24 × 60 = 1440 minutes
- Drop rate calculation:
  (156 × 60) ÷ 1440 = 6.5 drops per minute, rounded to 7 drops per minute

Monitoring after initiating intravenous (IV) fluids

Infusion Site and Equipment Monitoring

- Inspect the IV site hourly for displacement, redness, or swelling.
- Record the date and time of cannula insertion clearly in the patient's chart and/or on the plaster at the site.
- Monitor and document the fluid type prescribed, volume infused, and the corresponding date and time.

Weight Monitoring

- Weigh the baby daily, preferably using an electronic weighing scale.
- Use birth weight for all fluid calculations until birth weight is regained following the normal physiological weight loss.
- Use the current postnatal weight for calculations after birth weight has been regained.
- Adjust fluid volumes appropriately in cases of inadequate or excessive weight gain while on IV fluids.

Fluid and Electrolyte Monitoring

- Monitor fluid and electrolyte balance through:
  - Daily weight measurement
  - Strict intake-output charting
  - Observation for signs of overhydration
  - Assessment of urine output

Urine Output Monitoring

- Normal urine output in neonates is at least 5–6 light-coloured voids per day.
- Oliguria is defined as urine output < 1 ml/kg/hour over a 6-hour period, after the first 48 hours of life.
- Methods for estimating urine output include:

1. Counting the frequency of urination
2. Weighing nappies before and after urination using an electronic scale
3. Using uro-bags to collect urine

Note: Clinical signs of dehydration are less reliable in neonates. Serial weight monitoring remains the most accurate method for assessing hydration status.

a. Monitor the clinical status:

- Heart rate, pulse volume, respiratory rate and skin perfusion by checking capillary refill time (CRT).
- Check for oedema/puffiness of eyes (may indicate volume overload).
- Each time you see the patient, assess the drip site for swelling of the site in case the cannula is out of the vein.
- Weight and urine output are the best overall clinical guides to assessing the adequacy of therapy.

b. Urine output

- Ensure every baby achieves urinary output of at least 1ml/kg/hour in first 24hours of life and more than or equal to 2mls/kg/hour thereafter.
- 6 wet nappies or more in a day indicate good urinary output.
- Ill infants need urine output quantified 6 hourly.
- Aim for a minimum urine output of 0.5-1 ml/kg/hour.
- Monitor 6hrly urine specific gravity, pH and daily dipstick urinalysis.

c. Sodium

- A useful indicator of hydration status in the first few days of life.
- A rising sodium indicates dehydration, and a falling one indicates over hydration.
- Aim to maintain serum [Na] between 135-145mmol/L.

d. Weight

- Weigh baby daily to detect excessive weight gain (excess fluid) or loss (insufficient fluid); adjust IV fluids appropriately.

- Weight loss of >3-5% weight daily is of concern.
- Weight loss > 10% of birth weight for term babies and >15% of birth weight for preterms within first week is of concern and is beyond the physiological range

Micronutrient Supplementation (WHO Micronutrient supplementation 2016)

Preterms and VLBW require the following supplementation:

- Vitamin D supplements at a dose ranging from 400 IU to 1000 IU per day until 6 months of age.
- Calcium (120-140 mg/kg per day) during the first months of life.
- Phosphorus (60-90 mg/kg per day) supplementation during the first months of life.
- Iron 2-4 mg/kg per day starting at 2 weeks until 6 months of age.
- Routine vitamin A and Zinc supplementation are not recommended.

5. Feeding intolerance and necrotizing enterocolitis

- If newborn has feeding intolerance as indicated by mild abdominal distension, gastric residuals of > 30% or,
- 3 mls volume of previous feeding, or vomiting, hold feedings (start IV fluids), slow the advancement of feeds or consider smaller feeds at increased frequency (such as every 2 hours).
- If the newborn has bloody stool, marked abdominal distension, visible loops of bowel, discoloration of the abdominal wall, especially if accompanied by signs and symptoms of sepsis necrotizing enterocolitis (NEC). Air in the bowel wall (pneumatosis) on abdominal X ray is diagnostic.
- Newborns with NEC should be referred for a higher level of care.

Management of NEC

- Stop all enteral feedings, leave NGT open to air to vent stomach.
- Start IV fluids. D10% ¼ RL at 150 mL/kg/day to maximize caloric intake.
- Due to fluid losses into the bowel, newborns may need higher IV fluid volume or normal saline boluses. > The newborn should receive broad spectrum antibiotics: ampicillin, gentamicin, metronidazole

* Metronidazole dose:

- 35 weeks corrected age: 7.5 mg/kg IV Q24 hours
- 35 weeks corrected age: 15 mg/kg IV Q12 hours
- Duration of bowel rest and antibiotic therapy: 7 to 14 days. Recommended course: 10 days.

- Newborns may need medication for pain control. Use morphine with caution because it can cause hypotension and decreased bowel motility. (Refer to protocol for pain management for details).
- After course of bowel rest and broad-spectrum antibiotics, slowly reintroduce enteral feeds, watching closely for intolerance, malabsorption and obstruction due to strictures.

CHAPTER 16:
NEONATAL ACUTE MALNUTRITION

Acute malnutrition in neonates reflects the difficulties in breastfeeding and most times is related to low-birth-weight babies. Few cases may be due congenital disorders (cleft palate, laryngomalacia and congenital heart defects).

Admission criteria

1. Any visible wasting +- bilateral pitting oedema
2. Any neonate that fails to gain satisfactory weight
3. High risk of acute malnutrition because of a defective breast feeding secondary to a mother or neonatal related problems.

Higher risk of acute malnutrition in neonates include:

1. Neonate is too weak to suckle or unable to suckle
2. Neonate is not gaining satisfactory weight at home despite breastfeeding counselling
3. Mother does not have enough breast milk and/or is malnourished
4. Mother is absent or dead

Potential problems that lead acute malnutrition in neonates include:

1. Lack of breast feeding
2. Partial breast feeding
3. Dead or absent mother
4. Mother is malnourished, traumatized, ill and/or unable to respond normally to her infant's needs
5. Neonate has a disability which prevents his ability to suckle or swallow and/or developmental problems which affect the neonate feeding.

Investigations

1. Full blood count
2. Blood glucose level
3. HIV assay
4. Echocardiogram, ECG and Chest Xray (for neonates with suspected congenital cardiac defects).

Management

The aim of treatment is to restore full and exclusive breastfeeding which allows the neonate to catch with its growth potential and develop properly

The neonate must be weighed daily

Give IV ampicillin + IV GeWntamycin for infections

A. Babies who are being breastfed

- Breastfeed babies on demand for 20-30 minutes
- 30-60 minutes after breastfeeding, give supplemental feeds (expressed breast milk, infant formula or dilute F100) @130ml/kg per day distributed across 8 feeds. If baby has oedema, use F75 in place of diluted F100 until oedema resolves.
- If the baby starts gaining weight at 30g/day, reduce supplemental feeds by 50%.
- If the baby continues to gain weight @30g/day on breast feeding and 50% supplemental feeds, stop the supplemental feeds.

Table 49, Feeding Guidance for Breastfed Neonates Receiving Supplemental Feeds

Weight of the neonate	F100 diluted or F75 in case of oedema
	ml per feed of 8 feeds per day
>1.2kg	25
1.3-1.5	30
1.6-1.7	35
1.8-2.1	40
2.2-2.4	45
2.5-2.7	50
2.8-2.9	55
3.0-3.4	60
3.5-3.9	65
4.0-4.9	70

Feeding advice:

1. Ensure good attachment and effective suckling
2. Build the mother's confidence
3. Provide suitable non distractive environment both for the mother or caregiver, and the neonate
4. Use only naso-gastric tube when the neonate is not taking enough milk by the mouth
5. Encourage more frequent and longer breastfeeding sessions to increase milk production
6. Give breast feeding advice either individually or in a group
7. Encourage the mothers to share their positive experiences with breast feeding

Supportive care for mothers (or caregivers)

1. Create supportive conditions such as breast-feeding corners, counselling and mother to mother support
2. Mental and emotional support
3. Educate mother on acute malnutrition treatment and related maternal health issues
4. Adequate nutrition and supplementation to breast feeding mothers:

- Breast feeding mothers need 450 Kcal per day of extra energy and she needs a daily energy consumption of 2500 Kcal
- Breast feeding mother should drink at least 2 litres of water daily
- Breastfeeding infants should be screened for Severe Acute Malnutrition (SAM) and provided with supplemental feeding as required

5. Psychological care for breast feeding mother
6. Breast feeding counselling
7. Establish good communication and build trust with the breast-feeding mother
8. Treat the breast-feeding mother difficulties related to breast feeding.

Table 50, Possible Difficulties Encountered by Breast feeding Mothers of Neonates with Acute Malnutrition

Possible Difficulties	Action Points
Nutrition and fluid intake	Provide enough fluid and balanced food Screen mother for acute malnutrition
Physical and mental	Provide medical services whenever requested
Physical difficulties related to breast feeding	Treat retracted nipples, sore nipples, cracked nipples and mastitis with breast feeding counselling
Misinformation and misconception	Establish good communication with the breast-feeding mother

Discharge home when the baby is:

1. Gaining weight @30g/day on exclusive breastfeeding only for 3 days
2. Has no bilateral pitting oedema
3. Clinically well and alert
4. Has no danger signs

B. Babies with no prospect of breastfeeding

These neonates whose mothers are:

a. Dead

b. Mothers are severely ill to the extent it is impossible for them to produce breast milk or breast feed her baby e.g. mothers with chronic debilitating or end stage disease.

The aim is to the provision of dilute F100 or infant formula until they are old enough to take semi-solid complimentary feed at 6 months of age.

1. Give infant formula or dilute F100 (F75 if there is oedema) @130ml/kg per day distributed across 8 feeds ***(stabilisation phase)***.
2. When appetite returns and the baby is taking infant formula or dilute F100 and oedema has resolved ***(transition phase)***, increase the supplemental feeds to 150-170ml/kg per day for minimum of 2 days.
3. When the baby is able to take 90% of feeds ***(rehabilitation phase)***, then increase the supplemental feeds to 200ml/kg per day.

Table 51, Dilute F100 amounts in Stabilisation Phase

Weight of Neonate	Dilute F100 in Stabilisation Phase
	ml per feed in 6-8 feeds per day in the absence of breast feeding
<1.5	30
1.6-1.8	35
1.9-2.1	40
2.2-2.4	45
2.5-2.7	50
2.8-2.9	55
3.0-3.4	60
3.5-3.9	65
4.0-4.4	70

Table 52, Dilute F100 amounts in Transition Phase

Weight of Neonate	Dilute F100 in Transition Phase
	ml per feed in 6-8 feeds per day in the absence of breast feeding
<1.5	45
1.6-1.8	53
1.9-2.1	60
2.2-2.4	68
2.5-2.7	75
2.8-2.9	83
3.0-3.4	90
3.5-3.9	96
4.0-4.4	105

Table 53, Dilute F100 amounts in Rehabilitation Phase

Weight of Neonate	Dilute F100 in Rehabilitation Phase
	ml per feed in 6-8 feeds per day in the absence of breast feeding
<1.5	60
1.6-1.8	70
1.9-2.1	80
2.2-2.4	90
2.5-2.7	100
2.8-2.9	110
3.0-3.4	120
3.5-3.9	130
4.0-4.4	140

Discharge home when the baby is:

1. Gaining weight @30g/day on supplemental feeds
2. Has no bilateral pitting oedema
3. Clinically well and alert
4. Has no danger signs

Follow up babies on discharge to:

1. Monitor the baby's progress:

- Check weight

- Check length
- Occipito-Frontal Circumference (Head Circumference).

2. Continue to support breast feeding (or dilute F100/infant formula for babies not breast feeding) and introduce complementary feeds at the age of 6 months.
3. Treat any acute conditions or infections.

CHAPTER 17:
OXYGEN AND CONTINUOUS POSITIVE AIRWAY PRESSURE THERAPY IN NEWBORNS

OXYGEN THERAPY IN NEWBORNS

Oxygen is important in the care of newborn infants because many conditions that affect babies in the first days of life can result in low levels of oxygen in the body. Hypoxia and hypoxaemia leading to respiratory failure are the most common causes of cardiac arrest and death in newborns. Supplemental oxygen is an essential lifesaving treatment.

- Hypoxaemia means low levels of oxygen in the blood (low blood oxygen saturation or content).
- Hypoxia is inadequate oxygen in tissues for normal cell and organ function, and hypoxia results from hypoxaemia.

THE REQUIREMENTS FOR SAFE OXYGEN USE IN NEWBORNS INCLUDE

- Systems for delivering different oxygen concentrations (blenders to provide 21% to 100% oxygen).
- Non-invasive systems for measuring oxygen levels in the blood (pulse oximetry).
- Adequate number of trained staff who understand the importance of controlling oxygen levels.

SOURCES OF OXYGEN

Depending on the facility, it could be one or more of the following:

1. **Oxygen concentrator:** Oxygen concentrators (figure AC) are one of the most used sources of oxygen therapy, concentrating 85-95.5% oxygen from ambient air using two sieve beds made of a substance that captures nitrogen. They can deliver up to 10L/min oxygen. They can provide a continuous supply of oxygen for many patients at the same time when used with flow splitters (See figure AC) or flow meters.
2. **Oxygen cylinder:** This involves transport of filled oxygen cylinders to and from the bulk supply depot to the hospital.
3. **Central wall piped oxygen:** In many larger hospitals, oxygen is distributed through a system of copper pipes from a central source, usually located outside the building. The source may be liquid oxygen, high-pressure gaseous oxygen cylinders, a large oxygen concentrator or a combination.

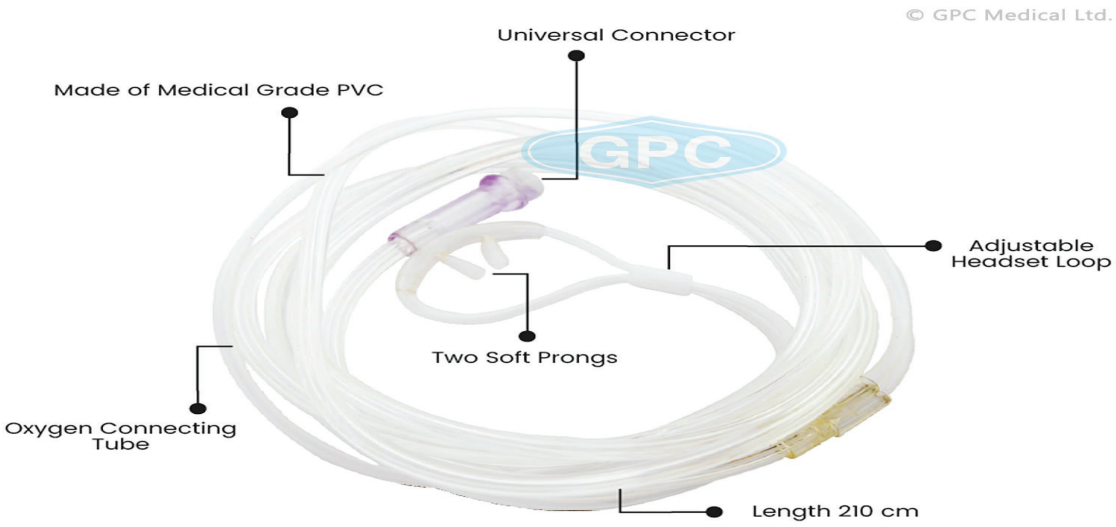
Figure AC, Oxygen Concentrator

METHODS OF ADMINISTRATION OF OXYGEN

1. Nasal prongs (also called nasal cannulae)

- Nasal prongs are preferred over nasal tubes or catheters for delivering oxygen to newborns and young infants. The cannulae split into two prongs. Place them just inside the nostrils and secure with a piece of tape on the cheeks near the nose.
- Prongs come in different sizes. Ensure the appropriate prong size for the newborn.
- There is a slight risk that the airway will become obstructed by mucus, especially if a high flow with no humidification is used. Take care to ensure that the nostrils are kept clear of mucus, which could block the flow of oxygen.
- The standard flow rates through nasal prongs are 0.5–1 L/min for neonates.
- Aim for oxygen saturations >90%-95%.

Figure AD, Parts of a Nasal Prong (nasal cannulae) and a Child Using a Nasal Prong



2. Nasal tube/catheter

This is a thin, flexible tube (size 5-6 F) with some holes at the tip, which is passed into the nose and ends with its tip in the nasal cavity (see figure AD). Determine the distance the tube should be passed by measuring the distance from the side of the nostril to the inner margin of the eyebrow.

This device has generally been replaced by the nasal cannulae (nasal prongs). Gently insert the catheter into the nostril. A flow rate of 0.5-1 litres/min in infants will deliver 30-35% oxygen.

Aim for oxygen saturations >90%.

Nasal catheters are usually well tolerated, and they are unlikely to be dislodged. Catheters can become blocked with mucus, which can cause upper airway obstruction (may need to be rechecked).

Figure AE, Nasal Tube/Catheter Position

Table 54, WHO Recommendation on Oxygen Delivery Methods

	RECOMMENDATION	QUALITY OF EVIDENCE
1.	Nasal prongs are the preferred method of delivering oxygen to infants with hypoxaemia who require oxygen therapy.	Strong recommendations
2.	Where nasal prongs are not available, use nasal or pharyngeal catheters as alternative delivery methods. Face masks and head boxes are not recommended.	Moderate quality evidence
3.	Standard flow rates for oxygen through nasal prongs or nasal catheters are 0.5–1 L/min for neonates, 1–2 L for infants.	Moderate quality evidence

Source: Oxygen therapy for Children, WHO 2016

STEPWISE ADMINISTRATION OF OXYGEN IN NEWBORNS

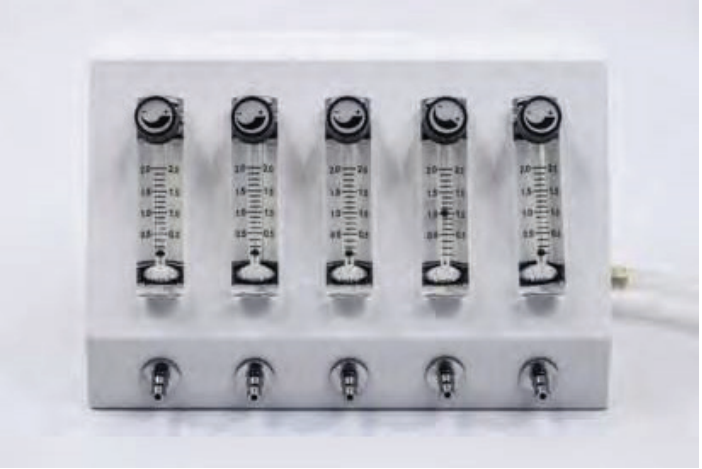
- Before oxygen administration, ensure that the airway is clear.
- Then administer oxygen via nasal prongs or nasal catheter, start with 0.5 litres/minute.

- Assess after 15-30 minutes with a pulse oximeter; if oxygen saturations remain <90%, escalate O2 quickly to 1 litre/minute up to a maximum of 2 litres/minute.
- Reassess after 30 minutes and, if the O2 saturation is still below 90%, administer O2 at 4 litres/minute through a face mask.
- Consider CPAP if there is no improvement on oxygen therapy and there are no contraindications.

Oxygen splitter equipment

Sometimes, an oxygen source from a concentrator or from the cylinder can be shared by two or more babies. An oxygen splitter is an accessory device that divides oxygen from one source to give to several patients at independent flow rates (@NEST360 Clinical modules).

Figure AF, An Oxygen Splitter



Pulse Oximeters to monitor oxygen delivery

- Neonatal patients should reach oxygen saturations of 90 – 95% by 15 minutes after birth. If oxygen is needed it is recommended to give between 0.5-1 L/min. Whilst on oxygen, regular monitoring should be conducted using a pulse oximeter to ensure that this saturation range is maintained whilst the patient is on the concentrator.
- Pulse oximeters have one red- and one infra-red light-emitting diode and a photodetector. The light emitted by the diodes is absorbed by tissues, and the amount of absorption is measured by the photodetector.

Pulse oximeters can be

- Fixed (for continuous reading of one patient)
- Handheld (for spot reading vital signs between patients or the same patient at intervals)

Ideally, patients suffering from severe respiratory distress should have continuous pulse oximetry monitoring throughout care.

Finger clip - for spot reading of vital signs. Use appropriate size clip for age and size of newborn.

Figure AG, Handheld Pulse Oximeter

Figure AH, Fixed Pulse Oximeter

Normal SpO2 for neonatal patients should be:

- 90% - 100% depending on the age of the newborn and altitude of the geographical area.
- Target SpO2 of 90-95% if on oxygen

If SpO2 readings are less than 90%, the patient should be considered for supplemental oxygen therapy; and if baby is already on oxygen should be re-evaluated and promptly treated.

WHEN AND HOW TO STOP OXYGEN THERAPY

Once patients can maintain normal oxygen saturations and are clinically stable, the oxygen flow rate should be reduced in a stepwise manner, based on clinical response:

i. Reduce oxygen flow by 0.5 L/min, recheck oxygen saturations and clinical condition every 15 minutes.
ii. If oxygen saturations and clinical condition remain stable, reduce oxygen flow by 0.5 L/min, recheck saturations 15 minutes after each reduction.
iii. If oxygen saturations drop below 90% or the patient clinically deteriorates increase the oxygen until normal oxygen saturations are obtained and the patient clinically improves.

CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

Introduction

Respiratory distress can cause hypoxia, contributing to both morbidity and mortality. Continuous positive airway pressure (CPAP) is used to maintain continuous positive pressure during both inspiratory and expiratory phases when the infant is breathing spontaneously. CPAP is a means of providing respiratory support to neonates with either upper airway obstruction or respiratory failure. Respiratory failure constitutes either failure of ventilation or failure of lung function.

CPAP delivers oxygen concentrations and distending airway pressures via the ventilator without the hazards associated with full endotracheal intubation and mechanical ventilation. The delivery of constant positive pressure to the airway of a spontaneously breathing neonate maintains adequate functional residual capacity within the alveoli to prevent atelectasis and improves oxygen and carbon dioxide exchange within the pulmonary circulation.

Nasal continuous positive airway pressure (nCPAP) is an established modality of respiratory support in the newborn. Bubble continuous positive airway pressure (BCPAP) is a low-cost nasal CPAP delivery system with benefits for developing nations. Bubble CPAP devices use a pump to provide a blend of air and oxygen at a continuous positive pressure. This pressure keeps airway spaces open and increases alveolar recruitment throughout the respiratory

cycle in a spontaneously breathing infant, which improves oxygenation and reduces the work of breathing.

MECHANISM OF ACTION

i. Continuous positive airway pressure (CPAP) consists of delivery of mild air pressure to keep the airways open.
ii. CPAP delivers PEEP with a variable amount of oxygen to the airway of a spontaneously breathing patient to maintain lung volume during expiration. CPAP decreases atelectasis (alveolar and lung segmental collapse) and respiratory fatigue, and improves oxygenation.
iii. It is indicated for infants with severe respiratory distress, hypoxaemia, or bradypnoea despite receiving oxygen. CPAP requires a source of continuous airflow (often an air compressor) and usually requires an oxygen blender connected to an oxygen source.
iv. A CPAP system needs reliable oxygen systems, adequately trained staff, and close monitoring should be assured.

CPAP's EFFECT

1. Increase in functional residual capacity, leading to an increase in PaO2
2. Establish and maintain lung inflation
3. Increases spontaneous tidal volume and reduces respiratory effort
4. Decrease in alveolar-arterial oxygen pressure gradient
5. Prevents alveolar collapse
6. Increases airway diameter
7. Conserves surfactant
8. Splints the airway
9. Splints the diaphragm
10. Reduces mechanical obstruction (e.g., meconium)
11. When using CPAP, the baby may be nursed prone, skin-to-skin (kangaroo), supine or side-lying (that is, there are no limitations to positioning!).Orogastric feeds are as ordered/tolerated.

Indications for CPAP

CPAP may be used to treat neonatal patients with:

Any signs of significant respiratory distress:

- Increased work of breathing
- Tachypnoea (RR >60 breaths/min)

- Nasal flaring
- Dyspnoea
- Head nodding
- Grunting
- Retractions/severe recession
- Cyanosis
- Oxygen requirement of >1 L/min with saturations of <90%, in premature or term infants

Diseases with low functional residual capacity (FRC):

- Respiratory Distress Syndrome (RDS)
- Severe Transient Tachypnoea of the Newborn (TTN)
  Pulmonary oedema

Meconium Aspiration Syndrome

Airway closure diseases:

- Bronchopulmonary Dysplasia (BPD)
- Bronchiolitis
- Apnoea and bradycardia of prematurity
- Following neonatal resuscitation
- Congenital pneumonia
- Persistent pulmonary hypertension of the newborn
- Meconium aspiration syndrome (be cautious if there is air-trapping)
- Neonatal sepsis with severe respiratory distress
- Weaning from mechanical ventilation

Criteria for use of CPAP:

- Birthweight more than 1499 g and gestation at 32 weeks.
- Have clinical signs of respiratory distress.
- Require FiO2 of at least 0.25 to maintain a saturation between 91 and 95 per cent.
- Transient tachypnoea of the newborn.

Process: Follow the steps below to set up CPAP Circuit.

Procedure for bCPAP

There are many bCPAP devices, with similar set-up procedures:

1. Assemble the machine and choose the appropriate nasal prong size (ensure functionality of every part of the machine).
2. Prepare the baby:
    a. Wash hands and wear gloves.
    b. Suction nose and mouth.
    c. Insert orogastric tube (OGT) to prevent air from filling in the stomach and compromising respiration (CPAP belly).
3. Attach the baby to the bCPAP machine
4. Initial bCPAP settings: usually set at 5 – 8cm H2O pressures. An increase in CPAP pressure may be necessary for initial settings if work of breathing is high. Oxygen requirement is guided by oxygen saturation.

Monitoring of baby on CPAP

Monitoring the patient should be completed 4-hourly, but may be required more frequently depending on clinical condition.

Monitoring should include:

1. Vital signs, including respiratory rate, heart rate, oxygen saturation, temperature, arterial blood gases, if available.
2. Work of breathing.
3. Nasal blockages.
4. Abdominal distension.
5. Nasal septum trauma or breakdown.

Nursing care

- Care of the airway – suction as required.
- Vital signs monitoring every half hour to hourly.
- Positioning and pressure care.
- Monitor for abdominal distension and place oro-gastric tube (leave open to straight drain unless during feeding to decompress stomach).
- Feeding as prescribed.
- Ensure baby is kept warm.
- Support parents and reduce parental stress as much as possible.
- Perform other duties as requested by the medical team and to maintain at pH >7.25.

Table 55, Step-by-Step Setup and Application of Bubble CPAP for Neonates

Step	Action	Rationale
1	Use disposable self-filling humidifier top with a 1 litre bag of water attached.	Adequate humidity will prevent drying of secretions.
2	A flow of 6-10 litres per minute is delivered via a blender. An oxygen analyser is used continuously and calibrated once a shift: ■ To air if O2 <60% ■ To 100% O2 if >60%	A flow of 6-10 L/m: ■ Provides adequate pressure to wash out carbon dioxide from the system. ■ Compensates for the normal air leakage from tubing connections. ■ Generates adequate CPAP pressure (verified by bubbling of the water in the CPAP generator). N.B The baby should receive the specific percentage of oxygen required.
3	A pressure relief valve is part of the circuit with the valve fixed to blow off at 17cm H2O. This ensures that any pressure more than 17cm H2O will blow off the pressure relief valve should the expiratory line become occluded.	This is a safety precaution only. The pressure relief valve does not affect the CPAP pressure.
4	Occlude pressure line connection port with white plug provided.	This completes the CPAP circuit. NB: Check the CPAP circuit is complete (bubbling) before applying to baby.
5	The default pressure is set at 6cm H2O Pressures greater than this (up to 10cm H2O) may be used.	This controls the pressure generated in the system. It is important to check the water level and adjust for evaporation, if required.
6	Place a roll under the infant's neck to slightly extend the neck.	Ensures optimum airway.
7	Suction airway prior to application of CPAP prongs. Pass an orogastric tube and aspirate stomach contents (a larger baby may not need an indwelling tube if Nil By Mouth)	If these procedures are done prior to prong placement then less handling is required after infant is on CPAP.
8	Preductal SaO2 probe in place (preferably right arm).	Optimal saturation maintained according to unit target saturations.

<table>
<tr><th>Step</th><th>Action</th><th>Rationale</th></tr>
<tr><td>9</td><td>CPAP hat is applied to baby – it must not be too tight a fit as this causes excessive moulding to the head but should be sufficiently snug to stay in place.
Ribbed stockinette is available in two sizes to make hats.
Individual hats are also available for infants weighing approximately 1000-2000 grams.</td><td>A snug fitting hat is a must. The hat is the anchor for the prongs. A loose hat will allow any movement of the head to dislodge the prongs.</td></tr>
<tr><td>10</td><td>Applying the prongs. Gently insert the prongs that fit the nares snugly without causing pressure:
Place curve side down into the baby's nose (follow the natural curve of the nose).
Adjust the angle of the prongs and the way the corrugated tubing is twisted until the correct positioning is achieved.
<table><tr><th>Infant Size</th><th>Prong Size</th></tr><tr><td><700g</td><td>0</td></tr><tr><td>700-1250g</td><td>1</td></tr><tr><td>1250-2000g</td><td>2</td></tr><tr><td>2000-3000g</td><td>3</td></tr><tr><td>>3000g</td><td>4</td></tr><tr><td>>4000g</td><td>5</td></tr></table>
Apply duoderm base tapes to cheeks with rough (hook side) velcro patches attached.
Wrap 'soft' (loop side) velcro around the prongs.</td><td>Nasal prongs should fill the nasal opening completely without stretching the skin or putting undue pressure on the nares (blanching around the rim of the nostrils suggests that the prongs are too large).
The corrugated tubing will not be touching the baby's skin.
There will be no lateral pressure on the septum causing it to be pinched or twisted.
There will be a small space between the tip of the septum and the bridge between the prongs.</td></tr>
<tr><td>11</td><td>Secure the inspiration and expiration lines to the CPAP hat using small safety pins and rubber bands. Ensure safety pins are away from the eyes.</td><td>If prongs are correctly positioned in the nose and the tubing allowed to sit naturally in place, rotating pressure on the prongs is avoided.</td></tr>
</table>

Step	Action	Rationale
12	Position chin strap. This can be simply made using nonelastic tape and gauze. ■ Cut a piece of tape that will reach from one side of the hat across under the chin and attach to the other side of the hat. ■ The tape needs to be backed with folded gauze to prevent the adhesive contacting the skin. ■ The jaw is gently pulled forward, closing the mouth. ■ A pacifier (dummy) may be used with the chinstrap in place if this will help the baby settle.	An air leak via the mouth will reduce the effectiveness of the system by allowing a significant loss of positive pressure. Keeping the design simple will be both cost-effective and convenient, as the chinstrap may need replacing every few hours. It will easily become soiled, and the tape loses its adhesives each time it is detached from the hat for suctioning or feeding. The strap will not be so firm as to prevent the infant from crying or yawning.

Figure AI, Setting up a Bubble CPAP System

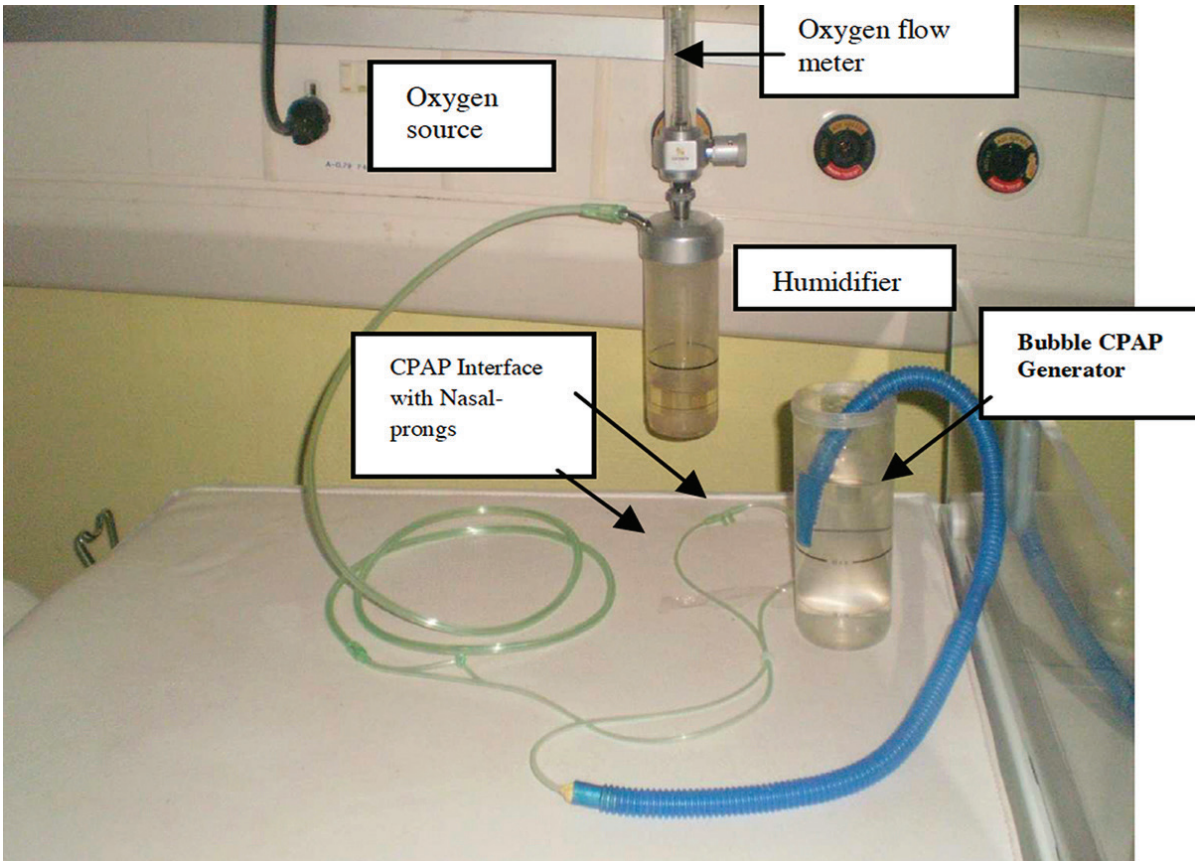
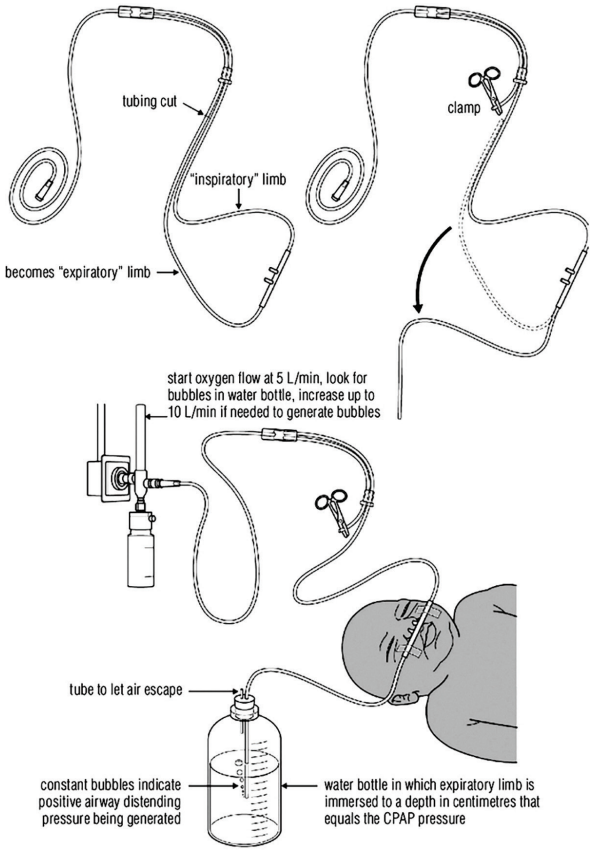


Figure AJ, Schematic Diagram of a Bubble CPAP Set-up



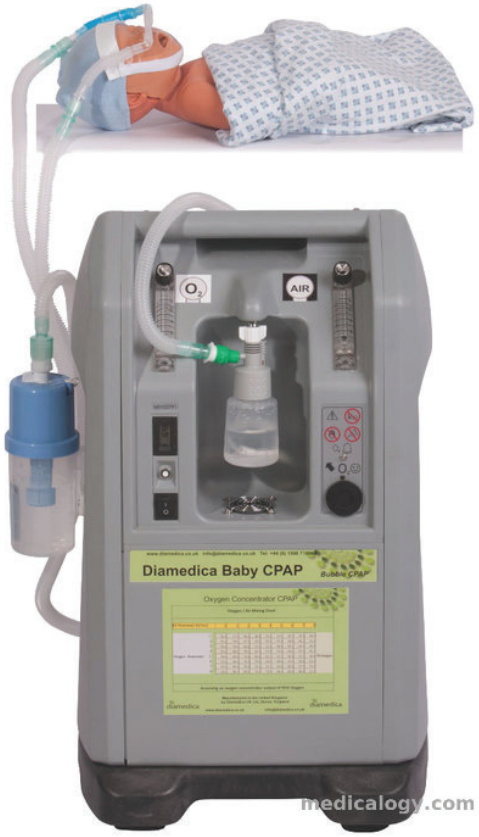


Table 56, Complication of CPAP

Nasal excoriation, scarring, pressure necrosis, and septal distortion	■ This is preventable when using appropriate sized prongs that are correctly positioned.
Risk of air leak syndromes (e.g., pneumothorax)	■ Usually occurs in acute phase. ■ It is uncommon (<5%). ■ It usually results from the underlying disease process rather than positive pressure alone. ■ It is not a contraindication to the use of CPAP.
Abdominal Distension and vomiting from swallowing air “CPAP Belly”.	■ Pass orogastric tube once starting CPAP to prevent ○ This is benign ■ Easily reduced with gastric drainage or aspiration
■ Nasal obstruction from mucus plugging	■ From improper prong placement or inadequate airway care.
Reduction in cardiac output if increased pressures	
Skin irritation of the head and neck from improperly secured bonnets or CPAP head harnesses.	

Table 57, Ongoing Care and Monitoring of Neonates on CPAP

Step	Action	Rationale
1.	Care of the baby: Observe and document a baseline assessment of the infant prior to the commencement of CPAP. This includes: ■ Respiration: Rate, effort, breath sounds, signs of distress (tachypnoea, nasal flaring, sternal indrawing, rib retractions, grunting). ■ Temperature. ■ Cardiovascular: Central and peripheral perfusion, blood pressure, auscultation. ■ Neurological: Tone, response to stimulation and activity. ■ Gastro-intestinal: Specific characteristics (e.g., cleft palate, omphalocoele), abdominal distension, visible loops, bowel sounds. ■ Technical: Pre-ductal (preferably right arm) oxygen saturation probe, cardio-respiratory monitor.	Baseline observations are essential to the ongoing assessment and management of the baby. Underlying, contributing conditions may be discovered, e.g. hypothermia, choanal atresia, cardiac murmur, narcotic depression, etc. NB: This assessment should be done with the minimum of delay. The sooner CPAP respiratory support is initiated the better the baby's outcome. If significant symptoms of respiratory distress exist, commence CPAP immediately. Assessment can continue once the acute situation is addressed.
2.	■ Regular observations as outlined above need to be performed. ■ Minimal handling is essential for a sick infant therefore "hands on" intervention should be limited to 2-4 hourly if possible. Initially some fine tuning of the CPAP system may be necessary but limit handling to essentials such as suctioning and core temperature monitoring. ■ Complete blood drawing, IV insertion, x-rays, etc., with minimum delay.	Decisions regarding ongoing treatment are made based on serial assessments.
3.	Keep the baby's parents informed of what is happening. Answer questions and offer information, as you do regarding all other aspects of the baby's care.	Parents are members of our care team and have the right to understand the care their baby receives.
4.	Once the infant is stable on CPAP and is tolerating handling without compromise or agitation the usual activities of care can be performed.	

Step	Action	Rationale
5.	Parents can be encouraged to participate by being shown the techniques of soothing and containment. They can perform oral cares, nappy changes, etc. as their confidence and the baby's condition permits.	This facilitates attachment and reinforces their role as parent and caretaker.
6.	Change the baby's position 4-6 hourly. Kangaroo care is an ideal variation in position along with its other tactile emotional advantages.	Changing position is a gentle way to move lung secretions along the airway.

- Upper airway abnormalities that make (nasal CPAP) nCPAP ineffective or dangerous:
  - Choanal atresia
  - Cleft palate
  - Unrepaired trachea-oesophageal fistula
- Congenital Diaphragmatic hernia (pre-surgical repair).
- Severe cardiovascular instability and impending respiratory arrest.
- Unstable respiratory drive with frequent apnoeic episodes resulting in desaturation and/or bradycardia.
- Ventilatory failure as indicated by the inability to maintain PaCO2 at < 60 mmHg.

Weaning off CPAP

Criteria:

i. Respiratory rate has been < 60cpm for at least 6 hours
ii. Oxygen saturation consistently > 90% for ≥ 6 hours
iii. No significant grunting, recessions, nasal flaring, apnoea or bradycardia for ≥ 6 hours.

- CPAP is usually weaned by a reduction of 1 cm H_2O every 12–24 hours.
- The timing and rate of weaning will be decided by the managing team and the baby's response. When the infant has demonstrated a stable respiratory pattern on CPAP of < 5 cm H_2O in < 30% oxygen for 12–24 hours, the CPAP may be discontinued.

CHAPTER 18:
MANAGEMENT OF NEWBORNS OF MOTHERS WITH INFECTIOUS AND EMERGING DISEASES

1. HEPATITIS B

- Is caused by hepatitis B virus.
- Risk of vertical transmission is up to 90% and occurs primarily at the time of birth.
- Although, there is limited evidence that the hepatitis B virus is transmitted by breast-feeding, this risk will be further minimized by vaccinating the baby at birth according to the NPI schedule.

Prophylaxis guidelines

A. Infants of HBsAg positive mothers

- All women attending ante-natal care must be screened for Hepatitis B surface antigen (HBsAg)
- If positive, the mother should be duly educated about what hepatitis B infection is, how it is transmitted, its effects on the baby and the need for prophylaxis at birth.

Arrangement should be made to have the Hepatitis B vaccine and immunoglobulin available during delivery.

- Paediatricians should be informed.
- Within 12 hours of birth:
    - Give Hepatitis B Immunoglobulin (HBIG) 0.5 mL IM in the anterolateral thigh immediately after birth.
    - Give 0.5 mL monovalent hepatitis B paediatric vaccine IM in the second anterolateral thigh.
- The infant should continue with routine immunization schedule in which hepatitis B vaccine is given as part of pentavalent vaccine at 6weeks, 10weeks and 14weeks.
- Post immunization testing for HbsAg (to check for infection) and anti-HBs (to check for vaccine – induced immunity) should be conducted at least one month and no more than four months after the last dose of vaccine is administered. The result is interpreted as follows:

- HBsAg is negative and anti-HBs level is >10 IU/L at age 9 months-: immunity is proven.
- HBsAg is positive-: the baby has become infected despite prophylaxis: refer to an appropriate specialist i.e. a paediatric gastroenterologist.
- HBsAg is negative and anti-HBs level is ≤10 IU/L at age 9 months-: give 1 to 3 further doses of hepatitis B vaccine at least 4 weeks apart. Recheck serology 4 weeks after each dose to determine if further doses are necessary (i.e., if anti-HBs is still ≤10 IU/L). If there is no seroconversion after the third further dose of hepatitis B vaccine, discuss with a specialist.

B. Infants of mothers with unknown HBsAg status

For mothers whose hepatitis B status is unknown at delivery:

- Give hepatitis B vaccine to the baby within 12hours of birth.
- Immediately take the mother's blood sample for hepatitis B serology.
- If mother's HbsAg is positive the infant should also receive hepatitis B immunoglobulin within 48 hrs of birth; complete routine immunization series and have post immunization testing done as described above.
- If mother's HbsAg is negative, baby should complete routine immunization series and does not need to have post immunization testing.

NOTE:

- There is no clear evidence that the hepatitis B virus is transmitted by breastfeeding, thus, positive maternal status is NOT a contraindication to early initiation of breastfeeding and the practice of exclusive breastfeeding.
- The protective efficacy of the hepatitis B vaccine in preventing mother-to-child transmission ranges from 80 to 95%.
- The efficacy of the vaccine in preventing perinatal transmission declines with increasing intervals between birth and the administration of the vaccine. It is therefore recommended that the first dose of hepatitis B vaccine be given within 12 hours of birth and not later than 24hours.

2. TUBERCULOSIS

- Caused by Mycobacterium tuberculosis
- Vertical transmission of TB occurs through:

  - Transplacental transmission,
  - Aspiration and swallowing of infected amniotic fluid in utero or intrapartum; causing primary infection of foetal lungs and gut.

- Congenital tuberculosis occurs in newborns who acquire TB through vertical transmission.

Management of newborns of mothers with TB

- Ensure the mother is on anti-tuberculous medications and encourage compliance.
- Isoniazid prophylaxis is recommended if the mother has received treatment for <2 weeks or is on therapy for >2 weeks, but is sputum smear positive.
- Give isoniazid to the baby at 5 – 10mg/kg/day for 6 months.
    - Isoniazid treatment for the infant should be continued until the mother is sputum culture negative for ≥3 months.
- Withhold BCG vaccine at birth till completion of isoniazid prophylaxis.
- Baby should have a Mantoux test at the end of isoniazid prophylaxis. If positive, do a chest X-ray. If there is evidence of active infection, treat fully for TB or refer to a TB treatment centre.
- If Mantoux test is negative and there is no evidence of active disease, vaccinate baby with BCG.
- Encourage and support exclusive breastfeeding.

Mothers with active TB (sputum positive, has had no or <2weeks medications) should wear face mask while breastfeeding or having contact with baby.

Newborns with congenital TB

- Treat as stipulated in National TB guideline.

Summary (In a box):

- The mother's treatment should be commenced or continued if already started.
- The baby should start INH soon after delivery and continued till mother's sputum has been negative thrice.
- After this, the infant should have the Mantoux test:
    - If the Mantoux is negative, INH should be discontinued and child vaccinated with BCG.
    - If the Mantoux is positive, infant should have CXR. If CXR is normal, continue INH for 12 months.
    - If CXR is abnormal, treat as TB with combination chemotherapy.

3. INFANTS OF HIV POSITIVE MOTHERS (HIV EXPOSED INFANTS)

- Following the test and treat policy, all HIV positive pregnant women should be commenced on highly active antiretroviral therapy (HAART). Ensure that mother has commenced HAART during pregnancy even if late in pregnancy or post- partum period (if that is the first contact).

Early Infant Diagnostic Testing Algorithm

- Perform nucleic acid testing (NAT) for any HIV-exposed child from 0–18 months.
- **HIV testing at 0–2 weeks:** HIV-exposed new-born should be tested on NAT from 0–2 days or within 2 weeks. If the child/infant is reactive on NAT, ART should be initiated immediately, and NAT repeated to confirm infection. This is also applicable to HIV-exposed-infant/child (4– 6 weeks to 18 months).
- **HIV testing at 4–6 weeks:** HIV-exposed infants with non-reactive NAT at birth (or who are not tested at 0-2 weeks) should be re-tested on NAT at 4–6 weeks or at earliest opportunity thereafter.
- **HIV testing at 9 months:** HIV-exposed infants with non-reactive test result at 4–6 weeks or earlier period should be tested on NAT at 9 months.
- All HIV– exposed infants should have initial DNA PCR testing at 0-3 days of age, then at 6-8 weeks of age (or earliest opportunity thereafter) and 6 weeks after complete cessation of breastfeeding. DNA PCR test results should be provided to the clinic and caregiver as soon as possible; latest within four weeks of specimen collection.
- It is recommended that infants delivered to HIV positive mothers who are stable on ART should receive Nevirapine (NVP) prophylaxis daily. These infants irrespective of the type of feeding should receive daily NVP from within 72 hours of birth to 6 weeks of age.

All HIV exposed infants should receive ARV prophylaxis.

Infants at a low risk of acquiring HIV from their mothers should receive NVP only once daily for 6 weeks. While infants born to mothers with HIV who are at a high risk of acquiring HIV should receive dual prophylaxis with AZT (twice daily) and NVP (once daily) for the first 12 weeks of life, whether they are breastfed or formula-fed. Antiretroviral prophylaxis should commence within 72 hours of birth.

Table 58, ARV Prophylaxis for Low-Risk Infants with NVP

Birth to 6 weeks:

Infant Age	Daily Dosing
Birth weight <2.5kg	10 mg (1 ml) once daily
Birth weight =2.5kg	15 mg (1.5 ml) once daily

- Newborns of mothers with HIV who are at a high risk of acquiring HIV should receive dual prophylaxis with Zidovudine (AZT) twice daily and Nevirapine (NVP) once daily for the first 6 weeks of life, whether they are breastfed or formula fed.

High-risk infants are defined as those:

- Born to women with established HIV infection who have received less than four weeks of ART at the time of delivery

OR

- Born to women with established HIV infection with viral load >1000 copies/mL in the four weeks before delivery, if viral load measurement available;

OR

- Born to women with incident HIV infection during pregnancy or breastfeeding;

OR

- Infant of a positive mother identified for the first time during the postpartum period, with or without a negative HIV test.

Table 59, ARV Prophylaxis for High-risk Infants with NVP and AZT

Infant Age	Nevirapine daily dosing	Zidovudine daily dosing
Birth to 6 weeks (dual prophylaxis):		
Birth weight <2.5kg	10mg (1ml) once daily	10mg (1ml) twice daily
Birth weight >2.5kg	15mg (1.5ml) once daily	15mg (1.5ml) twice daily
6 weeks to 12 weeks	20mg (2ml) once daily	60 mg (6ml) twice daily

Table 60, Intervention for Safe Vaginal Delivery and Baby Care at Delivery

Interventions during labour/delivery	Care of the baby at delivery
Perform vaginal cleansing with warm (0.25%) chlorhexidine solution to prevent genital infections ■ Avoid the following: ■ Frequent vaginal examinations ■ Episiotomies (unless absolutely necessary) ■ Instrumental delivery (unless when necessary) ■ Milking the cord before clamping ■ Clamp cord immediately after the baby is delivered and cut, under cover of wrapped gauze swab to avoid blood spurting	■ Wipe the baby's mouth and nostrils with gauze at the delivery of the head. ■ Handle all babies with gloves regardless of the mother's HIV status until blood and secretions are washed off. ■ Keep all babies warm soon after delivery ■ Where suctioning is indicated, a mechanical suction unit (at a pressure below 100mmHg) or bulb suction should be used; mouth operated suction should be avoided ■ Place the baby on the mother's body for skin-to-skin contact soon after delivery.

Care and Support of the HIV-Exposed Infant

Immediate and on-going care of the new-born of HIV positive women

The immediate care of the new-born follows standard practice regardless of the mothers' HIV status. At delivery all newborns should:

- Be handled with latex gloves until maternal blood and secretions are washed off,
- Have their mouths and nostrils wiped with sterile gauze after delivery of the head,
- Have the cord clamped immediately after the baby is delivered and avoid milking the cord,
- Have the cord cut under cover of a lightly wrapped gauze swab to avoid blood spurting,
- Be kept warm,
- Be suctioned if indicated using a mechanical/electrical suction unit at a pressure below 100mmHg or bulb suction. Mouth operated suction is contraindicated,
- Be cleaned with warm chlorhexidine solution or wiped dry with a towel or surgical cloth to remove maternal body fluids,
- Place the baby on the mother's chest for skin to skin contact soon after delivery. In this position, the baby will latch on to one of the mother's breasts to initiate feeding unless the mother opted for an alternative feeding method,
- Have vitamin K administered, ensuring injection safety.

Infant feeding in the context of HIV

Appropriate infant feeding is critical to child survival because the natural food for infants is breast milk. In the context of maternal HIV infection, infant feeding can become complex. HIV infection may be transmitted through breast milk from mother to child and this risk approaches 5%-15% in the absence of any intervention. Breast milk substitute has the benefit of zero HIV transmission but carries with it the risk of increased morbidity and mortality from malnutrition, diarrhoea and pneumonia.

- It is recommended that mothers of HIV exposed infants breastfeed their babies exclusively for the first six (6) months of life,
- Adequate complementary feeds should be introduced at 6 months in addition to breast milk,
- Breastfeeding complemented by adequate complementary and household foods should be continued till 12 months of age. Mothers who breastfeed should be aware that:
- Mixed feeding (breast milk plus substitutes or foods) increases the risk of MTCT of HIV,
- ARV provided during labour and to the mother/infant pair throughout breastfeeding protects the infant from MTCT of HIV,
- The risk of transmitting HIV to her infant during breastfeeding is higher in certain conditions such as:
    - When the woman is severely ill (by clinical or laboratory measures),
    - When she has mastitis, breast abscess, or other similar conditions,
    - When the child has ulcers in the mouth,
    - When breastfeeding is prolonged beyond 12 months of age.

Breast milk substitute: Breast milk substitute means feeding infants who are receiving no breast milk with correctly prepared commercial infant formula that provides most of the nutrients' infants need until the age at which they can be fully fed on family foods. Unlike breastfeeding, it does not protect against infections. During the first 6 months of life, breast milk substitutes should be with a suitable commercial infant formula prepared hygienically. After 6 months the suitable commercial formula should be complemented with other foods.

Childhood immunisations in the context of HIV

HIV-exposed infants, children and adolescents with HIV should receive all vaccines under routine vaccination according to recommended national immunisation schedule (NPI) as shown. The WHO recommends that the certain situations require special considerations for HIV exposed and infected neonates, infants and children as outlined below.

6.7.4.1 Considerations for BCG Vaccination

- Neonates born to mothers of unknown HIV status should receive BCG vaccination, as the benefits outweigh the risks.

- Neonates of unknown HIV status born to HIV-positive mothers should also be vaccinated if they show no clinical signs of HIV infection, regardless of whether the mother is on antiretroviral therapy (ART).
- For neonates with confirmed HIV infection (via early virological testing), BCG vaccination should be delayeduntil:
    - ART has been initiated, and
    - The infant is confirmed to be clinically and immunologically stable (i.e. CD4 count > 25%).
- HIV-infected children on ART who are clinically and immunologically stable should receive BCG vaccination:
    - For children aged under 5 years: CD4% should be greater than 25%
    - For children aged 5 years and above: CD4 count should be ≥ 200 cells/mm³

Cotrimoxazole Prophylaxis for HIV exposed infants

Cotrimoxazole prophylaxis is recommended for HIV-exposed infants from 6 weeks of age and should be continued until HIV infection has been excluded by an age-appropriate HIV test 6-12 weeks after complete cessation of breastfeeding.

If the child/infant is reactive on NAT, ART should be initiated immediately, without delay and, at the same time, a second specimen should be collected to confirm the initial positive virological test result.

Do not delay ART. Immediate initiation of ART saves lives and should not be delayed while waiting for the results of the confirmatory test. This is applicable to HIV-exposed- infant/ child reactive on NAT at any age (0–2 weeks, 4–6 weeks to 18 months).

CHAPTER 19:
ESSENTIAL DRUGS FOR NEWBORN CARE SERVICES

Table 61, Essential Intravenous Medications for Newborn Care: Dosages, Dilution, and Indications

INTERVENOUS MEDICATIONS				
Drug	**Dose**	**Frequency**	**Diluents**	**Indications**
AMPICILIN Vial 500mg Do not mix in the same syringe as Gentamycin as this causes inactivation of both drugs	<7 days: 50 mg/Kg	12 hourly	Water for injection Normal Saline 5%, 10% Dextrose water For 500 mg powder, add 5 ml of diluents Then 1 ml=100 mg Ampicilin	Management of neonatalSepsis
	7-21 days: 50 mg/Kg	8 hourly		
	>21 days: 50 mg/Kg *Note: 100 mg/kg for Meningitis Max 1 g per dose	6 hourly		
AMPI-CLOX Vial 500mg Do not mix in the same syringe as Gentamycin as this causes inactivation of both drugs	<7 days: 100 mg/Kg	12 hourly	Water for injection Normal Saline 5% Dextrose water Add 5 mL water for injection Makes 100 mg/mL Push slowly (3-5 min)	Management of neonatal Sepsis
	7-21 days:100 mg/Kg	8 hourly		
	>21 days: 100 mg/Kg	6 hourly		
CEFOTAXIME Vial 500 mg Used for jaundiced babies and preterm instead of Ceftriaxone	<7 days: 5 0mg/Kg	12 hourly	Water for injection Normal Saline 5% Dextrose water Add 5 mL water for injection Makes 100 mg/mL Push slowly (3-5 min)	Management of neonatal Sepsis
	7-21 days: 50 mg/Kg	8 hourly		
	>21 days: 50mg/Kg	6 hourly		

INTERVENOUS MEDICATIONS				
Drug	**Dose**	**Frequency**	**Diluents**	**Indications**
CEFTRIAXONE Vial 1 g Contra-indicated when there is jaundice or in preterms.	100 mg/Kg Max 4g per dose	Once a day	Water for injection Normal Saline 5% Dextrose water Add 10 mL water for injection MAKES 100 mg/mL Push slowly	Management of neonatal Sepsis
GENTAMICIN Vial 80 mg/2 mL It can be given IM if no access	< 2 Kg: 3 mg/Kg > 2 Kg: 5 mg/Kg 7.5 mg/kg Max 240 mg per dose	Once a day Once a day Once a day	Water for injection Normal Saline 5% Dextrose water Add 6mL water for injection MAKES 1 ml=10 mg/mL Push slowly	Management of neonatal Sepsis Management of Meningitis
Amikacin 500mg in 100mls	<7days:15mg/kg >7days: 15m/kg	Daily Daily	Dilute 500 mg to 100- or 200-mL sterile diluent (0.9% NaCl or D5W)	Management of Neonatal sepsis
Ciprofloxacin 200mg in 100mls	10mg/kg	12 hourly	No need for dilution	Management Of Neonatal sepsis
Merepenem 500mg/vial 1g/vial	20mg-40mg/kg	6-8hourly	Water for injection Normal Saline Give via infusion	Management of Neonatal sepsis

INTERVENOUS MEDICATIONS				
Drug	**Dose**	**Frequency**	**Diluents**	**Indications**
METRONIDAZOLE 500 mg in 100 ml	NEONATES UP TO 26 WEEKS CORRECTED GESTATIONAL AGE Loading dose 15 mg/kg, followed by 7.5 mg/kg after 24 hours, then 7.5 mg/kg daily for 7 days (10-14 days in C. difficile infection). NEONATES 26 WEEKS to 34 WEEKS CORRECTED GESTATIONAL AGE Loading dose 15 mg/kg, followed by 7.5 mg/kg after 12 hours, then 7.5 mg/kg every 12 hours for 7 days (10-14 days in C. difficile infection). NEONATES 34 WEEKS CORRECTED GESTATIONAL AGE AND ABOVE Loading dose 15 mg/kg, followed by 7.5 mg/kg after 8 hours, then 7.5 mg/kg every 8 hours for 7 days (10-14 days in C. difficile infection).		No need for dilution	Treatment of NEC, Omphalitis, Anaerobic Infections, Clostridium difficile infections etc.
Caffeine citrate Via Oral or IV (10mg/ml or 20mg/ml depending of the manufacturer)	Loading dose: 20 mg/kg (slowly over 30 minutes) Maintenance dose: 5mg/kg daily Start maintenance dose 24 hours after loading dose	Immediately Daily	Water for injection Normal Saline	Management of Apnoea of prematurity

INTERVENOUS MEDICATIONS				
Drug	**Dose**	**Frequency**	**Diluents**	**Indications**
AMINOPHYLINE Vial 250 mg/10 mL	Loading dose: 6 mg/Kg (over 30 minutes) Max 300mg per dose	Immediately	Water for injection Normal Saline 5% Dextrose water	Management of Apnoea of prematurity
	Maintenance dose: 2.5 mg/ Kg Start maintenance dose 24 hours after loading dose	every 12h	Add 15ml of diluents to250mg vial, then 1ml=10 mg aminophylline Push slowly	
PHENOBARBITONE 200 mg/2 ml 100 mg/1 ml	Loading dose: 20 mg/kg (over 30 min) Max 200 mg per dose	Immediately	Water for injection Normal Saline	Treatment of Neonatal Sizures (drug of choice)
		12 hourly	For 200mg/2ml: add 18 ml of diluents For 100mg/1ml: add 9 ml of diluents Then 1ml=10mg	

INTERVENOUS MEDICATIONS				
Drug	**Dose**	**Frequency**	**Diluents**	**Indications**
PHENYTIOIN 250 mg in 5 ml	Loading dose: 20 mg/kg (over 30 min)	Immediately	Water for injection Normal Saline Add 20ml of diluents to 250mg/10 ml vials, Then 1ml=10mg	Treatment of Neonatal Sizures (if sizures is not control with phenobarbitone)
	Maintenance dose: 2.5mg/kg Start maintenance dose 24 hours after loading dose	12 hourly		
ARTESUNATE Vial 60 mg	3 mg/Kg	at 0, 12 and 24h		Add 1 mL 5% bicarbonate + 5mL NS or D5 MAKES 10 mg/mL Do not mix with water for injection

Table 62, Essential Intramuscular Medications for Newborns: Dosage, Dilution, and Indications

INTRAMUSCULAR MEDICATIONS				
Drug	**Dose**	**Frequency**	**Diluents**	**Indications**
VITAMIN K 10mg in 1 ml Ampules need to be used immediately or discarded. Discard after 6 hours after opening the ampule	< 1.5 Kg: 0.5 mg	Immediately after birth	Water for injection Add 9 ml of diluents to 10mg/1ml vail, then 1ml=1mg	Prevention of heamorrhagic disease of newborns
	> 1.5 Kg: 1 mg	Immediately after birth		
	1-10 mg -intervenous (IV	Immediately after diagnosis		Treatment of heamorrhagic disease of newborns
ANTITETANUS IMMUNOGLOBULIN Ampule 0.75 mL/1500UI	150 UI/Kg as a single dose.	Immediately	Adding 4.25mL NS MAKES 1500UI/5mL	Treatment of neonatal tetanus.

Table 63, Essential Oral Medications for Newborns: Dosage and Indications

ORAL MEDICATIONS			
Drug	**Dose**	**Frequency**	**Indications**
AMOXICILLIN Syrup 125 mg/5 mL	25 mg/kg Max per dose 125 mg	12 hourly	Only for babies discharged with antibiotics
ERYTHROMYCIN Syrup 12 5mg/5 mL	12.5 mg/kg	6 hourly	Only for babies discharged with antibiotics
NEVERAPINE Syrup 50 mg/5 mL	Birth weight<2 Kg: 2 mg/Kg	daily	For HIV exposed babies Birth to 6 weeks:
	Birth Weight 2-2.4 Kg: 1 ml	daily	
	Birth Weight >2.5 kg: 1.5 ml	daily	
	6-12 weeks: 2 ml	daily	
ZIDOVUDINE SYR 50MG/5ML	1.5MLS	TWICE DAILY	For HIV exposed babies Birth to 6 weeks (HIGH RISK)

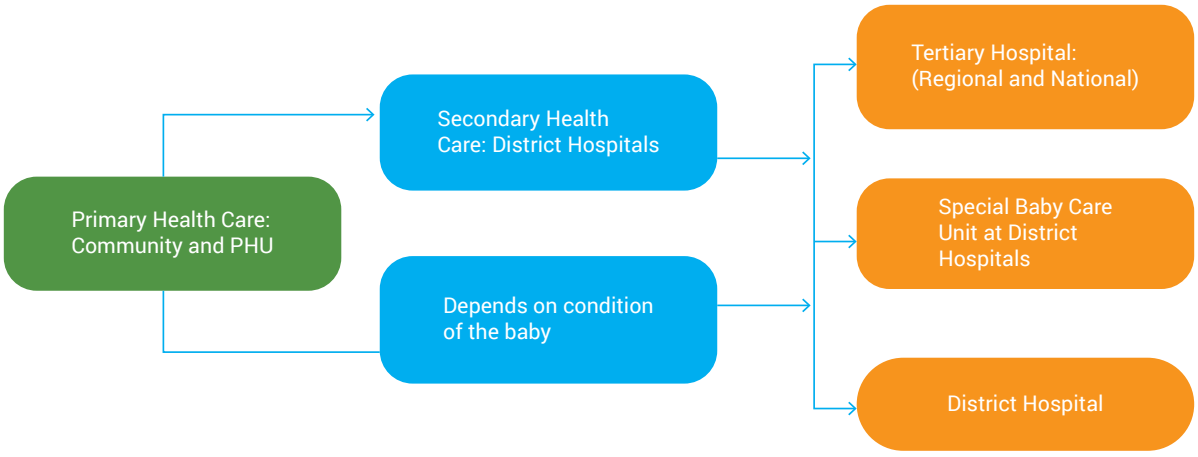
CHAPTER 20:
NEONATAL TRANSPORT AND REFERRAL

If the baby needs to be transferred to a tertiary hospital, specialized centre, or to a different service area within the same facility (e.g. from the delivery room to the special care baby unit), ensure a safe and timely transfer. It is important to prepare the baby for transfer, communicate with the receiving or sending facility, and provide care during transfer. The success of transportation of a sick neonate depends on early identification, stabilization, referral and care during transport.

Types of Referrals:

- From home or peripheral facility to SBCU,
- Intra hospital transport (Labour room/Operation theatre /Radiology),
- Inter facility transport (SBCU to tertiary care facility with NICU),
- Reverse transport after treatment (from hospital to the PHUs).

Figure AK, Neonatal Transport and Referral Pathways Across Levels of Care



Indications for referral to a higher level of care:

- Centre not having the capacity to manage the baby
- Sick neonates not responding to treatment or deteriorating
- Shock not responding to fluid challenge
- Jaundice requiring exchange transfusion

- Major congenital malformations e.g. meningomyelocele, tracheo-esophageal fistula, diaphragmatic hernia, etc.
- Refractory seizures
- Refractory hypoglycaemia
- Abdominal distension with bilious vomiting and/or black tarry stool

Preparation Before Referral and Care During Transport to Higher Level of Care
Preparations Prior to Referral:

- ***Assess:*** Make careful assessment of the baby. Make sure that there is a genuine indication for referral.
- ***Stabilsze the neonate:*** Stabilise with respect to temperature, airway, breathing, circulation and blood sugar prior to referral.
- Give the first dose of ***antibiotic.***
- ***Counselling:*** Explain the condition, the prognosis and the reasons for transfer of the baby to the family.
- ***Complete the baby's referral form:*** Fill in the baby's referral form providing details of the baby's condition, reasons for referral, laboratory tests done and treatment given to the baby. (See sample neonatal referral form below).
- Inform the Hospital: The hospital should be informed about the baby's referral prior to the transport.
- ***Encourage mother to accompany baby:*** Mother should accompany the baby for breastfeeding and for providing warmth and supportive care to the baby on the way and in the hospital. In case she cannot accompany the baby immediately, an appropriate caregiver should accompany the baby, and the mother should be encouraged to reach the facility at the earliest possible time.
- ***Arrange a provider to accompany:*** A nurse/health worker should accompany the baby, if feasible, to provide care to the baby in route.
- ***Communication:***
- Communication with the referral facility in advance and request for feedback,
- Explain where to go and indicate whom to contact.

Ensure Warmth During Transport:

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

- **Skin to skin contact:** This is probably the most effective, safe and convenient method.
    - Baby is wearing a cap and a diaper.
    - Baby is placed facing the mother, skin- to- skin contact between breasts.
    - Baby's back is covered by tying the blouse or with a fold of gown.

- [The skin-to-skin contact can also be provided by another person].

- **Cover the baby:** Cover the baby fully with clothes including the head and the limbs.

Note: The use of hot water bag/bottle is related to considerable danger due to accidental burns to the baby if the bottle is not wrapped properly or remains in contact with baby's body. It is therefore best to avoid this method.

Provide Other Care During Transportation:

The accompanying person must ensure the following:

Ensure Warmth:

- Whichever method of keeping the baby warm is used, the baby's feet must be warm to touch. Warm feet indicate that the baby is not in cold stress.
- If the baby passes urine or stool, clean and dry the baby promptly. The baby should not remain wet; otherwise, they will lose heat.

Ensure an Open Airway:

- Keep the baby's neck in slight extension.
- Do not cover the baby's mouth and nose.
- Suction and clean the mouth and nose if required.

Check Breathing:

- Watch the baby's breathing. If the baby stops breathing, provide tactile stimulation to the back and soles to restore breathing, and administer bag-mask ventilation if required.

Provide Feeds:

- Breastfeeding should be given if the baby is active. If the baby can breastfeed but the mother is unable to accompany and breastfeed, the baby must be fed using a cup and spoon.
- If the baby is unable to feed, insert a feeding tube if possible.

Support to the Family:

One of the most important and often very difficult aspects of transport is the emotional support provided to the parents and family. Hospitalisation and the need for transport of a newborn can precipitate a crisis for the entire family. Any kind of emotional outburst should be handled in a calm and gentle manner. Reassurance of the parents is crucial.

- Allow parents or caregivers to see and touch their child prior to transport.
- Explain to the parents or caregivers the clinical problems of the baby and the care that will be provided during transport.
- Provide the family with information about the receiving hospital, including its location and visiting policies.
- Arrange transport for the parents.
- Share general SCBU/NICU information with the family.
- Consider maternal transfer whenever possible.
- Obtain informed written consent for transfer (see sample informed consent form below).

SAMPLE of Neonatal Referral Sheet:

Date: _____ Time: _____

Name of baby: _____ Mother's Name _____

Father's name: _____ Sex of baby: _____

Age of baby: _____ hours/days/weeks _____

Birth Weight: _____ Current Weight: _____

Gestational age: _____ weeks _____

Client's Registration no: _____ Baby's Blood Group (If Known): _____

Mother's Blood Group (If known): _____ Antenatal history: Hypertension _____

Diabetes Mellitus, Antepartum haemorrhage, Hypertensive disorder, Rupture of membrane, Twin pregnancy, Polyhydramnios, Oligohydramnios, Maternal fever, others

RVS (HIV) status: _____ Treatment _____

Birth History:

Place of delivery: _____ Mode of delivery: _____

Date of delivery (dd/mm/yr) _____ Time of delivery: _____

Attended by: _____ Drugs used in labour: _____

Duration of rupture of membrane: _____

hours. Liquor: Meconium stained; foul smelling Baby cried: Immediately/ _____

min after birth/ did not cry. _____

Resuscitation needed at the time of birth: yes/ no. _____

If yes, mode of resuscitation: _____ Apgar score: _____

Examination findings: _____

Problem/ Diagnosis: _____

Blood sugar (if done) and other investigations (with date): _____

Pre-Referral treatment given: _____ Reason for referral: _____

Signature: _____

(Name of referring doctor in capital letter with designation)

Date: _____ Time: _____

Contact Number _____

SAMPLE Consent Form

I, Mr. /Ms _____ relation) of _____

(baby's name) hereby give consent to transport my baby to neonatal unit of _____ Hospital, I have been fully counselled by staff at health center _____ about my baby's condition. I have been informed about risk and untoward incidents, which may occur during transport. I have also been informed about the referral hospital, which has facilities to treat my child's illness and I understand the Government free health care policy for mothers and children < 5years.

I, also give my consent for any emergency procedures, which may be needed during the transfer. In case of deterioration during the transfer, the baby will be taken to the nearest available health facility.

Signature of the guardian	Signature of the health care provider
Name _____	Name _____
Relation _____	Date _____
Date _____	Time _____
Time _____	

_____

Signature of the witness

CHAPTER 21:
INFECTION PREVENTION AND CONTROL (IPC) CARE AND HOUSEKEEPING PROTOCOLS

Requirements for IPC in a Special Baby Care Unit:

- Hand washing basin with running water/handwashing station with veronica buckets,
- Hand washing soap,
- Strict hand washing practice,
- Avoid overcrowding in the units,
- Good supply of personal protection equipment (gloves, aprons, masks),
- Supply of disposable equipment (nasogastric tubes etc.),
- Maintain good housekeeping and asepsis routines.

Guidelines for ENTRY in a Special Care Baby Unit:

- Remove watches, rings etc.,
- Remove shoes and use the unit slippers when entering the unit,
- Use the gown,
- Roll up sleeves up to the elbows,
- Wash hands with soap and water before entering the unit.

Note: Personnel with active infection are NOT allowed to enter the Special Care Baby Unit.

Personal Practise Inside a Special Baby Care Unit:

Sterile gloves:

- Always use disposable gloves prior touching the baby and procedures such as sampling, starting intravenous lines, giving intravenous injections, etc.
- Wash gloved hands to remove the bloodstains and secretions. Remove gloves and discard. Wash hands again with soap and water.
- Always use sterile gloves for invasive procedures such as insertion or access of central venous catheters, lumbar punctures and insertion of urinary catheters.

Full sleeve gowns and masks:

- Health providers use gown and mask for all invasive procedures e.g. lumbar, puncture, blood exchange transfusion, etc.
- Mothers and family members visiting the baby should wear the gown.

Other important information:

- Each bed should have a separate spirit and betadine swab containers, stethoscope, tape measure and thermometer.
- Change IV cannula after 72 hours of use.
- Change intravenous sets after 72 hours.
- Change the feeding tubes after one week.
- Do not keep files, X-ray films, pens etc. on the baby cot.
- Change antiseptic solution in suction bottles and sterile water in oxygen humidification chambers every day.
- Sterilise the bottles/chambers daily by dipping in 0.5% chlorine for 10-15 minutes.

Nursery environment:

- Floor should be cleaned with 0.5% chlorine solution water once in each duty shift (3 times) and when required.
- No dry mopping, only wet cleaning should be done.
- Clean the walls with 0.5% chlorine once in each duty shift.
- Dustbin should be washed daily with soap and water. Polythene bag should be changed daily or whenever full.

Hand washing:

- It is the single MOST IMPORTANT means of preventing nosocomial infections.
- It is VERY SIMPLE and LOW-COST.

Hand washing norm:

- Hand washing (11 steps) should be done before entering the unit.
- 20-30 second of hand hygiene with alcohol-based hand rubs to be done before and after touching babies.

Steps of effective hand washing

- Roll sleeves above the elbow,
- Remove wristwatch, bangles, rings, etc.
- Using plain water and soap, wash parts of the hand in the following sequence:
    - Palm to palm,
    - Palm to back of hands,
    - Fingers and knuckles,
    - Thumbs,
    - Fingers tips,
    - Wrists and forearm up to elbow.
- Once you have washed your hands, do not touch anything, e.g. hair, pen or any fomite, until you carry out the required job:
    - Keep elbows dependent, i.e. lower than your hands,
    - Close the tap with elbow,
    - Air dry or dry hands using autoclaved paper pieces or cloth towels,
    - Discard napkin to the bin kept for the purpose. If newspaper piece, discard in the black bucket,
      Do not keep long or polished nails.

Remember: Rinsing hands with alcohol is NOT A SUBSTITUTE for proper hand washing!

Skin preparation for venepuncture

Steps:

1. Wash and dry hands
2. Wear sterile gloves
3. Prepare skin site, confine to smallest possible area of skin
4. Swab with alcohol, allow it to dry
5. Skin is now ready for puncture of prick

IV fluids and medications

Skin preparation for venepuncture and other procedures

Skin preparation is an important part of asepsis routines. It should be performed meticulously to avoid entry of pathogens during insertion of IV cannula, pricks or procedure.

Always wear sterile gloves after thorough hand washing. The procedure of skin preparation is given in the box below.

- Never use the used and stored IV fluids. Do not use the same dextrose/saline bottle for > 24 hours.
- Label the bottle with date and timing of opening.
- After seal is removed, first clean with spirit swabs, then use betadine-soaked sterile cotton to cover the stopper of the bottle.
- Change the burette set every 72 hours.
- Use syrups within 1 week of opening, write the opening date on the bottle.
- Antibiotic vials (e.g. injection Ampicillin or Cefotaxime) should be changed after 24 hours.
- There is no need for flushing with heparin saline to keep the IV-line patent.

Table 64, Disinfection Protocols for Neonatal Linen, Utensils, and Clinical Equipment

DISINFECTION PROTOCOLS		
Name of Disinfection/Equipment Sterilization Method		**Frequency & Other Considerations**
Baby linen, blanket (cover)	Wash	Wash the linen every day. Use washed linen each time.
Cots and mattresses	Clean with soap and water daily if occupied with 0.5% chlorine.	Clean with soap and water daily, if occupied. Clean daily with 0.5% chlorine after the baby is discharged. Replace mattress whenever surface covering is broken.
Cotton gauze	Autoclave	As required. Every time use autoclaved cotton.
Feeding utensils (cup, spoon, etc.)	Wash with soap and water and then boil for 20 minutes.	Wash before and after each use
Swab container, injection and medicine tray	Wash with soap and water/autoclave.	Daily in the morning shift. Use separate swab containers for each bed.
Sets for procedures	Autoclave	After each use. Every 72 hours, if not used.
Cheatle steriliser forceps	Autoclave	Daily. Put in sterile autoclaved bottle containing dry sterile cotton.
Stethoscope, measuring tape, BP cuffs, probes of radiant warmer/ incubator/pulse oximeter	Clean with spirit swab.	Daily, before and after use.
Thermometer	Clean with spirit swab.	Daily, before and after use. Each bed should have on Thermometer, keep in bottle containing dry cotton.
Laryngoscope	Clean with spirit swabs thoroughly daily, before and after each use.	If used for an infected baby, wash with soap and water. Put the blade in 0.5% chlorine (10 minutes) after removing the bulb. Wash thoroughly after removing from the 0.5% Chlorine. Wrap in autoclaved cloth, put date on cover.

Table 65, Disinfection Protocols for Medical Devices and Equipment in Newborn Care

DISINFECTION PROTOCOLS		
Name of equipment	**Disinfection/ Sterilization method**	**Frequency & other considerations**
Syringe pumps	Clean with wet clean cloth. If blood stained, use soap, water and 0.5% chlorine.	Daily in morning shift; if possible, in each shift.
IV equipment	Clean with spirit swab.	Cannulas and infusion sets should be changed every 72 hours.
Oxygen hood	Wash with soap and water; dry with clean linen.	Daily in morning shift.
Face mask	Clean with soap and water, immerse in 0.5% chlorine for 10-15 min, rinse in distilled/running water, dry and wrap with autoclaved linen.	Daily and after each use.
Resuscitation bag and reservoirs, oxygen tubing, bottle and tubing of suction machine	Clean with detergent/soap and water after dismantling. Immerse in 0.5% chlorine for 10-15 minutes. Rinse in distilled water. Dry, wrap in autoclaved linen and put a date.	Disinfect daily.
Suction apparatus	Soap and water-suction bottle. Flush with water and dry, soak in 0.5% chlorine solution and rinse with water-tube connector.	Daily. Suction bottle should be cleaned with detergent and changed. Daily. Change tube connected to bottle. Flush with water and dry. Soak for disinfection in 0.5% chlorine solution. Use disposable suction catheter.
Weighing machine	Wipe with 0.5% chlorine (surface disinfectant).	Daily in morning shift and when required.
Radiant warmer & Incubator	Clean with soap water daily, if occupied. If not occupied, clean with 0.5% chlorine (surface disinfectant).	Daily canopy and mattress should be cleaned with a detergent solution. Weekly: Thorough cleaning after dismantling weekly and every time after shifting or discharging of baby.

Adapted from: https://www.newbornwhocc.org/Dec2014_pdf/Prvention-of-infection-house-keeping-in-facilty-2014.pdf

Safe and Colour-Coded Disposal of Hospital Waste

Proper disposal of hospital waste is important to maintain a clean environment. Waste should be disposed of appropriately. All healthcare professionals should be well-versed in their local hospital policies for waste disposal, which may vary from place to place.

The following are the different drums/bags/buckets with their corresponding colours for various types of waste, along with their disposal methods:

Black bucket/bags:

This waste is disposed of as regular household waste (e.g. leftover food, fruit, feeds, vegetables, wastepaper, packing material, empty boxes, bags, etc.).

Yellow bucket/bags:

Infected non-plastic waste, e.g. human anatomical waste, blood, baby fluids, placenta, etc.

This type of waste requires incineration.

Red bucket/bags:

Infected plastic waste, such as used disposable syringes and needles (first destroy the needle in the needle destroyer if available) and soiled gloves.

Used sharps, blades, and broken glass should be placed in puncture-proof containers before discarding.

Dispose of sharps in sharp containers, which will be incinerated.

Patients' IV sets, blood transfusion sets, endotracheal tubes, catheters, urine bags, etc., should be disposed of in the red bucket, which will be taken to the burning pit for incineration.

CHAPTER 22:
CONGENITAL ANOMALIES AND SURGICAL EMERGENCIES

Congenital anomalies are structural or functional anomalies that occur during intrauterine life and may be identified before birth, at birth, or later in life. They are also referred to as birth defects, congenital disorders, or congenital malformations.

Congenital anomalies are a significant cause of neonatal morbidity and mortality worldwide. According to the WHO, an estimated 6% of babies globally are born with a congenital anomaly, resulting in hundreds of thousands of associated deaths. Some malformations require immediate medical or surgical intervention for postnatal survival.

Causes of Congenital Anomalies

- Genetic factors – e.g. chromosomal defects
- Socioeconomic and demographic factors – low socioeconomic status, advanced maternal age
- Environmental factors – maternal exposure to certain pesticides, chemicals, medications, alcohol, tobacco, native concoctions, unorthodox drugs, and radiation during pregnancy
- Maternal infections – e.g. syphilis, rubella
- Maternal nutritional status – folate deficiency

Detection

- Preconception screening
- Periconception screening
- Neonatal screening

Prevention of Congenital Anomalies

- Health promotion activities
- Cessation of smoking and alcohol consumption
- Eating a healthy diet
- Avoiding exposure to harmful substances (mothers should avoid taking unprescribed drugs and native herbs during pregnancy)
- Maintaining a healthy weight
- Folic acid supplementation
- Management of pre-existing medical conditions such as diabetes

Emergencies and Lifelong Impacts

Many congenital anomalies present as emergencies requiring immediate surgical intervention, while others cause lifelong impacts (e.g. Down's syndrome).

Emergencies include:

- Choanal atresia
- Oesophageal atresia/Tracheoesophageal fistula
- Intestinal obstruction: duodenal, jejunal, ileal, or colonic atresia; malrotation with midgut volvulus; meconium ileus; meconium plug; and imperforate anus
- Abdominal wall defects (omphalocoele/Gastroschisis)
- Diaphragmatic hernia
- Posterior urethral valve with urinary retention
- Spina bifida/Meningomyelocoele

Management

Effective management requires cooperation and communication between the paediatric/neonatology team and the paediatric surgical team. A multidisciplinary approach is usually utilised.

- Once there is clinical suspicion of a surgical emergency, inform the paediatric surgical unit immediately.
- If diagnosed pre-delivery, and if feasible, the paediatric surgical team should be present at delivery.
- For Level 2 centres, in utero transfer to a Level 3 centre is preferred if the diagnosis is made pre-delivery.

1. Choanal atresia

- Choanal atresia is a congenital disorder in which there is lack of formation of the choanae, the openings between the nasal cavity and nasophraynx. It can be unilateral or bilateral and cause nasal obstruction or respiratory distress in neonates.
- Bilateral cases present with respiratory distress; and are only able to breath when they cry and open their mouth.
- Require oropharyngeal airway and elective correction by the ENT surgeon.
- It is advisable to stabilise the patient by placing a small tube to the laryngopharynx before referral.

2. Oesophageal atresia/tracheoesophageal fistula

- Oesophageal atresia is a congenital birth defect where the oesophagus does not connect properly to the stomach. Babies with this condition are unable to swallow or eat normally.
- Tracheoesophageal fistula is an abnormal connection (fistula) between the esophagus and the trachea.
- Oesophageal atresia should be suspected by history of polyhydramnios (excessive amniotic fluid at delivery), observation of copious oral secretions and/or inability to pass feeding tube.
- Keep infant in a head up position to prevent aspiration.
- Suction as frequently as required.
- Confirm by chest radiograph (CXR) with a radiopaque tube in situ.
- Level 2 centres to stabilise and refer to Level 3 centre.
- Inform paediatric surgical team.

3. Intestinal obstruction

- Maternal history of polyhydramnios may be suggestive.
- Large amount (>20 mL) of gastric fluid at birth, bilious or non-bilious emesis, or progressive abdominal distension. In any bilious vomiting of the newborn from birth rule out intestinal obstruction.
- Passage of meconium may not rule out obstruction in babies with atresia, as meconium is already present in the lower GIT from in-utero.
- Higher obstructions may present early with vomiting.
- Passage of nasogastric tube for gastric decompression.
- Place the baby on NPO.
- Commence parenteral nutrition (if available) and or intravenous fluid.
- Confirm diagnosis with abdominal X-ray (Features-duodenal atresia gives double bubble picture).
- Monitor input and output, electrolytes and weight.
- Level 2 centres to stabilise and refer to Level 3 centre.
- Call paediatric surgical team.

4. Delayed passage of meconium

- Most healthy babies pass meconium within 24 hours of birth.
- Delay beyond 48 hours is unusual and an underlying surgical pathology should be ruled out.

Possible causes are:

- Hirschprung's disease
- Meconium ileus
- Meconium plug
- Intestinal dysmotility, especially in growth restricted infants
- Imperforate anus
- Prematurity

Management

- Review history for any evidence of polyhydramnios. Ensure that no meconium was passed prior or at delivery; and check the mother's folder for any antenatal ultrasound reports.
- Take a feeding history, asking specifically about bilious vomiting and abdominal distension.
- Do a complete examination, paying special attention to the infant's perfusion, presence or absence of abdominal distension and tenderness, and check if the anus is patent.
- If the infant is < 48 hours old, well, no vomiting and a normal examination then observe.
- If the infant is > 48 hours old discuss with a senior clinician.
- If the infant at any time has worrying features on history or clinical examination: do abdominal X-ray, Keep NPO until a senior clinician has reviewed the infant. Involve the paediatric surgical team.

5. Omphalocoele and Gastroschisis

Figure AL, Omphalocoele

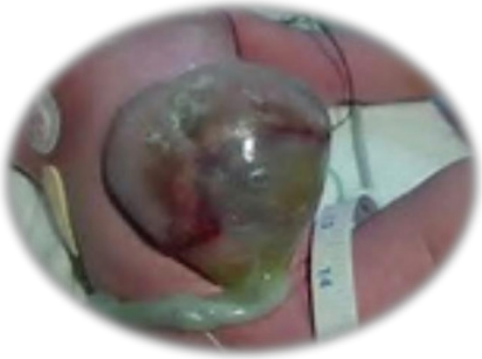
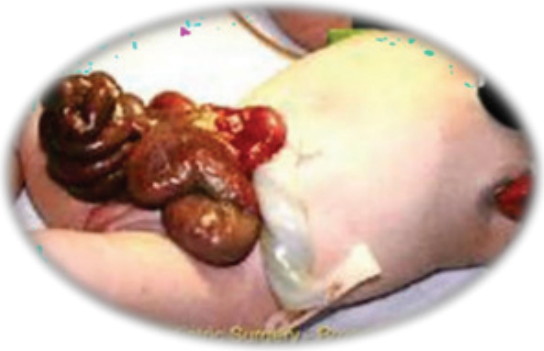


Figure AM, Gastroschisis



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Omphalocoele is the herniation of bowel and occasionally other organs including stomach and liver, into the umbilical cord usually covered by sac, which may rupture prior to or during birth. The umbilical cord is usually at the tip (See figure AL). There is a high association with other congenital anomalies which need to be ruled out prior to surgical intervention.

- Gastroschisis is the herniation of abdominal contents usually through a small right sided abdominal wall defect lateral to the umbilical cord. The exposed bowel is never covered by a peritoneal sac (See figure AM).
- Inform paediatric surgical team prior to the delivery, if possible.
- Do not tamper with the membrane; cover defect with gauze soaked with warm normal saline.
- Keep the baby warm.
- Pass nasogastric tube for decompression.
- Level 2 centres to stabilise and refer to Level 3 centre.
- Commence parenteral nutrition (if available) and/or intravenous fluid.

6. Congenital diaphragmatic hernia

- Developmental defect of the diaphragm that causes abdominal viscera to herniate into the chest. Diagnosis may be made pre-natally during antenatal USS. Otherwise, suspect if respiratory distress is noticed soon after birth in a baby with a scaphoid abdomen.
- If diagnosis is made pre-natally, at delivery ventilation by bag and mask must be avoided (as ventilation by bag and mask could compromise lung function because of pressure from herniated viscera).
- Immediately intubate the infant first WITHOUT any bag and mask ventilation
- Pass a nasogastric tube at birth to decompress the stomach.
- If possible, the surgical (cardio-thoracic) team should be present at delivery.

- The key principles of successful post-delivery management are airway management and the avoidance of high airway pressure while maintaining adequate preductal saturations.
- If diagnosis is made after birth, immediate referral to the surgical (cardio-thoracic surgical) team.

7. Meningomyelocele and other neural tube defects (spina bifida)

Figure AN, Meningomyelocoele (Spina bifida)

- During the first month of pregnancy, the two sides of the fetal spine join to cover the spinal cord, spinal nerves and meninges.
- Spina bifida means “split spine” and is any birth defect involving incomplete closure of the neural tube in the spine area. The most common location is the lower back, but in rare instances, it can be found in the middle back or even the neck (Figure AN).
- Cerebrospinal fluid (CSF) leak is commonly observed.
- Often leads to some degree of paralysis, bowel and bladder dysfunction, and orthopaedic disabilities.

Hydrocephalus occurs in 15-25% of babies with myelomeningocele.

- The opening can be corrected by surgery—usually in the first few days of life.

Management

- The major indication for early operative repair (within 48h of delivery) is prevention of infection.
- Involve neurosurgical and paediatric surgical team before birth, if diagnosis was made during antenatal care.
- Always nurse prone or side-lying position to avoid pressure on the sac or nerves.
- Avoid contamination of side and dressing from stool and urine.

- Perform a careful full neurological examination and note the presence of any orthopaedic deformities such as clubfeet.
- Measure the head circumstance and look carefully for clinical findings of hydrocephalus.
- Multidisciplinary team to manage associated anomalies.

If the defect is not covered by skind covered by skin:

- Cover with sterile gauze soaked in normal 0.9% saline.
- Always keep gauze moist and ensure that the baby is kept warm.
- Prophylactic antibiotics to prevent infection.
- Level 2 centres to stabilise and refer to level 3 centre for specific care and man.

CHAPTER 23:
SPECIAL CARE AND HANDING OF EQUIPMENT IN SBCUs

There are several important types of equipment used in the SCBUs to provide newborn care. These equipment and instruments must be well maintained and taken care to ensure sustainability.

Radiant Warmer

PARTS OF THE RADIANT WARMER:

- Bassinet (for placing the neonate)
- Radiant heat source (Quartz/ceramic or similar heating rod)
- Skin probe (for measuring baby's skin temperature and regulating heater output.
- Control panel (displays and control knobs)
- Mode selector (selects manual or servo mode)
- Heater output control key /knob (to increase or decrease the heater output manually)
- Heater output display (indicates heater output)
- Temperature selection key/knob (select the desired skin temperature)
- Temperature display (displays temperature of baby's skin)
- Alarm display

USE OF RADIANT WARMER:

- Connect to mains and switch on.
- Select the manual mode and keep heater output to maximum for 15-20 minutes for pre-worming the bassinet and linen.
- Select servo mode and set the desired skin temperature to 36.5ºC.
- Place baby in the bassinet. Cover head with cap, feet with socks and hands with mittens.
- Connect skin probe to baby's abdomen with a skin friendly tape.
- In manual mode, record baby's axillary temperature every 15 minutes. Do not leave the baby unattended when operation in this mode. Switch to servo mode once temperature is 36ºC.

CLEANING & DISINFECTION OF RADIANT WARMER:

Bassinet

- Soap/detergent – daily.
- Clean using disinfectant like 0.5% chlorine or glutaraldehyde when the bassinet is unoccupied or weekly (move the baby while using disinfectant).
- Clean using Isopropyl alcohol swab before and after each use.

Dos & Don'ts – Radiant Warmer:

- Place skin probe in the right upper abdomen in the supine position and in the flanks if baby is prone. Use skin-friendly adhesive tape to secure the probe in place. Do not place probe on bony structures.
- Ensure that the skin is dry or else prepare using alcohol/spirit swab to ensure good adhesion to the skin.
- Check repeatedly to ensure that the sensor probe is in a good position and well attached.
- Check temperature manually at least once per shift.
- Always respond to alarms promptly and take corrective measures.
- Do not apply probe to bruised skin.
- Do not reuse disposable probes.
- Do not lay baby on the probe/ always on the upside.

Trouble shooting (for malfunctioning) the Radiant Warmer:

CHECK POWER

- Check plug
- Check cord
- Check fuse

Side effects and dangers:

- 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.
- Hypothermia (due to equipment failure). To prevent hypothermia the equipment should be maintained in **good** condition and alarms should be attended to immediately.
- Increased insensible water loss (IWL) (occurs due to exposed skin surface to radiant heat more so in **preterm** neonates).

To prevent IWL:

- Clothe the baby and use caps and socks.
- Apply emollients to the skin.
- Maintain ambient temperature and humidity.

Maintenance of Radiant Warmer:

- Calibration every 4-6 months as per manufacturer's manual.
- Comprehensive warranty for 5 years at the time of purchase and thereafter.
- Annual maintenance contract.

Phototherapy Unit

Types of phototherapy units:

All phototherapy units have a designated light source to provide irradiance ranging from 6 – 40 uW/cm2/nm in the wavelength of 420 – 460 nm. The various types available are Conventional, CFL (compact fluorescent lamp) & LED units.

Parts of phototherapy unit:

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),
- Irradiance provided,
- 6-8 uw/cm2/nm (White light),
- 8-12 uw/cm2/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/cm2/nm.

3. Light emitting diode (LED)

- Multiple high intensity gallium nitrate LED encased in a unit,
- Irradiance provided 20-40 uw/cm2/nm.

Other parts:

- Radiator fan (as applicable),
- Hour meter (as applicable).

Use of Phototherapy Unit:

- Connect to mains,
- Switch on the unit & check that all tubes/lamps are working.

Cleaning of Phototherapy Unit:

- Soap/detergent once daily,
- Clean with disinfectant once a week,
- Keep the lamps, the covering shield and the grill clean.

Dos & Don'ts:

- Do cover eyes with an eye patch. Nurses should wear sunglasses if working around light intended time,
- Place baby naked only with the nappy to cover genitalia,
- Place baby as close as possible to light source avoiding hyperthermia,
- Check weight daily,
- Frequent breast feeding ,
- Increase in allowance for fluid if there is any evidence of dehydration. Check urine output/and colon**,**
- Change position frequently after each feed,
- Measure serum bilirubin every 12 hours or earlier if required,
- Low birth weight babies can have their socks, caps and mittens on while under phototherapy for **preventing** hypothermia,
- Use Fluxmeter to check for and ensure optimal irradiance. Replace bulbs per manufacturer **recommendation**,
- Do not put anything on top of the phototherapy unit (this may block the air vents) .

Trouble Shooting:

- Check power/plug,
- Check cord,
- Check fuse,
- Check tubes or lamps for flickering, blackening of ends and non-function.

Ineffective Phototherapy:

- Baby covered or frequently removed from phototherapy, and not turned 2-3 hours,
- Low irradiance (tubes old, flickering, black ends),
- Distance between phototherapy lights and baby is more than recommended,
- Haemolytic conditions can cause bilirubin to rise in spite of phototherapy.

Side Effects and Dangers:

- Transient maculopapular rash on the trunk,
- Hyperthermia/Hypothermia,
- Increased insensible water loss and dehydration,
- Loose stools,
- Bronzing the skin in the presence of direct hyperbilirubinemia.

Maintenance:

- Change lights if:
    - Irradiance as measured with flux meter <15
    - Lamp life > 1000 hours of use for fluorescent tubes, for LED > 10000-20000 and for CFL as per manufacturer's instruction manual (time log should be kept for this),
    - If Flux meter and hour meter are not available, then change every 3 months,
    - Tube ends are black or flickering or not working,
    - Comprehensive/ Annual Maintenance contract.

Suction Machine

There are 3 types of suction machines: mechanical (foot operated), electrical and wall suction.

Parts of the Suction Machine:

- Suction tubing

- Suction bottles
- Pressure gauge

Use of the Suction Machine:

Electrical

- Connect to the mains
- Switch on the unit and occlude distal end with your thumb to check the suction pressure. Ensure it does **not** exceed 100 mmHg (for low GI suction with 30mmHg)
- Use disposable suction catheters,
- Connect the desired size disposable suction catheter to suction tubing,
- Perform suction gently and intermittently,
- Switch off the suction machine.

Foot operated

- Pedal to build the desired level of suction, pressure
- Steps 3-6 are the same as above.

Wall suction

- Turn knob to 'ON' position**,**
- Check and adjust the pressure, gauge,
- Steps 3 to 6 are the same as above.

Cleaning & Disinfection of the Suction Machine:

- Wash suction bottle and tubing with soap & water daily.
- After cleaning, soak the tubing and the bottle in 2% glutaraldehyde solution for 20 minutes daily.
- Take out from glutaraldehyde solution and wash under running water.
- Connect to the machine after placing disinfectant solution (3% phenol or 5% Lysol) in the bottle.
- Flush the suction tubing by suctioning with clean water after each use.

Dos & Don'ts – Suction Machine:

- Suction gently and intermittently.
- Use only disposable suction catheters and discard them after single use.

- Check adequacy of suction pressure prior to use.
- Do not perform vigorous & deep suction.

Troubleshooting – Suction Machine:

- Check fuse,
- Check cord,
- Check for leakages in the bottle/tubing,
- Check with manifold room malfunctioning wall suction.

Side Effects & Dangers of suctioning:

- Local trauma
- Bradycardia
- Apnoea
- Infection

Maintenance:

- Check suction pressure daily,
- Change tubing for leaks or cracks,
- Comprehensive /Annual maintenance contract.

Resuscitation Bag & Mask

Indication: To provide positive pressure ventilation

Contraindication:

- Congenital diaphragmatic hernia,
- Meconium aspiration syndrome (relative contra-indication),

(After upper airway suction, need to provide Positive PV).

Parts of A Self-Inflating Bag and Mask:

- Bag
- Oxygen inlet
- Air inlet
- Patient outlet

- Valve assembly

a. Safety feature: Pressure release valve (or pop-off valve or pressure gauge)

- Oxygen Reservoir
- Rounded silicone cushioned mask for pre-term and term neonates (size 0 and 1)

Checking and Use of Bag and Mask:

- Assemble bag
- Check bag (For this, occlude the patient outlet tightly with your palm and then squeeze the bag and look for **the** release of the pop-off valve, the pop-off valve goes up along with a hissing sound- this indicates that the pop off valve - is functioning normally). This is a safety feature to prevent over distension of the lungs.
- Connect to oxygen source, if required,
- Attach the reservoir, if required (for CO2 concentration > 40%),
- Fix appropriate size mask (00 for extremely preterm, 0 for preterm and I 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),
- Apply mask, Ensure adequate seal.
- Perform PPV-Check for adequate chest rise.

Cleaning & Disinfection of Bag and Mask:

- Disassemble all parts, wash thoroughly with warm water and soap after each use.
- For decontamination, soak in 0.5% chlorine solution for 10 minutes and wash thoroughly with warm water **and** soap after each use.
- For disinfection, soak in glutaraldehyde 2% for 30 minutes and for sterilization, soak for 6 hrs
- After removing from glutaraldehyde rinse with clean water, dry with sterile cloth, reassemble, and then **test** before storing.
- Clean mask with spirit between patient use.

Dos and Don'ts:

- Check bag prior to setting up for resuscitation,
- Choose the appropriately sized mask,
- Don't perform overzealous PPV: RR 40-50 b/min,
- Make sure that the airway is patent,
- Ensure adequate seal,

- Look for adequate chest rise but avoid over filling of the chest. The baby's chest should like breathing at rest **not** after running a marathon.

Trouble Shooting Bag and Mask:

- Change bag – should have been checked before needed,
- Check for oxygen source. Apply reservoir,
- Remedial actions for no chest rise – (MR SOPA) M- mask; R- reposition; S- suction; O- open mouth; P- pressure increase; A- alternate airway.

Maintenance:

- Replace if damaged or leaking,
- Do not keep under radiant warmer.

Weighing Machine (Electronic/Mechanical)

Parts of Weighing Machine:

- Pan or baby tray
- Weight scale dial or digital display
- Machine proper (base)

Use of Weighing Machine:

- Clean the pan before each use and between babies with 0.5% chlorine.
- 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.
- The machine should always display zero every time before weighing.
- Place baby naked on the middle of the pan and wait till the display stabilises (Do not record blinking or **changing** values).
- Record weight.
- Remove and clothe the baby.
- Switch off the machine.

Cleaning and Disinfection of Weighing Machine:

- Clean with soap and water daily
- Wipe with spirit swab before each patient use

Dos & Don'ts:

- Always look for and adjust zero error, in mechanical machines it is done by adjusting the knob and in **electronic** by using the Tare/Zero switch.
- Regularly (weekly) calibrate using a known weight
- Weigh baby naked
- Do not stack up linen or other objects on the weighing pan when not in use
- The machine should be placed on a flat stable surface during use.

Maintenance of Weighing Machine:

- Check with a standard known weight at least once a week; request engineer for calibration if incorrect weight
- Comprehensive / Annual maintenance contract

Pulse Oximeter

Parts of Pulse Oximeter:

- Display panel
  - Numeric display
  - Graphic display
- Control buttons
  - Power / standby button
  - SpO2 alarm setting button
  - HR alarm setting button
  - Set button (alarm, volume, trend)
  - Alarm silence button
- An electric cable
- An extension cable for attachment of the patient sensor
- A patient sensor which is to be connected to the extension cable

Use of Pulse Oximeter:

- Connect to the mains
- Switch on the machine

- Set the alarm limits for heart rate 100 – 160 bpm
- Set saturation alarm limits – 89 – 95%
- Connect the patient sensor to the patient by wrapping it around the baby's hand or foot.
- 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 waveform or bar signal is good.
- Values are reliable when the display is constant and not blinking or repeatedly changing.

Cleaning and Disinfection of the Pulse Oximeter:

- Clean display panel with moist soft cloth.
- Clean body with soft cloth dampened with soap water followed by moist soft cloth.
- Clean reusable sensors with spirit after each patient use.

Dos & Don'ts Pulse Oximeter:

- Inspect sensor site every 2 to 4 hours for any erythema or discoloration z Change sensor site every 4 – 6 hourly
- Do not apply sensor too tightly.
- Do not go from patient to patient for spot checks without cleaning thoroughly between patients.

Trouble Shooting Pulse Oximeter:

- Check fuse,
- Check plug,
- Check battery,
- Check for internal failure,
- Check for sensor failure by checking for a red glowing light on the sensor.

Side Effects & Dangers Pulse Oximeter:

- Failure of operation.
- Explosion hazard in presence of any flammable anaesthetic mixture.
- Local reddening, blistering, skin discoloration, burn etc. because of the sensor placement.

Maintenance of Pulse Oximeter:

- Cleaning the oximeter as necessary
- Recharging the battery as necessary.
- Replacing the fuses in power module as necessary.
- Comprehensive/annual maintenance contract.

Infusion Pump

Parts of Infusion Pump:

- Syringe barrel clamp
- Pusher & push guard/flange guard
- Handle & assembly bolt
- Swing lock clamp
- ON/OFF
- Screen
- Silence alarm
- Bolus or Prime
- Value selection
- Pre alarm & alarm warning
- Stop – Infusion stop.
- Menu

Cleaning & Disinfection of Infusion Pump: Use a cloth soaked in soap for cleaning.

Dos & Don'ts – Infusion Pump:

- Cross check the flow rate (e.g. 5 ml/hour instead of 0.5 ml/hour).
- Label the syringe with the drug name and concentration, date and time and your initials.
- Respond to alarms and take corrective action immediately.

Trouble Shooting – Infusion Pump:

- Check continuous display.
- Check indicator lights.
- Check alarm and safety features.

Side Effects & Dangers – Infusion Pump: Inadvertent IV extravasation/if IV cannula is displaced.

Maintenance of Infusion Pump: Comprehensive/Annual maintenance contract.

Oxygen Delivery Systems

Following oxygen delivery devices are used in neonates:

1. **Nasal prongs:** Nasal prongs provide FiO2 (Fraction of inspired Oxygen) between 25 to 45% with flow rates of 1-2 L/min. Among the various types of nasal prongs available, short bi-nasal prongs are most 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 3-5 L/min. These are capable of providing FiO2 between 30 to 90%. They have occludable portholes on the sides. With one porthole opened it provides a FiO2 close to 40-50%, while with both opened it provides 30-40%. With both portholes closed, 80-90% FiO2 can be achieved.
3. **Nasal Cannula:** Nasal cannula can provide a FiO2 ranging from 25-45% with flow rates between 1-2 liter/ min. It mainly comprises of a catheter, or a feeding tube inserted a few centimeters (= distance between the nostril and medical canthus) into the nostril and then connected to Oxygen. Nasal cannulas are not the preferred mode of providing oxygen.

Precautions – Oxygen Delivery Systems:

- Pre-warm and humidify oxygen especially when the flow rates are >2 L/min
- Oxygen saturation should not cross 95% in preterm infants as hyperoxia leads to widespread free radical **injury** and blindness. Set appropriate alarm limits on pulse oximeter.
- Use oxygen analyzer to check the FiO2 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 – Oxygen Delivery Systems:

Humidification of gases is very important as dry gases cause drying and damage to the airway mucosa.

The minimum recommended temperature at the level of nostrils is 33 degrees Celsius. Commonly available humidifiers include cold-water humidifiers, stand-alone humidifiers and heat & moisture exchangers (HME/ HMEF). The target is to achieve 33 mg/L of absolute humidity with a relative humidity of 70-100%.

Oxygen Concentrators:

An oxygen concentrator is a device providing oxygen therapy to 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 therapy and 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 of up to 96% consistently. Most of the portable oxygen concentrator systems available today provide oxygen and maximize the purity of the oxygen.

Safety – Oxygen Concentrator:

The Concentrator's instruction manual indicates as to 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 most 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 can, if ruptured or leaking, greatly increases the combustion rate of a fire.

Oxygen concentrators are considered sufficiently fool proof to be used in neonatal units. They can be used for more than one patient by using flow splitters. However, they need a power source.

CHAPTER 24:
DIFFERENT PROCEDURES FOR NEWBORNS CARE

Capillary Refill Time (CRT) is a simple sign to assess perfusion of a baby. A CRT of >3 seconds denotes poor peripheral perfusion. This can also be prolonged in hypothermia due to peripheral vaso-constriction. If the baby is hypothermic, CRT should be reassessed after s improvement in temperature.

Umbilical venous access is a quick IV access method through the cord stump for infusing volume expanders and drugs during resuscitation.

Peripheral **IV access** is used to provide parenteral fluids and medications.

Lumbar puncture is useful to obtain **Cerebrospinal Fluid (CSF)** for laboratory examination. The various procedures are described below.

Capillary Refill Time (CRT) Assessment:

- Wash and dry hands
- Press the forehead or sternum using index finger/ thumb for 5 seconds, release and look at the blanched (lightened) area for return of colour. Note the time taken for return of colour. Normal CRT is up to 3 seconds.
- CRT > 3 seconds indicates poor perfusion, however in presence of hypothermia interpretation may be **misleading**.

Umbilical Venous Cannulation:

- Wash hands & dry.
- Wear gloves.
- Connect syringe to the catheter, flush the catheter with saline & keep ready.
- Make sure that there is no air bubble in the catheter.
- Hold or mount cord.
- Place a purse string loosely.
- Cut the umbilical cord transversely clean with a sterile blade.
- Identify 2 arteries & I vein – the umbilical vein is thin walled with patulous large opening in contrast to the arteries that are thick walled and much smaller in calibre. (In the normal position, the umbilical vein is at 11-12 o' clock position and arteries at 4 and 7 o'clock position).
- 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).

- 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.
- Inject the drug and follow it by flushing it with normal saline (about 0.5ml).
- Pinch the catheter & remove.
- Press the cord/tighten the purse string to prevent bleeding.

Figure AO, Umbilical Vein Catheterization in Neonates: Identification and Insertion Technique

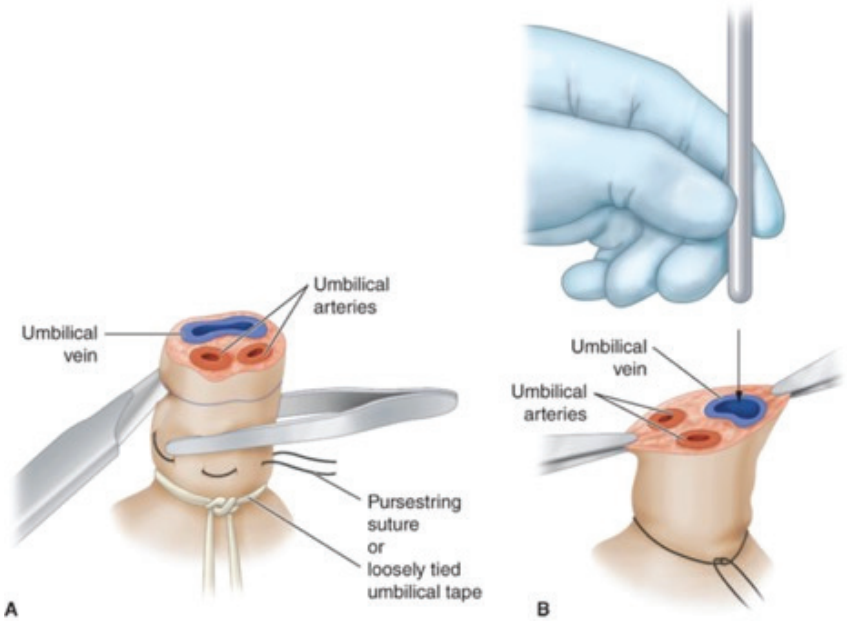


Table 66, Procedure for Establishing Intravenous (IV) Access in Neonates

Intravenous (IV) Access:
■ Select the vein (dorsum of hand/ foot).
■ Wash hands and dry.
■ Wear gloves.
■ Prepare skin- spirit 3 times, let dry between applications.
■ Hold the limb proximally to make the vein prominent.
■ Pierce skin distal to the intended site of puncture.
■ Insert needle into the vein (feeling of give way).
■ Ensure free flow, thread the needle further up into the teeth.
■ Secure the scalp vein needle by adhesive tape.
■ Secure splint.
■ Flush the cannula with normal saline 0.5 ml.
■ Inject fluid/medications.
■ Check distal limb for adequacy of circulation.

Lumbar Puncture:

- Equipment needed: sterile LP package (containing a kidney tray, sponge holder, S/S small galipot (6 ounces capacity), 2 towels), 22 to 24 G Spinal needle or 24 G/26 G 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.

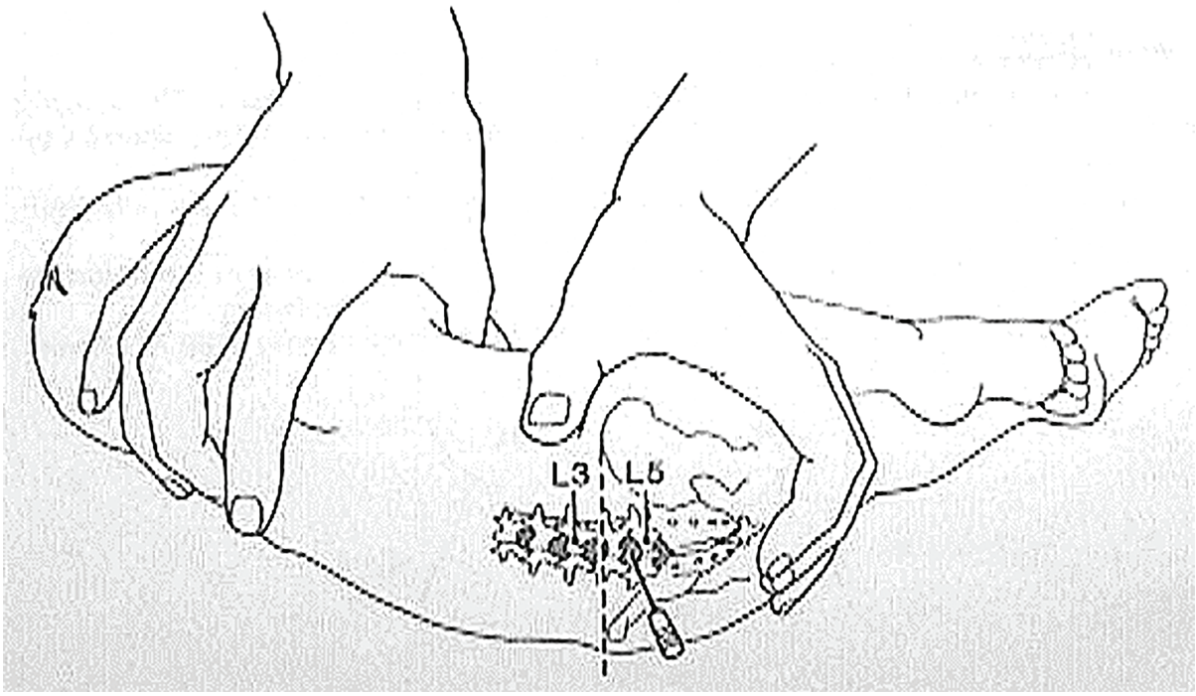
Steps of the Procedure:

- Place the neonate in the lateral decubitus position or in the sitting position with leg straightened. One assistant should hold the infant firmly at the shoulders and buttocks. AVOID neck flexion while holding the baby.
- Wash and dry hands.
- Wear sterile gloves prior to the procedure.
- Prepare the skin over the puncture site by cleansing the area:
    - First with a spirit (70% alcohol) swab; let it dry.
    - Clean with 10% povidone iodine swab; let it dry.
    - Clean again with a fresh spirit (70% alcohol) swab.

- **Note:** Cleanse the area in vertical motion from above towards the anus.

- Cover the cleaned area with sterile towels.

Figure AP, Positioning of a Baby for Lumbar Puncture. Aim for Between L4-L5.



- 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.

Cerebrospinal Fluid (CSF) Examination:

- Inspect the CSF for turbidity and colour; it should be clear.
- Use one of these tubes for examination under microscope; the other two samples are sent to the laboratory for examination as detailed in the table below.

Table 67, CSF Examination by Parameters

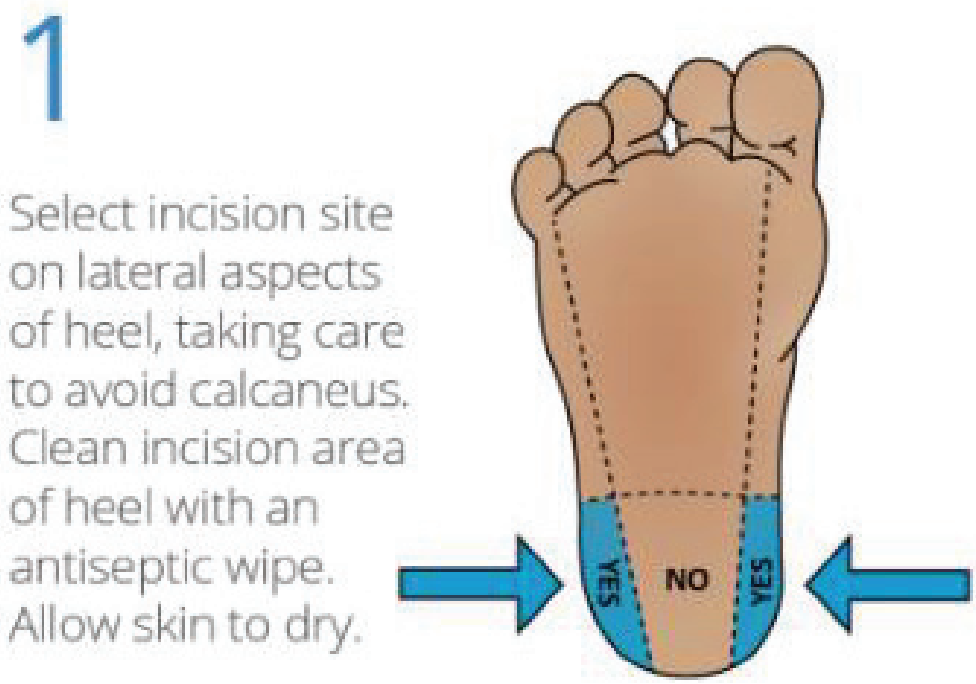
Parameter	Minimum	Services for All Newborn/Newborn at Birth (0-3 year)
Cell count – total and differential	0.5 mL	Mix equal amount of CSF and red cell lysing fluid; load one drop of this fluid into the Neubauer chamber; count the number of cells in the 4 WBC counting chambers. Multiply the number of cells counted by 5 to give the estimated number per mm3.
Glucose and protein	1.0 mL	Send the second sample to the laboratory for glucose and protein estimation; REMEMBER the samples must be analysed IMMEDIATELY.
Culture	1.2 mL	Send the third tube to the microbiology laboratory.

CAPILLARY BLOOD LETTING (HEEL PRICK)

This is a procedure used in newborns to collect capillary blood samples for investigations. A needle prick is made on the extreme lateral or medial aspect of the heel (see figure AQ).

- Flex the foot up towards the leg and hold it in this position with one hand.
- Squeeze the heel firmly enough to make it flush red.
- Puncture the skin about 1 – 2mm deep firmly with a lancet.
- Aim towards the lateral or medial side of the heel.
- Avoid the heel pad because of risk of infection.
- Squeeze the heel gently and intermittently to enhance blood flow.
- Avoid excessive squeezing and rubbing of the heel as this will cause bruising and dilution of blood with tissue fluid giving inaccurate result.
- After blood is collected, apply gentle pressure to the puncture site with a dry cotton wool ball to prevent bleeding.

Figure AQ, Incision Site



ENDOTRACHEAL INTUBATION

- To provide a secured airway for respiratory support,
- Drug administration (Adrenaline and surfactant),
- Appropriately sized endotracheal tube,
- Sterile towel or drape,
- Laryngoscope with straight blades,
- **Emergency equipment:** T-piece and mask, suction apparatus,
- Pulse oximeter or multi parameter monitor,
- Bag & mask,
- Oxygen,
- Stethoscope,
- Face mask, eye shield and sterile gloves,
- Scissors and adhesive tape.

Table 68, Determination of Endotracheal Tube Sizes and Depth of Insertion

Weight	GA	ETT Size	Laryngoscope blade	Depth ofinsertion (oral) 6+wt (kg)
<1000g	<28wks	2.5	00 OR 0	6
1000-2000g	28 - 34wks	3.0	0)	7 -8cm
2000-3000g	34-38wks	3.5	0	8 - 9cm
>3000g	>38wks	3.5-4.0	0 - 1	9 + (use formula above)

- Wash hands with soap and water.
- Wear face mask/eye shield and sterile gloves.
- Extend infant's neck slightly – (avoid hyperextension; consider roll of cloth to support shoulders).
- Clear airway and empty stomach with gentle suctioning, if necessary.
- Ventilate with bag and mask with 100% FiO2 before starting, if necessary.
- Hold laryngoscope in left hand, open infant's mouth & move tongue with the blade.
- Insert laryngoscope blade in midline; advance until its tip is between base of tongue and epiglottis within vallecula, position blade to visualize glottis.
- Suction, if necessary.
- Hold tube with concave curve anterior, pass down right side of mouth (outside the blade) through the cords approximately 2cm into trachea (using the vocal cord guide). Do not insert into oesophagus which is lying inferiorly.
- Check correct placement. In general, correct placement is: (Birth weight + 6) in cm (Table 68).
- After intubation, auscultate for equal breath sounds in both lungs and over stomach or test with CO2 detector.
- Secure tube with adhesive tape, using trouser leg pattern.
- Confirm appropriate tube placement with CXR.

NOTE: Stop procedure to ventilate with bag & mask anytime heart rate drops below 100bpm or if the infant becomes cyanotic. Attempt not to last more than 20secs. (NRT 8th edition).

MICRO-ESR DETERMINATION

It is a test that involves the use of haematocrit capillary tube to measure the distance that red blood cells have fallen after one hour in a vertical column of anti-coagulated blood under gravity.

- Obtain blood into heparinised capillary tube (do not allow air to interrupt the column of blood to avoid false positive result; do not fill the capillary tube to the brim, leave one-quarter space)
- Seal one end with plastacine or softened bar soap.

- Immediately place the capillary tube vertically on a wall; anchor it firmly with an adhesive tape; write patient's name and time of blood collection on the tape.
- Set alarm clock to one hour from time of collection.
- After one hour, measure the height of the plasma column in the tube (in millimeter) using a tape measure or ruler.
- For babies aged 0 – 14days, micro ESR is elevated (suggestive of sepsis) if the result is greater than the formula: n + 3.
- Where n = age of babies in days.
- For babies aged 15 – 28 days, it is elevated if result is greater than 15mm in first hour.

CHAPTER 25:
QUALITY IMPROVEMENT IN NEONATAL PRACTICE

QUALITY OF CARE

The WHO definition of quality of care is "the extent to which health care 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-centered."

The framework of eight domains of quality of care for pregnant women and newborns in facilities increases the likelihood that the desired individual and facility outcomes will be achieved. The crosscutting domains are human and physical resources. As such, quality provision of care for pregnant women and newborns in health-care facilities require competent and motivate d health-care professionals and the availability of essential physical resources, such as clean water, essential medicines, equipment and supplies. In addition, evidence - based practices for routine and emergency care require functional referral systems between levels of care, as well as information systems that enable review and audit to take place.

In response to the huge maternal and newborn mortality worldwide, WHO with other partners established a Quality of Care (QoC) initiative to reduce preventable maternal, newborn and child illness and deaths and to improve every mother's experience of care.

What is quality improvement?

There are several common reasons why people do not receive the requisite care in the health facilities / hospitals. These include:

- Lack of resources in terms of physical infrastructure and basic facilities, appropriate staff, essential equipment and supplies.
- Health workers have insufficient clinical knowledge and skills or understanding of how to ensure good quality of care.
- Lack of organisation of services at the health facilities so that staff are not able to easily provide care that they know is important.

In Sierra Leone, quality of care for newborn is defined as: "Healthcare for all newborn at all levels that is safe, efficient, timely, equitable, accessible, respectful, responsive and people centered using evidence-based interventions that results in the best possible outcomes, and provided by competent and compassionate workforce in an enabling environment in accordance with national standards" (SL 2019).

Quality improvement (QI) is a management approach that health workers can use to re-organize patient care at their level to ensure that patients receive good quality healthcare. While QI primarily focuses on re-organizing care within the existing resources, it can also

contribute to addressing related issues. For example, QI leads to more efficient use of resources that can solve at least some issues of scarcity. It could help identify the most relevant gaps in knowledge and skills among the health care workers and help target training and skills building. Quality improvement does help identify deficiencies in quality of care but is NOT a fault-finding exercise, but a problem solving approach without requiring additional resources, as far as possible.

STANDARDS FOR NEWBORN QUALITY IMPROVEMENT (WHO: SEPTEMBER 2020)

The standards for the care of small and sick newborns in health facilities must be defined, standardized and mainstream inpatient care of small and sick newborns, building on essential newborn care and ensuring consistency with the WHO quality of care framework (WHO Standards 2020). They provide a resource for policymakers, health care professionals, health service planners, programme managers, regulators, professional bodies and technical partners involved in care, to help plan, deliver and ensure the quality of health services. It ensures every small and sick newborn receives evidence-based routine care and management of complications according to National/WHO guidelines.

1. STANDARD 1:

Quality statements

A. CARE FOR ALL NEWBORNS

1.1. All newborns receive care with standard precautions to prevent health care-associated infections, including implementing additional measures required during outbreaks and pandemic situations.

1.2. All newborns are assessed immediately while receiving essential newborn care.

1.3. All newborns at risk are correctly identified as soon as possible after birth or on presentation to the health facility and receive additional care.

1.4. All referred newborns are triaged, promptly assessed for danger signs or injuries to determine whether they require resuscitation and to receive appropriate care according to WHO guidelines.

1.5. All newborns receive routine postnatal care, including weighing and temperature measurement.

1.6. All newborns are assessed for immunization status and receive recommended vaccinations according to the guidelines of the WHO Expanded Programme on Immunisation.

1.7. All newborns are given vitamin K according to WHO guidelines.

1.8. All newborns are protected from unnecessary or harmful practices, including separation from their mothers and families during their care.

1.9. All newborns are screened for evidence of maltreatment, including neglect and violence, and receive appropriate care.

1.10. All newborns are assessed for congenital abnormalities, managed appropriately and referred in a timely manner.

1.11. All newborns whose gestational age is unknown are assessed with an appropriate tool for scoring gestational age.

1.12. All newborns are assessed for suspected infection or risk factors for infection and, if required, investigated and given the correct antibiotic treatment according to WHO guidelines, avoiding overuse of antibiotics.

1.13. All newborns at risk of congenital syphilis are assessed, investigated and managed according to WHO guidelines.

1.14. All newborns receive eye prophylaxis, are assessed for ophthalmia neonatorum and, if required, managed according to WHO guidelines.

1.15. All newborns at risk for tuberculosis and/or HIV infection are correctly assessed, investigated and managed appropriately according to WHO guidelines.

1.16. All newborns at risk of impaired metabolic adaptation associated with asphyxia, small for gestational age and maternal diabetes are assessed to identify and manage hypoglycaemia.

CARE FOR SMALL AND SICK NEWBORNS

B1. Care for respiratory conditions

1.17. Small and sick newborns are assessed for signs of respiratory compromise, and a neonatal pulse oximeter is used to detect hypoxia or hyperoxia and to guide administration of supplemental oxygen according to WHO guidelines.

1.18. Preterm newborns born at or before 32 weeks of gestation who require respiratory support are given between 21% (air) and 30% oxygen, and the need for increasing oxygen concentrations is reviewed to ensure oxygen saturation between 90% and 95%.

1.19. Small and sick newborns who require supplemental oxygen therapy receive it safely through appropriate neonatal equipment, including neonatal nasal prongs, low-flow meters, air– oxygen blenders, humidifiers and a pulse oximeter.

1.20. Small and sick newborns are assessed and managed for apnoea, and preterm newborns are managed to prevent apnoea according to WHO guidelines.

1.21. Newborns with respiratory distress are treated with continuous positive airway pressure as soon as the diagnosis is made, according to WHO guidelines.

1.22. Small and sick newborns are assessed for surfactant deficiency, and surfactant replacement therapy is administered to preterm newborns within the first 2 hours of birth according to WHO guidelines.

1.23. Small and sick newborns at risk of bronchopulmonary dysplasia are assessed, investigated and managed as per standard guidelines.

B2. Nutritional support for newborns

1.24. Small and sick newborns are fed appropriately, including assisted feeding with the mother's own milk when possible, according to WHO guidelines.

1.25. Small and sick newborns who cannot tolerate enteral feeding or for whom enteral feeding is contraindicated are provided with parenteral nutrition in correct amounts and composition according to standard guidelines.

1.26. All newborns of HIV-infected mothers are fed appropriately according to WHO guidelines.

1.27. All very-low-birth-weight newborns are given vitamin D, calcium, phosphorus and iron supplements according to WHO guidelines.

B3. Care for other conditions

1.28. All newborns are routinely monitored for jaundice; bilirubin is measured in those at risk and treatment initiated in those with hyperbilirubinaemia according to WHO guidelines.

1.29. Small and sick newborns are assessed and managed for seizures according to WHO guidelines.

1.30. Small and sick newborns at risk for neonatal encephalopathy receive early evaluation, close monitoring and appropriate management according to WHO guidelines.

1.31. All newborns are assessed and managed for anaemia, including for causes of haemolytic disease of the newborn.

1.32. Small and sick newborns at risk of necrotizing enterocolitis are assessed and managed according to WHO guidelines.

1.33. Small and sick newborns at risk of retinopathy of prematurity are appropriately identified, screened and treated.

1.34. Small and sick newborns at risk of intraventricular haemorrhage are assessed and managed according to standard guidelines.

1.35. All referred newborns with surgical conditions are screened for surgical emergencies and injury and receive appropriate surgical care.

B4. Clinical monitoring and supportive care

1.36. Small and sick newborns, especially those who are most seriously ill, are adequately monitored, appropriately reassessed and receive supportive care according to WHO guidelines.

1.37. Small and sick newborns are given antibiotics and other medications only if indicated, by the correct route and of the correct composition; the dose is calculated, checked and administered, the need for medication is regularly reassessed, and any adverse reaction is appropriately managed and recorded.

1.38. Small and sick newborns who cannot tolerate full enteral feeds are given intravenous fluids containing glucose or safe, appropriate parenteral nutrition; fluids are administered through an infusion pump and a neonatal burette, the volume is recorded, and the intravenous site is checked with other routine observations.

1.39. Small and sick newborns are given blood transfusions when indicated, the blood given is appropriate, the volume is recorded, and the newborn is monitored before, during and after the transfusion.

B5. Pain management and palliative care for newborns

1.40. All small and sick newborns are assessed routinely for pain or symptoms of distress and receive appropriate management according to WHO guidelines.

1.41. Small and sick newborns have access to appropriate palliative care.

B6. Care and advice at discharge

1.42. Small and sick newborns are discharged from hospital when home care is considered safe and carers have received a comprehensive discharge management plan and are competent in the care of their newborn.

2. STANDARD 2:

The health information system enables collection, analysis and use of data to ensure early appropriate action to improve the care of every small and sick newborn.

Quality statements

2.1. Every small and sick newborn has a complete, accurate, standardized, up-to-date medical record, which is accessible throughout their care, on discharge and on follow-up.

2.2. Every health facility has a functional mechanism for collecting, analyzing and using data on newborns as part of monitoring performance and quality improvement.

2.3. Every health facility has a mechanism for collecting, analyzing and providing feedback on the newborn services provided and the perceptions of families of the care received.

3. STANDARD 3:

Every small and sick newborn with a condition or conditions that cannot be managed effectively with available resources receives appropriate, timely referral through integrated newborn service pathways with continuity of care, including during transport.

Quality statements

3.1. Every small and sick newborn who requires referral receives appropriate pre-referral care, and the decision to refer is made without delay.

3.2. Every small and sick newborn who requires referral receives seamless, coordinated care and referral according to a plan that ensures timeliness.

3.3. For every newborn referred or counter-referred within or between health facilities, there is appropriate information exchange and feedback to relevant health care staff.

3.4. Every health facility that provides care for small and sick newborns has been designated according to a standard level of care and is part of an integrated newborn network with clear referral pathways, a coordinating referral centre that provides clinical management support, protocols and guidelines.

3.5. Newborn transfer services provide safe, efficient transfer to and from referral neonatal care by experienced, qualified personnel, preferably specialist transport teams, in specialist transport vehicles.

3.6. Every newborn who requires referral is transferred in the kangaroo mother care position with their mother, when possible.

4. STANDARD 4:

Communication with small and sick newborns and their families is effective, with meaningful participation, and responds to their needs and preferences, and parental involvement is encouraged and supported throughout the care pathway.

Quality statements

4.1. All carers of small and sick newborns are given information about the newborn's illness and care, so that they understand the condition and the necessary treatment.

4.2. All small and sick newborns and their carers experience coordinated care, with clear, accurate information exchange among relevant health and social care professionals and other staff.

4.3. All carers are enabled to participate actively in the newborn's care through femicentric care and kangaroo mother care, in decision-making, in exercising the right to informed consent and in making choices.

4.4. Carers of small and sick newborns and staff understand the importance of nurturing interaction with the newborn, recognize and respect the newborn's behaviour and cues, and include them in care decisions.

4.5. All carers receive appropriate counselling and health education about the current illness of the newborn, transition to kangaroo mother care follow-up, community care and continuous care, including early intervention and developmental follow-up.

4.6. In humanitarian and fragile settings, including outbreak and pandemic situations, special consideration is given to the specific psychosocial and practical needs of small and sick newborns and their care-takers.

5. STANDARD 5:

Newborns' rights are respected, protected and fulfilled without discrimination, always with preservation of dignity and in all settings during care, transport and follow-up.

Quality statements

5.1. All newborns have equitable access to health care services, with no discrimination of any kind.

5.2. The carers of all newborns are made aware of and given information about the newborn's rights to health and health care.

5.3. All newborns and their care-takers are treated with respect and dignity, and their right to privacy and confidentiality is respected.

5.4. All newborns are protected from any physical or mental violence, injury, abuse, neglect or any other form of maltreatment.

5.5. All newborns have their birth registered and have an identity.

5.6. All newborns who die and all stillbirths have their death registered.

6. STANDARD 6:

All small and sick newborns are provided with family-centred developmental supportive care and follow-up, and their families receive emotional and psychosocial support that is sensitive to their needs and strengthens their capability.

Quality statements

6.1. All small and sick newborns stay with their care-takers, with minimal separation, and the role of carers is recognized and supported at all times during care, including room-ing-in during hospitalization.

6.2. All newborns born preterm or with a low birth weight receive kangaroo mother care as soon as possible after birth, and the parents are supported in its provision.

6.3. All small and sick newborns receive appropriate developmental supportive care, and their families are recognized as partners in care.

6.4. All families receive care in an environment in which their socioeconomic, emotional and cultural needs are respected and supported.

6.5. All small and sick newborns receive appropriate, coordinated developmental follow-up with minimal disruption to family life and routines.

7. STANDARD 7:

For every small and sick newborn, competent, motivated, empathetic, multidisciplinary staff are consistently available to provide routine care, manage complications and provide developmental and psychological support throughout the care pathway.

Quality statements

7.1. All small and sick newborns have access to a sufficient multidisciplinary workforce, including health professionals, allied health and support staff, always according to standard levels of care.

7.2. Health professionals and allied health and support staff have appropriate skills to support the health and the psychological, developmental, communication and cultural needs of newborns and their families.

7.3. All staff working in neonatal units of a health facility have the necessary knowledge, skills and attitudes to provide infection prevention and control, basic resuscitation, kangaroo mother care, safe feeding and medications and positive interaction with newborns and communication with carers.

7.4. Every health facility that provides care for small and sick newborns has managerial leadership for developing and implementing policies and legal entitlements, clinical governance and fostering an environment for continuous quality improvement.

8. STANDARD 8:

The health facility has an appropriate physical environment, with adequate water, sanitation, waste management, energy supply, medicines, medical supplies and equipment for routine care and management of complications in small and sick newborns.

Quality statements

8.1. Small and sick newborns are cared for in a safe, secure, well-maintained, organized physical environment that is appropriately designed to provide kangaroo mother care and family- centred care according to standard levels.

8.2. Water, sanitation, hand hygiene and waste disposal facilities are easily accessible, functional, reliable, safe and sufficient to ensure strict infection control and meet the needs of newborns, carers and staff.

8.3. Equipment designed specifically for the medical care and developmental and emotional support of small and sick newborns are always available.

8.4. Adequate stocks of medicines and medical supplies specific for small and sick newborns are available for routine care and for management of complications.

8.5. All carers of small and sick newborns have a dedicated area with supportive elements, including adequate space for kangaroo mother care, family-centred care, privacy for mothers to express breast milk and facilities for hygiene, cooking and laundry.

8.6. In humanitarian and fragile settings, including outbreaks and pandemic situations, provision of a safe, secure environment for the care of small and sick newborns is included in preparedness, response and recovery plans.

Steps to Practice Quality Improvement at SCBU:

Four steps to practice quality improvement at health facility level:

1. How to review data to identify problems
2. How to prioritize which problem to work on

3. How to form a team to work on that problem
4. How to write a clear aim statement

ROOT CAUSE ANALYSIS

The key to solving a problem is to first truly understand it. Often, our focus shifts too quickly from the problem to the solution, and we try to solve a problem before comprehending its root cause.

Tools to use include the “fishbone analysis” and the “5 whys” approach.

a. Fishbone Technique

The fishbone diagram is a graphic tool used to explore and display the possible causes of a certain problem. Write the problem in the “head” (box at the top) of the fish. Use each “bone” (line) of the fish to group possible causes of the problem. You may want to group the causes into the following categories: Materials, Methods, Equipment, Environment, and People.

Figure AR, The Fishbone Diagram

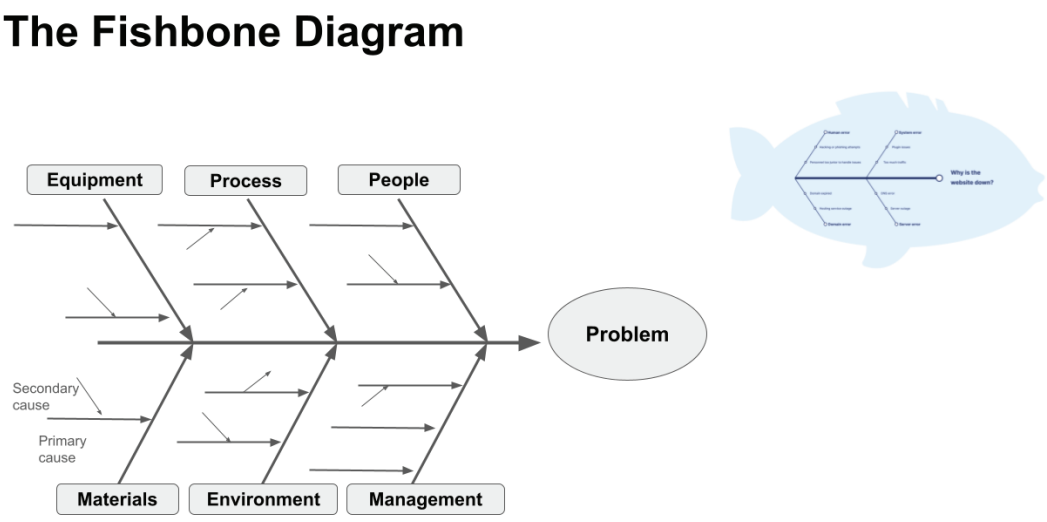
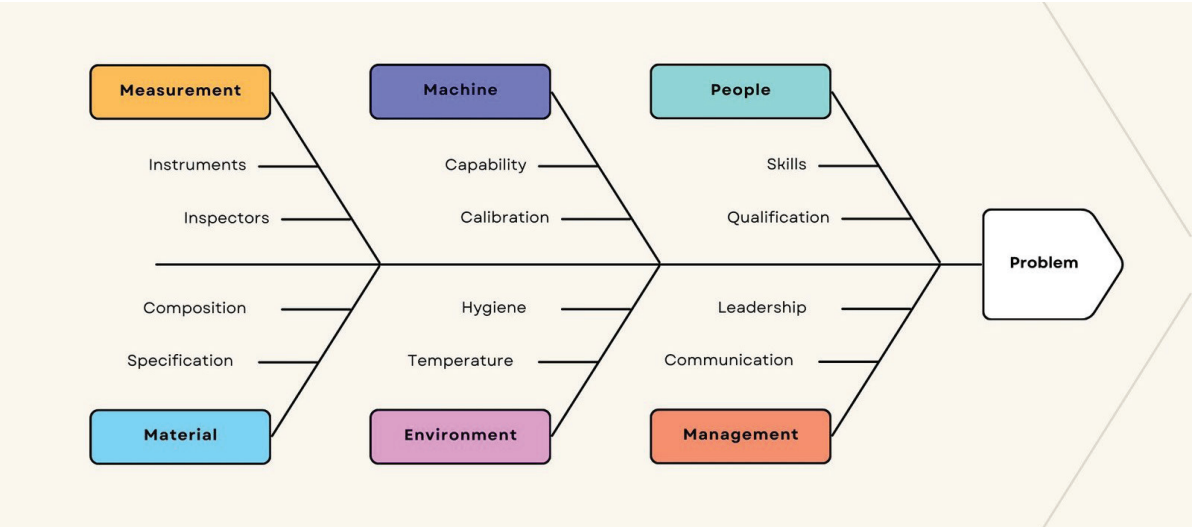


Figure AS, Fishbone Diagram for Root Cause Analysis of a Problem



b. Five Whys Technique

One way to identify the root cause of a problem is to ask "Why?" five times. When a problem arises, ask, "Why did this happen?" Then, do not stop at the answer to this first question. Ask "Why?" repeatedly until you reach the root cause.

Problem:

- Why does this happen?
- Why does this happen?
- Why does this happen?
- Why does this happen?
- Why does this happen?

Table 69, Quality Improvement Project Review Sheet

Step 1: Identifying a problem, forming a team and writing an aim statement

Why is this a good aim?

Can you get results quickly?
What extra resources do you think will be required?
How important is the aim to the QI team - has the team used the prioritization matrix?
Who else will think the aim is important?
How can you motivate others to support this initiative?

Why is this the right team? Do you have people on the team who are:

Enthusiastic about fixing this problem?
Involved in delivering care related to this problem?
Influential enough to get more people involved?

Step 2: Analyzing and measuring quality of care

Why is this the right analysis plan?

Will the tools you have chosen help you to identify the right changes?
Do you have people on the team who can analyze what happens at the patient level?

Why is this the right measurement plan?

How difficult will it be to collect the data? Easy to measure valid data? Are these new data variables?
Can you review these data frequently? What will be planned to share and analyze the data?

Step 3: Developing and testing changes

Will these changes address the root-cause of the problem?

How do the changes you are planning address what you found in your analysis?
If all your changes are related to education or management directives; how sure are you that lack of information or lack of direction are the root cause?

How easy will it be to put these changes into action?

Were the staff who will have to make these changes involved in picking them?
Will you need to change anything else to test these changes?

Are you making sure you can learn as much as possible from your tests?

Is there any way of doing the testing faster?
What will you do if the change doesn't work?

Step 4: Sustaining Improvement

How should we get other people involved?
How can the organisation and its leaders promote improvement?

DECISION-MAKING APPROACH

The decision--- making approach helps providers use their knowledge and skills to make

decisions about the care of a newborn. It provides order and direction to that care. Some know this concept as problem--- solving approach or clinical decision--- making. It involves an organized thinking process, which leads to purposeful, safe, and effective care. Solving problems in a step--- by--- step process has three main advantages:

- It helps the provider collect information in an organized way
- It helps the provider use information so a problem or need can be correctly identified
- It helps to ensure that the baby only receives care or treatments that are needed

The main steps in the decision-making approach are to:

- **Step 1:** Obtain a history
- **Step 2:** Do a physical examination and perform any lab investigations
- **Step 3:** Make an assessment or diagnosis based on the information in steps 1 and 2
- **Step 4:** Make a plan on how to manage/treat the problem, need or diagnosis
- **Step 5:** Follow--- up to evaluate the plan of care; this may involve repeating steps 1 and 2, for additional/updated information, and revising the plan

Assuming responsibility for implementation of the care plan may be considered an additional step. Some health records or forms are organized in such a way that guides the provider in this or a similar manner. Whether or not this is the case, all findings, treatment and management of the newborn conditions must be documented adequately. The main steps of the decision-making process are utilized in this manual repeatedly to emphasize the importance of a consistent, organized approach to care.

DOCUMENTATION IN THE NEONATAL UNIT

Background

- Good clinical records are a prerequisite to delivering high-quality, evidence–based healthcare, particularly where several different clinicians are contributing simultaneously to patient care. Unless everyone involved in clinical management has access to the information they require, duplication of work, delays and mistakes are inevitable.

Note that until the activity has been documented, it literally has not been done.

Why keep good clinical note?

- Administrative and managerial decision making within hospitals
- Meeting current legal requirements
- Assisting in clinical audit
- Supporting improvements in clinical effectiveness through research
- Providing the necessary factual base for clinical negligence claims

What makes good clinical notes?

- History – relevant to the condition (get detailed notes from the mother's folder)
- Examination of the patient – all systems and identification of the baby with the tag
- All of the important findings, both positive and negative
- Differential diagnosis
- Investigations – details of any investigations arranged
- Referral – details of any referral made
- Information given to the parents concerning risks and benefits of treatments
- Consent – details of consent given to proposed treatments or procedures
- Treatment – details of the main doses of drugs
- Follow-up – arrangements for follow-up tests and future appointments
- Progress – any further consultations, how the baby has progressed

Good clinical notes should have the following attributes:

- Legible and understandable when handwritten
- Legibly signed with the date, time, name and designation
- Objective and factual
- Free from subjective comments about patients or parents
- Contemporaneous – at the time of the incident
- Correction to notes should be dated with name of the person amending it
- To correct an entry run a single line through it so it can still be read
- Abbreviation should be unambiguous and universally recognized

Record keeping and audits

To maintain quality in the unit, in addition to the clinical and staffing requirements, several other administrative, protocol, and logistics need to be in place to support quality service delivery.

These include:

- Record keeping and documentation
    - Each unit must have a stock of appropriate logs, patient records and other documentation regarding care, including transfer or referral information.
    - There must be, at a minimum, the following documents for each SCBU baby:
- Case folder or case booklet
- Treatment sheet
- Medications/procedure chart
- Vital signs chart
- Fluid chart/feeding chart
- Weight chart
    - All staff to follow guidelines for record keeping (as per other wards/units) and any logs or documentation specific to the SCBU
- Procurement and inventory process in place to avoid stock outs
    - As per hospital protocol
- Periodic audit/Quality assurance
    - As per hospital protocol
- Written protocol on Infection control
    - As per hospital protocol
- Establish linkage with the assigned tertiary/specialist centre for referral purposes and collaboration with such centre(s)
    - Contact information posted and visible to all staff responsible for referral
    - Information about transport (such as ambulance) available
    - Referral and transfer forms for all hospitals consistent and completed with information needed by tertiary/specialist centre
    - Identify alternative specialist centre (if/when first one not available)

MAINTAINING KNOWLEDGE AND SKILLS

Maintaining clinical competency is one of the hallmarks of professionalism and quality of care. The World Health Organisation Quality of Care framework emphasizes that competent,

confident, evidence-based and up-to-date practice must be the minimum requirement for all providers. The overall aim is to provide the safe care that is of the highest quality whilst maintaining respect and dignity of the family.

There are many effective approaches to maintaining providers' skills at their facilities. The primary purpose is to facilitate continuous learning, preferably at the practice site and includes self, peer- led and team activities. Ongoing learning is an integral part of overall quality improvement (QI), and QI teams should be established at all facilities in at all levels of care.

Globally, there are numerous programs linking existing activities to provider performance and thus, quality of care. A few examples follow. Think about how they can be modified to suit your context.

SUPPORTIVE SUPERVISION

- According to WHO, supportive supervision is a process of helping staff to improve their own work performance continuously. It is carried out in a respectful and non-authoritarian way with a focus on using supervisory visits as an opportunity to improve knowledge and skills of health staff. Supportive supervision includes regular follow-up with staff to ensure that new tasks are being implemented correctly.
- Routine supervisory visits by Ministry or other officials are an opportunity for on-going learning. Skills observation using skills learning exercises and checklists, may be used to assess skills and provide on-the spot correction or revision.
- As proposed, QI teams are responsible for supervising the activities in order to improve quality of care in maternal and newborn units. This may include training and other health provider capacity building activities.
- This involves training all the staff providing maternal newborn care in a facility (even including ancillary staff and non-clinical staff).
- All staff members are not given the same technical content (for example, everyone does not learn to insert a gastric tube) but all are taught general content relevant to their roles. For example, all are taught newborn danger signs and how to respond—even the security and cleaning personnel. Thus, training is tailored to the roles and learning needs of individual staff.
- Whole site training facilitates teamwork and recognizes that each person has a part to play in newborn care, regardless of his or her role.

ONSITE PRACTICE OF SKILLS

This involves the use of checklists, case studies (from training sessions or actual cases), pre/post course questionnaires, and when possible, simulation equipment to review and update knowledge and skills.

- Requires a dedicated space or room, which is set up and equipped with supplies and models to practice skills—often at any time of the day or night. Alternatively, any space or empty room may be used. Have copies of checklists and case studies (with identifying

info removed) on the ward or unit available to all staff. Pre-service students or interns may also make use of the practice area.

- Challenges may include maintenance of the rooms and supplies/equipment

ON THE JOB UPDATES AND REFRESHERS

To ensure that providers have access to knowledge and skills updates, these updates should be made available at their place of work. There are several ways this can be accomplished.

On-site trainers can facilitate training sessions or serve as mentors. Training and mentoring are held on-site so that participants may work part of the day or opt out during clinical emergencies. This makes training schedules flexible.

One of the biggest advantages of this approach is minimal disruption to service delivery. Providers are not absent for days or weeks, which is particularly beneficial in already busy and short-staffed environments. Below are a few examples of how on-site teaching and learning can take place:

- **Approaches to On-the-Job Training:**

1. Low-Dose, High-Frequency Approach
   - This method delivers clinical content through short, simulation-based learning activities, spaced over time to optimise learning.
   - It requires relatively little time out of the working day.

2. Evening or Night Training Sessions
   - These sessions allow staff on evening or night shifts to benefit from training without needing to adjust their work schedules to fit a daytime programme.
   - However, it is recognised that there is often minimal staff during later shifts. Therefore, arrangements must be made for adequate staffing to ensure quality care while training is taking place.

3. On-Call Training Sessions
   - “On-call” sessions provide brief training when clinical cases present themselves.
   - Participants agree to be on-call until an agreed-upon time in the late evening during the training week, in case a labouring woman, sick newborn, or emergency requires attention.

Other Training Methods:

4. Peer Chart Review
   - This approach involves an organised chart review, scheduled periodically and often implemented with a checklist or template to ensure accuracy and completeness.

- The review is conducted anonymously (i.e., the identity of the providers who completed the charts is not revealed), and is not a punitive measure. Instead, it is used to assess whether documentation and record-keeping meet the required standards and to help staff learn from any gaps or issues.
- The results of the review are usually presented in a group, where deficiencies are discussed anonymously, and solutions are agreed upon.

5. Case Reviews
   - A team of providers discusses past cases to review the management and learn from clinical situations.
   - Interesting cases from other institutions, literature, or other countries may also be presented and discussed.

6. "Near-Miss" Discussions
   - This is a form of case review involving the discussion of a patient situation that could have been fatal.
   - The group discusses the scenario and subsequent actions, including what went well, what did not, and what can be done differently in the future to improve care.
   - It is also an opportunity to discuss any new evidence or guidance that may be relevant for current and future cases.

7. Group Learning Sessions
   - These sessions can take on many forms and often involve informal gatherings to share knowledge, practice skills, or review literature.
   - The group may vary in size and may involve peer mentoring.Group learning sessions
   - These can take on many forms and often involves informal gatherings to share knowledge, practice a skill or review literature.
   - The group may be nearly any size and may involve peer mentoring.

TEAM PROBLEM SOLVING

This involves a team or group approach to tackling a quality care or other issue. Peer mentoring and facilitation provide support, leadership, and engagement of the team(s). The teams are usually facility-based, and often multi disciplinary. Although team problem solving can take on many different forms, the example used in this section will focus on Quality Improvement (QI) and maternal and perinatal death surveillance and response (MPDSR) teams.

The main purpose of MPDSR is to inform practice and ensure improved quality throughout the continuum of care. For this reason, some facilities have combined the MPDSR and QI teams into one QI team.

QUALITY IMPROVEMENT TEAMS

The MPDSR and/or QI teams are at most regional and district health facilities and point of care in the country. The team is comprised of representatives of all system functions working together (e.g. provider, pharmacist, lab technician, registrar).

The quality approach at these facilities is based on the WHO maternal and newborn Quality of Care framework. Health worker capacity building is one of the key quality improvement measures for the QI teams and includes support of:

- Health worker capacity to be able to report and use data for continuous improvement
- Health worker clinical skills to deliver best practices for mothers and newborns (e.g. training)
- Building of health worker (QI) skills

Integrating QI capacity building into existing activities

- Clinical training and step down
- Supportive supervision

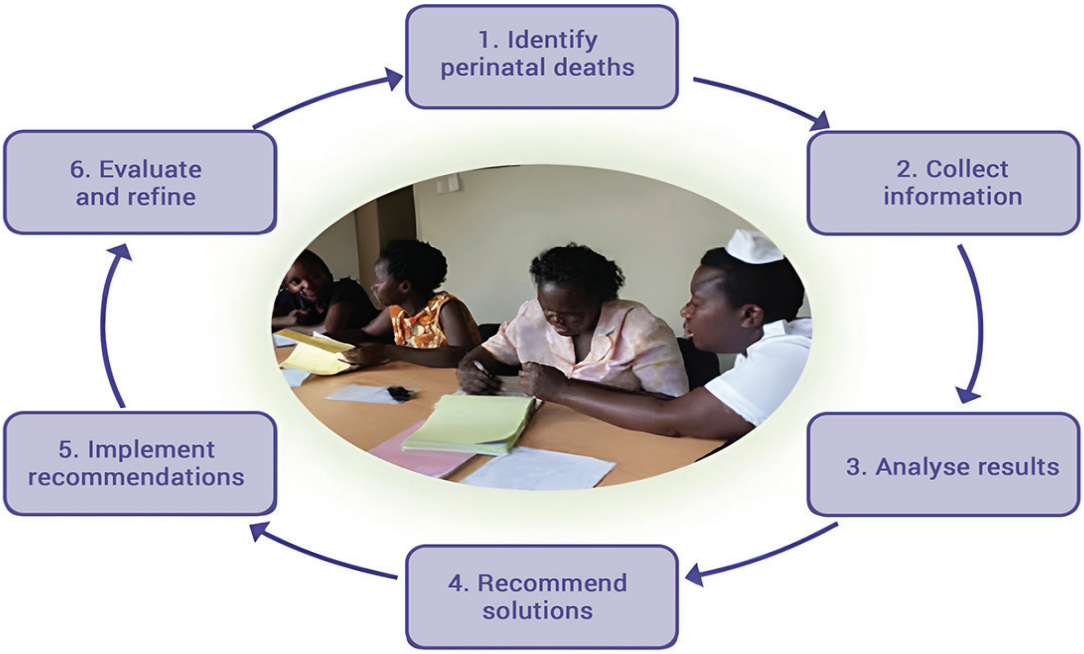
The WHO describes perinatal death audits (similar to Sierra Leone's MPDSR), as a systematic way of improving quality of care by collecting and analyzing data, linking solutions to identified problems and ensuring accountability for changes to improve care. The National QI teams and director will monitor these indicators regularly. At the core of this process is helping providers continuously learn and improve.

The steps to learning in this team approach follow the overall steps in the MPDSR process.

Together the team will undergo each of the six main steps:

1. Identify the problem or issue (e.g.: gap in service provision)
2. Collect information
3. Analyse results
4. Recommend solutions
5. Implement the recommendations
6. Evaluate and revise or refine the plan or recommendations

Figure AT, Making Every Baby Count: Audit and Review of Stillbirths and Neonatal Deaths (Source: WHO)



Chapter 26
Neonatal Neuro-Protective Practice Guidelines

Neuro-protective interventions are strategies intended to support the developing brain, facilitate normal development, and prevent disability. In the case of neuronal injury, neuro-protective interventions aim to help the brain reduce neuronal cell death and promote healing by fostering functional synaptic connections and pathways. Neuro-protective care is organised around the seven core measures identified by Altimier and Phillips (2013).* This also helps to prevent neurological complications arising from routine care, particularly in preterm, low-birth-weight infants.

**Altimier & Phillips. 2013. Neonatal Integrative Developmental Care Model: Seven Neuroprotective Core Measures for Family-Centred Developmental Care. Neonatal and Infant Reviews. (13) 9–22*

These core measures are summarised below into four (4) actionable areas:

Part 1: Creating a Healing Environment

1. Maintain neutral thermal environment in the SCBU with the temperature regulated between 28-32$^{0C.}$
2. Provide thermoregulation for the infant by maintaining skin-to-skin contact for as long as possible.
3. Ensure all equipment should be noiseless.
4. Silence alarms as quickly as possible and ensure they are reset.
5. Keep conversations brief and quiet.
6. Cupboards and other large containers with lids (e.g. trash bins) should be kept out of the ward. Where this is not possible, they should be noiseless.
7. The use of mobile phones is prohibited in SCBU, and the 'No Use of Phone' sign should be displayed.
8. A 'Keep-Off' sign should be placed the unit to control crowds and minimise external sources of noise to the barest minimum.
9. Maintain a day/night light cycle by using on/off switches or adjustable lights with a maximum of 200 lux for day and 50 lux for nighttime.
10. Control external light sources by using adjustable blinds or tinted windows, as applicable.
11. Use bedside lights for added illumination during procedures.
12. Avoid flashing lights within the unit.

Part 2: Neuro-Protective Care on Admission

1. All initial invasive procedures, including venepuncture, nasogastric tube insertion, and the collection of blood samples, must be done at point of admission by experienced personnel to minimise the intensity and duration of pain experience.

2. Encourage the use of skin-sensitive plasters when securing intravenous access, nasogastric tubes, etc.
3. Safety lancets (1.2 mm penetration depth) must be used for heel pricks instead of hypodermic needles.
4. Initial cleaning and handling of the baby should be conducted carefully to provide comfort and reduce stress.

Part 3: Neuro-Protective Care during Admission

1. Avoid disturbing sleep by using spontaneous wake periods for routine clustered care, including full assessment, vital signs check, diaper change, repositioning, oximeter site change, inspection of IV site for inflammation or infiltration and any other indicated interventions
2. Allow rest periods of at least 60 minutes to complete a normal sleep cycle
3. Give feeds at scheduled intervals (e.g. every 3 hours)
4. If necessary to wake up a newborn for feeding and kangaroo mother care, approach using a soft voice followed by a gentle touch
5. During diaper change lift knees to the chest while supporting the back and buttocks and consider placing the infant on one side to clean buttocks and diaper area.
6. Prevent skin breakdown from common sources such as removal of adhesives, thermal injury, abrasion/friction, diaper dermatitis, CPAP devices, pressure ulcers, and/or infection*.
7. Perform routine assessment for stress or stability cues** (training required for recognition)
8. Minimise procedural pain by breastfeeding, containment with hands, standard swaddling, hand to mouth for self-comforting and use of topical anaesthetic agent during the procedure.
9. Use vein finder to aid intravenous cannulation

Part 4: Parent Partnership for Neuro-protective Care

1. Discuss the infant's clinical condition and needs in a culturally appropriate and clear manner.
2. Ask parents/caregivers about their fears and concerns for the newborn.
3. Allow parents/caregivers to participate in the care of the newborn, e.g. breastfeeding and kangaroo mother care.
4. Help parents/caregivers become competent in newborn care, building confidence towards discharge.
5. Support parents/caregivers as they grow into their roles as experts and advocates for their child.
6. Acknowledge and support parents experiencing grief and loss.
7. Encourage family support and participation in groups.

RESOURCE: Adapted from the Neonatal Neuro-Protective Best Practice Guidelines by the Swedish Medical Center

*Ensure the correct removal of adhesives by using water (not spirit or chlorine) to wet the plaster before removing or changing it. Prevent thermal injury by continuously monitoring babies under thermal devices such as radiant warmers, incubators, and phototherapy units. Prevent nappy dermatitis by regularly changing nappies. Use appropriately sized nasal prongs for CPAP and oxygen delivery. Prevent pressure ulcers by repositioning the baby periodically. Prevent infection by adhering to optimal infection prevention and control measures.

APPENDIX

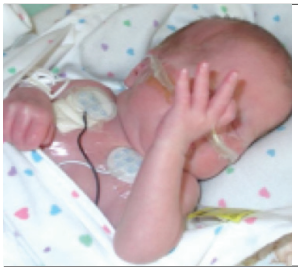
Stress signals

- Colour changes
- Breathing pattern changes
- Change in heart rate
- Flailing of arms and legs
- Frowning / grimacing
- Pushes feet & toes out
- Stretches out arms
- Pushes arm and hand out
- Covers eyes or face with arms
- Arching back and neck
- Hiccups, Sneezes
- Coughs, Cries
- Yawns

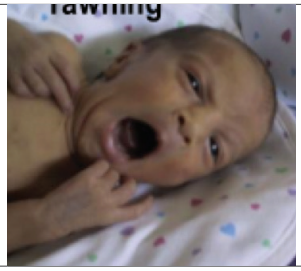
How to reduce stress

- Put baby into KMC position
- Hold baby secure against the
- body
- Talk softly to baby
- Reduce noise
- Dim lights shining on baby
- Avoid rocking & patting the baby
- Contain baby within open hands
- Brace feet
- No tapping, rubbing, patting
- No rocking or shaking

Recognise stress signals

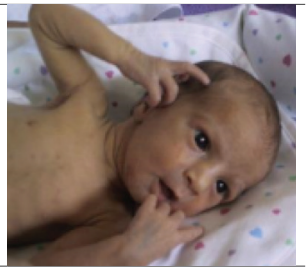


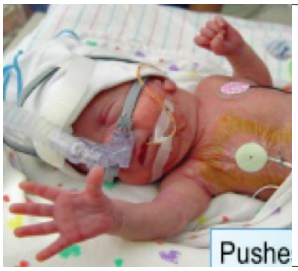
Face with arms Covers eyes



Yawning

Flailing of arms and legs



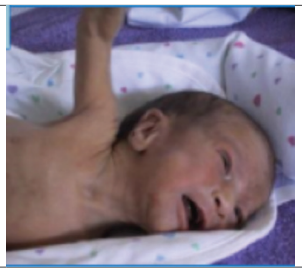


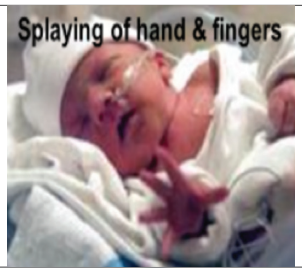
Pushes arm & hand out: Stop sign

Pushes feet & toes out

Stretches out both arms hands splayed

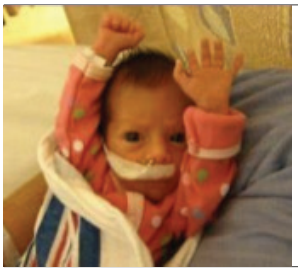
Arching back & neck





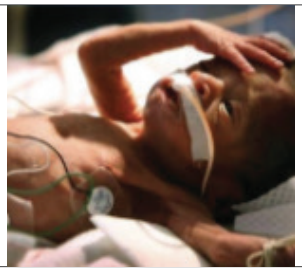
Splaying of hand & fingers

Loud crying

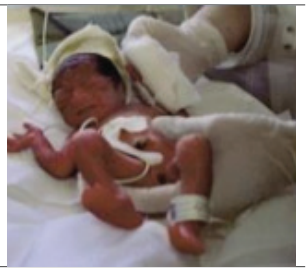


Stretches out arms & frowning

Yawning, frowning, grimacing,



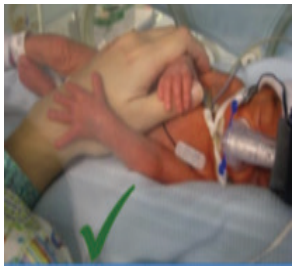
Covers eyes or face with arms

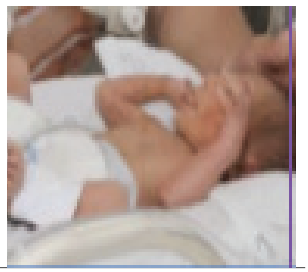


splaying of hands

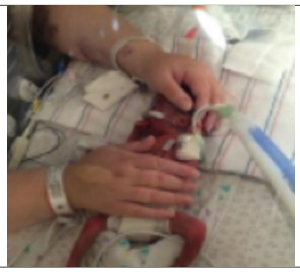
Physical handling

- Move slowly, handle gently and slowly
- Light touch with open hands
- Touch the baby more proximally
- Provide one form of stimulation at a time
- Give time to react and work through movements
- Comfort when baby cry and give more stability before moving on



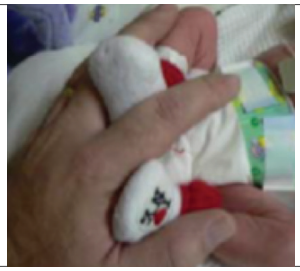






During Procedures

- Encourage sucking on own hand Brace feet
- Contain flexed limbs in open hands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Learning Web Link Resources

1. Nest360 Training Videos
   https://nest360.org/project/training-videos/
2. Newborn Health World Health Organisation (WHO)
   https://www.newbornwhocc.org/teaching.html
3. WHO Hand Hygiene Guidelines
   https://www.who.int/gpsc/tools/GPSC-HandRub-Wash.pdf
4. Google Images Search for Neonatal Resources
   https://images.app.goo.gl/45o1gTY7ZnMAYYxQ8
5. Prevent Sepsis – Wash Your Hands (WHO)
   http://www.who.int/gpsc/5may/en/
6. WHO Guidelines for Decontamination and Reprocessing of Medical Devices
   http://www.who.int/infection-prevention/publications/decontamination/en/
7. Pediatrics: Journal Article on Neonatology
   https://pediatrics.aappublications.org/content/146/Supplement_2/S165
8. Neonatology Mobile App (EHBB)
   https://play.google.com/store/apps/details?id=edu.uw.med.neonatology.ehbbmob
9. Neonatology Virtual Reality (EHBB VR)
   https://play.google.com/store/apps/details?id=edu.uw.med.neonatology.ehbbvr
10. National Center for Biotechnology Information (NCBI) Article
    https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2849391/
11. WHO: Health Care Without Avoidable Infections – People's Lives Depend on It (Video)
    https://youtu.be/K-2XWtEjfl8 or
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12. WHO: Health Care-Associated Infections (HAIs) and IPC Role
    http://www.who.int/infection-prevention/publications/ipc-role/en/
13. Global Health Media: The Cold Baby
    https://youtu.be/-6T7f40EB9E
14. Global Health Media: Taking a Heel Blood Sample
    https://youtu.be/MieKJa5YJd4
15. Global Health Media: Feeding with a Gastric Tube
    https://youtu.be/kytWVZqaaYA
16. Global Health Media: Breathing Problems
    https://youtu.be/MYCFuEP6Gd4
17. Global Health Media: Sepsis
    https://youtu.be/MdDD9n7Cz-o
18. Global Health Media: Skin Infections
    https://youtu.be/0mUlyeTIQ_8
19. Global Health Media: Umbilical Infections
    https://youtu.be/N4zL1BS95sw

20. Global Health Media: Neonatal Jaundice
https://youtu.be/p_GG4OddRRU
21. Global Health Media: Inserting an IV
https://youtu.be/v3Udt0p6jVo
22. Global Health Media: Lumbar Puncture in Neonates – The Basics (MPROvE)
https://youtu.be/DuKjOdso9aU
23. Global Health Media: Jaundice – Causes, Treatment, Pathology
https://youtu.be/gIACp5js4MU
24. Global Health Media: Omphalocele
https://youtu.be/1vaoR8HYJxI
25. Global Health Media: Pyloric Stenosis
https://youtu.be/AFMtilrmLYk
26. Global Health Media: Spina Bifida
https://youtu.be/jlDZA2PNW2o
27. Global Health Media: Providing Essential Care at Birth
https://youtu.be/M79WxV7aeJU
28. Global Health Media: Feeding with a Nasogastric Tube
https://youtu.be/aTjymWCGHdc
29. Global Health Media: Cup Feeding
https://youtu.be/OkhSJ16FHfY
30. Global Health Media: Lumbar Puncture in Neonates – Traumatic Tap and Tips
https://youtu.be/ggoHkKFG1_8
31. Pedscases.com: Approach to Lumbar Puncture
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