Federal Ministry of Health

National Guidelines for Comprehensive Newborn Care

REFERRAL LEVELS

November 2021 | First Edition

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First Edition

NATIONAL GUIDELINE FOR NEWBORN CARE

FOREWORD

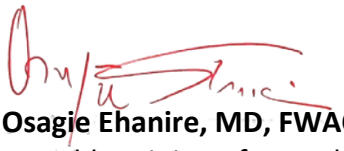
About 7 million babies are born annually in Nigeria, of which 240,000 die in the first 28 days of life. Neonatal mortality contributes 32% to overall annual under- five deaths. 80% of these deaths are caused by complications related to prematurity, birth asphyxia and infections, most of which are preventable and treatable. Under-five mortality has increased from 128 deaths per 1000 live births in 2013 to 132 deaths per 1000 live births in 2018 (NDHS) as a result of neonatal mortality of 38 per 1000 live births.

Nevertheless, there are key interventions to address this trend, but the areas covered are low. To have appreciable impact in newborn health, effective interventions must be provided across all delivery modes, within the continuum of care in the health system.

Much attention is currently channeled towards the primary level of care through “the Essential Newborn Care Course” program with its' well structured, blended training package, while the “Comprehensive and Advanced Newborn Care”, has no structured national guideline that clearly outlines services that are to be delivered at referral levels of care. This National Guideline for Comprehensive Newborn Care is to bridge the identified gaps.

The Global "Every Newborn Action Plan" underscores the need to focus on newborn interventions at the time of birth, for the greatest impact. Nigeria acknowledges the need to strengthen policies for implementing at scale, addressing equity issues, developing or updating policies, strategies, standards, guidelines and tools. Nigeria "Every Newborn Action Plan" also states the need to establish and strengthen "Special Care Baby Units" at secondary facilities and the more advanced Neonatal Intensive Care Units at selected tertiary facilities. The National Strategic Health Development Plan (NSHDP II) (2016—2021) reaffirms the necessity of comprehensive, advanced newborn care at referral levels.

I therefore call on partners, civil society groups, donors, the private sector and other stakeholders to work with government at all levels in implementing the National Guideline for Newborn Care in Nigeria. I recommend this National Guideline to all, as a tool to support achievement of reduction in neonatal mortality.



Dr. Osagie Ehanire, MD, FWACS
Honourable Minister for Health

ACKNOWLEDGEMENT

It is indeed sad to note that, Nigeria under-five and neonatal mortality is remains unacceptably high. Thus, necessitate development of the National Guideline for Newborn Care as a crucial turning point in the bid to end preventable stillbirth as well as newborn deaths.

The Federal Ministry of Health acknowledges all stakeholders who contributed invaluably to the development of the document.

Please permit me to recognise the outstanding contributions of the Nigerian Society of Neonatal Medicine (NISONM), Paediatric Association of Nigeria (PAN), Departments and Agencies of Government and the Development Partners, to actualize Nigeria's quest to provide quality care for the newborn by developing this document.

Worthy of note is the immense support and collaboration from UNICEF and NEST 360, who teamed up with the Child Health Division of the Family Health Department of Federal Ministry of Health to make this guideline operational by actualizing the development and production of this document.

My sincere appreciation goes to the officers of Child Health Division of the Department of Family Health for the concerted effort demonstrated from planning to execution of the entire process. In these regards, the tireless efforts of Dr Stella NWOSU, Head, Child Health Division and the Newborn Desk led by Dr. Ovuoraye John are recognized. Their tremendous commitment and unrelented efforts are highly commendable.

Dr. Salma Ibrahim Anas-Kolo, MBBS, MWACP, FMCPH
Director, Family Health Department

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LIST OF ABBREVIATIONS

AAP	American Academy of Pediatrics
ABC	Airway, Breathing, Circulation
ABG	Arterial blood gas
AGA	Appropriate for gestational age
ANC	Antenatal Care
AP	Antero-posterior
ART	Antiretroviral Therapy
ARV	Antiretroviral
AZT	Zidovudine
BCGE	Bacille Calmette - Guerin
bCPAP	Bubble Continuous Positive Airway Pressure
BCS	Blantyre Coma Scale
BIND	Bilirubin Induced Neurological Dysfunction
BPD	Bronchopulmonary Dysplasia
BP	Blood Pressure
BW	Birth Weight
CH	Congenital Hypothyroidism
CCH	Central Congenital Hypothyroidism
CHD	Congenital Heart Defect
CHEWs	Community Health Extension Workers
CLD	Chronic Lung Disease
CMV	Cytomegalovirus
CO2	Carbon dioxide
COVID-19	Corona Virus Disease of 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
OFC	Occipitofrontal circumference
OG	Orogastric
OGT	Orogastric tube
O2	Oxygen
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
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
UTI	Urinary tract infection
UVC	Umbilical vein catheter
VT	Tidal volume
VLBW	Very Low Birth Weight
WHO	World Health Organization

National Guidelines
for Comprehensive Newborn Care

SECTION ONE

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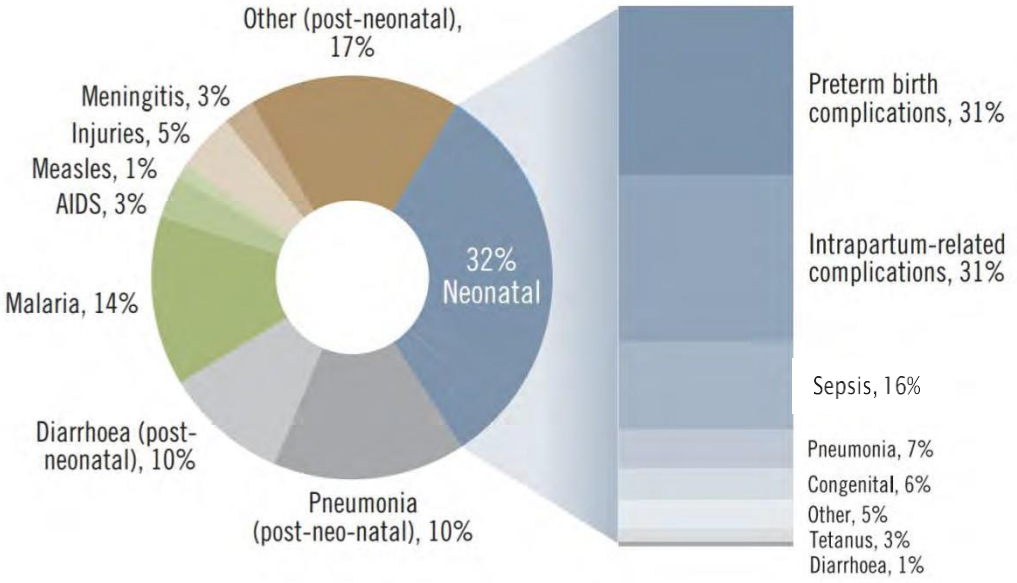
CHAPTER 1: INTRODUCTION

STATUS OF NEWBORN CARE IN NIGERIA

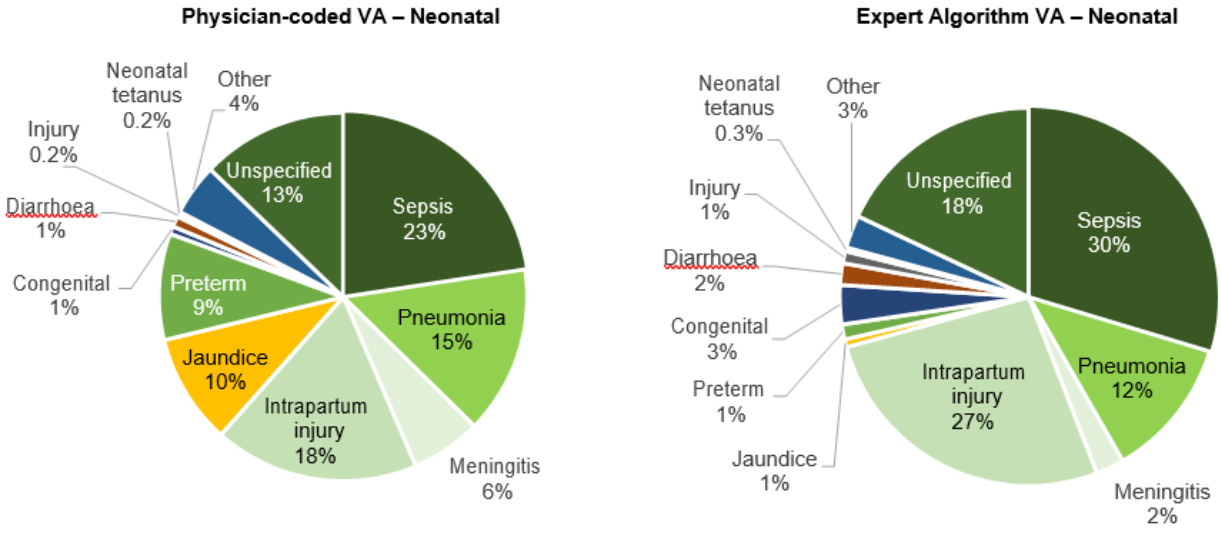
Each year in Nigeria, over seven million babies are born, of which about 240,000 die in their first month of life with 94,000 dying on the day of birth (FMOH: NiENAP 2016). Neonatal mortality contributes up to 32% of under- 5 mortality, with the leading causes of death being complications related to prematurity, birth asphyxia, and infections. (Figure 1.1A (MCEE,2015) and 1.1B (VASA,2019)



Data source: WHO and Maternal and Child Epidemiology Estimation Group (MCEE) 2015 data.unicef.org; Nigeria Every Newborn Action Plan, 2016.

Figure 1.1A: *Causes of child and neonatal mortality*

(Physician-coded and expert algorithm verbal autopsy for causes of 722 neonatal (0-27days) deaths in Nigeria, 2013-2018 (weighted data)



Nigeria 2019 Verbal and Social Autopsy Study Main Report

Figure 1.1B: *Causes of child and neonatal mortality (VASA,2019)*

Childhood mortality, including newborn deaths, remain high and the rate of reduction is slow. Using global mortality estimates, the annual rate of reduction for newborn mortality was slower (1.5 percent per year) than for post-neonatal under-5 mortality of 2.7 percent per year (FMOH NiENAP 2016).

As part of measures to improve newborn health in Nigeria, the Essential Newborn Care Course (ENCC) was introduced in 2008 by the World Health Organization (WHO) through a National Training of Trainers course. ENCC is a set of evidence-based, high impact, cost effective interventions and standards that will enable health care workers to give quality care to the baby during childbirth and postnatal period. Implementation of other training packages with varying methods and approaches necessitated a process of adaptation and harmonization of all the ENCC training packages, as several trainings were being conducted though not at scale. These ENCC packages that were harmonized and "blended" to form the National ENCC for Nigeria include the WHO generic ENCC materials, Save the Children's "Reference Training Manual for Newborn Care" as well as the "Helping Babies Survive" series from the American Academy of Pediatrics.

The harmonization and adoption process lasted till 2015, and this national ENCC document was formally adopted and launched during the World Prematurity Day Commemoration of 2016 by the then Honourable Minister of Health, Prof Isaac F. Adewole. Subsequently, a review and incorporation of new evidence for the modules was done from 2018, which led to the current FMOH ENCC second edition 2019. The modules of the course presently address the following: resuscitation at birth (Helping Babies Breathe (HBB) to prevent asphyxia); Essential Care for Every Baby (ECEB); Essential Care for Small Babies (ECSB); and treatment of Possible Severe Bacteria Infection (PSBI) when referral is not possible.

RATIONALE FOR THE GUIDELINE

The major need for this guideline is to standardize neonatal care in the nation's secondary and tertiary institutions where 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 is also in response to one of the thematic areas of the Nigerian Every Newborn Action Plan (FMOH NiENAP, 2016) that seeks to strengthen comprehensive newborn care in all secondary and tertiary institutions; and advanced newborn care in selected tertiary facilities.
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 by health workers in secondary and tertiary health facilities across the nation. 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 centered on the status of newborn care in the country; triaging and transportation of the newborn; and some basic physiologic 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.

CHAPTER 2: SUMMARY OF WHO STANDARDS FOR NEWBORN QUALITY IMPROVEMENT (WHO: SEPTEMBER 2020)

The standards for the care of small and sick newborns in health facilities define, standardize 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 policy-makers, 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.

Every small and sick newborn receives evidence-based routine care and management of complications according to WHO guidelines.

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 Immunization.

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.

B. 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.

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.

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.

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 family-centred 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 carers.

STANDARD 5:

Newborns' rights are respected, protected and fulfilled without discrimination, with preservation of dignity at all times 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 carers 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.

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 carers, with minimal separation, and the role of carers is recognized and supported at all times during care, including rooming-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.

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, at all times 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.

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 is available at all times.

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.

CHAPTER 3: LEVELS OF NEONATAL CARE IN NIGERIA

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 3.1: WHO's levels of newborn care with interventions

Level 1 **Immediate and essential newborn care**	Immediate newborn care (delayed cord clamping, drying, skin to skin etc) Neonatal resuscitation for those who need it Breastfeeding early initiation and support Essential newborn care Identification and referral of complications Targeted care as needed eg PMTCT of HIV
Level 2 **Special newborn care**	Thermal care including KMC for all stable neonates <2000gms Assisted feeing and IV fluids Safe administration of oxygen Detection and management of neonatal sepsis with injection antibiotics Detection and management of neonatal jaundice with phototherapy Detection and management of neonatal encephalopathy Detection and referral/management of congenital abnormalities
Transition	Management of preterm respiratory distress with CPAP Follow up of at risk newborns Exchange transfusion
Level 3 **Intensive newborn care**	Mechanical/assisted ventilation Advanced feeding support (eg parenteral nutrition) Paediatric surveys for congenital conditions Screening and treatment for RoP

THE CLASSIFICATION OF LEVELS OF NEWBORN CARE IN NIGERIA:

1. Level 1: Basic care available at Primary Health Care facilities
2. Level II: Specialty care available at Secondary Health Care facilities (General Hospitals, some Faith-based mission hospitals, and some Private health facilities)
3. Level IIIa: Subspecialty intensive care available at Tertiary Health Care facilities (University Teaching Hospitals, Federal Medical Centres, some General Hospitals, Faith-based mission hospitals and some Private facilities that offer specialist residency training and tertiary care services)
4. Level IIIb: Subspecialty intensive care, same as IIIa, but Regionalized with further specializations; and often more expensive equipment to offer highly specialized 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 post-natal ward where basic resuscitation such as Helping Babies Breathe and immediate post-natal 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 newborn.

- Delivery of intermittent positive pressure ventilation using 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.
- Stabilize 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 1800-2000g.
- Human resource: Personnel include skilled birth attendants like CHEWs, Nurses, Midwives, Medical officers, and Supervisory specialist. At least one skilled nurse has to 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 trainings and mentorship.

Level II:

Care in a specialty-level facility such as General and Cottage hospitals should:

- Be reserved for stable or moderately ill newborn who are born at ≥30 weeks' gestation or who weigh ≥ 1500g 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 the 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 size d bag and mask by experienced personnel who have undergone the full ENCC training.
- Be able to deliver continuous positive air way 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 that might include blood transfusions.
- Care provided at this level includes:
  - ✓ Monitoring of sick newborns
  - ✓ Kangaroo mothercare
  - ✓ Administration of oxygen
  - ✓ Management of hypothermia/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 clinician 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, to clean equipment, and to do other allocated duties depending on the need. There should be routine trainings and on-going 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 Foeto-maternal medicine who can manage mothers referred for the management for potential preterm, multiple pregnancy births and diverse perinatal maternal complications.

And should have specialized neonatal nurses per shift with ratio of at least 1: 4 babies depending on 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 well-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 physiologic 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. Appendix 3.1 shows the National Recommended Newborn Equipment List for all levels of newborn care in Nigeria.
- Provide specialized newborn diagnostic services e.g CT scan, MRI.

- Should be able to provide ongoing assisted ventilation for 24 hours or more, which may include conventional ventilation and high-frequency ventilation.
- Should have transport services with capacity to receive and safely transfer 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 sub-specialists team.
- Diverse specialized newborn diagnostic and interventional capacities should be available at this level eg 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.

MINIMUM REQUIREMENTS FOR SETTING UP A NEWBORN UNIT (PHYSICAL INFRASTRUCTURE)

The intent of setting up a newborn ward is to optimize resources and facilitate quality health care for small and sick newborns after stabilisation in the delivery room or receiving from a referring hospital. Sick newborns should not be treated in the general paediatric ward nor received in the general children emergency room. They require dedicated space, equipment, staff and procedures for optimal care. There are divergent opinion on the best designs but the ideal design should provide constant surveillance of each bed area from the nurses' station. The design should allow for flexibility and creativity to achieve the stated objectives factoring in the peculiarity of the local system. However, the minimum requirements are as highlighted below:

Location

The unit should be in close proximity to the labour ward with provision of quick access which avoids public corridors. The receiving area for outborn babies should have ready access to the transport receiving area. The area should have restricted access except to staff and parents of babies in the unit.

Capacity

The capacity for a level 2 general hospital for instance should be to accommodate at least 3 bed spaces per thousand annual deliveries in the hospital, and another 30% of the total inborn being dedicated for outborn babies. This may be modified upwards depending on the dynamics of neonatal admissions in the hospital as well as economic realities and sustainability. It does not also include provision for surgical cases.

For example, if a hospital conducts 3,000 deliveries per year, the number of beds required would be:

- For inborn: 3/1000 X 3000 = 9 beds
- For outborn: 30% of the calculated inborn ie 9= 3 beds
- Total beds required = 12

Hence at least 12 – 16 bed capacity is about a reasonable capacity to plan for in a small secondary facility for optimisation of resources: man and material.

Spacing

A minimum of 3.7m^2 (40sq feet) floor space per child for cot space, resuscitation, observation and other infant needs. If the unit will accommodate maternal bed for KMC, the space per child should be 11.2m^2 (120sq feet). The minimum space between beds should be 1.2m. These exclude hand washing space.

Configuration

One main entrance and an emergency exit
Designate unclean and clean areas

Unclean area

- Reception area leading to changing room for staff and parents.
- Staff changing room with washrooms
- Follow up clinic with access from the reception area.
- Hand wash area and wash rooms for mothers
- Store area

Clean area

- Corridor leading to main ward accessible to only mothers and staff after they have changed their shoes

Spaces to be allocated

- Patient care areas (Ward spaces) partitioned as preferred into single rooms or cubicles for multiple patients – see dimensions above
    - Advisable to have transparent partitions to allow visibility from the internal corridor
    - The ward should be divided into inborn section and outborn section
- Hand wash station at the entrance and handwash stations within 6meters (max) of each baby care area
- KMC space to accommodate mothers' bed or reclining chair, baby cot and other equipment (size as previously defined under spacing)
- Counselling room
- Nurses work station
- Nurses room
- Doctors room
- Seminar room
- Milk room, kitchenette
- Room for medication, consumables and other supplies
- Mother's room with dedicated mother's bath and toilet spaces
- Laundry room/linen store
- Sterilisation room
- Equipment store room
- Sluice room
- Side room laboratory
- Room or space for last office (better towards the back door)
- Ideal for all spaces within the ward to open into the internal corridor
- Emergency exit
- All doors should have self closing devices

- Additional space with bathroom facilities should be provided in the vicinity of the ward for mothers of outborn babies

Appendices 3.2 and 3.3 show sample floor plans of a Level 2 Secondary facility neonatal unit depicting the inborn and outborn sections; while Appendices 3.4 and 3.5 show sample lower level and upper level floor respectively for a Level 3 Tertiary facility neonatal unit.

CHAPTER 4: STANDARD PRECAUTIONS AND INFECTION CONTROL

Infection prevention is a crucial component of care of newborns. Newborn babies are more susceptible to infections because their immune system is immature; thus, the consequences of failing to follow infection prevention principles are particularly devastating.

Hospitals, wards, equipment and staff are all sources of infection for a baby. These infections are called health-care associated infection (HAI), which are often caused by bacteria that are resistant to commonly available antibiotics (multidrug resistant bacteria). These infections are difficult to treat or eradicate from the nursery and care is required to prevent such infections from spreading.

STANDARD PRECAUTIONS:

- Standard precautions are a set of infection control practices used to prevent transmission of diseases that can be acquired by contact with blood, body fluids, non-intact skin (including rashes), and mucous membranes.
- They are the minimum infection prevention practices that apply to all patient care regardless of suspected or confirmed infection status of the patient in any setting where health care is delivered
- They are designed to protect the healthcare practitioner (HCP) and prevent HCP from spreading infections among patients. These measures are to be used when providing care to all individuals, whether or not they appear infectious or asymptomatic.

INFECTION CONTROL POLICY

Every newborn unit should have a written infection control policy which should address:

- Methods and frequency of cleaning
- Policies for the supply of all cleaning and disinfectant products
- Disinfection/sterilization protocol
- Hand washing policy/protocol
- Use of personal protective equipment
- Waste disposal policy
- Care bundles for specific procedures
- Bed spacing policy – at least 1 metre apart between cots/incubators

GENERAL NURSERY INFECTION CONTROL MEASURES

- The unit should have several handwashing points with the steps in handwashing displayed.
- Aim to have hand washing stations at the entrance of the newborn ward.
- Infection prevention posters with short messages should be displayed on the ward
- The unit should have several alcohol hand rub dispensing points
- There should be minimal handling of babies as indicated by staff to avoid unnecessary cross- transfer of infection.
- There should be protocols for routine quarterly environmental and staff swabbing for infection surveillance
- Restrain hair in a manner that prevents its coming in contact with the infant.
- Do not eat, drink, or store food or drink within patient care areas in the newborn nurseries.
- Keep traffic (visitors, parents, and staff) to an absolute minimum and only as necessary
- Remove lab coats and jackets prior to entering the newborn unit and hang these outside of the patient care areas. Unit policy should be strictly followed.
- All hospital staff (including HCWs, maintenance and cleaning staff) should wear clean clothes with sleeves up above the elbows (with bare arms below the elbow) when entering the neonatal ward and having contact with babies in the newborn unit/nurseries.
- Gowns are not a standard precaution for HCWs or families in most neonatal units; if gowns are used, they should not be shared or reused until re-washed.
- Keep mobile phones away from patient care areas in the newborn wards as they are a source of infection
- Identify dedicated infection control Officers/Champions in the unit.
- Institute routine bi-weekly audit for infections in the newborn unit and have routine infection control reviews.

STRATEGIES FOR INFECTION PREVENTION AND CONTROL

The main strategies for infection prevention and control in the newborn wards include:

1. Hand hygiene
2. Environmental cleanliness and disinfection
3. Medical equipment maintenance and cleaning
4. Waste disposal

Hand Hygiene

- Hand hygiene is the simplest and the most important way to reduce transmission of infections in newborn units and healthcare settings.
- All health care workers (HCWs) and mothers/guardians should be taught thorough handwashing before and after handling every baby using the WHO technique.
- When entering a unit all HCWs and guardians must thoroughly wash their hands and arms up to the elbow with soap and water for at least 40-60 seconds. Make sure not to use clean hands to

turn off the tap/faucet. Use elbow or towel to turn off faucet. If elbow tap not available, use paper towel to turn off faucet.

- Hands should be air-dried or dried using single-use towels (washed, dried and ironed before reuse). Common towels for drying hands must not be used as they facilitate transmission of infection.
- To perform thorough hand hygiene, remove all rings, bracelets, wrist watches, phones.
- Ensure nails are kept short, natural, and no nail polish.
- Alcohol hand rubs are appropriate for rapid hand decontamination between patient contacts.
- Apply generously to completely cover hands and rub hands until dry before touching the baby. Allow up to 20-30secs for the alcohol to dry. Note that alcohol rubs are not a substitute for hand washing if hands are soiled.
- Hand washing or sanitizing with alcohol should be the last thing you do before touching a patient and the first thing you do after completing tasks on a patient.

"Hand washing is the simplest and the most important practice to reduce transmission of infections in newborn units and all healthcare settings"

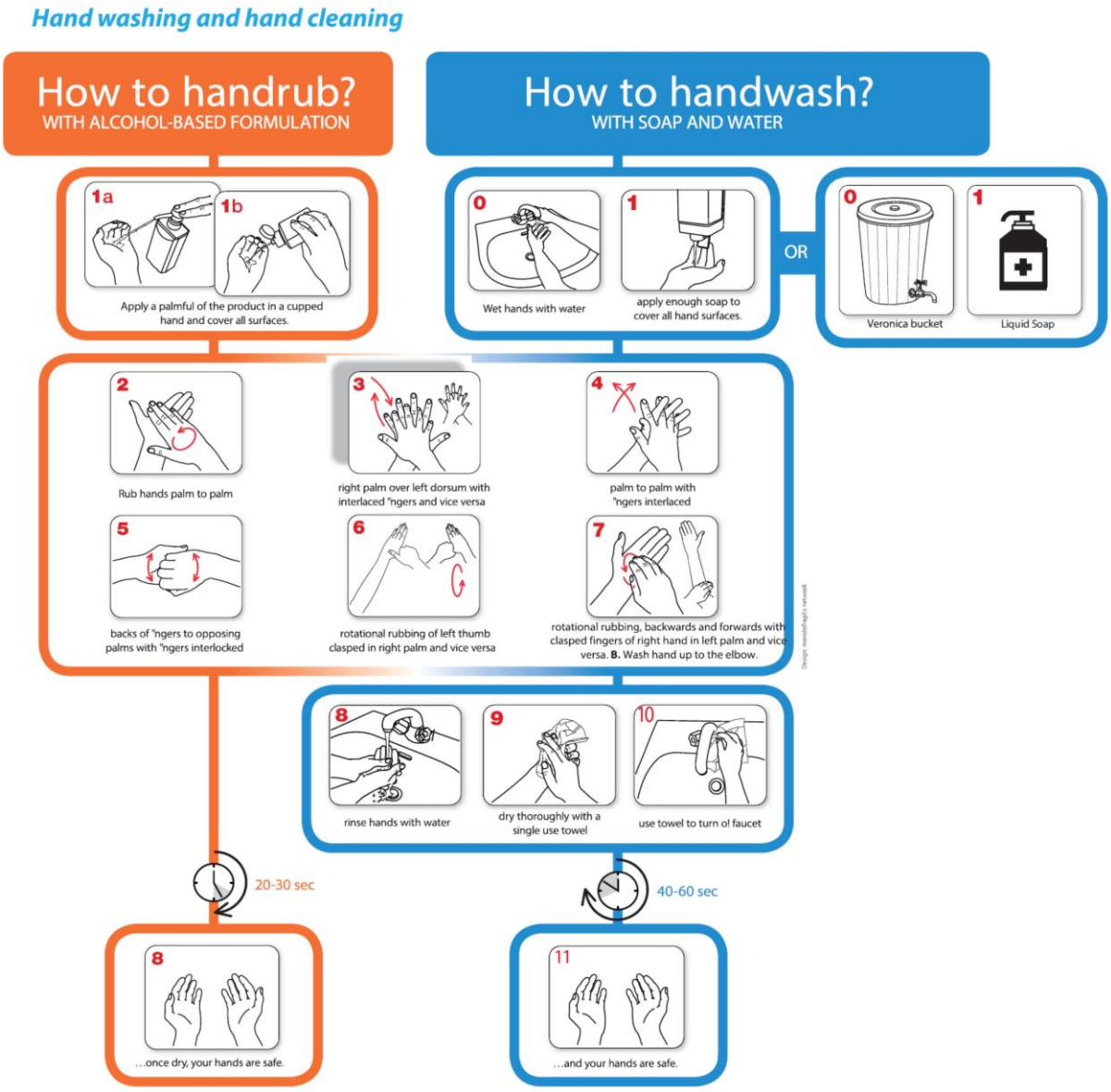


Figure 4.1. *Adapted from Standard World Health Organization procedures of alcohol-based handrub and handwash with soap and water.*

The WHO 5 moments of hand hygiene are (Figure 4.2):

- Before touching a patient
- Before any clean/aseptic procedure
- After body fluids, secretions, exposure/risk
- After touching any patient
- After touching patient surroundings

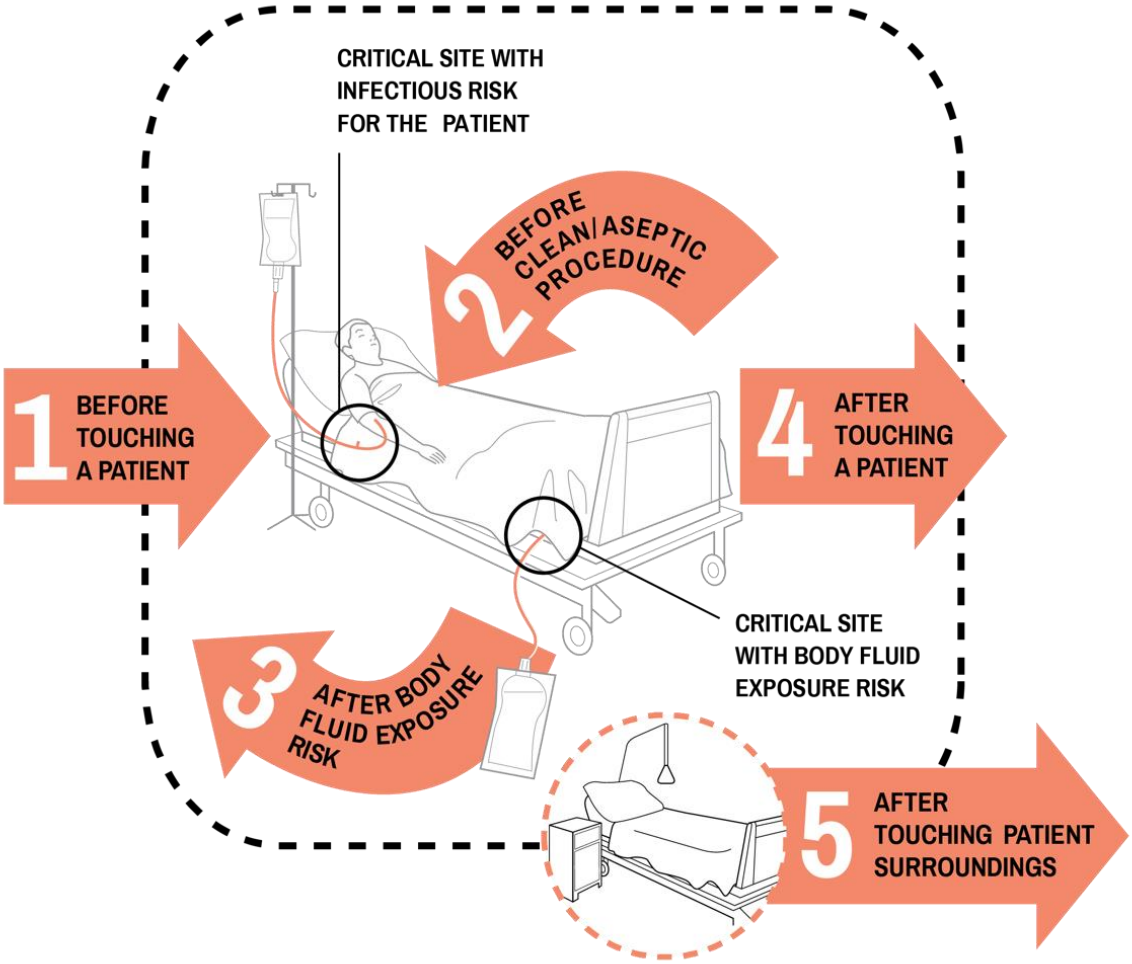


Figure 4.2: *WHO 5 moments of hand hygiene*

If alcohol handrub not available: Mix alcohol and glycerin solution: 2ml of glycerin + 100ml of alcohol 70-90%

Clean hands with 3 to 5ml of solution

Gloves and Other Personal Protective Equipment (PPE)

- PPE includes gloves, gowns, masks, respirators, and eye wears to create barriers that protect skin, clothing, mucous membranes, and the respiratory tract from infectious agents.
- The items selected for use depend on the type of interaction in the unit and the likely modes of disease transmission.
- Gloves should be worn only when necessary and disposed of immediately after use, such as when:
    - Touching bodily fluids, non-intact skin, and mucous membranes.
    - Performing invasive procedures.
    - Touching contaminated objects or surfaces.
- HCWs should not wear same pair of gloves for procedures for more than one baby as this is a main source of cross infection.
- Repeat hand washing or sanitizing immediately after removing gloves.

HEALTH SCREENING

Any HCW or guardian with an acute or transmissible infection should not be on the ward to minimise the spread of infection. Mothers or guardians who have an acute illness should be isolated with their infants, if possible. Any guardian who has an acute respiratory illness should wear a mask and be especially careful about hand washing.

PATIENT ISOLATION

Departmental isolation policies should cohort at-risk patients with similar infections in an isolation area within the nursery (e.g., babies with multi-drug resistant infections, highly contagious infections, babies born before arrival with signs of infection or any patients with airborne infections). Strict hand hygiene measures should be followed on entry and exit from this area. If equipment is used in any areas where patients are isolated, it should not be returned to the main neonatal care ward until it has been thoroughly cleaned and disinfected according to ward protocol.

Environmental cleanliness and disinfection

- Disinfection is the process that reduces the number of microorganisms (with exception of bacterial spores) on inanimate objects. Chemical disinfectants commonly used include alcohol, chlorine and chlorine compounds, hydrogen peroxide and chlorhexidine.
- Floors, surfaces, and handles in the neonatal unit should be cleaned daily with appropriate solutions and according to newborn unit policy.
- For metal and rubber surfaces which may be corroded by chlorine, 70% alcohol is also commonly utilised for low level disinfection. Table 4.1 below provides more information on low-level disinfectants appropriate for neonatal wards.
- All horizontal surfaces, including bedside equipment (bed rails, bedside tables, trolleys, taps, weighing scales) are to be routinely cleaned and disinfected with a hospital-approved detergent OR disinfectant such as 0.5% chlorine or 70% alcohol solution at least daily and whenever visibly soiled.
- Between patient admissions, all cots and patient beds should be cleaned thoroughly (including all surfaces of incubators) with a hospital-approved detergent/disinfectant such as 0.5% chlorine or 70% alcohol solution.

***Table 4.1**: Cleaning Solutions*

Disinfectant Common Name	Recommended Use	User & Equipment Precautions
Sodium Hypochlorite, 0.5% or 1% liquid bleach	General disinfectant Kills bacteria, fungi, mycobacteria, spores & viruses Not affected by hard water (e.g., high mineral content water) Use 0.5% concentration for disinfection of surfaces & equipment contaminated with blood and body fluids	Use in well-ventilated area Respiratory irritant (can cause breathing problems) Appropriate PPE required while handling & using because it can cause skin irritation and burns Should not be mixed with strong acids or ammonia to avoid release of chlorine gas
Alcohol, 70% isopropyl, ethyl alcohol, surgical spirit	Use on smooth surfaces, table tops, aprons & other small surfaces on which bleach cannot be used (e.g., metal, rubber) Can be used for surfaces including rubber stoppers on medication vials Does not leave residue	Use in well ventilated area and avoid inhalation Keep away from active heat sources, electrical equipment, flames, hot surfaces. Alcohol must always completely dry on equipment prior to use as otherwise it could result in fire . Allow to dry completely before using area
Improved hydrogen peroxide	General disinfectant for surfaces or equipment contaminated with blood & body fluids Unaffected by organic matter Non-corrosive & safe for workers	Can be expensive, particularly if purchasing large quantities
! **Phenolic germicidal detergent** Dettol, Triclosan	Should **not be used in neonatal wards** since affordable, effective alternatives are available	May cause **hyperbilirubinemia** and/or **neurotoxicity** in neonates

Medical equipment maintenance and cleaning

Introduction of essential devices to newborn care units is critical to improving newborn survival. However, devices can increase hospital acquired infections if adequate disinfection and cleaning measures are not put into place.

- WHO recommends 0.5% dilution of chlorine as the standard disinfectant for materials and surfaces contaminated by blood or body fluids. Bleach is one of the most common substances used to disinfect medical devices.
- Diluted bleach solutions have a lifespan of 24 hours and should be prepared daily. Ward guidelines should include accurate lifespans and dilution schedules for those in standard of practice.
- Figure 4.3: depicts how to prepare 0.5% bleach solution from 3.5% JIK Chlorine solution. One part 3.5% JIK to 6 parts of water dilution = 0.5% JIK bleach solution which is suitable to disinfect blood, faeces, vomitus and other body fluids,(equivalent of 1:10 dilution of a 5% bleach solution); if this constituted 0.5% solution is further diluted by 1:10, it will

make 0.05% JIK bleach solution which is equivalent to 1:100 parts dilution of a 5% bleach product.

- Clean with disinfectant all stethoscopes, tape measures, thermometers, pulse oximeter, glucometer, and ultrasound probe before and after use. It is recommended for each baby to have a dedicated stethoscope, tape measure and thermometer in the well newborn nurseries and intensive care sections.
- All neonatal medical equipment (suctions, CPAP, vital sign monitors, radiant warmers, etc.) should be cleaned regularly in accordance with the training modules and equipment manuals. Cleaning should be carried out when the equipment power source is switched off and it is unplugged. Care must be taken not to let water or other liquid enter the device.
- Patients should not share cots, radiant warmers or incubators as these predispose to cross transfer of infection between babies. These should all be thoroughly cleaned every time a baby is removed and a new baby is to occupy it.
- Dirty linen to be duly laundered and disinfected for routine use.

Bleach is one of the most common substances used to disinfect medical devices. Diluted bleach solutions have a lifespan of 24 hours and should be prepared daily.

I. Follow general guidelines for housekeeping

II. Ensure that a fresh bucket containing disinfectant solution is available at all times

III. Immediately clean up spills of blood or body fluids using disinfectant solution

IV. After each use, wipe off beds, tables, and procedure trolleys using disinfectant solution.

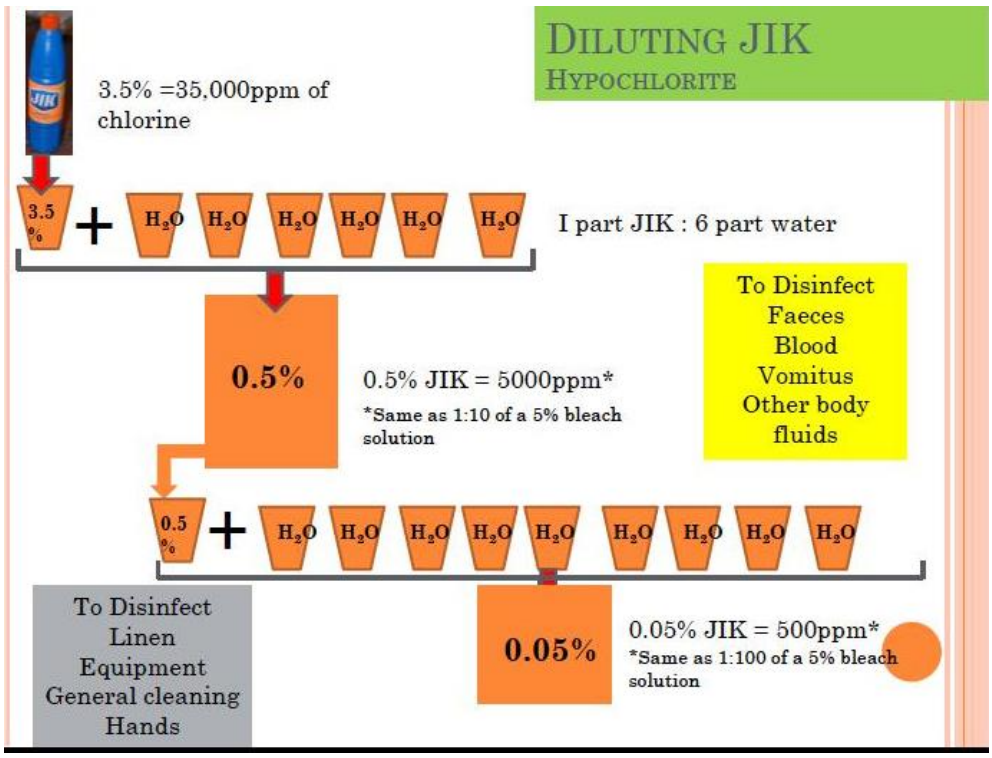


Figure 4.3: *WHO Bleach Preparation for Disinfection*

Waste Disposal

Waste Disposal and Safe Handling of Sharps

- All healthcare facilities should have policies and procedures in place for the correct management of all waste generated. Dispose all wastes as per standard protocol.
- Waste should be removed from clinical areas at least three times each day and more frequently as needed, such as from specialised areas
- Clinical waste should be placed in coloured biohazard bags as soon as possible
- Empty or send for incineration all wastes and sharp containers when the container is three- quarter full
- Burn in a pit if special incineration facilities are not available

Safe Injection Practices

- Injection safety, or safe injection practices, is a set of measures taken to administer injections in an optimally safe manner for patients, healthcare personnel and others.
- Always utilize safe sharps disposal practices
- Keep a puncture resistant container at every point where sharps are used
- Drop all used needles, syringes, blades, lancets and other sharps into this sharp box containers without recapping or passing to another person
- Practice safe sharps handling and disposal at all times. To prevent injuries, use extreme caution when handling sharps.
- Always use aseptic techniques when preparing and administering injections

- DO NOT RECAP used needles.
- Do not remove used needles from disposable syringes by hand.
- Do not bend or break used needles.

Figure 4.4: *Samples of sharp box containers for injection safety*

- **Never puncture a medication vial, bag, or bottle with a used syringe or needle.**
- **Never administer medications from the same syringe or needle to more than one patient.**
- **Never use medications packaged as single-dose or single-use for more than one patient.**

CHAPTER 5: ROUTINE CARE OF THE WELL NEWBORN WITH NO PROBLEMS/ DANGER SIGNS

The care that most babies receive at birth, the first few hours, first days and weeks of life can determine whether they remain healthy. Although some babies may require special attention, all babies need basic routine essential care to help ensure their survival and well-being. If this is done well, it vastly reduces the likelihood of problems.

These babies still need to be closely monitored as they can become sick and develop danger signs. The mother-infant pair needs counselling and appropriate treatment when required. Newborns delivered in health facilities should not be sent home before the crucial first 48 hours of life.

WHO IS A WELL NEWBORN?

- **A newborn with no problems/danger signs is one who has:**
  - Normal body temperature (36.5 - 37.5^{o}C)
  - Normal respiratory rate (40 – 60 breaths/minute)
  - Normal birth weight range of 2.5kg to < 4.0kg
  - No apparent danger signs
- **List of danger signs**
  - Not feeding, poor feeding, vomiting
  - Lethargy
  - Respiratory distress, chest-in-drawing, nasal flaring
  - Fast breathing (breathing rate >60 per minute), grunting
  - Low body temperature (<36.5°C)
  - Fever (>38°C)
  - Convulsions
  - Any jaundice in first 24 hours of life, or yellow palms and soles at any time

ADMISSION CRITERIA

Babies needing admission include those with:

- Weight less than <1.8kg
- In respiratory distress
- Hypothermia <36^{0}C (unresponsive to initial warming)
- Hypoglycaemia unresponsive to feeds
- Infants with sepsis
- All Infants of diabetic mothers
- Infants with meconium aspiration

- Infants with major congenital anomalies
- Cyanosis.
- Bleeding disorder.

ROUTINE CARE OF THE WELL NEWBORN

Before Delivery

- Be prepared for potential resuscitation by ensuring appropriate equipment and personnel are present.
- Prevent hypothermia
  - Close windows, curtains, and doors to avoid drafts
  - Prepare radiant warmer/resuscitaire and warm towels
  - Raise the temperature of ambient air if possible

At Delivery

- Deliver the infant on the mother's abdomen.
- Dry the newborn with a dry towel.
- Suction and/or stimulate if needed
- Assess for resuscitation. The Helping Babies Breathe (HBB) action plan Chart (FMOH: Essential Newborn Care Course) and the Neonatal Resuscitation Chart should be on the wall in all delivery rooms. (See Chapter 9 on Neonatal Resuscitation)
- Cut cord from 1-3 minutes after delivery while providing essential newborn care on mother's abdomen.
  - Early cord clamping (<1 minute after delivery) is only recommended if the newborn is not breathing and must be moved for immediate resuscitation.

CARE IN THE FIRST 90 MINUTES OF LIFE (FIGURE 5.1)

1) Initial care

- Keep baby in skin-to-skin contact with the mother for at least one hour
- Initiate breastfeeding within 30 minutes of birth

2) Prevention of disease

a) Eye care

- Apply 0.5% erythromycin eye ointment to both eyes to prevent eye infection
- If newborn is a referred baby with no record of eye care, administer 0.5%

  Erythromycin eye ointment at first contact if baby is within 24 hours of life.

b) Cord care

- ensure proper hand washing with soap and water
- apply 4% chlorhexidine (7.1% chlorhexidine digluconate) gel in 25g tube to umbilical cord to prevent infection.
- do not cover the cord with a dressing or diaper
- do not apply methylated spirit or other medications or substances

c) Vitamin K_1 administration

- to prevent haemorrhagic disease of the newborn
- give IM Vitamin K_1 into the anterolateral thigh (dose – 1mg for babies >1.5kg and 0.5mg for babies <1.5kg)
- if baby is an outborn with no record of vitamin K_1 administration, administer the injection

d) Bathing

- delay bathing newborn till after 24 hours of life.

e) Physical examination

- conduct a thorough physical examination, paying attention to presence of birth defects (refer to section on newborn examination)
- check breathing and count the respiratory rate (normal is 40 – 60 breaths/minute)
- measure the temperature (normal is 36.5 – 37.5°C)
- weigh the baby

f) Document your findings in the baby's notes.

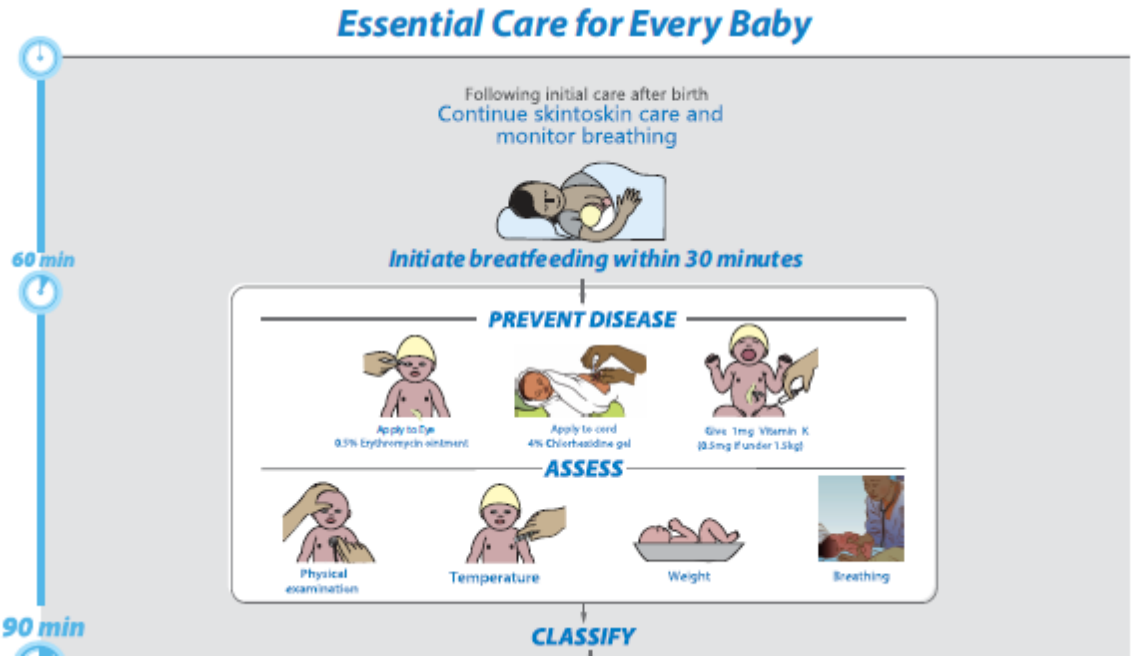


Figure 5.1: *Essential care for every baby in the first 90 minutes of life*

FURTHER CARE OF THE NEWBORN

1. Maintain normal temperature

- Skin–to–skin care or dress the baby in clean dry clothes, socks and cap, and wrap securely
- Keep the room warm (keep fan/air-conditioner off, close windows and put on room warming device where environmental temperature is low)

- Eliminate drafts and contact with wet or cold surfaces
- A room temperature of at least 25°C -28°C is required to help keep the baby warm.
- Keep baby away from direct sunlight

2. Support breastfeeding

- Keep mother and baby together unless there is a strong reason not to do so
- Always ask the mother to be sure baby is feeding well
- Encourage breastfeeding whenever the baby shows sign of readiness to feed—and keep asking her to confirm baby sucks well.
- Ensure good positioning and good attachment during breastfeeding

i. Good positioning – means baby can attach well and mother is comfortable. This can be achieved by:

- Placing baby with the head and body in a straight line
- Baby's body turned toward mother
- Baby's body close to the mother and baby's abdomen is touching mother's own
- Baby's whole body is supported

ii. Signs of good attachment are (See Fig 5.2):

- Baby's chin touching breast
- Baby's mouth wide open
- Baby's lower lip turned outward
- More areola visible above than below baby's mouth

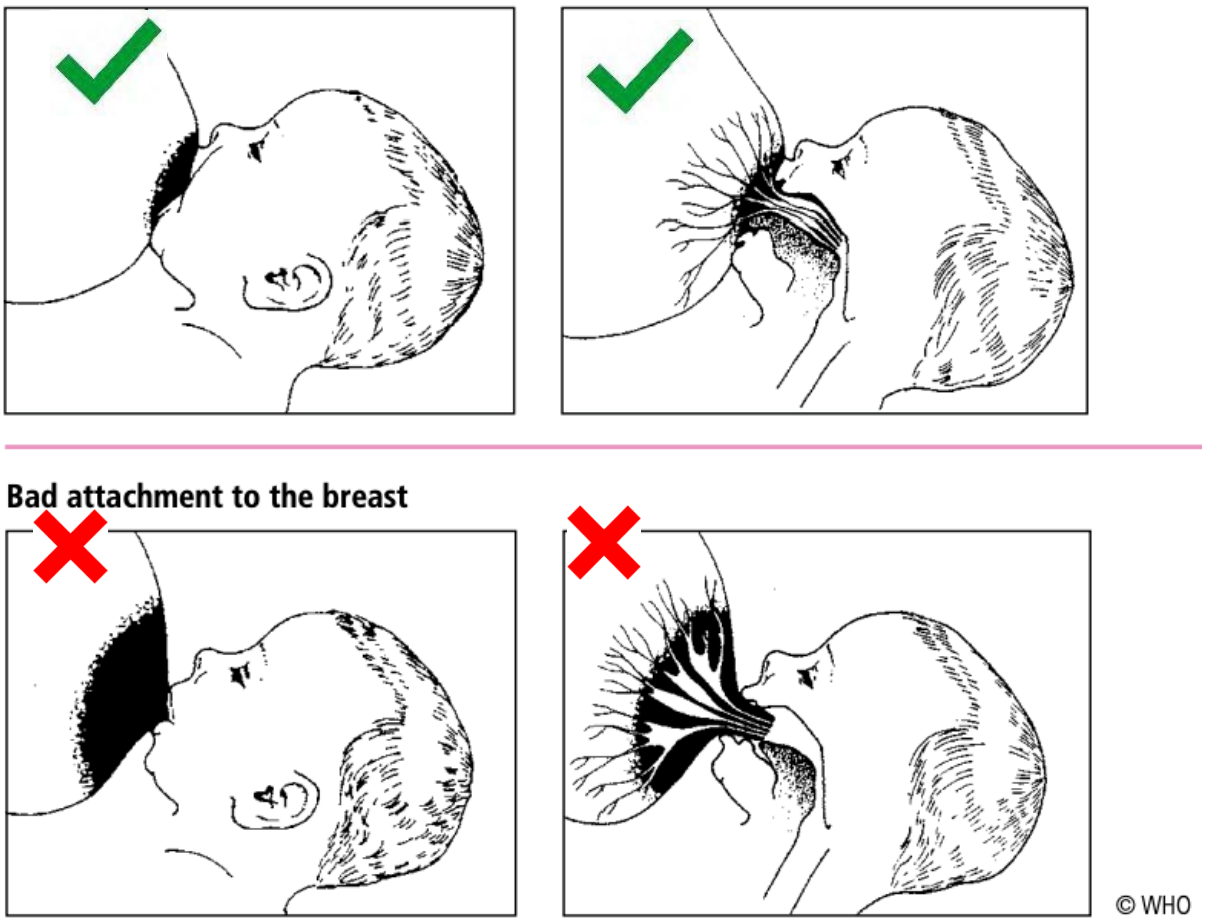


Figure 5.2: *Good attachment to the breast*

iii. Ensure adequacy of feeds – healthy babies feed every 2-3 hours or 8 -12 times a day. A baby is getting enough milk per feed if:

- Breasts soften with feeding
- Swallowing sounds are heard during feeding
- Baby sleeps well between feedings

3. Counsel about breastfeeding problems- Breast problems can prevent successful breastfeeding. Thus, counsel mothers about prevention, recognition and treatment of common breast problems before discharge. These problems include:

i. Inverted nipples

- Mother to stimulate nipples before feeding and shape the breast before attachment (Using the syringe technique).

ii. Breast engorgement

- Very full, tight and shiny breasts
- Advise mother to feed more often and/or express milk prior to attachment

iii. **Sore or cracked nipples** – usually results from poor attachment or skin infection.

- Teach and encourage good attachment
- Treat by applying drops of breastmilk to the skin of the nipple
- Counsel mother to wash her breasts with water daily and to avoid soaps, medicated lotions and ointments
- Encourage mother to continue breastfeeding and/or express breastmilk to feed baby

iv. **Mastitis** – occurs when there is a blocked duct or from infection.

- Usually affects one breast with a well-defined red, sore and swollen or hardened area.
- Encourage mother to breastfeed frequently or express breastmilk
- Ill mothers with fever should be evaluated and treated

v. **Inadequate milk volume**- increase milk supply by increasing maternal fluid intake and frequency of breastfeeding

- Increase flow of milk by applying warm compress to the breasts, massaging the back, neck, breasts and nipples.

4. Always ask if baby has passed stools and urine

5. Begin immunizations – BCG, OPV_0 and hepatitis B vaccine to be given within 24hours of delivery. Give appointment for next immunization visit at 6 weeks.

6. Reassess the baby and breastfeeding- conduct a second complete examination of the baby and document findings

7. Give parents guidance for home care – review key messages to enable mother to:

a. Register birth
b. Practice exclusive breastfeeding for six months
c. Recognize and manage common breast problems
d. Practice hand washing
e. Monitor closely for neonatal jaundice and recognize other danger signs and present at the health facility
f. Use only 4% chlorhexidine (7.1% chlorhexidine digluconate)) gel in 25g tube for cord care
g. Complete immunization schedule as in the child health card
h. At discharge give the parents the National Pictorial Newborn Discharge Guide Information Leaflet for basic instructions (Appendix 5.1)

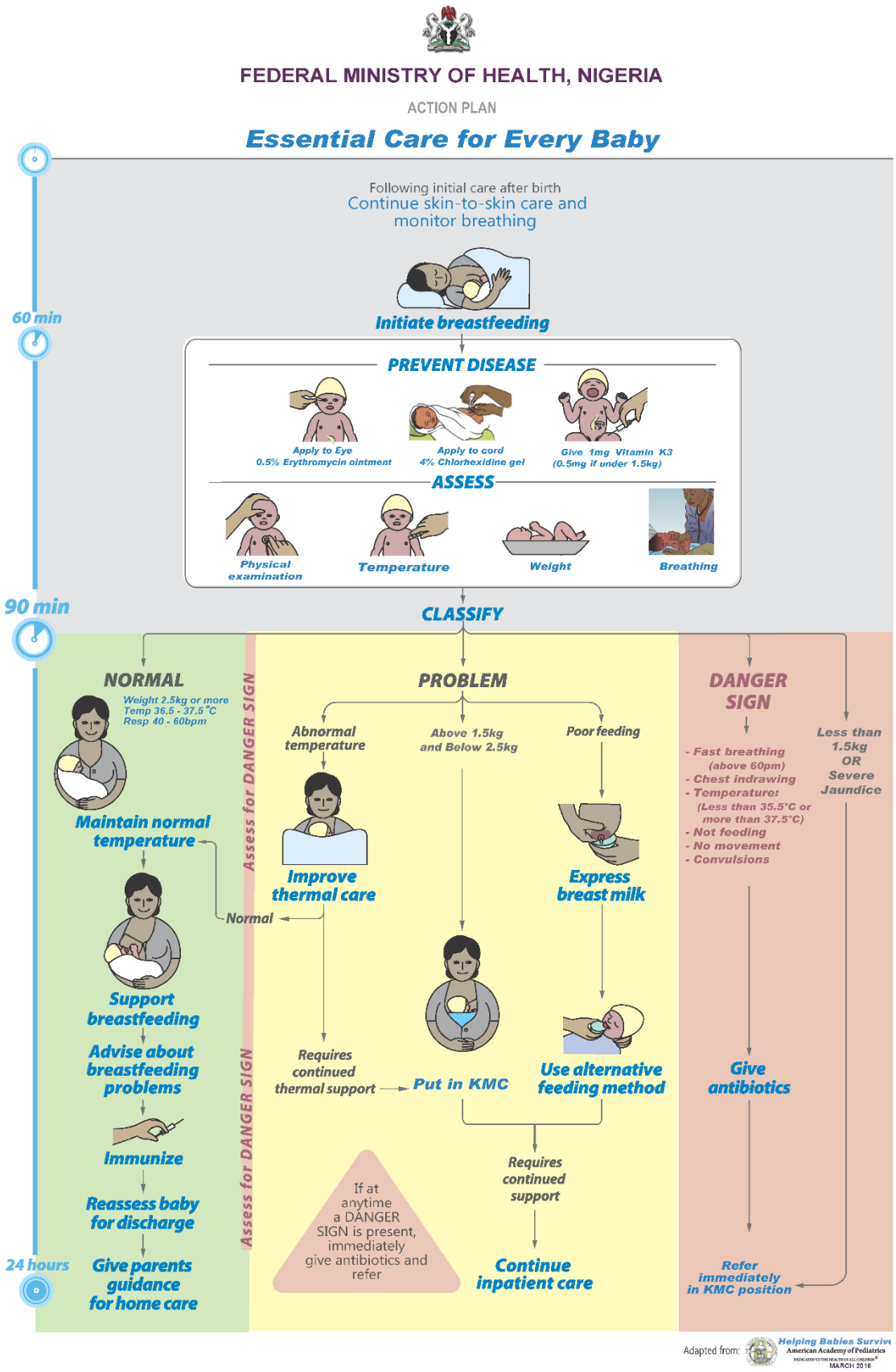


Figure 5.3: *Essential Care for Every Baby (ECEB) Chart*

CHAPTER 6: NEWBORN HISTORY AND PHYSICAL EXAMINATION

A thorough physical examination is important for every baby. The purpose is to find out if the baby is healthy, identify congenital anomalies at birth, identify common newborn problems and initiate prompt treatment.

Before starting the examination, wash hands; and explain to the mother and father what you are going to do and answer their questions. Aim to keep the baby uncovered for only a short time as needed, in order to reduce heat loss.

INDICATIONS

1. Initial examination of the newborn should be performed within 60-90 minutes of life, while a complete and comprehensive physical examination (PE) should be performed for every newborn within 24 hours of birth, and within 72 hours of life.
2. Every baby should have a pre-discharge complete physical examination
3. Physical examination has limitations and cannot identify all abnormalities that may be present in the newborn period.
4. Always review the mother's delivery notes and the baby's birth record
5. Examination should include:
    a. General physical and systemic examination
    b. Assessment for gestational age if prematurity is suspected. See New Ballard Scoring chart (Figure 6.1) Always ensure that chart is always available on the ward.
    c. Screening for:
        - Congenital malformations, syndromes, and associations
        - Congenital heart diseases
        - Congenital cataracts
        - Cryptorchidism
        - Developmental dysplasia of the hip

Neuromuscular Maturity

Score	-1	0	1	2	3	4	5
Posture							
Square window (wrist)	>90°	90°	60°	45°	30°	0°	
Arm recoil		180°	140°–180°	110°–140°	90°–110°	<90°	
Popliteal angle	180°	160°	140°	120°	100°	90°	<90°
Scarf sign							
Heel to ear							

Physical Maturity

Skin	Sticky, friable, transparent	Gelatinous, red, translucent	Smooth, pink; visible veins	Superficial peeling and/or rash; few veins	Cracking, pale areas; rare veins	Parchment, deep cracking; no vessels	Leathery, cracked wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	
Plantar surface	Heel-toe 40-50 mm: –1 <40 mm: –2	>50 mm, no crease	Faint red marks	Anterior transverse crease only	Creases anterior 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

Figure 6.1: Gestational Age Maturational Assessment Chart: New Ballard's Score

NEONATAL HISTORY TAKING

a. Maternal profile: age of the mother, occupation, parity, blood group and Rh, chronic maternal illnesses, history of sexually transmitted diseases, Hepatitis B infection
b. Current pregnancy: LNMP (last normal menstrual period), gestational age, ANC, bleeding, hypertension, diabetes, thyroid diseases, eclampsia, acute or chronic infection.
c. Previous pregnancy: history of abortion, fetal death, early neonatal death, premature birth, history of early neonatal jaundice, history of birth defect.
d. Drug history: history of alcohol ingestion, cigarette smoking, any medications in pregnancy (anticonvulsants, anti TB, warfarin, HAART, thyroid treatment drugs, antenatal steroid use, contraceptives)
e. Family history: the health worker needs to know the family history to see if there are any inherited diseases like diabetes mellitus, hypertension, bronchial asthma, thyroid disease and others.
f. Labour and delivery: presentation, onset of labour, duration of rupture of membranes, duration of labour, mode of delivery, presence of meconium, breathing condition of at birth, resuscitation, birth weight, place of delivery.

g. Presenting compliant: like inability to suck, fever, breathing difficulty, abnormal body movement, jaundice

PHYSICAL EXAMINATION OF NEWBORNS

The goal of physical assessment of the newborn is to identify neonatal problems and the specific objectives are:

- Understand the interpretation of all the findings when examining a newborn
- Describe the requirements and steps of newborn clinical examination
- Know and be able to list counselling points to discuss with mothers after the clinical
- examination

Consent and Preparation

- Introduce yourself to the mother and gain verbal consent.
- Ask about particular concerns
- Keep the baby warm and examine in quiet, well-lit environment
- At initial examination, the health worker has to focus on the following conditions
  - Baby's response to the transition from fetal life to extra uterine life
  - Any congenital anomalies
  - Any sign of infection
- Prepare the following items - Thermometer, Measuring tape, Weighing Scale (for babies), Stethoscope, Watch/stop clock, Gloves, glucometer, Data collection sheet
- Prerequisites
  - Review of the obstetrical file and health record.
  - Explain to the mother the purpose and process of the examination.
  - Wash hands with soap and water.
  - Undress and place the baby under a heat source if it is available or prevent heat loss (close shutters and windows, keep baby partially covered, keep examination time short).
- Key examination points
  - The order of newborn physical examination may not follow the usual cardinal steps.
  - General examination: look for movement of the extremities, hypotonia, colour, respiratory distress, dysmorphic features
  - Take the vital signs: take the respiratory rate, feel the pulses and count the heart rate while the baby is calm.
    - Respiratory rate per minute (30 to 60 breaths per min should be counted for a full minute.
    - Pulse oximetry
    - Heart rate per minute (normal rate is between 120 and 160 bpm).
    - Check capillary refill.
    - Axillary temperature (normal is between 36.5℃ and 37.5℃)
    - Measure blood pressure using appropriate cuff (upper and lower limb where necessary). The normal range blood pressure (BP)of a newborn varies based on birth weight, gestational age and postnatal age. As a rule of thumb, the lower limit of mean arterial pressure (MAP) on the day of birth is approximately equal to gestational age in weeks. Blood pressure

needs frequent measurements.
    - See newborn Blood Pressure chart (See *Appendix 6.1*)
- Take anthropometric measurement
  - Gestational age assessment (See Ballard score chart Appendix 2)
    - Weigh the baby (normal weight range for term babies is 2500g -3999g).
    - Measure the length (normal range is 48-53 cm),
    - Measure head circumference (normal range is 33-38cm),
  - Colour: normal colour is pink, should not be: blue, yellow, pale.
  - Examination of HEENT: examine the skull (caput succedaneum subgaleal hemorrhage, cephalohematoma), sutures (craniosynostosis), fontanel, face, nose, ears, mouth, neck, clavicles, eye discharge, icterus, cataracts
  - Mammary glands: enlargement of breast tissue and discharge (may be physiologic)
  - Respiratory system:
    - Check for signs of respiratory distress, breathing pattern, respiratory rate, air entry to the lungs, presence of abnormal sounds in the lungs, AP diameter and symmetry of the chest, stridor
  - Cardiovascular: synchronicity of upper and lower limb pulses (especially the femoral pulses), heart rate, heart murmurs, gallop rhythm
  - Abdomen: shape (scaphoid, distension), look for any organ enlargement like hepatomegaly, splenomegaly, mass, ascites, kidneys, abdominal wall defect, examination of the umbilical stump (correct vascular components – 2 arteries and 1 vein, bleeding and discharge), anal patency.
  - External genitalia: see if there are any abnormalities of the genitalia both in male and female newborns (size of penis, position of testicles, opening of urethral meatus, ambiguous genitalia), vaginal bleeding or discharge.
  - Musculoskeletal: limb defects (clubfoot, syndactyly, polydactyly), symmetry and spontaneous movement of the extremities to detect fractures and birth injuries, spina bifida, joints (hip should be examined to detect developmental dysplasia of the hip, look for gluteal fold symmetry), oedema.
  - Skin examination: rash, jaundice, pallor, plethora, meconium staining, cyanosis, birthmarks, etc. Acrocyanosis is a normal finding in the newborn.
  - Neurological examination: level of alertness, cry, spontaneous movements, abnormal movements, muscle tone, primitive reflexes;
    - Moro reflex, check for completeness and symmetry
    - Rooting reflex, absent or present
    - Grasp reflex (arm and plantar)
    - Sucking reflex, absent, weak or vigorous

After the clinical examination of the newborn, ensure DOCUMENTATION of findings:

- Complete neonatal examination record in medical notes and sign and date it. Record all the findings in the newborn's registration books or chart prepared for the purpose.
- Record any discussion or advice given to parents
- Record any congenital abnormality in the congenital abnormality registry
- Classify the newborn into normal or abnormal (specify problems identified)
- *Appendix 6.2* shows a sample summary sheet for newborn examination.

CLASSIFICATION OF THE NEWBORN

1. Based on the gestational age, using last menstrual period, Ultrasound estimation or new Ballard score, a newborn could be classified into:
   - Preterm: less than 37 completed weeks
   - Term: 37 completed weeks to less than 42 completed weeks
   - Post term: 42 completed weeks and above
2. Classifications of the newborn based on the birth weight:
   - Macrosomia: birth weight of 4000 gram and above
   - Normal weight: 2500 – 3999 grams
   - Low birth weight: 1500 – 2499 grams
   - Very low birth weight: 1000 – 1499 grams
   - Extremely low birth weight: less than 1000 grams
3. A newborn can also be classified with respect to birth weight and gestational age as follows (See Lubchenco chart in *Appendix 6.3*):
   - Appropriate for gestational age (AGA) if the birth weight is between 10th and 90th percentile
   - Large for gestational age (LGA) if birth weight is greater than 90th percentile
   - Small for gestational age (SGA) if birth weight is less than 10th percentile

DECISION AFTER EXAMINATION

Inform mothers about the results of the examination, provide explanations if needed and emphasize the importance of regular follow-up.

a) If normal on examination

I. Reassure the parents (teach the parents how to detect jaundice in the newborn daily).

II. Seek advice if any new concerns arise at home after discharge

III. Advise on post-natal visit as per guideline

b) If abnormal on examination

I. Admit in the Special Care baby unit (Appendix 6.4: shows sample of newborn admission record form)

II. Institute appropriate management or refer for advanced care

CHAPTER 7: NEONATAL TRIAGING

Triage is a process of rapid assessment and "sorting out" sick newborn babies soon after their arrival at referral hospitals to enable prioritization of care and treatment of patients according to their need and the resources available.

Triage should be carried out, on arrival, to all new babies to the hospital.

Following referral from a lower level facility or from self- referrals from home, the infants require immediate and urgent attention.

At arrival at the Referral Facility Emergency Section

- Newborns (0-28days) on arrival, should be attended to IMMEDIATELY.
- Newborns should be assessed before doing any of the usual administrative procedures.
- An experienced nurse/doctor on duty should triage immediately.
- Reception areas and other points of service for newborns should be organized in a way to ensure that every newborn can be seen quickly, stabilized and admitted as indicated.
- Introduce yourself to the caregiver, gently calm their fears and encourage them to ask any questions.
- Minimize contact and exposure to ill older patients.

TRIAGING

The provider should perform a brief focused assessment and assign the newborn into one of these three groups:

1. Emergency signs (danger signs)
   These are signs that indicate that the baby is in critical condition and at risk of dying within minutes if nothing is done.
2. Priority signs
   These are signs that indicate who should be given priority in the queue so that they can be assessed and treated without delay.
3. Non-urgent signs
   These are signs that are neither emergency nor priority signs.

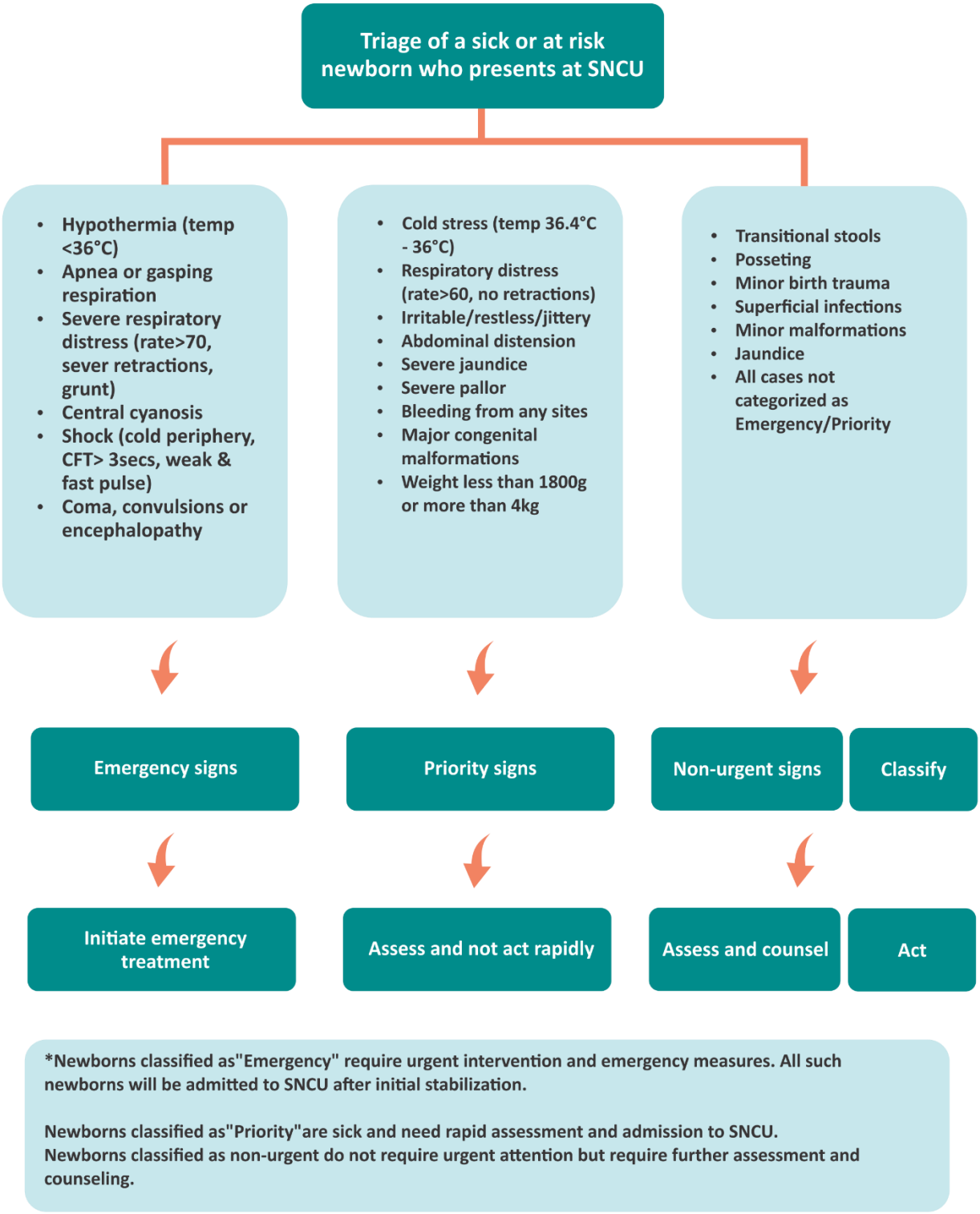


Figure 7.1: *Classification for newborn triage in a newborn unit*

If you find any of these Emergency Signs you MUST ACT IMMEDIATELY before progressing to the Priority Signs. Commence immediate assessment and resuscitate utilizing the ABC (Airway, Breathing, and Circulation) approach; and FIRST MANAGE SPECIFIC EMERGENCY SIGNS

Emergency signs in the newborn include:

- Apnoea (not breathing at all), gasping or respiratory rate of less than 30 breaths per minute
- Heart rate less 100beats per minute
- Hypothermia (temperature <36°C)
- Severe respiratory distress (rate >70 bpm, severe retractions, grunting)
- Central cyanosis (bluish/dark colouration of the buccal mucosa), SPO_2 less than 90%
- Shock (cold extremities, capillary refill time >3 seconds, weak & fast pulse)
- Bleeding
- Seizures, unresponsiveness

Priority Signs in the newborn include:

- Cold stress (temperature of 35°C – 36.4°C)
- Fever (temperature 38°C and above)
- Irritability/Restlessness/Jitteriness
- Abdominal distention
- Severe jaundice
- Severe pallor
- Major congenital malformations eg spina bifida cystica, gastroschisis, omphalocele
- Weight less than 1.5kg or greater than 4kg

Non-urgent signs in the newborn include:

- Minor birth trauma
- Superficial infections
- Minor malformations eg talipes equinovarus, polydactyl, syndactyl
- Mild jaundice (level of the face)
- All other cases not classified as emergency or priority signs.

Table 7.1: *Emergency Assessment and Immediate Treatment*

Assess for Hypothermia Temperature <36.5°C	Remove wet clothings/diaper, Re-warm baby under radiant warmer if available or keep baby in skin-to-skin position with mother and cover with a blanket. Otherwise, clothe baby and wrap with blankets. Note: Do not use hot water-bottle as it may burn or scald the baby's skin. Monitor temperature every 30minutes
Assess for Apnoea - Gasping or respiratory rate <30 breaths per minute	Place head in sniffing position (neck partially extended), Clear/suction airway and reposition Ventilate with bag and mask + Oxygen as indicated Monitor oxygen saturation (Target saturation 90-95%) Keep baby warm throughout the procedure
Assess for Severe respiratory distress - (RR >70, severe retractions, grunting) Assess for central cyanosis	Manage airway (position, suction as necessary) Commence bubble CPAP if available, otherwise, give Oxygen by nasal prongs at flow rate at 1-3L/min Monitor oxygen saturation (Target saturation 90-95%) Keep baby warm
Assess for Shock - Cold extremities, Capillary refill time >3seconds, weak & fast pulse)	If bleeding is the likely cause of shock: 1. Infuse normal saline or Ringer's lactate 10 ml/kg body weight over 10 minutes and repeat once after 20 minutes if signs of shock continue. 2. Transfuse with uncross matched O Rh-negative blood. 3. Give oxygen 4. keep baby warm. If bleeding is not the likely cause of shock: 1. Infuse IV fluid Normal saline @10 ml/kg body weight over 30 minutes, and reassess. 2. If still in shock, repeat fluid bolus up to 2 times more

	3. If in shock after completion of 30mls/kg, consider cardiogenic shock, commence dopamine and evaluate further. 4. Subsequent fluid management depends on the cause. 5. Keep baby warm 6. Evaluate for sepsis, critical congenital heart defect etc and treat accordingly
Assess for Bleeding	1. Stop visible bleeding, if possible (e.g. if the bleeding is from the umbilicus, re-clamp or re-tie the umbilical stump; if the bleeding is from a cut or male circumcision site, apply pressure with sterile compress). 2. Give vitamin K_1 1-5mg intravenously. 3. Take a blood sample for Packed Cell Volume and grouping and crossmatching. 4. Further evaluation and management
Assess for Coma or Convulsion	1. Manage airway 2. Check blood glucose and correct hypoglycaemia if present (if no glucometer, correct empirically for hypoglycaemia) 3. Abort seizures with IV/IM phenobarbitone 20mg/kg stat, if not available, consider rectal diazepam 4. Keep baby warm. Avoid hyperthermia

AFTER TREATING FOR EMERGENCY SIGNS, TAKE A HISTORY AND EXAMINE FOR PRIORITY SIGNS

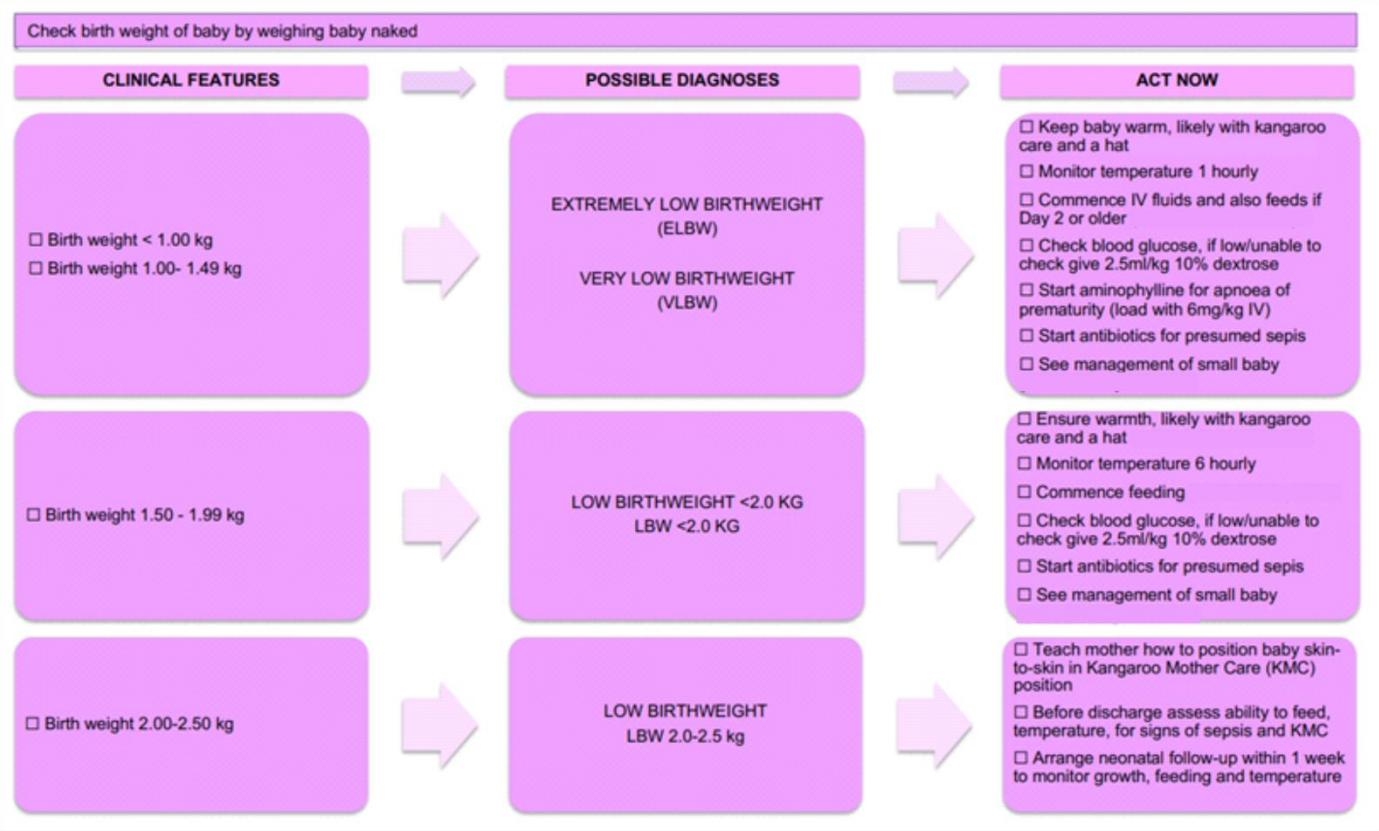


Figure 7.2: *Assessment for Priority Signs*

FURTHER ASSESSMENT AND MANAGEMENT

- Once the baby with emergency sign has received initial treatment, obtain the history of the mother and the baby, conduct a thorough physical examination to determine the underlying problem(s), make a diagnosis (at times in neonates, multiple problems may be present) and admit the baby if necessary.
- Examine the baby under a radiant heater if possible.
- Provide specific management for the problem(s) identified.
- Arrange for transfer and referral if indicated.

COMMUNICATION TIPS ON CARE OF THE SICK NEWBORN

General

- ☐ *Always* respect privacy and confidentiality
- ☐ *Always* explain things clearly; avoid technical language and jargon
- ☐ *Always* encourage parents to ask questions/express concerns at any time
- ☐ *Always* communicate in a language the parents understand
    - o If you do not fluently speak their language, find someone who does

Training and updates in communication techniques will help improve staff ability to communicate and respond appropriately

Parents/guardians May include grandparents or other relatives when parents are unavailable

Remember that parents:

- ☐ *May find hospital, and especially the newborn unit, a frightening place*
- ☐ *May be upset or in shock about baby's condition*
- ☐ *May take time to adjust to the newborn unit and how care is administered*
- ☐ *Depend heavily on doctors, nurses and midwives for information and support*
- ☐ *Require different information in times of crisis than in routine care*
    - o *Must receive complete information with as much detail as possible*
- ☐ *Need to be able to ask questions and have a sense of involvement with their baby*
- ☐ *Ensure a private, supportive environment for discussion of:*
    - o *Complicated diagnoses or interventions*
    - o *Decisions about the infants care*
    - o *Difficult information (e.g., worsening of baby's condition and death)*

Staff of Newborn Unit

Ensure that all information regarding the baby's care or condition is:

- ☐ *Provided by professional staff only (doctors, midwives, nurses)*
- ☐ *Consistent*
- ☐ *Communicated between the staff of the unit and multidisciplinary team*
- ☐ *Individualized for each situation and considers the baby's clinical condition*
- ☐ *Updated as appropriate*
- ☐ *Kept confidential*

CHAPTER 8: STABILIZATION, REFERRAL AND TRANSPORT OF THE SICK NEWBORN

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

In-utero transfer is the safest way of transfer; however, this is not always feasible. Thus, the need to have a standardized national transport protocol across all levels of care to improve neonatal outcomes. This will include facilities for communication and emergency transport both to and from the referral centres to the 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 his absence, the most senior doctor on ground.

2. Communication

Once the decision to refer a newborn has been taken:

- 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.

  Appendix 8.1 shows sample of a Two-way Referral Form
- 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 all through the transport system

3. Pre - transport stabilization

Transfer should not be undertaken until the baby has been resuscitated and stabilized. This stabilization before the transport is done by the health workers in the referring hospital.

The essence of this stabilization 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 (Chapters 10, 11 and 12)

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 stabilization

Check the blood glucose. if there is hypoglycaemia, correct appropriately and monitor blood glucose. (Chapter 20: Hypoglycaemia).

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 pre-referral antibiotics (Chapter 23: Neonatal sepsis).

SPECIAL CONSIDERATIONS REGARDING PRE-TRANSPORT STABILIZATION FOR SOME PATHOLOGIES

a. Abdominal wall defects (Omphalocele, Gastroschisis).
- Pass a naso or oro-gastric tube for gastric decompression
- For omphalocele, cover the abdominal defect with soft, sterile sheets or gauze.
- The sheets may be wet 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 lie prone to avoid pressure on the defect
- Cover the defect with soft, sterile sheets or gauze. This may be wet intermittently with warm normal saline.

c. Diaphragmatic Hernia.
- Intubate the baby
- Pass a naso or oro-gastric tube for gastric decompression

d. Other malformations of the gastrointestinal tract e.g. tracheoesophageal fistula, duodenal web or atresia
- Pass a naso or oro-gastric 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 (see Appendix 8.1), 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 analyzed send them with the transport team.

Informed consent obtained from parents to be documented and filed as appropriate. All documentations 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, topography of the area and clinical urgency amongst other factors. Babies are best transported in Kangaroo Mother Care (KMC) position except the clinical condition does not permit this.
   - **a.** Ambulance - this is the commonly used means of transportation. The ambulance is expected to have facilities for resuscitation including oxygen and intravenous fluids administration.
   - **b.** Other vehicles such as private or hired cars, tricycles, etc can be used in areas where there is no ambulance or where there is poor road network.
   - **c.** Boats, ferries - in areas where water transport is the only available means of transportation.

d. Helicopter/ Air Ambulance - in areas where the facility is available.

ii. Accompanying the baby

a. It is best to transport 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 require no 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 intervention or post-operative care.
iii. Babies on any form of respiratory support or support for at least two organ systems.

iii. Care of baby during transport

- The health worker accompanying the baby must ensure to have major resuscitative equipment viz;
  - Emergency drugs, fluids, endotracheal tubes, other consumables.
  - Portable suction apparatus
  - Enough oxygen to last the baby through the journey.
- Also do not try to resuscitate in a moving vehicle. The vehicle should stop for resuscitation activities.

a. Temperature maintenance:

- Use a transport incubator if available or
- Kangaroo mother care (KMC) position by mother or attendant
- Other methods like adequately covering the baby (with cap, socks and well wrapped)

b. Airway and breathing:

- Keep neck of the baby in slight extension position (neutral position)
- If airway is unstable, intubate
- If intubation is not possible, bag and mask ventilation or bCPAP can be provided

c. Circulation:

- Assess perfusion for warm peripheries, capillary refill time of ≤3 seconds, tone and activity
- If baby is on intravenous infusion, monitor and ensure prescribed rate.

d. Check oxygenation:

- Continuous Pulse oximeter monitoring is preferable (ensure SPO_2>90%)
- observe for central cyanosis; if possible, perform blood gas analysis before and during transfer

e. Feeds:

Babies with abnormal sensorium or severe respiratory distress can be fed EBM via orogastric (OGT) or nasogastric tube (NGT), otherwise, they should be commenced on intravenous fluid as appropriate for age and weight (See Chapters 18 and 19: Nutrition in the Newborn—Enteral and Parenteral).

A stable baby at risk of hypoglycemia may be fed in addition to intravenous fluid; if baby can accept, provide breast feeds; if not give expressed breast milk (EBM) via alternate feeding methods (cup, orogastric or nasogastric route).

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 stabilize baby before moving on.

Maintain communication with the referral hospital all through the transport.

7. Arrival and handover

On 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 patient's care.

- Handover should include a verbal and written account of the patient's history, vital signs, therapies and significant clinical events during transport.
- Referral form and other relevant documents should be handed over as well.

Steps in Intra-facility transport

As much as possible, transport of newborn should be avoided and services are better provided by the baby's bedside. Facilities such as mobile X-ray, ECG, and echocardiography should be provided by the bedside. Where this is not possible then consider the following:

1. Decision to transport

This shall be taken by the managing consultant or in his absence, the most senior health worker on ground.

2. Communication

Once the decision to transport a newborn has been taken:

- The parents or caregiver should be duly informed about the baby's status, the indication for the transport, the services required, the transport benefits and risk. Transport is permitted only if they give consent.
- The point of care should be contacted to enable them prepare appropriately to receive the baby

3. Pre - transport stabilization

Transfer should not be undertaken until the baby has been resuscitated and stabilized

4. Documentation

The transferring unit should document appropriately the reasons for the transfer, time, date and the consent for transfer as well as treatment given so far.

Transporting the baby

i. Mode of transportation: it is recommended that babies be transported in KMC position. Where this is not feasible (e.g. due to baby's clinical status), transport incubators should be used during baby's transport. There should be available transport mobile oxygen trolleys and resuscitation bag device to be used should baby deteriorate en-route.

ii. Accompanying the baby:

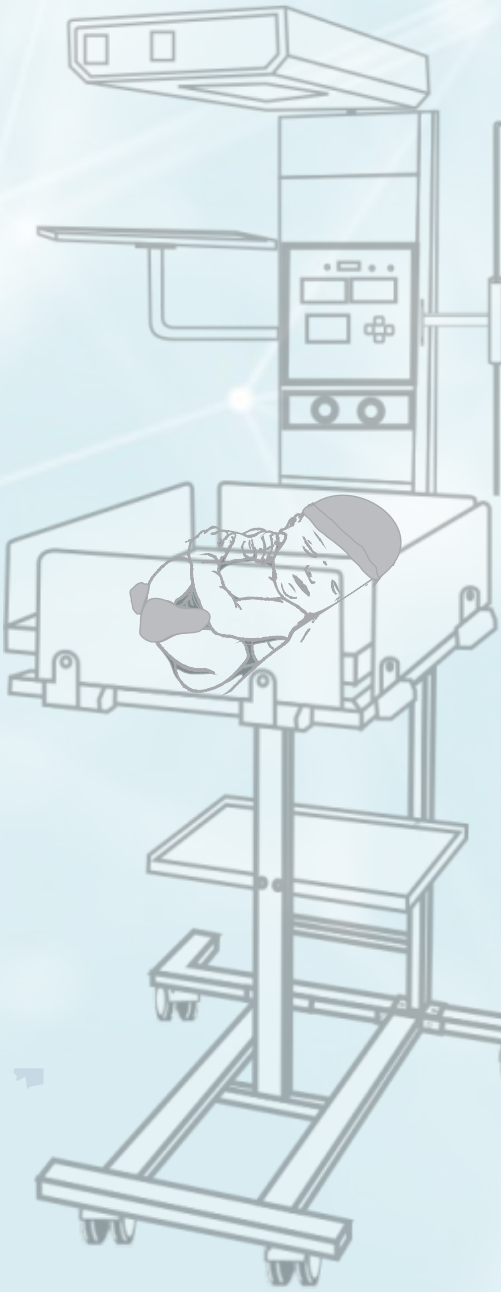
   a. It is best to transport baby with the mother except in situations where this is not possible.
   b. Medical personnel should accompany all babies for intra-facility services

5. What to do if the neonate deteriorates during transport

Initiate resuscitation and return back to the newborn unit.

National Guidelines
for Comprehensive Newborn Care

SECTION TWO



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CHAPTER 9: NEONATAL RESUSCITATION

Asphyxia is one of the commonest causes of neonatal mortality in Nigeria. When a baby is not breathing, urgent management is needed. For most babies, the breathing at birth occurs without any assistance, but some babies, however, need help to start or continue breathing. This help is called resuscitation.

It has been estimated that approximately 10% of newborns require some assistance to begin breathing at birth; and about 1% need extensive resuscitative measures to survive. Generally, apply the "ABC" of resuscitation; ensure the Airway is open, clear and baby is well positioned; Be sure that there is Breathing whether spontaneous or assisted within 60 seconds of delivery (the Golden Minute); and make certain that there is adequate Circulation of oxygenated blood. Please note that resuscitation after the immediate delivery period also follows the "ABC" sequence.

BE PREPARED FOR EVERY DELIVERY

- Always have resuscitation equipment checked and ready the need is indicated.
- Take a detailed history; ask specifically about antepartum and intrapartum risk factors in mother
- Ensure clean surfaces
- Close windows and doors to prevent drafts
- Wash hands and ensure standard precaution to prevent infections

High risk deliveries include:

- all preterm births <37 weeks
- meconium staining
- fetal distress and all cesarean sections
- known congenital malformations
- multiple births
- malpresentation
- maternal complications like pre-eclampsia, eclampsia, maternal diabetes, maternal bleeding

FOUR KEY QUESTIONS TO ASK OBSTETRIC PROVIDER BEFORE EVERY BIRTH

- What is the expected gestational age?
- Is the amniotic fluid clear?
- How many babies are expected?
- Are there any additional risk factors eg mother's health, medication history, labour history?

PERSONNEL NEEDED FOR DELIVERY ROOM RESUSCITATION

- Every birth should be attended by *at least 1 qualified person* skilled in the initial steps and PPV whose only responsibility is the baby.
- If risk factors are present, *at least 2 qualified* people should be available
- A qualified team with *full resuscitation skills* (intubation, chest compression, emergency vascular. access and medication) should be identified and immediately available for every resuscitation.
- Always perform a *pre-resuscitation team briefing* and assign roles, identify a team leader.
- *Team work and effective communication* are key for a successful resuscitation.

EQUIPMENT CHECKLIST AT DELIVERY

- There should be an organised *Equipment Checklist* for delivery staff to check that all equipment are clean and ready at all times.
- Clock or timer on the wall above the resuscitaire with a second hand.
- Umbilical cord ties or clamps

Table 9.1: *shows the required equipment based on the action steps during resuscitation.*

Warm	• Preheated warmer • Warm towels or blankets • Temperature sensor and sensor cover for prolonged resuscitation • Hat • Plastic bag or plastic wrap (< 32 weeks' gestation) • Thermal mattress (< 32 weeks' gestation)
Clear airway	• Bulb syringe • 10F or 12F suction catheter attached to wall suction, set at 80 to 100 mm Hg • Tracheal aspirator
Auscultate	• Stethoscope
Ventilate	• Flowmeter set to 10 L/min • Oxygen blender set to 21 % (21 %-30% if < 35 weeks' gestation) • Positive-pressure ventilation (PPV) device • Term- and preterm-sized masks • 8F orogastric tube and 20-ml syringe • Laryngeal mask (size 1) and 5-ml syringe (if needed for inflation) • 5F or 6F orogastric tube if insertion port is present on laryngeal mask • Cardiac monitor and leads
Oxygenate	• Equipment to give free-flow oxygen • Pulse oximeter with sensor and cover • Target Oxygen Saturation Table
Intubate	• Laryngoscope with size 0 and size 1 straight blades (size 00, optional) • Stylet (optional) • Endotracheal tubes (sizes 2.5, 3.0, 3.5) • Carbon dioxide (CO_2) detector • Measuring tape and/or endotracheal tube insertion depth table • Waterproof tape or tube-securing device • Scissors
Medicate	Access to • Epinephrine (0.1 mg/ml= 1 mg/1 0 ml) • Normal saline (100-ml or 250-ml bag, or prefilled syringes) • Supplies for placing emergency umbilical venous catheter and administering medications • Table of pre-calcuated emergency medication dosages for babies weighing 0.5 to 4 kg

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 details at the Essential Newborn Care Course (ENCC) and the Action Plan Chart is shown in Figure 9.1. It emphasizes the crucial need to commence breathing for the baby using the bag and mask within the first minute of birth (The Golden Minute).

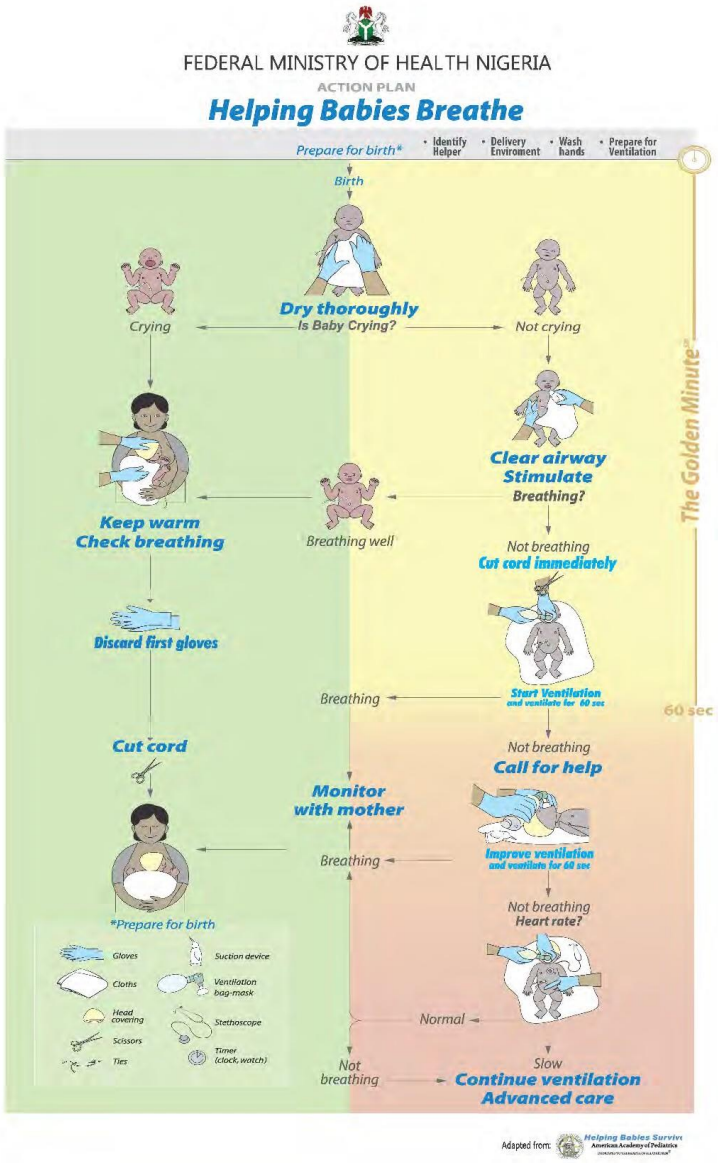


Figure 9.1: *Action Plan Chart of the HBB Course*

b) THE NEONATAL RESUSCITATION PROGRAM (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 5 blocks beginning with preparation for birth and the initial assessment. Throughout the diagram (Figure 9.2), diamond shaped steps indicate assessments and rectangles show actions that may be required.

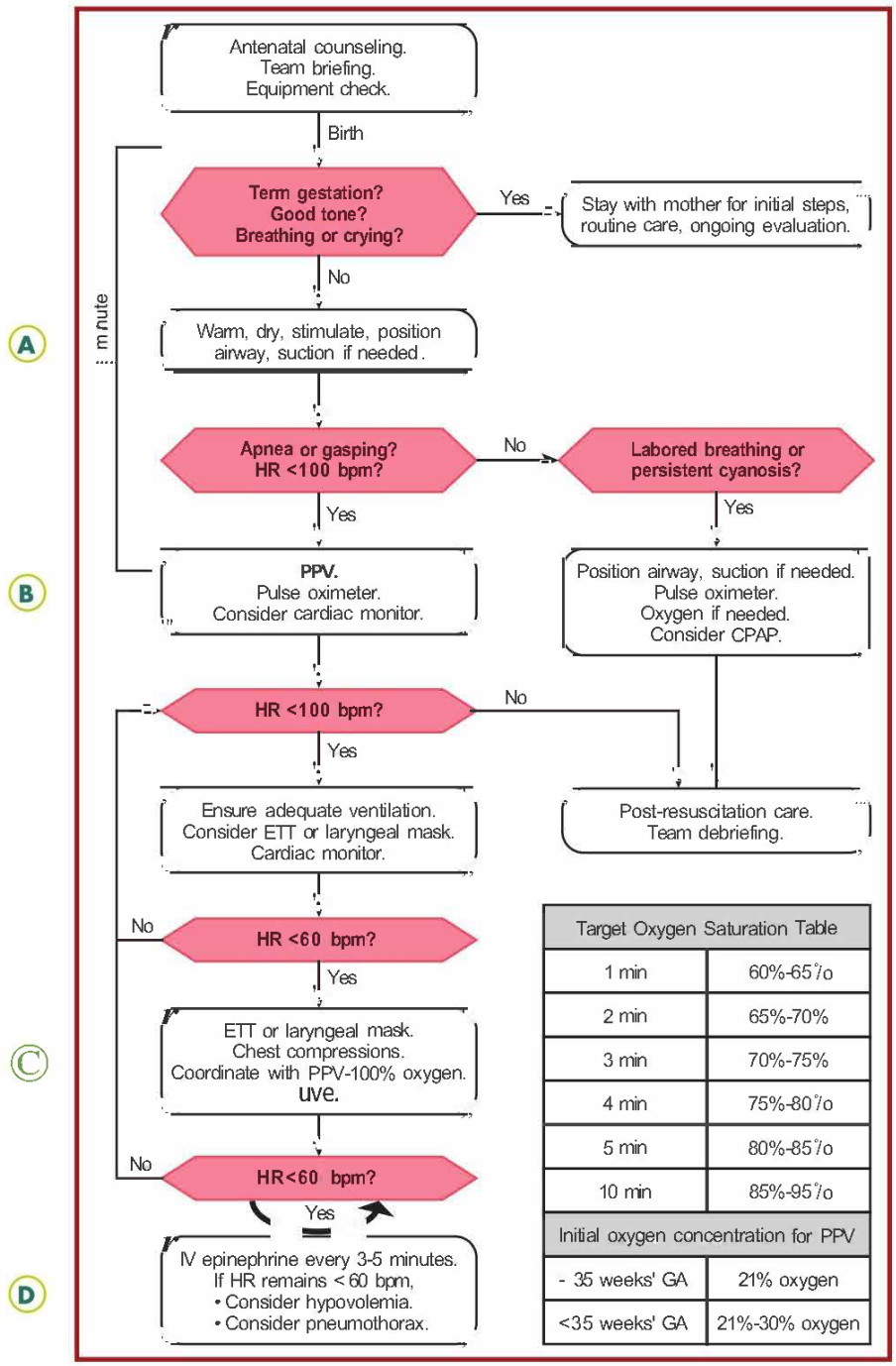


Figure: 9.2: *Neonatal Resuscitation Algorithm (Neonatal Resuscitation Program, 8th edition)*

Resuscitation Steps:

A - Airway (A) (clear airway and put head in neutral (sniff) position to help open airways)

: Perform the 5 initial steps to establish an open Airway and support spontaneous respiration.

- Provide warmth,
- Put baby's head in "sniffing" position to open airways
- Suction mouth, then nose if secretions.
- Dry baby and remove wet clothes
- Stimulate gently

B - Breathing (B) (stimulate and provide positive-pressure ventilation)

: Positive-pressure ventilation is provided to assist breathing for babies with apnoea or bradycardia.

- Bag-valve-mask ventilation for apnoea, gasping, or heart rate <100 bpm
- Ventilate at rate 40 to 60 breaths/minute
- Listen for rising heart rate, audible breath sounds
- Watch for slight chest movement with each breath
- Call for help
- Attach a pulse oximeter. Use pulse oximeter attached to right hand or wrist to guide use of oxygen
- Other interventions (continuous positive airway pressure [CPAP] or oxygen) may be appropriate if the baby has laboured breathing or low oxygen saturation for age.

The bag and mask must be available in all facilities that take delivery to help all babies who fail to breathe spontaneously at birth within the first 60secs of birth –the "Golden Minute".

Do not shake the baby as this is harmful!

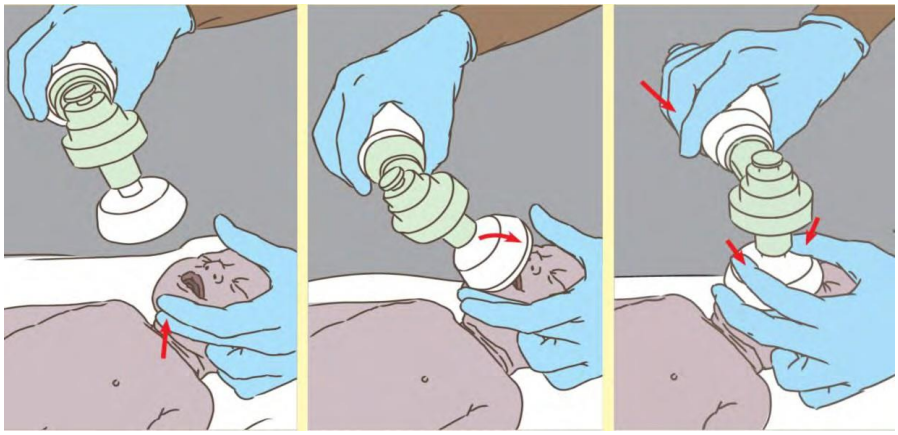


Figure 9.3: *Positioning and Commencing bag and mask ventilation within One Minute of delivery*

C - Circulation (C) (administer chest compressions)

If severe bradycardia persists despite assisted ventilation, Circulation is supported by performing chest compressions coordinated with PPV.

- Start compressions if HR is <60 after 30 -45 secs of effective ventilation
  Give (3 compressions: 1 breath) every 2 seconds.
- Compress one-third of the anterior-posterior diameter of the chest.
- Apply corrective steps MR SOPA, (Table 9.2) if ventilation does yield appropriate chest rise and heart rate not improving.

Table 9.2: *MR. SOPA Corrective steps to make ventilation effective*

	Corrective Steps	Actions
M	Mask adjustment	Reapply the mask. Consider the 2-hand technique
R.	Reposition airway	Place head neutral or slightly extended.
Try PPV and reassess chest movement		
S	Suction mouth and nose	Use a penguin suction or suction catheter
O	Open mouth	Open the mouth and lift the jaw forward
Try PPV and reassess chest movement		
P	Pressure increase	Increase pressure in 5 to 10cm H_2O increments, maximum 40 cm H_2O
Try PPV and reassess chest movement		
A	Alternative Airway	Place an endotracheal tube or laryngeal mask.
Try PPV and reassess chest movement		

D - Drug (D) (Administer adrenaline and/or volume expanders

The majority of newborns will respond to standard resuscitation (NRT algorithm above).
However, if HR persists <60 beats per minute after 45 to 60 seconds of compressions and ventilation, adrenaline should be administered per the chart below Table 9.3 and 9.4 below.

Caution: epinephrine dosage is different for ET and IV routes. See dosages in chart (Table 9.3). Furthermore, Adrenaline (1mg/ml or 1:1,000) is a high-dose solution. This must be diluted to standard-dose (0.1mg/ml or 1:10,000) before using it as high concentration will cause bradycardia and asystole.

YOU MUST DILUTE adrenaline 1mg/ml (1: 1000) solution to 0.1mg/ml (1:10,000) solution.

- Mix 0.1ml of 1:1,000 adrenaline with 0.9ml of sterile water/saline. Then give as in Table 9.3

Table 9.3: *A simplified chart of volume of diluted (1:10,000) adrenaline*

Weight (kg)	Volume (ml) 1:10,000 0.1ml – 0.3ml/kg of the diluted solution
1 kg	0.1 – 0.3ml of the diluted solution
2 kg	0.2 – 0.6ml of the diluted solution
3 kg	0.3 – 0.9ml of the diluted solution
4 kg	0.4 – 1.2ml of the diluted solution
5 kg	0.5 – 1.5ml of the diluted solution

Table 9.4: *Medications and Volume Expander Dosages*

Medications Used During or Following Resuscitation of the Newborn

Medication	Dosage/Route*	Concentration	Wt (kg)	Total IV Volume (mL)	Precautions
Epinephrine	IV (UVC preferred route) 0.1 to 0.3 mL/kg Higher IV doses not recommended Endotracheal 0.5 to 1 mL/kg	1:10,000	1 2 3 4	0.1-0.3 0.2-0.6 0.3-0.9 0.4-1.2	Give rapidly. Repeat every 3 to 5 minutes if HR <60 with chest compressions.
Volume expanders Isotonic crystalloid (normal saline) or blood	10 mL/kg IV		1 2 3 4	10 20 30 40	Indicated for shock. Give over 5 to 10 minutes. Reassess after each bolus.

*Note: Endotracheal dose may not result in effective plasma concentration of drug, so vascular access should be established as soon as possible. Drugs given endotracheally require higher dosing than when given IV.

- **Ventilation (ensuring air enters the baby's lungs) is the most effective step in neonatal resuscitation**
- **The primary respiratory problem in most cases of perinatal asphyxia is lack of initiation of ventilation or lack of effective ventilation, so the most important intervention is to assist the neonate to take breaths more effectively.**
- **Perinatal asphyxia is manifested as slow or absent breathing, hypotonia (floppiness), cyanosis or pallor and bradycardia (slow or absent heart rate) at the time of birth.**

Table 9.5: *Endotracheal Intubation: ET tube sizes and depth*

Gestation (weeks)	Endotracheal tube insertion depth at lips (cm)	Baby's Weight (grams)	ET Tube Size (ID, mm)
23-24	5.5	500-600	Size 2.5
25-26	6.0	700-800	<1,000 g or <28 weeks
27-29	6.5	900-1000	Size 3.0
30-32	7.0	1,100-1,400	1,000 - 2,000 g or 28-34 weeks
33-34	7.5	1,500-1,800	Size 3.5
35-37	8.0	1,900-2,400	>2,000g or >34 weeks
38-40	8.5	2,500-3,100	
41-43	9.0	3,200-4,200	3.5 - 4.0

SUCTION EQUIPMENT

Suction equipment are used in patients with secretions or blood in the mouth, nostrils or upper airway. If meconium stained liquor is present at delivery and the baby is not vigorous or has not taken a breath, inspect the nose and mouth for obstruction.

Obstruction of the nostrils, mouth or upper airway with secretions or blood will cause respiratory compromise and potential hypoxia.

Penguin suckers (A) are reusable devices made of a flexible silicone, which may also be used for providing low pressure suctioning. Penguin suckers are autoclavable. Although suction bulbs (B) may also be used, they are not autoclavable and are thus not recommended due to greater infection risk between patients. A suction pump (Adult is C and Neonatal suction is D) uses a negative vacuum created by an internal pump to remove blood or secretions from oral and nasopharyngeal cavities. Although an adult suction pump (C) can be used on paediatric or neonatal patients, the vacuum range is much higher which makes it more difficult to control for the low ranges required for neonatal patients (80-100mmHg). Use of an adult pump to treat neonatal patients is not encouraged.

A

B

C

D

POST RESUSCITATION CARE:

Post-resuscitation care is intended to optimize ventilation and circulatory function, preserve organ and tissue function and maintain recommended blood glucose levels and temperature (Table 9.6). Once the respiratory status is stable, return to mother for skin-to-skin contact as soon as possible, and closely monitor for breathing difficulties, signs of asphyxia and anticipate need for further care.

It is strongly recommended that children with oxygen saturation < 90% be given oxygen therapy.

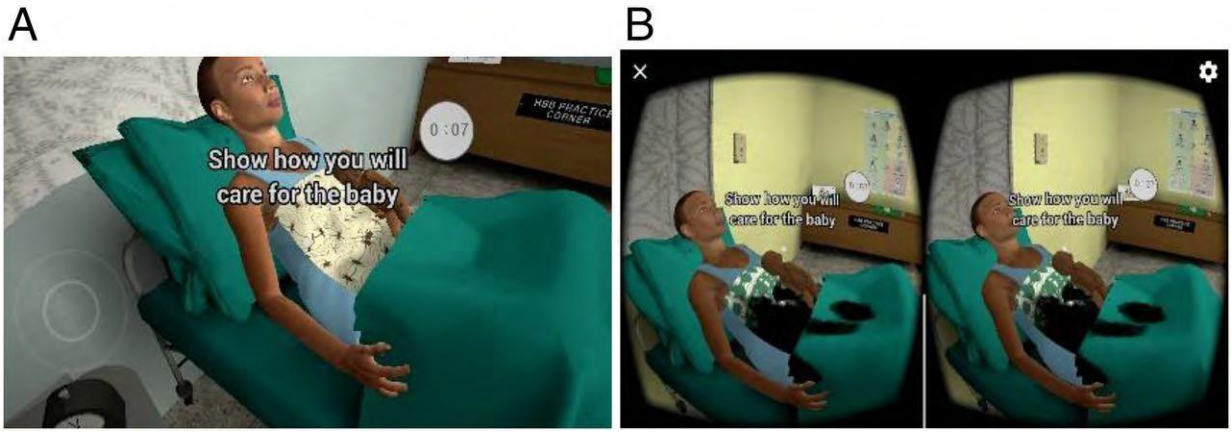
Table 9.6: *Post Resuscitative Care treatment*

Organ System	Clinical Signs and Laboratory Findings	Management Considerations
Neurologic	Apnea, seizures, irritability, poor tone, altered neurologic examination, poor feeding coordination	Monitor for apnea. Support ventilation as needed. Monitor glucose and electrolytes. Avoid hyperthermia. Consider anticonvulsant therapy. Consider therapeutic hypothermia. Consider delayed initiation of feedings and use of intravenous fluids.
Respiratory	Tachypnea, grunting, retractions, nasal flaring, low oxygen saturation, pneumothorax	Maintain adequate oxygenation and ventilation. Avoid unnecessary suctioning. Cluster care to allow periods of rest. Consider antibiotics. Consider x-ray and blood gas. Consider surfactant therapy. Consider delayed initiation of feedings and use of intravenous fluids.
Cardiovascular	Hypotension, tachycardia, metabolic acidosis	Monitor blood pressure and heart rate. Consider volume replacement or inotrope administration if baby is hypotensive.
Renal	Decreased urine output, edema, electrolyte abnormalities	Monitor urine output. Monitor serum electrolytes as indicated. Monitor weight. Restrict fluids if baby has decreased urine output and vascular volume is adequate.
Gastrointestinal	Feeding intolerance, vomiting, abdominal distention, abnormal liver function tests, gastrointestinal bleeding	Consider abdominal x-ray. Consider delayed initiation of feedings and use of intravenous fluids. Consider parenteral nutrition.
Endocrine-Metabolic	Metabolic acidosis, hypoglycemia (low glucose), hypocalcemia (low calcium), hyponatremia (low sodium), hyperkalemia (high potassium)	Monitor blood glucose. Monitor serum electrolytes as indicated. Consider intravenous fluids. Replace electrolytes as indicated.
Hematologic	Anemia, thrombocytopenia, delayed clotting, pallor, bruising, petechiae	Monitor hematocrit, platelets and coagulation studies as indicated.
Constitutional	Hypothermia	Delay bathing.

NEONATAL RESUSCITATION TRAINING AND SKILLS RETENTION

Healthcare workers who work in Labor and Delivery and newborn units should receive training in newborn resuscitation and practice their newborn resuscitation skills routinely as they may be called upon to resuscitate a newborn at any time. Regular practice of neonatal resuscitation basic skills through manikin-based simulation such as positive pressure ventilation using a newborn manikin at a designated HBB corner in the facility is recommended and using digital simulation options such as the eHBB mobile (A) (Helping Babies Breathe) or eHBB VR (B) (Virtual Reality) newborn resuscitation scenarios may help to support critical decision making during newborn resuscitations. NRP eSIM (www.aap.org/nrp) and the current WHO *ENC Now!* simulation practices can be used by health workers routinely to retain skills.

Figure: 9.4: eHBB mobile (A) and eHBB VR (B)



NOTES FOR TERTIARY LEVEL 3 CENTRES

- Use a T-Piece/Neopuff® device if available to give positive pressure in the delivery room.
- Infants < 32 weeks gestation must be placed in a food-grade plastic wrap or bag, without drying, immediately after birth. This reduces insensible water loss by 70-80%.
- Use capnography (CO_2 detector) in addition to clinical assessment to confirm placement of tracheal tube if available. If ET tube is in place, the detector will change to yellow.
- Therapeutic hypothermia is offered to newborn infants at term or near term with evolving moderate to severe HIE (See section on perinatal asphyxia).

CHAPTER 10: RESPIRATORY DISORDERS IN THE NEWBORN AND APPROACH TO CARE

Breathing problems are the most common clinical presentation in sick and small neonates. The causes are quite diverse and can be respiratory and non- respiratory in origin. Thus, a thorough history, physical examination, radiologic and laboratory investigations will aid in the evaluation.

NEWBORNS AT RISK OF DEVELOPING BREATHING PROBLEMS

- Preterm infants
- Infants born to mothers with fever, prolonged rupture of membranes, foul-smelling amniotic fluid
- Meconium in amniotic fluid
- Infants born by caesarean section or after a quick delivery
- Infants with birth asphyxia
- Infants of diabetic mothers
- Infants with congenital abnormalities

Respiratory disorders mostly present as:

- ☐ Abnormal respiratory rate
  - Tachypnoea: RR >60 breaths/minute
  - Bradypnoea: RR < 30 breaths/minute
- ☐ Apnoea: cessation of breathing for > 20 seconds or any duration associated with bradycardia and cyanosis
- ☐ Increased work of breathing
- ☐ Grunting on respiration
- ☐ Flaring of alae nasi
- ☐ 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. Fig 10.1 shows Silverman Anderson respiratory severity scoring (RSS)

RESPIRATORY DISTRESS SEVERITY SCORING

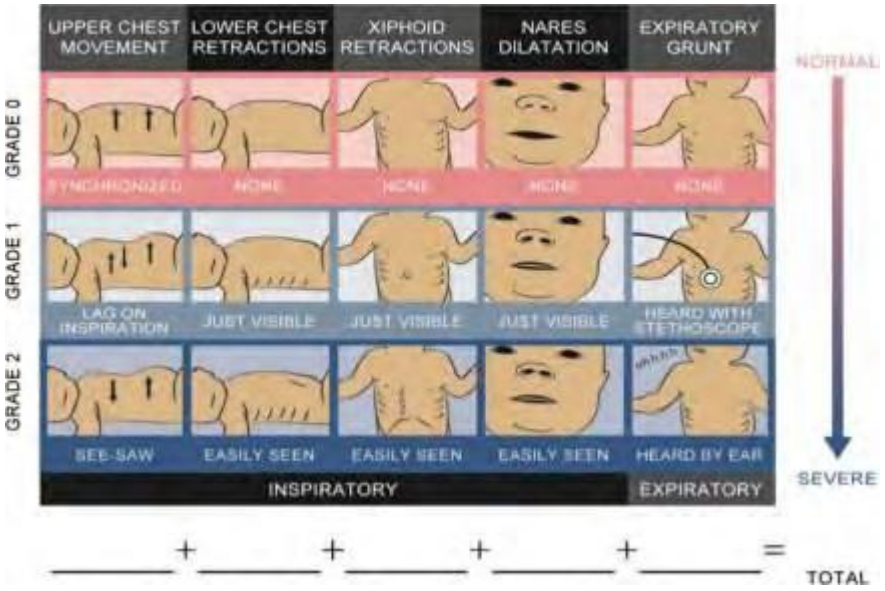


Figure 10.1: The Silverman Anderson Respiratory Severity Score (SAS)

The RSS evaluates five parameters of inspecting for work of breathing and assigns an overall score with a patient breathing comfortably a "0" and a patient in severe respiratory distress a "10".

Score <5 indicates mild respiratory distress and usually requires oxygen therapy (Oxygen hood, nasal prongs)

Score 5 – 7 indicates moderate respiratory distress and patient should be commenced on CPAP

Score >7 connotes severe respiratory distress/impending respiratory failure and may require mechanical ventilation.

The other scoring that has been used for assessment of respiratory distress is the Downe's Score (DS). The DS is used for assessment of both term and preterms; but the SAS has been validated mostly in the preterms. However, the two scores are used interchangeably in the preterms. One limitation of the DS is the parameter to assess in 40% FiO_2 blended oxygen; thus leading to the current Modified Downe's Score (See Table 10.1A and B)

Table 10.1A: *Downe's Respiratory Distress Score*

Score	0	1	2
Respiratory rate/min	<60	60-80	>80
Cyanosis	None	At room air	With 40% O2
Retractions	None	Mild	Moderate-severe
Grunting	None	Audible with Stethoscope	Audible without Stethoscope
Air entry	Clear	Decreased	Barely audible

Table 10.1B: *Downe's Respiratory Distress Score (Modified Version)*

Score	0	1	2
Respiratory Rate (rate/min)	<60	60-80	>80
Cyanosis	None in room air	No cyanosis with oxygen support	Cyanosis in spite oxygen support
Retractions	None	Mild	Moderate to Severe
Grunting	None	Audible with Stethoscope	Audible without Stethoscope
Air Entry	Good	Decreased	Barely Audible

Table10.2: *Simplified table for classification and management of breathing difficulty*

NUMBER OF BREATHS/MINUTE	GRUNTING OR CHEST INDRAWING		MANAGEMENT
More than 90	Present	Severe	• Stabilize baby and treat • Continue on oxygen • Organize transfer if at secondary facilities and baby is not improving
More than 90	Absent	Moderate	• If SPO2 <90%, start on bCPAP ; if not available start 02 via nasal prongs • Set up IV line/IV fluid at maintenance
60 – 90	Present	Moderate	• If SPO2 <90%, start on bCPAP ; if not available start 02 by nasal prongs • Set up IV line/IV fluid at maintenance
60 -90	Absent	Mild	• Start 0_2 by nasal prongs • Check SPO_2 after 15min: - If >90%, continue 0_2 - If <90%, start bCPAP

For all respiratory distress in newborns, stabilize the baby and treat any other co-existing problems.

If the breathing difficulty worsens at any time during the observation period or a congenital heart anomaly is suspected at the level 2 facility, REFER to a level 3 specialized centre.

CAUSES OF RESPIRATORY DISTRESS

Causes of respiratory disorders vary, may be respiratory or non-respiratory (central, cardiac, metabolic, mixed) in origin (See Fig 10.2).

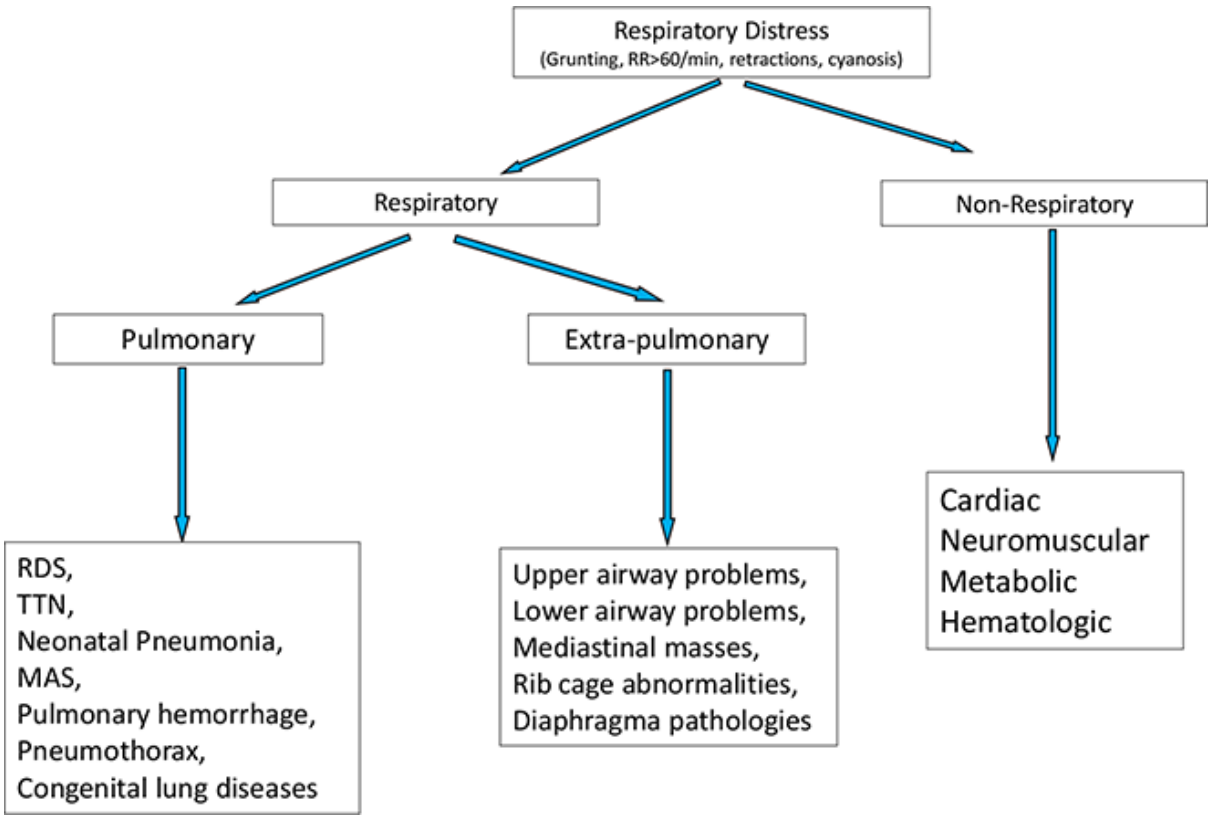


Figure 10.2: *Causes of respiratory distress in the newborn*

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

Table 10.3: *Common causes of respiratory distress and their typical presentations are summarized below:*

	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 negative for sepsis
Chest X-ray	Fluid in fissure, usually on the right 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.	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.

Investigations

- Oxygen saturation with oximetry
- Blood gas analysis
- Sepsis work-up
- Chest X-ray
- Echocardiography (if congenital cardiac defect is suspected)

Treatment approach

Aims of treatment:

- Resuscitation of the neonate
- Optimizing 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

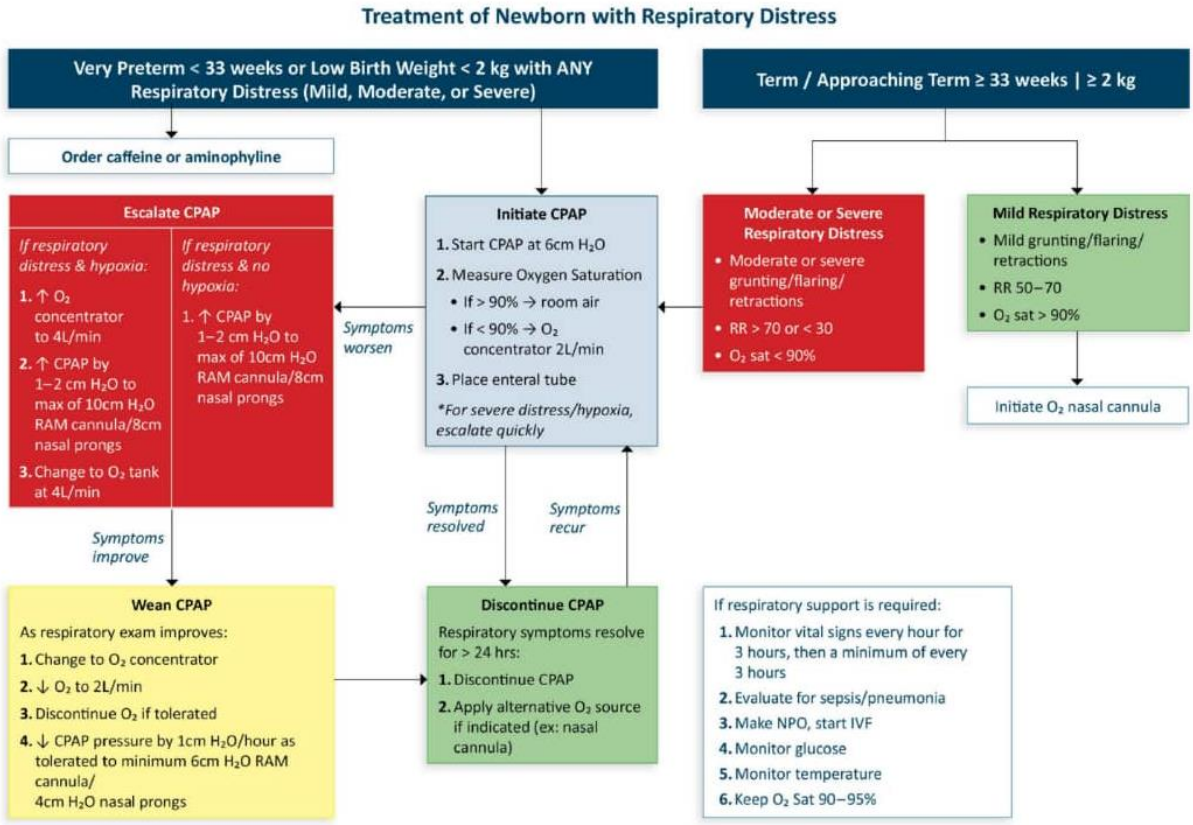


Figure 10. 3: *Algorithm for evaluation and treatment of a baby with respiratory distress*

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 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 utilized 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, stabilize glucose, correct electrolytes and acid base balance -as adverse factors reduce endogenous surfactant production (See Appendix 10.3; Newborn Early Warning Chart for danger signs).

Monitoring is key for all newborns. Use the sample Neonatal Standard Monitoring Chart (Appendix 10.1); and For the critically ill neonates in the NICU, Use the Sample Intensive Critical Care Monitoring Chart (Appendix 10.2) for intensive monitoring and documentation.

SURFACTANT REPLACEMENT THERAPY (SRT)

Exogenous surfactant has been shown to reduce neonatal mortality, death or bronchopulmonary dysplasia (BPD) and air leaks in at risk babies. The principle of administration is to deliver surfactant as early as possible to those infants with a high probability of surfactant deficiency.

Indications

- Neonates <28 weeks GA
- Neonates with clinical and radiographic evidence of RDS
- Neonates with RDS on CPAP requiring FiO_2 >30-40%
- Preterm neonates (<30 weeks) needing IPPV, intubation and needing mechanical ventilation at birth

Surfactant replacement therapy may also used for:

- 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

Administration Techniques

- Minimally Invasive Surfactant Therapy (MIST or LISA)
- INtubate-SURfactant-Extubate (INSURE)

Surfactant administration and mechanical ventilation should be for Level 3 specialist centres that have appropriate facilities and expertise.

PREPARATION OF EQUIPMENT AND SUPPLIES FOR SURFACTANT REPLACEMENT THERAPY

- Continuous cardiovascular monitoring equipment (Pulse Oximeter or Multi-parameter Monitor)
- Surfactant (all brands of surfactant are suitable for INSURE, BLES® is appropriate for both INSURE and MIST)
- Size 5-6 Fr feeding tube
- 5ml syringe
- Alcohol swab 70%
- Sterile towel or drape
- Tape measure
- Sterile scissors
- Emergency equipment: T-piece and mask, suction, BMV device
- Oxygen tube
- Laryngoscope with blades (00, 0, 1) - sterilised
- ETT sizes 2.0, 2.5, 3.0, 3.5
- Stethoscope
- Pulse oximeter or multi parameter monitor

Perform the following interventions

- Pre-oxygenation: the oxygen concentration should be increased to achieve SpO2 >95% before surfactant delivery.
- Suction airway and /or ETT and listen for the air entry.
- Record all vital signs (heart rate, RR, blood pressure, SpO2).
- Give strict instructions to your assistant/s.

Procedure

- Surfactant replacement therapy and the methods of administration are aseptic procedures and strict techniques of asepsis must be observed.

- Premedication to ease discomfort and prevent bradycardia may be considered using
- mother's expressed breast milk or sucrose oral drops and atropine (20mcg/kg) can be used to reduce secretions.
- Intubate.
- Administer surfactant (according to manufacturer's instruction on dose and frequency).
- Extubate to continue bCPAP or continue to mechanical ventilation (if indicated)
- Continue monitoring (O_2 Saturation, RR, HR)
- Ensure to readjust settings of respiratory support as needed after surfactant administration to reduce risk of pneumothorax.

Administration procedure for minimally invasive surfactant therapy(MIST):

- Maintain infant on bCPAP throughout procedure.
- Use 5-6F feeding tube, Mark feeding tube with tape indicating the tip to lip depth of insertion (6 cm plus weight of the infant in kg).
- Insert the tube through the vocal cords under direct vision using standard laryngoscopy technique
- After the tube placement, remove the laryngoscope and stabilize the tube using two fingers at the level of the upper lip.
- Once the tube is correctly positioned, connect the syringe with surfactant and administer the calculated volume of surfactant slowly over 5minutes
- Synchronize every surfactant bolus with the inspiration for ease of spread.
- Monitor the vital signs (HR, RR, and Oxygen Saturation) throughout the procedure.
- Remove the syringe from the tube and observe for surfactant reflux.
- At the end of the procedure, flush the tube with 0.5 ml of air before removing.

If the infant becomes bradycardic, or develops significant desaturation during the procedure, interrupt the administration of surfactant for 20 to 30 seconds until the vital signs return to baseline. During this time ensure the mouth is closed while continuing CPAP.

If the infant does not recover after a trial of increasing the bCPAP pressure and FiO2 levels and the vital signs remain unstable or deteriorate, or child is apnoeic stop the procedure and commence IPPV or intubate and ventilate the infant according to the neonatal resuscitation guidelines.

Note:

- Surfactant administration is a minimum two-person procedure.
- The infant must have cardio-respiratory monitoring throughout.
- A third person is ideally present, with the sole responsibility for continuous adjustment of respiratory support devices and monitoring.

Nursing Care for Surfactant Administration

- Before procedure, record baseline vital signs/observations: heart rate, respiration rate, oxygen saturation, plus a blood gas if required
- Assemble required materials and supplies; prepare the baby
- Assist the doctor during the procedure
- Monitor neonate's vital signs closely every 10 minutes for 30 minutes then resume hourly
- for four hours then 4hrly thereafter.

- A repeat blood gas should be performed 30-60 minutes post administration.
- Do not suction airways for 1 hour after surfactant administration unless signs of significant airway obstruction occur
- Note and report changes in non-pulmonary haemodynamics that may indicate significant changes - particularly in the very premature and/or unwell patient.

APNOEA IN THE NEWBORN

Definition Apnoea

Cessation of breathing lasting >20 secs or any duration associated with bradycardia and/or oxygen desaturation/cyanosis.

Bradycardia: is abnormally slow HR <100 beats per minute in the newborn.

Causes of Apnoea

Apnoea may be due to prematurity or secondary to other causes. It is most common in 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 reduces 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.
- 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.

Evaluation

- 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.
- Prompt response to alarm is required to ascertain cause of any desaturation.
- If no monitor is available it is important to closely observe neonate for cyanosis, mottling, and not breathing.
- Work up for apnea: -FBC, CRP, glucose, blood culture, RBS, serum electrolytes, serum aminophylline level if possible and cranial ultrasound scan to rule out IVH.
- If not tolerating feeds, +/- abdominal distension, consider necrotizing enterocolitis.

Prevention of apnoea of Prematurity

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 is able to 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

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 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

If apnoea 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.

second line antibiotics if already on 1st line antibiotics

- KMC should be continued or started if baby is stable.

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 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 assessment of the severity of the condition and avoids hypoxaemia

B. Care of neonate with MAS

1. Minimal handling to prevent agitation
2. Correct hypoglyacaemia
3. Pay particular attention to electrolytes particularly calcium and monitor blood gas (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 level above 15mg/dl (improves oxygenation)
7. Monitor renal function

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%, maximum CPAP pressure of 8cm and a 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
   a. Required if excessive CO_2 retention (PaCO2>60mmHg) or persistent hypoxaemia (PaO2<50mmHg)
   b. Infants require higher inspiratory pressures (30-35cm H2O), PEEP (3 to 6cm H2O) should be selected based on response. Adequate expiratory time

should be permitted to prevent air trapping behind partially obstructed airways

c. Useful starting points; inspiratory time of 0.4 to 0.5 seconds at a rate of 20 to 25 breaths per minute. Adjust as required
d. HFOV if not coping on conventional ventilation and in those who develop air-leak syndromes

3. Medications

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

Complications of MAS

a. Air leak; pneumothorax and pneumomediastinum in 15 to 33%. Common with mechanical ventilation, especially in the setting of air trapping.
- Treatment is by chest tube insertion for drainage
- Paediatric surgical consult

b. Persistent Pulmonary Hypertension of the Newborn: treatment options include:
- Inhaled nitric oxide
- Phosphodiesterase e.g. Sildenafil and Milrinone
- Cardiologist consult

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

CHAPTER 11: 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 commonest 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, could be one or more of the following:

1) **Oxygen concentrator:** Oxygen concentrators (Figure 11.1) are one of the most commonly used sources of oxygen therapy, concentrating 85-95.5% oxygen from ambient air using two sieve beds made of a substance that captures nitrogen. 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 11.5) 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 11.1: *A typical oxygen concentrator.*

METHODS OF ADMINISTRATION OF OXYGEN

1. Nasal prongs (also called nasal cannulae)

- Nasal prongs are preferred over nasal tube or catheter for delivering oxygen to newborns and young infants. The cannulae splits 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 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 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%.

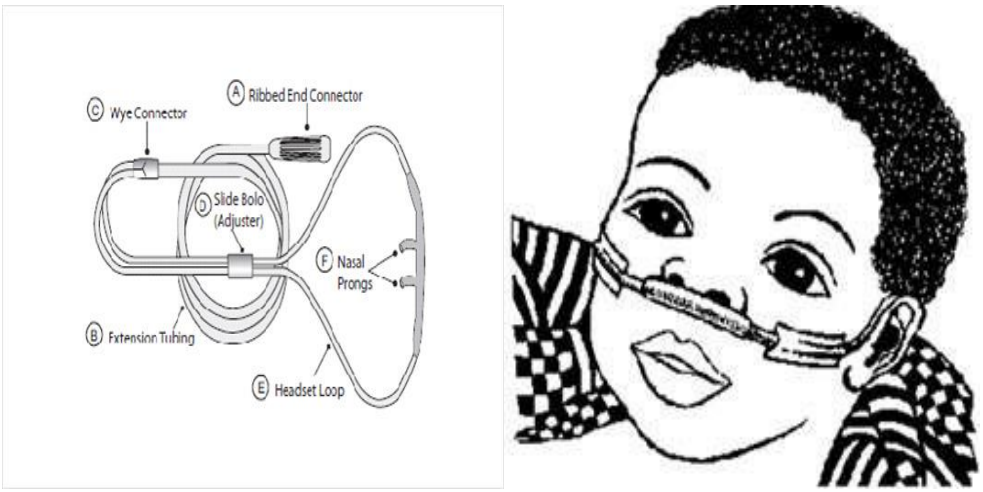


Figure 11.2: *Parts of a nasal prong (nasal cannulae) and a child using a nasal prong.*

2. Nasal tube/catheter

This is a thin, flexible tube (size 5-6 F) with some holes at the tip; that is passed into the nose and ends with its tip in the nasal cavity (see Fig.11.3). 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 11.3: Nasal catheter

3. Head boxes, incubators, tents and face-masks

These are non-invasive methods of oxygen administration. They require high oxygen flows up to 3- 4L/min to prevent rebreathing of expired air.

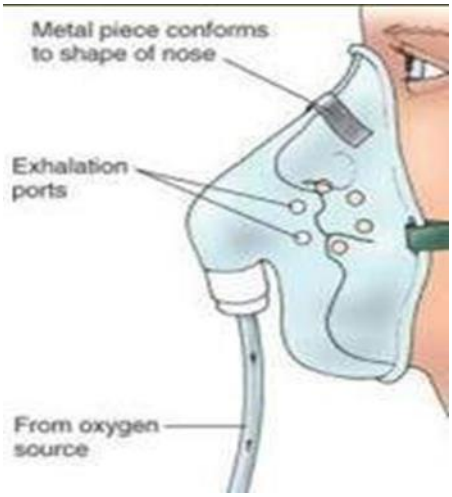


Figure 11.4: *A face mask device*

Table 11.1: *Oxygen delivery methods in children and infants*

METHOD	MAXIMUM O_2 FLOW (L/MIN)[a]	ACTUAL INSPIRED O_2 FRACTION (%) FROM 1 L/MIN BY A 5-KG INFANT	PEEP	HUMIDIFICATION	RISK FOR HYPERCAPNOEA	RISK FOR AIRWAY OBSTRUCTION	EQUIPMENT REQUIRED	NURSING DEMAND
Nasal prongs	Neonates: 0.5–1							
	Infants: 2							
	Preschool: 4							
	School: 6	45	Minimal	Not required	No	Minimal	Nasal prongs	+
Nasal catheter	Neonates: 0.5							
	Infants: 1	50	+	Not required	No	+	8-F catheter	++
Nasopharyngeal catheter	Neonates: 0.5							
	Infants: 1	55	++	Required	No	++	8-F catheter, humidifier	+++
Head box, face-mask, incubator, tent *Not recommended, as oxygen is used inefficiently*	Head box: 2–3 L/kg per min		Nil	Not required	Yes	No	Head box, face-mask	+++

F, French; PEEP, positive end expiratory pressure

[a] Higher flow rates without effective humidification may cause drying of nasal mucosa, with associated bleeding and airway obstruction.

Table 11.2: *WHO recommendation on Oxygen delivery methods*

	RECOMMENDATION	QUALITY OF EVIDENCE
1.	Nasal prongs are the p r e f e r r e d method of d e l i v e r i n g oxygen to infants with hypoxaemia who require oxygen therapy	Strong recommendations
2.	Where nasal prongs 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, 1-2L for infants	Moderate quality evidence
Source: Oxygen therapy for Children, WHO 2016		

Humidification is essential when cold oxygen is delivered from a cylinder through a nasopharyngeal catheter or when high oxygen flows are used. Humidifier reservoirs should be cleaned regularly to avoid bacterial contamination.

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 pulse oximeter, if oxygen saturations remain <90%, escalate O_2 quickly to 1 litre/minute up till a maximum of 2 litres/minute.
- Reassess after 30 minutes and if the O_2 saturation is still below 90%, administer O_2 at 4 litres/minute through 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 2 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 11.5: *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 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 11.6: Handheld Pulse oximeter

Figure 11.7: *Fixed pulse oximeter*

Normal SpO_2 for neonatal patients should be:

- 90% - 100% depending on age of the newborn and altitude of the geographical area
- Target SpO_2 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.

(*See the FMOH National Comprehensive Newborn Care Training Manual for details on oxygen concentrator, oxygen splitter and pulse oximeter).*

- **Peripheral pulse oximetry is a non-invasive and painless process of measuring oxygen saturation (oxygen bound to haemoglobin in the capillaries) and heart rate. It should be available in any facility that takes care of newborns.**
- **Saturations between 90-95% are reasonable to minimize complications associated with low and high oxygen levels, including chronic lung disease, retinopathy, of prematurity, neurodevelopmental impairment and death**

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.

CHAPTER 12: CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

Respiratory distress can cause hypoxia contributing to both morbidity and mortality. 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 to 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 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.

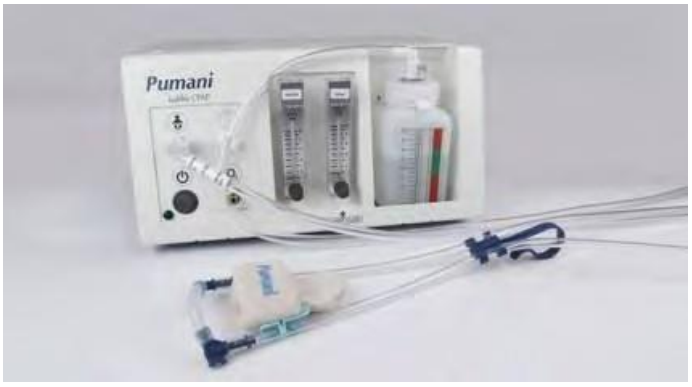


Figure 12.1: *A typical bubble CPAP (Pumani) device with patient circuit*

Figure 12.2: *Vayu CPAP device with patient circuit*

Figure 12.3: Fisher and Paykel *Bubble CPAP*

BUBBLE CPAP SYSTEM

General components of the CPAP set up include: Air-oxygen blender, Humidifier, warmer, circuits, Pressure generator and Interphase (binasal prongs, nasal mask). The system has three components:

1. Continuous gas flow into the circuit: The gas flow rate required to generate CPAP is usually 5–10 L/min and usually requires an oxygen blender.
2. A nasal interface connecting the infant's airway with the circuit: short nasal prongs are generally used to deliver nasal CPAP. They must be carefully fitted to minimize leakage of air (otherwise, CPAP will not be achieved) and to reduce nasal trauma.
3. An expiratory limb with the distal end submerged in water to generate end expiratory pressure.

Indications

CPAP may be used to treat neonatal patients with:

- Increased work of breathing (tachypnoea RR >60 breathe/min, nasal flaring, dyspnoea, grunting, head nodding, severe recession, cyanosis) or an oxygen requirement of >1 L/min with saturations of <90%, in premature or term infants
- Respiratory Distress syndrome (RDS)
- Apnoea of prematurity
- Following neonatal resuscitation
- Congenital pneumonia
- Severe transient tachypnoea of the newborn
- 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

Contraindications to nCPAP

- 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 $PaCO_2$ at < 60 mmHg and to maintain at pH > 7.25
- *See the FMOH National Comprehensive Newborn Care Training Manual for details on CPAP equipment).*

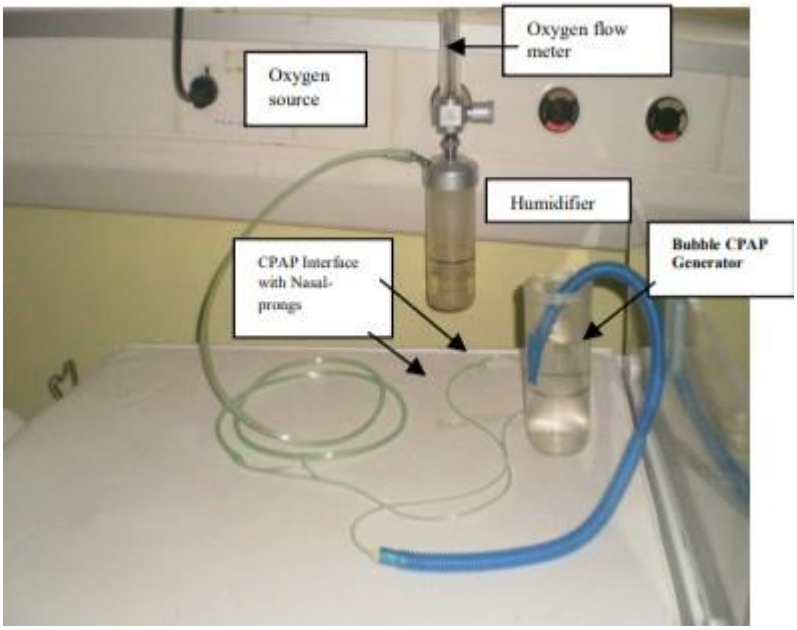


Figure12.4: *Setting up a Bubble CPAP system*

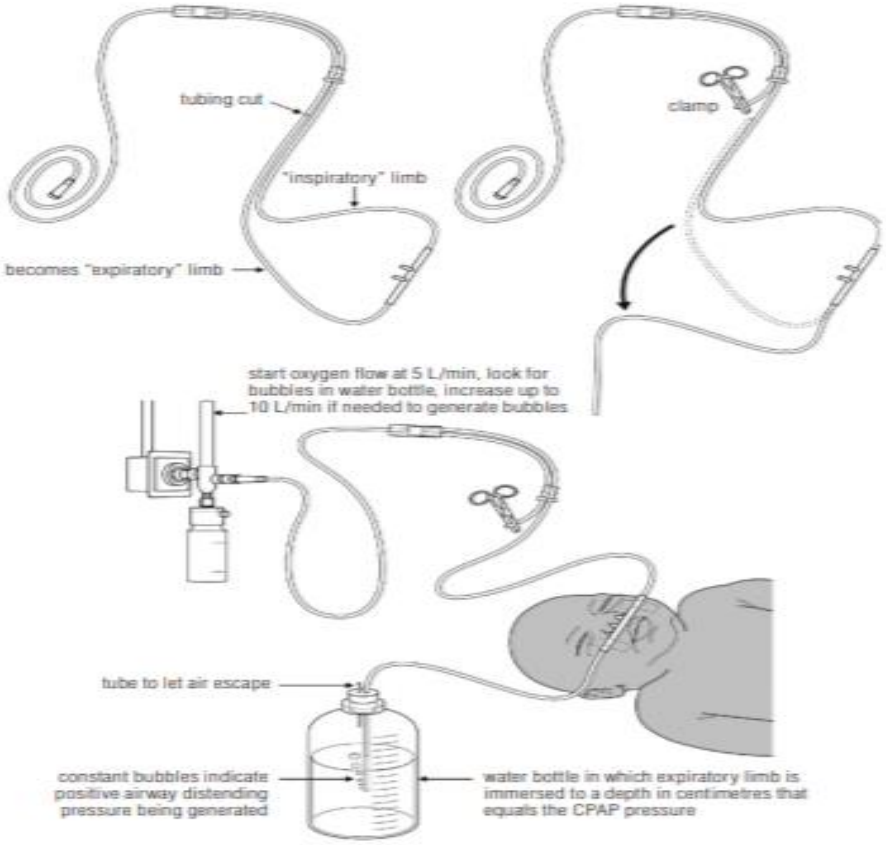


Figure 12.5: *Schematic diagram of a Bubble CPAP set up*

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 (Figure 12.6). 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 half hourly 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

Pumani CPAP Monitoring Sheet

Patient Name:	**Date of Birth:** dd__/__mm__/_yyyy_ **Birth Weight:** ____ g
Day of life:	**Today's Date:** dd__/__mm__/_yyyy_ **Current Weight:** ____g
Diagnosis:	
Indications for CPAP:	

Patients on CPAP must be monitored VERY closely!!
- Assess patient ***1 hour*** after starting CPAP or making any setting changes
- Assess patient ***every 6 hours*** if stable on CPAP settings

CPAP ASSESSMENTS

Goals: RR < 60, SpO2 > 90%, Improved Respiratory Distress

Date & Time	Current CPAP Settings					RR	HR	SpO2	Temp	Signs of Respiratory Distress			Abd Dist	OGT	Suction/ saline drops	Changes Made	Signature
	Water Level	Total Flow	O2 Flow	Bubbling	Prongs in place / Check hat					Grunting	Nasal Flaring	Recessions (mild, mod, severe)					

Routine Initial CPAP Settings: Water level = 6 cm, Total flow = 6 L/min, O2 flow = 3 L/min

Figure 12.6: *Sample CPAP Monitoring Chart*

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 reduction of 1cmH_2O every 12-24 hours.

The timing and rate of weaning will be decided by the managing team and baby's response.

When the infant has demonstrated a stable respiratory pattern on CPAP of <5cmH_2O in <30% oxygen for 12-24 hours, the CPAP may be discontinued.

Complications of CPAP

- Gastric distension and vomiting; hence pass orogastric tube once starting CPAP to prevent "CPAP Belly".
- Risk of air leak syndromes (e.g pneumothorax)
- Reduction in cardiac output if increased pressures
- Nasal obstruction from mucus plugging
- Nasal excoriation, scarring, pressure necrosis, and septal distortion.
- Skin irritation of the head and neck from improperly secured bonnets or CPAP head harnesses.

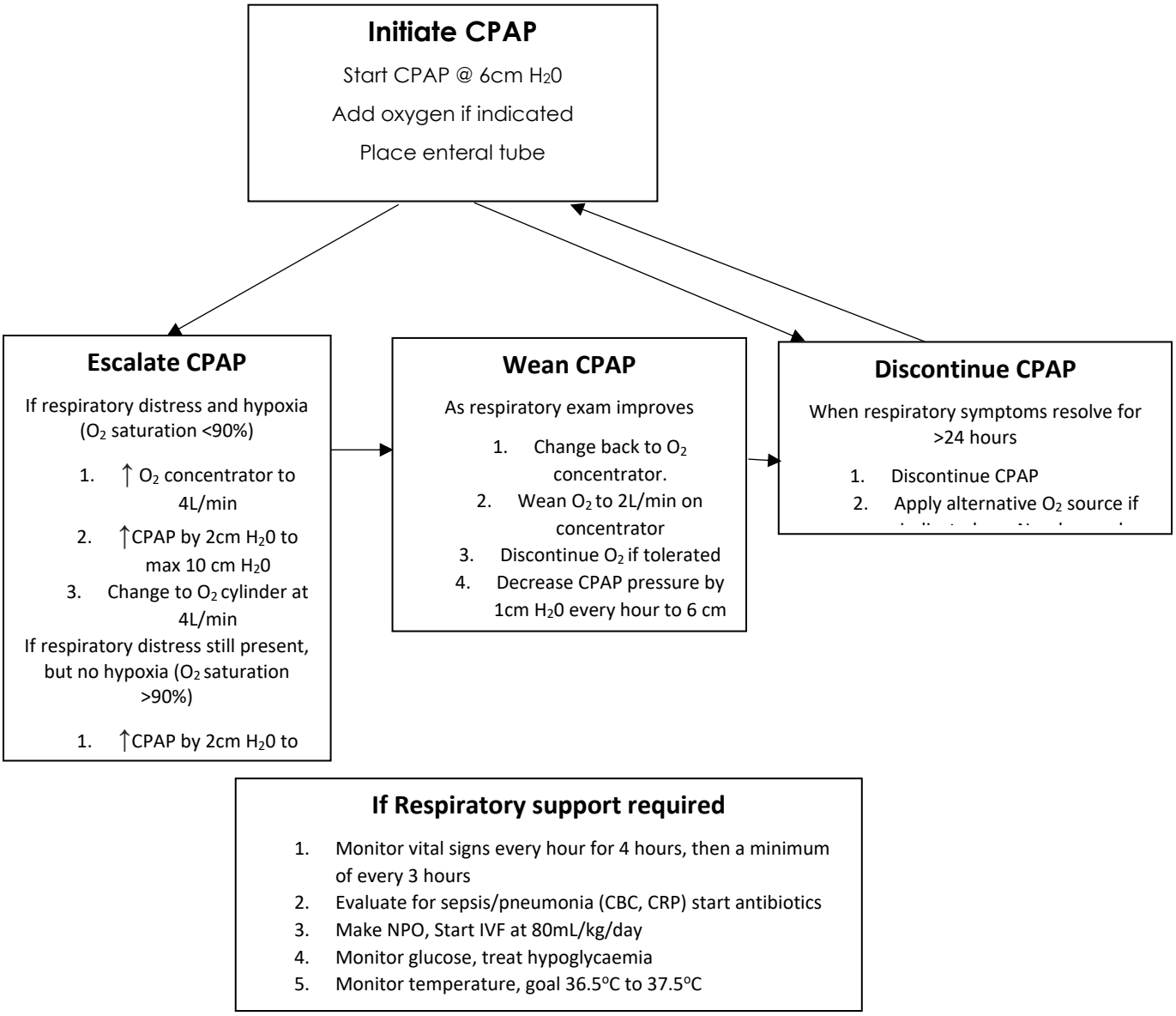


Figure 12.7: *An algorithm for the management of a newborn on CPAP*

CHAPTER 13: OTHER MODES OF RESPIRATORY SUPPORT

HIGH FLOW NASAL CANNULA(HFNC)

High Flow Nasal Cannula is a mode of 'non-invasive' respiratory support for preterm and term infants; and entails the delivery of humidified, heated and blended oxygen/air to flow rates greater than 1litre/min (2 – 8 L/min) via a nasal cannula (bi-nasal prongs). Baby to be breathing spontaneously.

Benefits of HFNC:

- Babies on HFNC appears to be well settled and comfortable; and accommodates feeding better than CPAP
- Less abdominal gaseous distension than other flow devices
- Babies do not require "time off" for nose breaks as the seal is not complete like in CPAP.
- Easy to see more of the baby's face
- HFNC is flow- based while CPAP is mostly pressure-based.
- Easier access for cranial ultrasound scans.

Indications for HFNC:

- Non-invasive ventilation of preterm/extremely preterm infants.
- HFNC reduces and "washes out" upper airway/nasopharyngeal dead space and resistance; and is considered a less invasive respiratory support than CPAP.
- Non-invasive ventilation for infants with parenchymal lung disease (Hyaline Membrane disease/pneumonia/Chronic lung Disease/Meconium Aspiration Syndrome/pulmonary hypoplasia/bronchiolitis).
- Treatment/prevention of apnoea of prematurity.

Instituting HFNC:

- Attach appropriately sized nasal cannula
- Cannula should not obstruct or be larger than ½ the diameter of the nostrils (~50-80% nares) to prevent occlusive seal unlike in CPAP in which occlusion is desired for effect.
- Adjust the flow to the desired rate and place the cannula on the patient
- Operational flow rates range from 2 – 8 L/min
- Start at flow rate of 6-7 L/min
- Start at flow rate of 3 L/min for 32-34 weeks gestation, 4 L/min for 34-36 weeks gestation and 4-5 L/min for > 36 weeks gestation. Maximum flow of 6 L/min for stable patients, up to 7 L/min for unstable patients awaiting CPAP or transfer
- Flow can be increased in increments of 0.5-1 L/min (maximum 8 L/min)
- Minimal handling - judicious approach to interventions/investigations

Failed HFNC defined by any of:

- FiO_2 > 60% required to maintain normal oxygen saturation >90%
- Respiratory acidosis with a pH <7.2
- Recurrent apnoea requiring bag/mask ventilation.

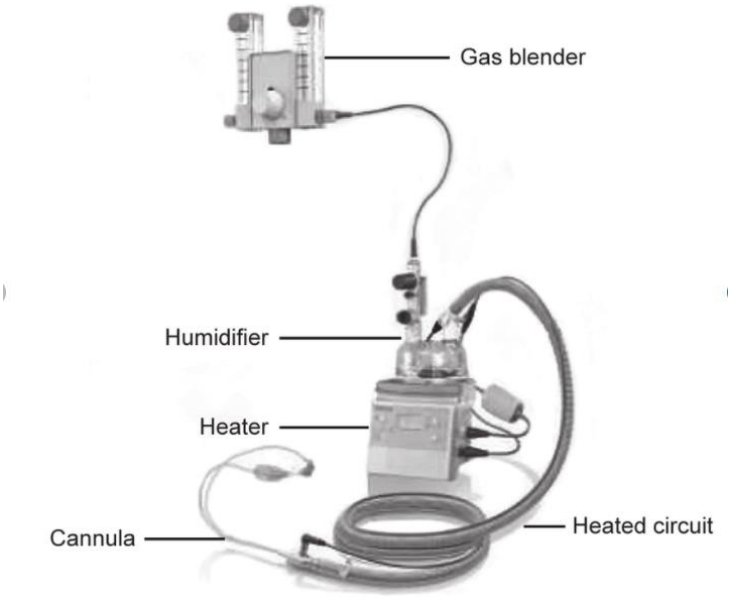


Figure 13.1: Basic Components of a High-Flow Nasal Cannula (HFNC) system

MECHANICAL VENTILATION (FOR LEVEL 3 CENTRES IF AVAILABLE)

Assisted ventilation involves the delivery of flow and pressure to the patient's airway in order to effect change in lung volume.

A mechanical ventilator is a machine that generates controlled flow of gas into a patient's airway and takes over the action of breathing.

Indications

- Apnoea: cessation of breathing.
- Inadequate respiratory drive
- Circulatory failure/cardiogenic shock
- Failed CPAP: FiO_2 >0.6 after surfactant or respiratory acidosis with pH < 7.2
- Inability to protect airway (low GCS/BCS coma scales)
- Congenital anomalies-congenital diaphragmatic hernia, large tumors obstructing the airways.

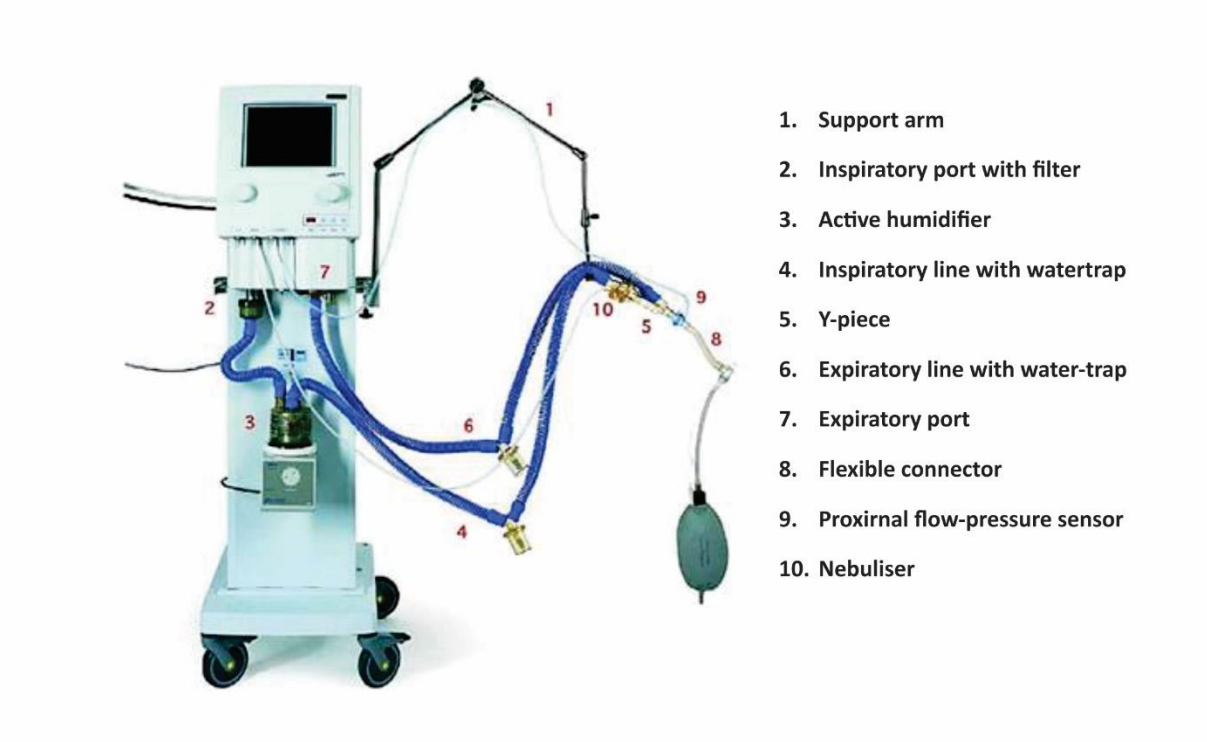


Figure 13.2 *--: A mechanical ventilator for intensive care, with the external circuit*

Mechanical ventilation Terminologies

1. Inspiratory time (Ti): set time for inspiration
2. Expiratory time (Te): set time for expiration
3. Inspiratory: Expiratory (I:E) ratio: the ratio of inspiratory to expiratory time
4. Rate (RR)/frequency (F): set number of breaths delivered over a minute.
5. Fraction of inspired oxygen FiO2:
6. Flow rate (V insp) and (V exp): Volume delivered per unit time.
7. Peak inspiratory pressure (PIP): the maximum pressure used to inflate infant's lungs during inspiration.
8. Positive end expiratory pressure (PEEP): the pressure above zero at the end of expiration. Provides continuous distending pressure to the infant's lungs.
9. Mean airway pressure (MAP): average pressure generated by the ventilator over each inspiratory / expiratory cycle (value will depend on rate, pressures (PEEP, PIP) and tidal volume).
10. Tidal volume (VT): the volume of gas inspired or expired during a breath. The desired tidal volume for neonates is 4-6mls/kg.
11. Minute volume (MV): the amount of gas that passes in or out of the infant's lungs during one minute. (Minute volume = tidal volume x rate). The desired minute volume in neonates is 200-400mls/kg.

Initial ventilator settings

- Positive end expiratory pressure (PEEP) is usually set at 4-6 cm water. Severe lung disease or abdominal splinting requires the higher pressure.
- In the Volume targeted mode (recommended), set tidal volumes (VTE) at 4-6 ml/kg.

- In Pressure mode, the Peak inspiratory pressure (PIP) should be set to just enough to achieve adequate chest movement and expired tidal volumes (VTE) of 4-6 ml/kg. In a preterm with lung disease initially set PIP at 18cm H_2O. Normal lungs rarely require PIP>12cm H_2O.
- Rate: initially 40 breaths per minute, if lung disease is present – decrease after surfactant administration. Use a much lower rate (30) if the lungs are normal
- Inspiratory time (T_i): 0.35 – 0.4 seconds. Use the lower T_i for fast rate or AC mode (T_i termination set by senior clinician)
- Pressure support: set at 2/3 of PIP initially. Pressure support is not set in Assist Control mode as every spontaneous breath is fully supported.

Modes of mechanical ventilation

- A mode of mechanical ventilation is the set of operating characteristics that controls how the ventilator functions.
- It describes the way a ventilator is triggered into inspiration and cycled into expiration, what variables are limited during inspiration and whether or not the mode allows only mandatory or spontaneous breaths or both.
- The terminologies associated with ventilator modes indicate the type of breath being delivered and how the breaths are triggered, controlled and cycled. Some of the modes can be combined.

Basic modes of mechanical ventilation

1. Synchronized mandatory ventilation (SMV)- Ventilator breaths are synchronized with patient's inspiration.
2. Synchronized intermittent positive pressure ventilation (SIPPV)
3. Patient triggered ventilation (PTV)
4. Assist control ventilation (AC)
5. Pressure support ventilation (PSV)
6. Volume control ventilation (VC)
7. High frequency oscillation ventilation (HFOV)
8. High frequency jet ventilation (HFJV)

Monitoring of a baby on mechanical ventilation

i. Ensuring the ventilator delivers the correct settings prescribed by the medical team
ii. Checking the ventilation parameters continuously and document any changes made.
iii. Assess for endotracheal tube displacement or obstruction, pneumothorax, or equipment malfunction if the patient's clinical condition changes while receiving mechanical ventilation (DOPE: D=dislodgement; O=obstruction; P=pneumothorax; E=Equipment)
iv. Monitoring the patient and notifying the medical team immediately, should the baby's condition deteriorate. Anytime a problem is encountered with the ventilator, your first action should be to remove patient from the ventilator, and ventilate manually with bag and mask (with PEEP valve if available)
v. Assessing the infant on admission, after intubation, on taking over the shift and at other times/intervals specified by the medical team. Such nursing assessment shall include:
   - General appearance, colour, perfusion, tone
   - Respiratory rate/effort, adequacy and symmetry of chest expansion, breath sounds

- Observe for any significant leak around the tube

vi. Documentation of ventilator parameters and settings
vii. Noting the adequacy of humidification
viii. Setting ventilator alarms correctly and responding promptly to alarms
ix. Suctioning the airway as required
x. Pulse oximetry and/or transcutaneous oxygen monitoring
xi. Positioning and pressure care

Target arterial blood gas (ABG) values:

ARTERIAL BLOOD GAS variables	NORMAL VALUES
pH	7.35-7.45 (Acceptable: Preterm: 7.28-7.32
$PaCO_2$	35-45 mmHg
PaO_2	50-70 mmHg (Term infants) 45-65 mmHg (preterm)
HCO_3	20-24 mEq/L
Base excess	-5 to + 5 mEq/L

Weaning off from ventilator

- Weaning is the process of stepping down the ventilator support towards discontinuation and removal of the endotracheal tube. Weaning and extubation shifts the work of breathing from ventilator to patient.
- Pre-requisites for weaning
- Improvement or resolution of the indication for its commencement
- Adequate gas exchange
- Low positive end expiratory pressure (PEEP)
- Low fraction of inspired oxygen (FiO_2)
- Presence of respiratory drive to initiate and maintain spontaneous breathing
- Stable haemodynamic state
- Post extubation management
- Start bCPAP or HFNC immediately after extubation
- Commence methylxantine, preferably Caffeine (if baby has not been on it)
- Systemic steroids and diuretics may be useful in preterms
- Supportive management: correct anaemia; adequate nutrition, and very close monitoring.
- Prone positioning can be helpful in stabilizing the chest wall and improving diaphragmatic excursion.

CHAPTER 14: PERINATAL ASPHYXIA

Perinatal asphyxia refers to when the baby does not begin or sustain adequate breathing at birth. Lack of oxygen supply to organs especially the brain before, during, or immediately after birth, results in multi-organ dysfunction especially hypoxic ischaemic encephalopathy (HIE). Clinical features evolve in these babies within the first 2-3 days of life.

COMMON RISK FACTORS FOR INTRAPARTUM ASPHYXIA

- High risk pregnancy
- Non-reassuring cardiotocography (CTG)
- Fetal heart rate abnormalities during labour (fetal bradycardia/tachycardia)
- Arterial blood gas analysis with pH <7 or base deficit > 12 mmol/L from fetal scalp sampling
- Prolonged labour
- Meconium staining of liquor
- A sentinel event (such as ruptured uterus or abruptio placenta or placenta previa)

Table 14.1: *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 • Anaemia • Infection • Congenital malformations	• General anaesthesia • Epidural anaesthesia • Maternal drug therapy • Pregnancy-induced Hypertension • Chronic hypertension • Maternal infection • Maternal diabetes mellitus • Antepartum haemorrhage	• Chorioamnionitis • Placenta previa • Placental abruption • Cord prolapse • Polyhydramnios • Oligohydramnios

ASSESSMENT OF NEWBORNS WITH PERINATAL ASPHYXIA

1. Always obtain history of pregnancy, labour, fetal heart monitoring, medications in 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 on 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 > 100bpm
   - Time of onset of regular (non-gasping) respirations
   - Drugs/fluid administered to infant
3. May need to check placental tissue—appearance, surface, weight and size and send for histology if any anomaly is suspected.
4. Consider 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, abnormal neurologic exam, abnormal tone, and seizures
5. Note that every organ may be affected by asphyxia even in the absence of HIE

Apgar score is usually assigned to describe the newborn's clinical state during the first few minutes of life.

Note that resuscitation of any baby who is not breathing at birth must have commenced immediately at birth. Do not delay resuscitation.

6. APGAR SCORE record
   - Apgar score is assigned to describe the newborn's condition from the 1st minute of life after resuscitation has commenced and the 5th minute; and can be extended to 10th, 15th and 20th minute depending on the baby's response during resuscitation.
   - In view of the subjective nature of the Apgar score it is considered more appropriate to document in clear terms the infant's condition in terms of heart rate, breathing, colour and tone. These assessments can be made at regular intervals during resuscitation.
   - Document all information in baby's record.

Table 14.2: *APGAR Score Chart*

Apgar Score	0	1	2
Heart rate	Absent	<100 beats/min	>100 beats/min
Respiration	Absent	Slow, irregular	Good. Crying
Muscle	Limp	Some flexion of extremities	Active motion
Reflex/irritability (response to simulation)	No response	Grimace	Cough
Color	Blue or pale	Body pink, extremities blue	Pink

CLINICAL SYMPTOMS AND SIGNS OF HIE

Clinical signs vary with time. Moderately or severely affected infants typically develop increasingly obvious signs during the first 48-72 hours. Seizures are often subtle.

There are three stages of encephalopathy (See Table 14. 3: Sarnat and Sarnat Staging chart)

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

Other signs and symptoms related to effects on other organ systems

- Renal system – oliguria, anuria, fluid retention, haematuria (late)
- Respiratory system – persistent pulmonary hypertension - respiratory distress, Hypo/hyperventilation
- Cardiovascular system – bradycardia, arrhythmias, hypotension, PDA, cardiogenic shock
- Digestive system – feeding intolerance, abdominal distension, NEC
- Haematological system – bleeding (DIC), thrombocytopenia
- Immunologic system – increased predisposition to infection
- Metabolic abnormalities – SIADH, hyponatraemia, hypo/hyperglycaemia, hypocalcaemia, hypomagnesaemia, hyperbilirubinemia.

Table 14.3: *Sarnat and Sarnat HIE Staging Chart*

	Stage 1	**Stage 2**	**Stage 3**
Level of consciousness	Hyperalert	Lethargic or obtunded	Stuporous
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	Overactive	Weak or absent
Tonic neck	Slight	Strong	Absent
Autonomic function	Generalized sympathetic	Generalized parasympathetic	Both systems depressed
Pupils	Mydriasis	Miosis	Variable, often unequal, poor light reflex
Heart rate	Tachycardia	Bradycardia	Variable
Bronchial and salivary secretions	Sparse	Profuse	Variable
Gastrointestinal motility	Normal or decreased	Increased, diarrhoea	Variable
Seizures	None	Common, focal or multifocal	Uncommon (excluding decerebration)
Electroencephalogram findings	Normal (awake)	**Early:** low-voltage continuous delta and theta **Later:** periodic pattern (awake) Seizures: focal 1-to 1-Hz spike-and-wave	**Early:** periodic pattern with Isopotential phases **Later:** totally isopotential
Duration	Less than 24 hours	2 – 14 days	Hours to weeks

Investigations

- Blood gas analysis including lactate
- Blood glucose
- FBC, Blood culture
- Serum EU/Cr, calcium, magnesium
- Clotting profile

Urine test

- Urine dipsticks for specific gravity, proteinuria, haematuria and glycosuria

Cranial ultrasound: Perform at least on Day 1 and again at Day 7-14. Cranial US may show gross anatomy, established damage at birth and evolving focal or global injury. Typical features include:

- Generalised increase in echogenicity, indistinct sulci and narrow ventricles (cerebral oedema)
- After 2–3 days of age, increased echogenicity of thalami (basal ganglia structures) and parenchymal echo densities
- After 1week, parenchymal cysts, ventriculomegaly and cortical atrophy may develop

Cerebral Doppler

- Early finding of relative increase of end-diastolic blood flow velocity compared to peak systolic blood flow velocity (Resistive Index <0.55) in middle cerebral artery predicts poor outcome (repeat after 24 hr)

Cerebral function monitoring using amplitude integrated electroencephalogram (aEEG)

- Normal trace should be upper margin >10 microvolts and lower margin >5 microvolts
- Moderately abnormal trace upper margin >10 microvolts and lower margin <5 microvolts
- Severely abnormal upper margin below 10 microvolts and lower margin below 5 microvolts

Conventional EEG

- Normal EEG during first 3 days is associated good prognosis
- Abnormal background activity is associated with a poor outcome

Magnetic resonance imaging (MRI)

This is the best neuroimaging which gives information on nature, timing and extent of brain lesion, and prognosis in neonatal encephalopathy. If available, it is best done at 7-14 days for optimal prognostic information.

Typical findings include:

i. Abnormal signal intensity in basal ganglia and thalami
ii. Loss of normal signal in the posterior limb of internal capsule
iii. Loss of grey/white matter differentiation
iv. Watershed injury

Perform Thompson Score (For daily assessment of baby)

- The Thompson HIE score should be performed on admission, before age 5 hours, and daily while on admission until normal or age 7 days. This allows for monitoring of evolution or resolution of encephalopathy
- Total score staying below 10 and becoming 0 at 1 week of age carries a good prognosis,
- Typically improves over the first few days in infants with a good outcome
- Peak total score above 15 predicts poor outcome in 92%
- It can be assessed in mechanically ventilated infants,
- Limited usefulness in sedated infants
- Increases to a maximum on day 3 to 4 and then improves slowly over many days in infants who go on to develop cerebral palsy

Table 14.4: *Thompson HIE scoring Chart*

Sign	0	1	2	3
Tone	Normal	Hypertonia	Hypotonia	Flaccid
LOC	Normal	Hyperalert, Stare	Lethargic	Comatose
Fits	None	< 3 Per Day	> 2 Per Day	
Posture	Normal	Fisting, Cycling	Strong Distal Flexion	Decerebrate
Moro	Normal	Partial	Absent	
Grasp	Normal	Poor	Absent	
Suck	Normal	Poor	Absent ± Bites	
Respiration	Normal	Hyperventilation	Brief Apnea	IPPV (Apnea)
Fontanel	Normal	Full, Not Tense	Tense	

Maximum Score = 22, Mild HIE: 1-10, Moderate HIE: 11-14, Severe HIE: 15.
LOC: Level of consciousness.

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 SpO_2 at 92-95%
- Maintain body normal temperature (36.5^{o}C – 37.5^{o}C). 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 – 50ml/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 boluses

- 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 be done only by skilled personal where absolutely necessary for adequate monitoring of urinary output, it is safe to use external urine bag.
- Avoid hypothermia except therapeutic cooling will be available within 6 hours
- Therapeutic hypothermia within 6 hours of birth for 72 hours if neonate meets criteria (for Level 3 centres) if facilities available.

Fluid balance, circulation, acidosis and metabolic management

- Intrinsic renal failure and syndrome of inappropriate antidiuretic hormone (SIADH) secretion commonly occur.
- Initial fluid restricted to 40 – 50ml/kg/24 hours till satisfactory urine output.
- 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 dobutamine starting at 5 mcg/kg/min as first line. If not available give dopamine at 5mcg/kg/min and increase as necessary.
- An echocardiogram can assess cardiac function to guide fluid and inotrope management. Endeavor to use routine serial Blood Pressure and urine output if no echo.
- Assess baby for further fluid restriction if serum sodium decreases below 130mmol/L, if there is excessive weight gain or if there is failure to gain weight /or
- Or if features of fluid retention (facial puffiness, bloating and sacral oedema).
- Acidosis will normally correct itself once adequate respiratory and circulatory support provided. There is no proven benefit of routine sodium bicarbonate to treat lactic acidosis.

Glucose

- Regular blood glucose monitoring at least 4-6hrly.
- Target levels >45mg/dl (>2.6 mmol/L).
- Avoid hyperglycaemia RBG levels >150mg/dl (>8 mmol/L).
- Adjust according to further monitoring.

Monitor electrolytes. Serum EU/Cr/Calcium /Phosphates

- Asphyxiated babies are at increased risk of early hypocalcaemia.
- Hypocalcaemia and hypomagnesemia should be anticipated and treated.
- Treat with calcium gluconate when total serum calcium <8 mg/dL (2 mmol/L) or ionized calcium <4.4 mg/dL (1.1 mmol/L) in term infants and preterm infants weighing ≥1500 g; total serum calcium <7 mg/dL (1.75 mmol/L) or ionized calcium <4 mg/dL (1 mmol/L) in infants weighing <1500 g.
- Treat hyponatraemia < 130 mmol/l according to cause (Acute kidney injury (AKI) or SIADH)

Seizures

- Prophylactic anticonvulsants are not indicated
- Watch out for seizures which may set in 6 – 36 hours after insult. Keep a Seizure Chart.
- Give intravenous (IV) phenobarbitone 20mg/kg loading dose (or IM if no IV line), if seizure persist within 30 -60 minutes, repeat phenobarbitone in aliquots of 5-10mg/kg up to a maximum of 40mg/kg total. Followed 12- 24hrs later by a maintenance dose of 5mg/kg/day. For uncontrolled seizures move to 2nd line, give phenytoin. Give Levetiracetam if available.
- If no response, give 3rd line; clonazepam or midazolam (see guideline for management of neonatal seizures below)
- Once baby is seizure free for 48 – 72hours, anticonvulsants can usually be discontinued.
- Consider neuroprotective agents (example-magnesium sulphate)
- Avoid mannitol except in symptomatic raised intracranial pressure (ICP).
- No role for corticosteroids.

Gastrointestinal system

- Some babies with severe HIE are unable to suck for several weeks and require tube feeding
- Term babies who suffer a severe asphyxial insult are at risk of developing necrotizing enterocolitis (NEC), gastric motility can be reduced so introduce enteral feeds slowly.
- If NEC develops, follow guideline for management of NEC

MONITOR HAEMOGLOBIN AND COAGULATION PROFILE

- Treat active bleeding with vitamin K1 (1-2mg/kg IV) and fresh frozen plasma (FFP) (15mls/kg over 30 minutes) – consider cryoprecipitate if poor response or low fibrinogen.

COMMUNICATION WITH PARENTS

- Explain the clinical condition 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 as their baby may be very sick and the outcome of HIE is often poor. Encourage the mother to hold her baby.

DOCUMENTATION, DISCHARGE AND FOLLOW-UP

- Document in case records if HIE as mild, moderate, or severe.
- Document parental counselling done, occipitofrontal circumference (OFC), Seizures
- Arrange clinic follow-up 1 week after discharge
- Repeat cranial ultrasound scan before discharge
- Arrange hearing screen
- If severe HIE, arrange for a physiotherapy appointment (initially floppy infants often become

stiff requiring the mother to learn massage and basic physiotherapy skills) and follow up at six months - focus on head growth, general health, and motor neurodevelopment. Assessments through 12 to 24 months of age to focus on cognitive skills and language development.

PROGNOSIS

- Risk of long-term problems increases with the degree of encephalopathy
- Overall risk of death or significant handicap is high if Apgar score is <5 at 5minutes and increases with severity of HIE
- Poor prognostic factors include
  i. prolonged encephalopathy
  ii. persistent oliguria
  iii. prolonged duration of ventilation
  iv. prolonged need for anticonvulsants/intractable seizures
  v. long duration of time taken to establish oral feeding
  vi. multi-organ failure
  vii. persistent burst suppression pattern on cerebral function monitoring on aEEG

- **Mild HIE – usually normal outcome**
- **Moderate HIE – increased risk for developmental delay including cerebral palsy**
- **Severe HIE – mortality high, severe developmental delay and**
- **cerebral palsy in survivors**

PREVENTION OF PERINATAL ASPHYXIA

The prevention of perinatal asphyxia involves the following:

- Recognition of high-risk pregnancies.
- Recognition of IUGR and placental insufficiency.
- Accurate assessment of gestation and the use of antenatal steroids.
- Appropriate management of postmaturity.
- Assessment of fetoplacental function, e.g. Doppler ultrasound, fetal movements.
- Appropriate intrapartum fetal heart rate monitoring.
- Treatment of fetal distress in utero, e.g. mother in left lateral position, maternal oxygen and expedite delivery.
- Ensuring that all birth attendants are trained in neonatal resuscitation.
- Good communication between maternity and neonatal teams.
- Ensuring that a person with advanced resuscitation skills is available for high-risk deliveries or where there is an anticipated problem.

FOR LEVEL THREE CENTRES

CRITERIA FOR THERAPEUTIC HYPOTHERMIA FOR HIE

Therapeutic cooling is a process of maintaining a baby in strictly controlled moderate hypothermia range of 33 – 34^{0}C in the first 72hours post asphyxia insult. It helps to protect neuronal function. It may be total body cooling or selective head cooling. It should not be confused with inadvertent cooling in which babies who develop hypothermia are not rewarmed prior to commencement of therapeutic cooling. All infants that are considered for cooling should be assessed for these criteria before cooling:

A. All of the following:

1. ≥ 35-weeks gestation
2. Birth weight > 1800g
3. Able to begin cooling by age 6 hours
4. Absence of: severe congenital anomaly; or uncontrolled bleeding, systemic hypotension, and/or pulmonary hypertension (FiO_2 > 0.8) not responding to treatment

AND

B. Suspected intrapartum hypoxia based on the presence of at least one of the following:

1. First hour blood gas (cord/infant/arterial/capillary/venous): pH ≤ 7 or base deficit ≥ 10mmol/l
2. 5-minutes Apgar < 7 or assisted ventilation at birth continued for ≥ 10 minutes
3. Moderate-severe neonatal encephalopathy with abnormal amplitude – integrated EEG (aEEG) occurring at any time during the first 6 hours

CHAPTER 15: NEONATAL ENCEPHALOPATHY / NEONATAL SEIZURES

Neonatal encephalopathy is defined as neurologic dysfunction in the earliest days of life in an infant and can manifest as seizures, altered level of consciousness, apnoea, depressed tone and reflexes.

The commonest neonatal encephalopathy in newborns, is HIE which is the neurological complication of perinatal asphyxia. Other underlying aetiologies of neonatal encephalopathy include: toxins (kernicterus); metabolic abnormalities (hypocalcaemia, hypoglycaemia), inborn errors of metabolism, intracranial bleeding, CNS infections (meningitis, TORCHES); and neuromuscular disorders.

Neonatal seizures are manifestation of neurological dysfunction and is the commonest manifestation of all neonatal encephalopathies. Status epilepticus is continuous seizures lasting 30 minutes or recurrent seizures occupying 50% of a given epoch (any given period).

Clinical manifestation of neonatal seizures may be:

- Subtle: Eyes (eye deviation, eyelid fluttering, staring, blinking); Oro-facial (chewing, sucking, tongue thrusting, lip smacking,); Limbs (cycling, fisting, pedalling)
- Tonic
- Clonic: focal or multifocal
- Myoclonic

There can be autonomic changes: apnoea, tachycardia, unstable blood pressure, colour changes (blanching) and a high-pitched cry.

DIAGNOSTIC APPROACH

- History: family, pregnancy, birth, clinical course, substance use by mother
- Confirm seizure and monitor response to treatment using aEEG if available
- Measure serum glucose, magnesium, calcium and sodium
- Serum bilirubin
- Sepsis screen – FBC, CRP, blood culture, micro ESR
- Do a lumbar puncture if sepsis is suspected
- Electroencephalography EEG and aEEG (to identify and monitor electrographic seizures and to monitor response to therapy
- Cranial ultrasound
- Other neuroimaging: CT Scan and MRI
- Congenital infection screen (TORCH screen)
- Screen for maternal substance abuse
- ECG (if indicated)

- Trial of pyridoxine treatment, preferably during EEG monitoring, may be diagnostic as well as therapeutic.
- Consider inborn errors or metabolism if other causes are not obvious.
- Measure serum lactate, ammonia and amino acid and urine organic acids,CSF and glycine levels where facilities are available.

DIFFERENTIAL DIAGNOSIS OF NEONATAL SEIZURES

- Jitteriness: tremulous, jerky, stimulus-provoked and ceasing with passive flexion or holding of the limb
- Benign sleep myoclonus: focal or generalized, myoclonic limb jerks that do not involve face, occurring when baby is going to or waking up from sleep. EEG is normal; resolves by age 4–6 months

Table 15.1: Differentiation between jitteriness and seizures

Sign	Jitteriness	Seizure
Stimulus provoked	Yes	No
Predominant movement	Rapid, oscillatory, tremor	Clonic, tonic
Movements cease when limb is held	Yes	No
Conscious state	Awake or asleep	Altered
Eye deviation	No	Yes

PRINCIPLES OF MANAGEMENT

- Ensure that the baby's airway is patent, breathing and circulation is adequate (ABC)
- Administer oxygen as necessary
- Treat underlying cause
- hypoglycaemia: give 10% Dextrose (D10) 2 mL/kg IV bolus, followed by maintenance infusion at 6-8mg/kg/min (See section on hypoglycaemia)
- hypocalcaemia (see section on perinatal asphyxia): give 10% calcium gluconate 0.5 mL/kg IV over ≥10 min with ECG monitoring if possible (risk of tissue damage if extravasation occurs)
- 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
- Pyridoxine (50-100 mg IV) can be given to babies unresponsive to conventional anticonvulsants or seek neurologist opinion
- After stabilization, take a detailed history including prenatal history to identify risk factors for neonatal seizures and do a detailed physical examination.

ANTI-CONVULSANTS THERAPY

- Abort seizures with anticonvulsants.
- Anti convulsants should be given if seizures persist after correction of hypoglycaemia/ hypocalcaemia. Monitor blood sugar.
- Anticonvulsants should be considered in the presence of even a single clinical seizure (See Table 15.2 and Figure 15.1)
- Administer Intravenously to achieve rapid onset of action and effective blood levels
- Administer drugs to maximum dosages before introducing a second drug.
- Do not use diazepam for seizures in newborns as causes respiratory depression.
- Keep duration as short as possible depending on diagnosis and likelihood of recurrence
- Monitor serum drug levels if feasible
- Keep a Chart for seizure monitoring

Table 15.2: *Anticonvulsant drug therapy schedule (acute treatment and maintenance)*

Drug	Loading dose	Maintenance dose
1st line Phenobarbitone	• 20 mg/kg IV stat– administer over 15 mins slowly push or IM if no line • After 30 mins, if still seizure, give additional 10 mg/kg IV (IM) • And if seizure after next 30mins, give another 10mg/kg IV (IM) so that a total dose of 40 mg/kg is reached. • If seizures persist or recur within 6 hours move to 2nd line	2.5–5 mg/kg IV or oral once daily (or in 2 divided doses) beginning 12–24 hr after loading dose
2nd line Phenytoin	• 20 mg/kg IV – dilute with 0.9% sodium chloride up to 5mg/ml and give slowly over 30minutes • Monitor cardiac rate and rhythm and blood pressure for hypotension • Monitor site of administration for redness. • Levetiracetam can be used before phenytoin if available. Loading dose 40 – 60mg/kg over 15-20mins, then 20 –30mg/kg	• 2.5–5 mg/kg IV or oral 12-hrly • When seizures occur while the newborn is on phenobarbitone maintenance therapy; • Give phenytoin 20 mg/kg loading dose, followed by maintenance dose of 2.5 –5mg/kg BD, starting 12 hours after loading dose administration. • Start 10 mg/kg/day in 2

	maintenance	divided doses (via NGT possible) • Weekly increase by 5-10 mg/kg/ day • Typical maintenance dose 30-40mg/kg/day • Maximum dose: 60 mg/kg/day
3rd line Midazolam (if no response to above drugs)	Give 200 microgram/kg IV over 5 min followed by continuous infusion 60– 300 microgram/kg/hr. (0.05 – 0.2 mg/kg IV slowly) • Reconstitution and dilution: dilute 15 mg/kg of midazolam up to a total of 50 mls with 0.9% sodium chloride or 5% dextrose or 10% dextrose. 1. 0.1 mL/hr = 30 microgram/kg/hr. 2. May cause significant respiratory depression and hypotension if injected rapidly or used in conjunction with narcotics	• Ensure constant observation of respiration and oxygenation monitoring
Clonazepam (if midazolam not available)	100 microgram/kg IV push, over 2 min, repeat dose after 24 hr if necessary. • Concurrent treatment with phenytoin • reduces the half-life of clonazepam.	

Lidocaine (if above medications ineffective)	2 mg/kg IV over 10 min, then commence infusion 6 mg/kg/hr for 6 hr, then 4 mg/kg/hr for 12 hr, then • 2 mg/kg/hr for 12 hr	• Never give with phenytoin as concurrent intravenous infusion of both these drugs has a cardiac depressant action

DISCONTINUATION OF ANTICONVULSANTS

- After 48-72 hours without seizures on maintenance dosing of anticonvulsants, commence trial discontinuation of therapy to determine whether or not infant will require longer term, outpatient anticonvulsant therapy.
- If on second line drug (phenytoin), discontinue that first. Monitor for 48 hours and if seizures recur, re-bolus with loading dose and restart maintenance
- If seizures do not recur, discontinue Phenobarbitone. Monitor for 48 hours.
  - If seizures do not recur, newborn may be discharged home off anticonvulsant therapy.
- If seizures do recur then re-bolus with loading dose and restart maintenance.

DISCHARGING A NEWBORN WHO REQUIRED ANTICONVULSANT THERAPY

- If newborn requires longer term, outpatient anticonvulsant therapy, the Phenobarbital should be changed to PO route. The same IV dose can be given orally.
- Phenytoin cannot be orally dosed with adequate serum levels. Therefore, infant must remain in the hospital if phenytoin is required for seizure control
- Any infant who has required an anticonvulsant should be observed for at least 48 hours after the last dose to ensure that seizures do not recur.
- Have a neurology discharge policy. Monitor OFC, transfontanelle ultrasonography
- Assess for seizures and developmental milestones on serial outpatient visits
- Assess for review by paediatric neurologist once necessary.

DISCHARGE AND FOLLOW-UP

Discharge

- Ensure parents are provided with appropriate discharge documentation
  - Seizure emergency management plan, copy of discharge summary, including types of seizures, medications/anticonvulsants administered and follow-up information.

Follow-up

- All babies admitted and discharged should be follow up as per protocol-up will depend on cause of seizures and response to treatment
- Consider: specialist follow-up for babies discharged on anticonvulsant drugs.

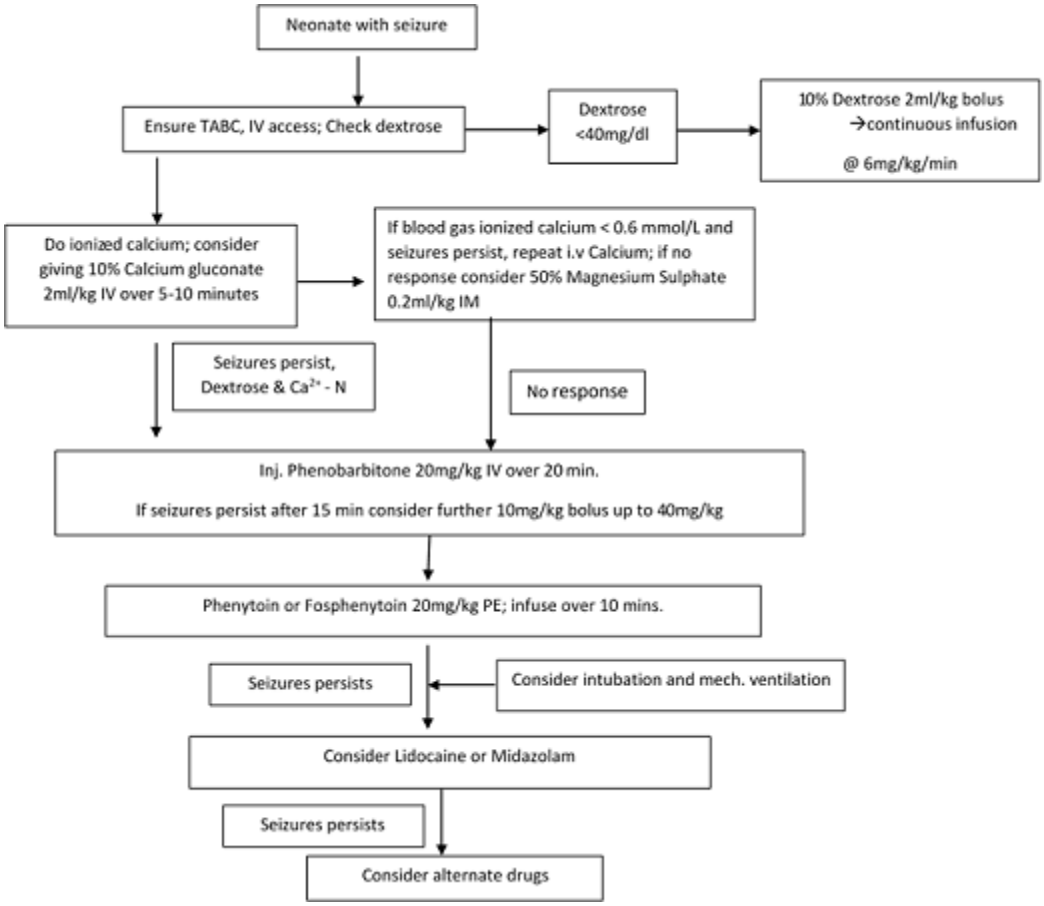
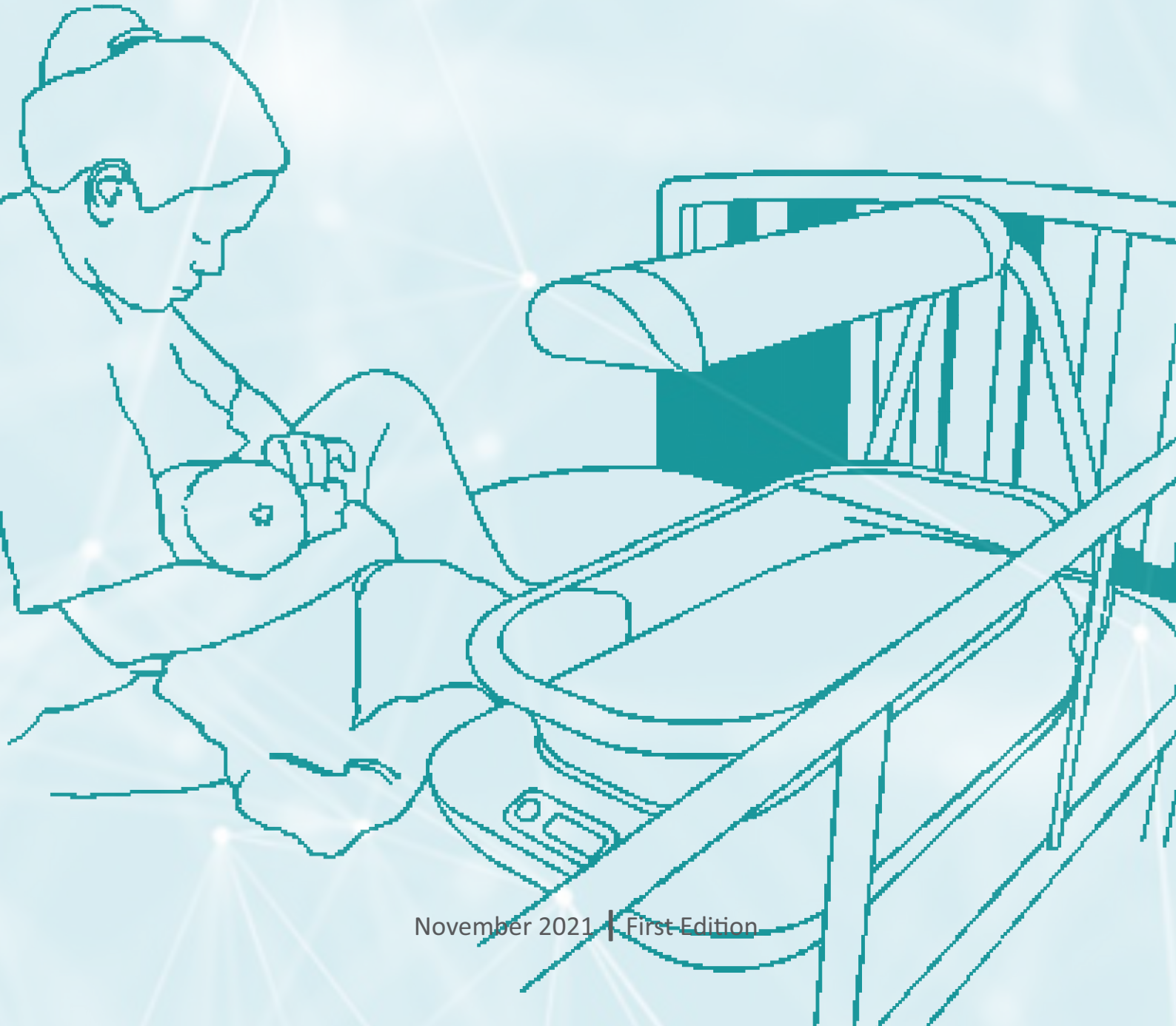


Figure 15.1: *Flow chart for management of neonatal seizures*

National Guidelines
for Comprehensive Newborn Care

SECTION THREE



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CHAPTER 16: CARE OF THE PRETERM / LOW BIRTH WEIGHT NEWBORNS

Preterm babies are babies born before 37 completed weeks of gestation. They are usually small, weighing less than 2500g at birth. Most preterm babies are more likely to have problems particularly the smaller one, than the babies with a birthweight of 2500g or more; and those who survive are likely to have more medical and developmental problems than normal term babies.

Infants with LBW may be small due to either prematurity or intra-uterine growth retardation (IUGR).

IUGR results in a baby who is small for gestational age (SGA). It is helpful to try and decide if the baby is premature or SGA, as the management is slightly different.

CLASSIFICATION OF PREMATURE BABIES

1. **Based on their birth weight:**
   - **i.** Less than 2.5kg - Low birthweight
   - **ii.** Less than 1.5kg - Very low birthweight
   - **iii.** Less than 1.0kg - Extreme low birthweight
2. **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
3. **Based on weight percentile (see appendix 6.3 for Lubchenco chart)**
   - **i.** Large for gestational age (LGA) – babies above 90th percentile of their gestational age
   - **ii.** Appropriate for gestational age (AGA) – babies between the 10th and 90th percentile
   - **iii.** Small for gestational age (SGA) – babies less than 10th percentile. Low birth weight babies can be preterm babies or small for gestational age or both.
4. **Based on clinical status:**
   - i. Well small baby
   - ii. Sick small baby

HOW TO ESTIMATE THE GESTATIONAL AGE:

Often the gestational age of newborns is not clear and approximations have to be made. The most accurate way to do this is to use a maturity chart. This can be done by using clinical parameters to score the newborn and utilizing standard charts like Ballard's (Figure 6.1) or

Dubowitz scores (See chapter 6 on examination of the newborn). Physical assessment of gestational age should be done within 72hours of birth.

COMMON PROBLEMS OF PREMATURE BABIES

Small babies are prone to complications: the smaller the baby, the higher the risk of developing immediate and long-term problems. Some of the common problems are highlighted in the Table 16. 1 below and discussed in detail in relevant section of this guideline.

Table 16.1 *Common problems of preterms and management approaches*

PROBLEM	POSSIBLE AETIOLOGY	MANAGEMENT
Respiratory distress syndrome	Lack of surfactant in alveoli Lung immaturity	--Ensure IM Dexamathasone injection 6mg 12hourly x 48hrs (12 hourly x 4 doses) for mothers GA <34 weeks before delivery. --Early delivery room bubble CPAP/mechanical ventilation --Surfactant administration, --Aim to use T-Piece resuscitator and NOT bag and mask
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 sub – cutaneous fat/brown fat	Keep warm See section on thermoregulation (chapter 17)
Hypoglycaemia	Inadequate glycogen store Impaired glycogenolysis due to immature liver	Early initiation and sustenance of breast feeding Intravenous glucose infusion/partial parental nutrition.
Feeding difficulties	Uncoordinated sucking and swallowing process	Feed with EBM via naso/orogastric tube or via nifty cup Total /partial parenteral nutrition as indicated
Jaundice	Impaired bilirubin metabolism due to immaturity of the liver	Adequate fluid/feeds Phototherapy Exchange blood transfusion

Anaemia	Depleted iron stores Bone marrow immaturity Iatrogenic (repeated phlebotomy)	Prompt commencement of iron, folic acid and other supplements (commence iron at 2weeks, others when baby is receiving >100ml/kg/day of enteral feeds and parenteral lipid provision is ≤5ml/kg/day) Minimize volume of blood per phlebotomy session Blood transfusion as indicated
Infections	Immature immune system	Handwashing/universal precaution Prompt and judicious use of antibiotics
Necrotizing enterocolitis	Immature GI tract Aggressive feeding protocol	Modify feeding protocol NPO Nasogatric tube to decompress
	Use of infant formula	Intravenous antibiotics Intravenous fluids Radiological evaluation +/- surgical intervention
Intraventricular haemorrhage	Immaturity of the germinal matrix of the lateral ventricles. Acidosis, asphyxia, shock and blood pressure fluctuations are risk factors	Prevent risk factors. Cranial USS and serial OFC measurements
Retinopathy of prematurity	Abnormal proliferation of retinal vessels More severe with administration of unblended 100% oxygen for prolonged periods.	Follow guideline for ROP screening Aim for blended O_2 therapy and strict monitoring with pulse-oximeter Paediatric opthamologist for early detection and treatment

Criteria for admission/referral of preterms

- Clinical conditions requiring constant monitoring, especially if <34weeks and birthweight <1800g
- Poor condition at birth requiring prolonged resuscitation >5 minutes, and cord PH<7.0
- Respiratory distress
- Apnoea or cyanosis
- Signs of encephalopathy
- Jaundice
- Major congenital anomalies
- Seizures
- Feeding problems
- Critically ill mothers

CARE FOR STABLE PRETERMS OF VARIOUS WEIGHT CATEGORIES

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

- This category of preterms are usually mature enough to breastfeed and maintain their body temperature.
- Initiate breastfeeding within 30 minutes of delivery (their mothers usually need additional support for exclusive breastfeeding).
- Follow the guidelines for routine care of newborns (Chapter 5)
- 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

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

- Follow the guideline for routine care of newborns.
- Commence early breastfeeding within 30mins of delivery
- Keep baby warm and commence KMC immediately. Monitor temperature 1 hourly
- 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 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 baby warm. Nurse in an incubator and commence early intermittent KMC even with the incubator.
- Check blood glucose and correct if <45mg/dl.
- Set up an IV line and put up a glucose infusion (5% (for less than 1000g) or 10% Dextrose/water (See Chapter 18). Add early amino acid (trophamine or other specific solutions for newborns) from first day of life.
- Commence oral colostrum buccal swabbing within first 6 hours of birth even if baby is on IV fluids. Counsel mother prior to delivery that colostrum will be needed within 6 hours of birth.
- Commence intravenous antibiotics empirically using the sepsis protocols after a blood culture has been taken and pending the results.
- Minimal handling except when necessary.
- Ensure close monitoring for the following:
  - Temperature
  - Respiratory difficulties, Apnoea or respiratory distress
  - Jaundice
  - Feeding
  - Oxygen saturation
  - Blood glucose
  - Signs of infection

- Fluid input/output (keep input/output chart)

(See appendices 10.1 and 10.2 monitoring charts)

- The following should also be considered:
  - Use of early prophylactic theophylline (caffeine citrate) or aminophylline (if caffeine not available) for apnoea of prematurity from birth.
  - Routine trans-fontanelle scan within first week of life.
  - 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.

This category of preterms <1500g should be managed in secondary facility level ONLY if a paediatrician is available and supporting facilities are available. Otherwise, they should be referred to a specialized centre in kangaroo mother care position for specialized care.

CHAPTER 17: 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. Newborn babies can drop their body temperature very quickly, even within minutes. 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: ---------- 36.5°C-37.5°C
- 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; and a newborn baby's temperature may fall within seconds of being born. Newborns lose heat through four main mechanisms as shown in Figure 16.1 and Table 16.1:

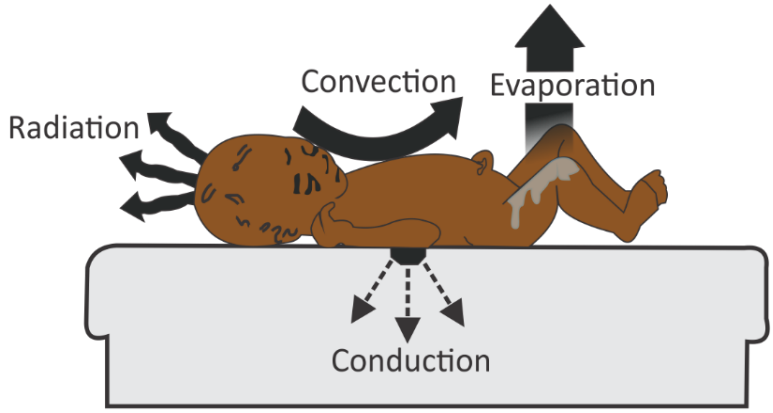


Figure 17.1: *Mechanisms of heat loss in the newborn*

Table 17.1: *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

Low body temperature (hypothermia) may be caused by exposure to a cold environment (low ambient temperature, cold surface, or draught), or the baby may be wet or under-dressed for age and size.

The body cannot function well when it is cold as it needs a thermoneutral environment. 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, with the head of the baby kept free from the plastic See Figure 17.2. This prevents heat loss. Remove plastic wrap in the SCBU once temperature is controlled (36.5-37.5°C), and nurse in KMC or in an incubator.

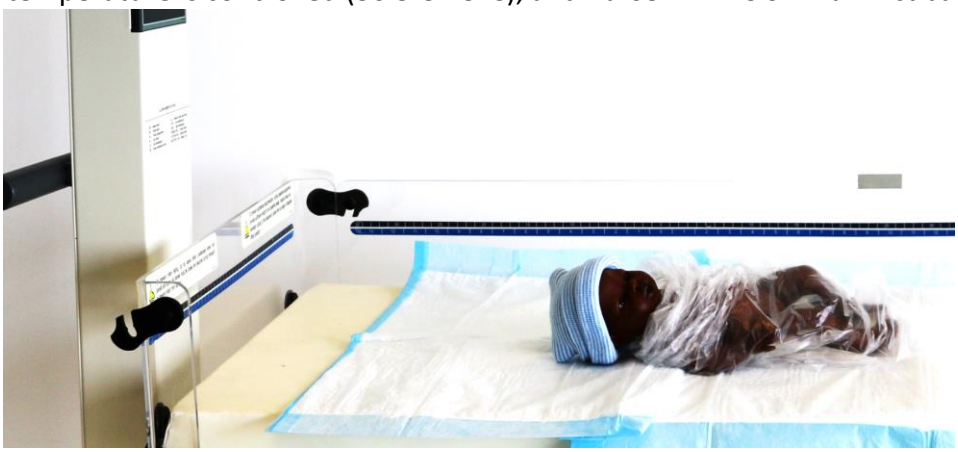


Figure 17.2: *Neonatal patient wrapped in plastic, with head free, under radiant warmer, to prevent heat loss.*

Normal axillary temperature in neonates range from 36.5°C to 37.5°C. Every effort must be made to keep a baby's temperature within this normal range as temperature below 36°C is an independent risk factor for death in newborns. And for each degree reduction, this risk of death worsens.

Table 17.2: *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 0.5°C 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 17.3: *Ten steps of the "Warm Chain" (adapted from WHO, 1997)*

S/n	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.
		• Newborns should be uncovered as little as possible during assessments and interventions. • Newborns can be maintained in skin-to-skin contact with the mother: • while she is being attended to (placenta delivery, suturing) • during transfer to the postnatal unit, recovery room • during assessments and initial interventions • for the first hours after birth
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.
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 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 servocontrol 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.

B. 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 17.3: *A mother with baby in KMC position*

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
- 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 17.4: *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.

4. KMC Criteria for discharge from facility

This refers to discharge of mother and baby from the KMC units of a health facility, to continue KMC at home.

When to discharge from the hospital: Discharge when the baby has a sustained weight gain of at least 15 grams /kg /day. Bring the baby back for follow up in the next few days to ensure that baby is well and growing. It is advised practice to follow up KMC babies in a designated place.

The following criteria must be met:

Baby

- normal respiration without any difficulty in breathing.
- temperature is within the normal range in the KMC position for at least three consecutive days (axillary temperature of 36.5-37.5^{o}C).
- There are no danger signs.
- There is appropriate weight gain (15 grams/kg/day) for 3 consecutive days (after birthweight is regained).
- The baby feeds well, and is exclusively breastfeeding or incase of maternal demise.

Mother

- Is capable of adequately feeding the baby either through breastfeeding or cup feeding using expressed breast milk.
- Is proficient in putting and maintaining baby in KMC position
- Accepts the method, is willing to continue with KMC at home and has support from family, and is able and willing to come for follow-up visits.

Pre-discharge readiness score sheet (See Table 17.4 below) should be completed and a KMC register kept on the ward for data collection and reporting (See chapter 29).

5. KMC Follow up

- All LBW newborns <2000g (2kg) should have follow-up appointment to assess temperature and weight gain. 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 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 visit 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.

FOR DETAILED GUIDE ON KMC, SEE THE NATIONAL KMC OPERATIONAL GUIDELINE (FMOH KMC Operational Guidelines 2021)

Table 17.4: *KMC Pre-discharge readiness score sheet*

KMC Daily Score Sheet				Date ➔	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18
Name:	Hospital No:		Breastfeeding:	Started 24h KMC:																		
GA at birth:	Postnatal Age KMC commenced:		BMS:	...../...../.....																		
Evaluation	Score			Weight ➔																		
	0	1	2	Remarks																		
Socio-economic support	No help or support	Occasional help or support	Good support system																			
Mother's milk production	Expresses 0-10 ml breast milk	Expresses 10-20 ml breast milk	Expresses 20-30 ml breast milk	*Must score 2 before discharge. N/A for formula*																		
Positioning and latching baby onto breast	Always needs assistance	Occasionally needs assistance	No assistance needed	*Not applicable for formula feeding*																		
Baby's ability to suckle at the breast / bottle	Gets tired very quickly	Gets tired infrequently	Takes all feeds well																			
Confidence in handling baby i.e. feeding, bathing, changing	Always needs assistance	Occasionally needs assistance	No assistance needed																			
Baby's weight gain per day	0-10g	10-20g	20-30g	*Must score 1 or 2 for a few days before discharge*																		
Confidence in administering vitamin and iron drops	No confidence	Some confidence	Fully confident																			
Knowledge of KMC	No knowledge	Some knowledge	Knowledgeable																			
Acceptance & application of KMC	Does not accept or apply KMC method	Partly accepts & applies KMC method	Fully accepts and applies KMC method	*Applies KMC without having to be told*																		
Confidence in caring for baby at home	Does not feel sure or able	Feels slightly unsure & unable	Feels confident																			
TOTAL SCORE per day																						

Ready for discharge: Breastfeeding: if baby and mother score >19 ■ Formula feeding: if mother and baby score >15

Adapted from the Groote Schuur Hospital

C. 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.
Using pre-warmed towels, neonatal patients should immediately be dried, wrapped and placed on a radiant warmer following delivery.

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. Warmers may vary in complexity, including only heating functionality or heating functionality with resuscitation and oxygen equipment.

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 17.5**: 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.
- Radiant warmers heat in various modes, the names of which may vary based on device. (*See the FMOH National Comprehensive Newborn Care Training Manual for details on radiant warmer).*

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.

D. Use of Incubator

Incubator (Figure 17.6) is an apparatus used in the hospital to help premature babies survive and thrive. It 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/infections".

Hence the humidity of the incubator and temperature settings should be considered in its functionality.

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.

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 17.5). Hypothermic infants may need the incubator temperature raised by 0.5^{0}C every half-to one hour until normothermic.

Note that written policies; procedures and operations guide; and a maintenance devices pre-determined schedule guide should be available for all devices in the newborn unit.

Table 17.5: *Incubator temperature setting by birth weight and postnatal age*

		Birth weight and temperature range			
		1-1.2kg +/- 0.5^{0}C	1.2-1.5kg +/- 0.5ºC	1.5-2.5kg +/- 1.0ºC	>2.5kg & 36/40 +/- 1.5ºC
Age	0-12 hours	35.0	34	33.3	32.8
	12-24 hours	34.5	33.8	32.8	32.4
	24-96 hours	34.5	33.5	32.3	32.0
	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	3206	31.4	
	4-5 weeks	32.0	32.0	30.9	
	5-6 weeks	31.4	31.4	30.4	

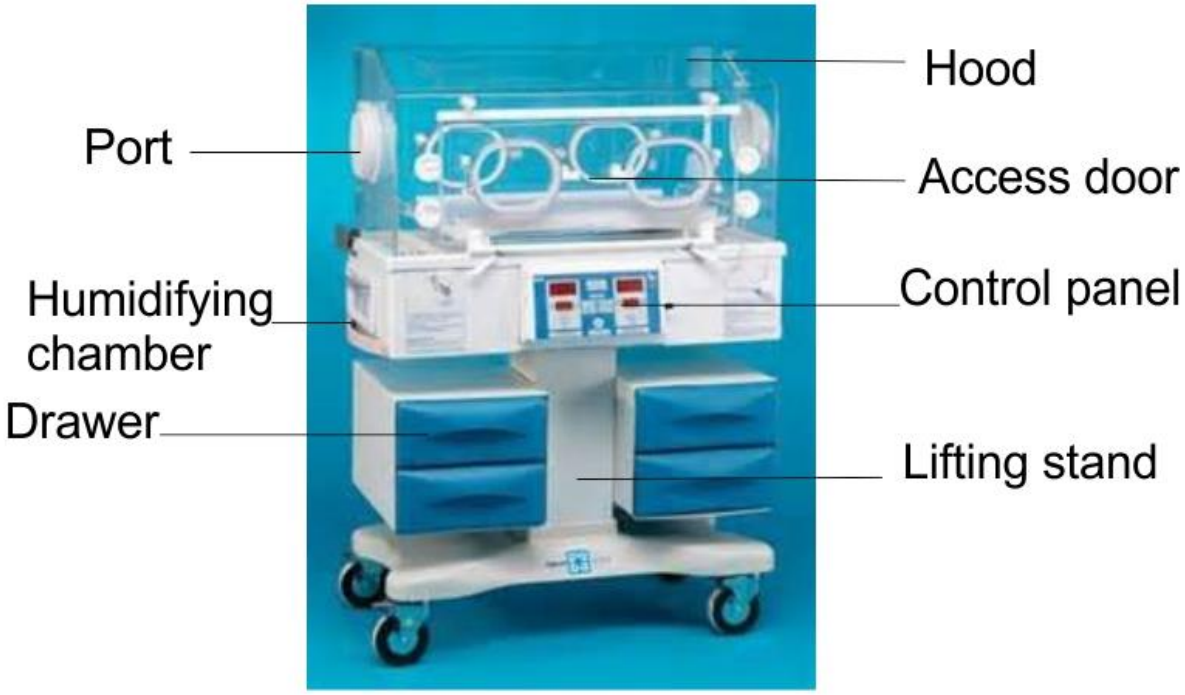


Figure 17.6: *A typical infant incubator*

HYPERTHERMIA

It is less frequently seen when compared with hypothermia. It occurs when axillary temperature is above normal the core temperature of 37.5◦C. Hyperthermia is also as harmful to the newborns.

It is important to note that hyperthermia is not same as fever which is strictly related to infections or other causes of inflammation; though it is not always feasible to differentiate the two by just measuring body temperature or clinical signs.

When a newborn has a raised temperature, it is important to consider both causes. Infections should always be suspected first; except there are obvious external reasons for a newborn to become overheated eg from a radiant warmer.

Common predisposing causes of hyperthermia

- Environmental causes –excessive environmental temperature, excessive clothing or swaddling, overheating from incubators and radiant warmers.
- Dehydration
- CNS dysfunction eg HIE Stage 3
- Maternal fever in labour
- Maternal epidural analgesia during labour
- Medications, drug withdrawal

Symptoms and signs

- When environmental temperature is the cause of hyperthermia, the trunk and extremities will have the same temperature, and the infant appears pink/vasodilated. But infants with sepsis are often vasoconstricted and the extremities are 2^0C to 3^0C colder than the trunk.
- Heat stress increases metabolic rate and oxygen consumption, resulting in:
- tachycardia, tachypnea, irritability, sweating, flushed, bright pink skin; and apnoea.
- If severe, it may lead to dehydration, acidosis, seizures, brain damage and death.

Treatment

- Defining the cause of elevated body temperature is the most important initial issue.
- Initiate early and frequent breast feeding to prevent dehydration
- Treat the underlying cause and treat accordingly eg sepsis
- Expose the baby, remove extra cloths
- When high environmental temperature is suspected as a cause of hyperthermia, adjust room temperature, dress them with suitable clothing, expose them to room temperature.
- If baby is in the incubator: recheck incubator temperature and settings.
- Use of acetaminophen when the temperature is above 38.5^{O}C (5-10mg/kg/dose, orally or rectally every 4hours x 3 doses). Do not use antipyretics as first line treatment.

CHAPTER 18: NUTRITION IN THE NEWBORN (ENTERAL)

Adequate nutrition is essential for the optimal growth, development and long term health of newborns particularly the very low birth weight (VLBW) and sick babies. Nutrients can be delivered via the enteral and parenteral routes.

Breast milk is the preferred milk because it has the right constituent in the right proportion for each category of gestational age as required for rapid growth and optimal development of the baby. The antibodies and other anti- infective factors in mother's milk are very necessary for the survival of a preterm baby.

Details of nutrition and breastfeeding of the normal weight newborn have been discussed in Chapter 5 (Routine care of the well newborn). This section describes feeds for the small and sick preterm/LBW newborns.

1. CARE OF THE SMALL WELL NEWBORN:

Enteral Nutrition: Early and Exclusive Breastfeeding

The goal is to reach full enteral feeding in the shortest time, while maintaining optimal growth and nutrition and avoiding the adverse consequences of rapid advancement of feeding in the VLBW.

The recommended feeds for every newborn is the breast milk. Thus, all health workers should support mothers to breast feed successfully by doing the following:

- Initiate breast feeding within 30 minutes of birth according to national essential newborn care (ENCC) protocols
- Explain to the mother and her family the benefits of early and exclusive breastfeeding
- Teach mother good positioning and attachment
- Encourage the mother to breastfeed the baby on demand, both day and night (eight or more times in 24 hours), for as long as the baby wants.
- Feeding should be scheduled because preterm infants rarely demand feeds. Work out a schedule with the mother for her to follow. LBW babies may take longer on the breast.
- Manage breastfeeding problem as outlined in the routine care of the well newborn section (Chapter 5).

Caloric requirements

- Full term infant: 60-80kcal/kg/day in the first week of life and thereafter 80-120kcal/kg/day
- Preterms: 50-90kcal/kg/day in the first week of life and thereafter 100-150kcal/kg/day

Feeding Guidelines for Stable Preterm/LBW Newborns

Birth weight, gestation, presence or absence of sickness, and individual feeding efforts of the baby determine the decision as to how a LBW neonate should receive fluids and nutrition. The gestational age is one of the most important determinants, as coordinated sucking and swallowing does not develop until about 34 week's gestation.

Follow the volume of breastmilk according to birthweight and postnatal age in Tables 18.2 and 18.3.

1. **Birth weight 2000g – <2500g (33 - 34weeks GA)**
   - Allow the baby to suckle directly at the breast
   - If the baby cannot be breastfed, give expressed breast milk using an alternate feeding method - cup feeding. Table 18.4 gives guidance on how to express breast milk.
2. **Birth weight 1500g – <2000g (30 - 32 weeks GA)**
   - Give expressed breast milk using an alternate feeding method every two to three hours until the baby is able to breastfeed adequately
3. **Birth weight <1500g (<30 weeks GA)**
   Commence buccal colostrum swabbing within first 6 hours of birth. About 0.1 ml of colostrum is placed in each cheek, given by 2ml syringe or a sterile cotton swab 2 hourly.
   - This aims to stimulate the oropharyngeal tissue, build up baby's immunity to help prevent infection.
   - Then commence minimal enteral nutrition/trophic feedings/gut priming small feedings at 10- 20 ml /kg/day, via oral Gastric/NG tubes within 24hrs (Start EBM within 1st day of birth divided 2hrly (12feeds/24hrs) with the remaining fluid requirement met by IVF) Advance daily depending on clinical status by 20-30ml/kg/day. WHO recommends 30mls/kg/day depending on baby's stability.
   - Minimal enteral nutrition promotes gastrointestinal maturation, reduce mucosal atrophy, and protects against Necrotizing Enterocolitis (NEC).
4. **For ill babies:** Beyond the preterms, for critically ill babies, if a newborn cannot receive enteral feeds (e.g. NPO due to extremely LBW on day 1, severe asphyxia on day 1, surgical conditions) he should be given colostrum swabs starting from delivery. Colostrum, the thick first breast milk, is very rich in immunoglobulin protective factors and therefore especially important for critically ill neonates. A small amount of colostrum is placed directly onto the mucosa in the cheeks for absorption and will not be swallowed (buccal colostrum).
   - If feeding of full amounts of breast milk is delayed in preterm or and these sick newborns, Minimal Enteral Feeds (MEF) (trophic feeds) help to avoid atrophy of the intestinal mucosa, bacterial overgrowth and other associated problems; start with breast milk 10 - 20ml/kg/day 2 – 3 hourly on day one and advance the amount daily by 20 – 30 ml/kg/day according to feed.

Scheduling of enteral feeds:

Weight	Ideal Feeding Regime
<1500 g or < 30 weeks	Feed every two hours
>1500 g or > 30 weeks	Feed every three hours

Advancement of feedings

- Increments of 20 to 30 mL/kg per day
- Aim to reach full enteral feeding (150–180 mL/kg/day) within 7 days in stable babies >1500g and above, and within 7-10 days in babies <1500g.
- Preterms will usually lose about 10-15% body weight physiologically within the first 7-10days, but by 10-14th day, these babies should regain birth weight. Always aim for the newborns not to lose more than 10% of weight.
- Note that birth weight should be used for calculations of feeding volumes until the newborn exceeds birth weight.
- Expected daily weight gain subsequently is 15g/kg/day. If the baby has already reached full feeds (160 – 180 ml/kg/day) and still weight gain is inadequate (less than 15 g /kg per day over three days), increase the volume of milk to 200 ml/kg per day.
- Aim for the provision of 120 - 150kcal/kg/day
- Any baby gaining weight of <10g/kg/day MUST be re-assessed.
- And if weight gain is inadequate for more than three days and the newborn has been taking 200 ml/kg breast milk per day, investigate for possible underlying conditions.

What to Feed

- Mother's breast milk preferably for all preterms at all times. Intensive efforts to be made for breast milk to be available.
    - Donor breast milk to be considered as second choice as recommended by WHO when feasible.
    - Preterm formula to be on strict prescription if no breastmilk option

Route and timing of feeding

- Babies < 34 weeks cannot co-ordinate suckling, swallowing and breathing effectively and must be tube fed.
- Those unable to feed directly on the breast, but who are clinically stable, to be given expressed breast milk (EBM). Use gavage feeding with either naso- or orogastric tube. Use orogastric tube if baby is receiving oxygen or on CPAP.
- Cup feeds should be gradually tried in babies >1500g and in babies <1500g but have been on admission for over two weeks. Monitor weight closely and avoid spillage.
- Babies less than 1500g are to be fed every 2 hours while babies more than 1500g are to be fed every 3 hours on the average. Monitor closely.
- In order to promote lactation, and enable the baby to learn to suck, all babies more than 1500 grams and 32 weeks of gestation should be put to breast for 5-10 minutes before cup or tube feeding. Generally, encourage intermittent skin to skin contact with the mother for all preterms starting from within 24hours of delivery once feasible.
- Furthermore, putting the babies skin to skin in preterm babies within one hour of birth (once stable) promotes mother's milk flow.

Table 18.1: *Chart showing possible route of feeding according to age*

Birth weight/ Gestational age	<1500 grams / <30 weeks	1500-1800 grams / 30-32 weeks	>1800-2500 grams / >32 weeks
1-3 days of life	Tube feeds	Tube feeds or cup	Breastfeed, if unsatisfactory use cup
3 days-3 weeks of life	Tube or cup	Breastfeed, if unsatisfactory use cup	Direct breastfeeding

Table 18.2: *Approximate total volume for feeds/fluid (WHO)*

Amount of milk (or fluid) needed per day by birth weight and age								
Birth weight	Feed frequency	Day 1	Day 2	Day 3	Day 4	Day 5	Days 6-13	Day 14
1000-1499g	2 hours	60ml/kg	80ml/kg	90ml/kg	100ml/kg	110ml/kg	120-180 ml/kg	180-200 ml/kg
>1500g	3 hours	60ml/kg	80ml/kg	90ml/kg	100ml/kg	110ml/kg	120-180 ml/kg	180-200 ml/kg

Table 18.3: *Approximate feeding volumes by birth weight and postnatal age. (WHO)*

Birth Weight	Number of feeds per day	Day 1	Day 2	Day 3	Day 4	Day 5	Days 6-13	Day 14
1000g	12	5ml	7ml	8ml	9ml	10ml	11 -16ml	17ml
1250g	12	6ml	8ml	9ml	11ml	12ml	14-19ml	21ml
1500g	8	12ml	15ml	17ml	19ml	21ml	23-33ml	35ml
1750g	8	14ml	18ml	20ml	22ml	24ml	26-42ml	45ml
2000g	8	15ml	20ml	23ml	25ml	28ml	30-45ml	50ml

Table 18.4: *How to express breastmilk*

How to Express Breast Milk

It is useful for all mothers to know how to express their milk. Expression of breast milk is required in the following situations:

- To maintain milk production and for feeding the baby who is premature, low birth weight or sick and cannot breast feed for some time.
- To relieve breast problems e.g., engorgement.

Technique of expression – teach mother to:

- Wash her hands with soap and water thoroughly before expression. Sit or stand comfortably and hold the clean container near her breast.
- Put a thumb on her breast above the nipple and areola, and her first finger on the breast below the nipple and areola, opposite the thumb. She supports the breast with her other fingers.
- Press her thumb and first finger slightly inwards towards the chest wall.
- Press her breast behind the nipple and areola between her fingers and thumb. She must press on the lactiferous sinuses beneath the areola. Sometimes in a lactating breast it is possible to feel the sinuses. They feel like soft peanuts.
- If she can feel them, she can press on them. Press and release, press and release.
- This should not hurt – if it hurts the technique is wrong. At first no milk may come, but after pressing a few times, milk starts to drip out.
- Press the areola in the same way from the sides, to make sure that milk is expressed from all segments of the breast.
- Avoid rubbing or sliding her fingers along the skin. The movements of the fingers should be more like rolling.
- Avoid squeezing the nipple itself. Pressing or pulling the nipple cannot express milk.
- Express one breast for at least 3-5 minutes until the flow slows; then express the other side; and then repeat both sides. She can use either hand for either breast.
- Explain that to express breast milk adequately may take 20-30 minutes. Having the baby close or handling the baby before milk expression may help the mother to have a good let-down reflex. It is important not to try to express in a shorter time. To stimulate and maintain milk production she should express milk frequently – at least 8 times in 24 hours.

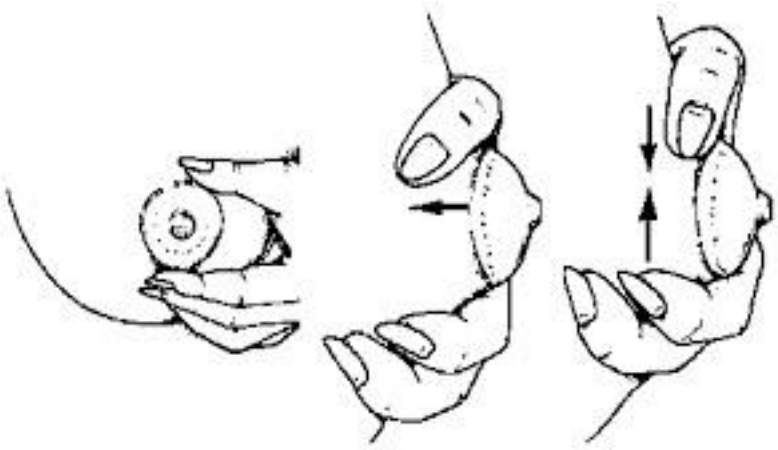


Figure 18.1: *How to express breast milk*

Oro-gastric tube feeding (OG tube) and naso-gastric tube feeding (NGT)

Gastric tubes are used for feeding the sick and small newborns; and also for gastric decompression. A nasogastric tube is inserted if the baby is breathing regularly and is not on oxygen by nasal prongs or CPAP; otherwise, use orogastric tube if baby has nasal prongs.

Steps of oro-/nasogastric tube feeding (Table 18.5 and Figure 18.3)

For orogastric tube insertion: measure the distance between angle of mouth to earlobe, and then to the midpoint between the xiphoid and umbilicus. Mark the position on the tube with a piece of tape. This is the length of tube that is inserted.

For nasogastric tube feeding: The catheter is measured from the tip of the nose to the ear lobe and then to the midpoint between the xiphoid and umbilicus.

a) Procedure:

Have French size 5 or 6 nasogastric tubes, 5ml syringe, adhesive tape/plaster, Stethoscope or blue litmus paper, galipot with water ready. Wash hands

Raise the head slightly and wet the catheter with sterile water, saline or mother's breast milk. Gently pass through the nose (nasogastric) or mouth (oro-gastric) down through the oesophagus to the stomach. Observe for any choking, gagging, change in colour in baby; and remove if any sign of tube in the trachea.

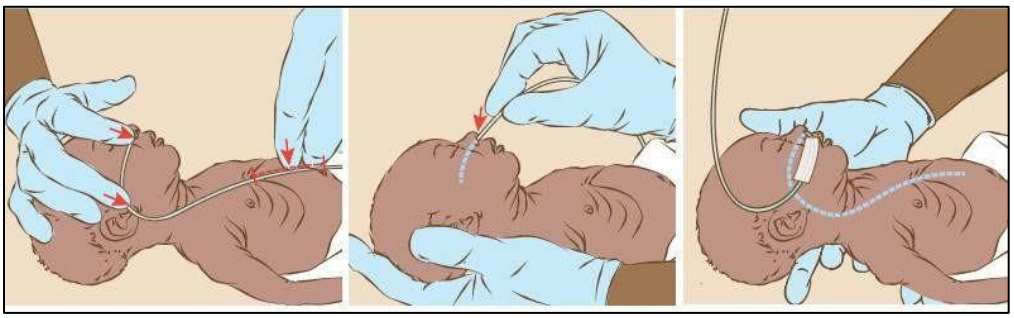


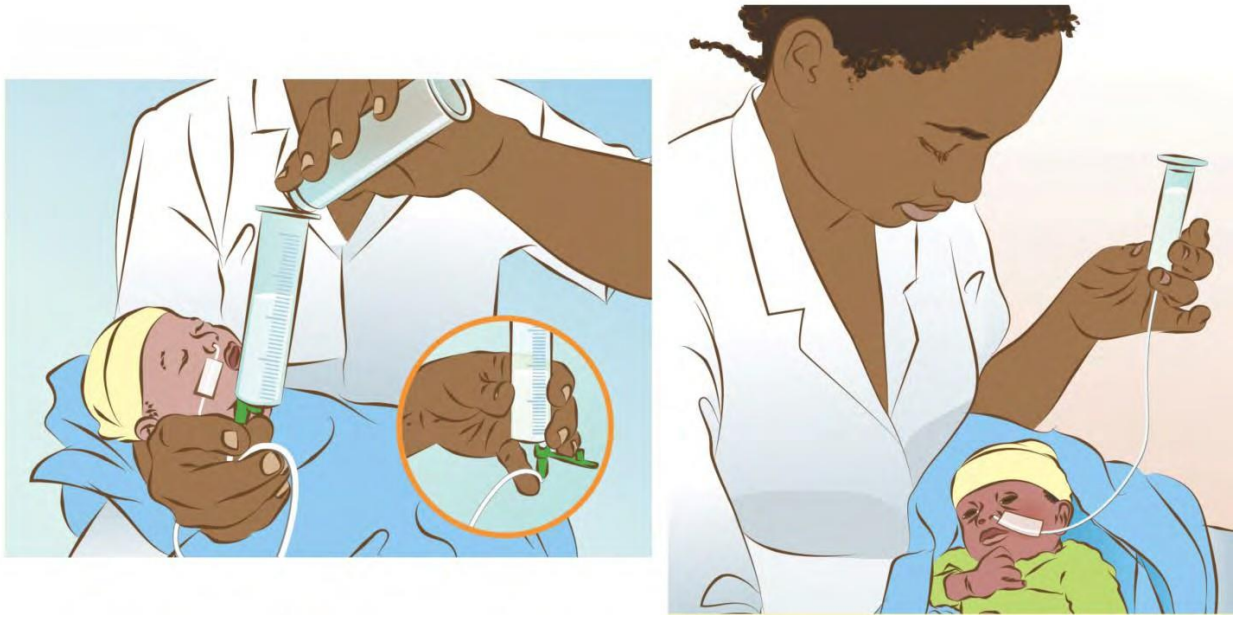
Figure 18.2: *How to insert NGT*

b) Confirming proper placement of gastric tube

Fill a syringe with 1 to 2 ml of air and connect it to the end of the tube. Use a stethoscope to listen over the stomach as air is quickly injected into the tube. You should hear a woosh as it enters the stomach .

- If a whistling sound is heard through the stethoscope as the air is injected, the end of the tube is correctly positioned in the stomach;
- If a whistling sound is not heard, the tube is not properly positioned. Remove the tube and repeat the procedure.

- Alternatively, put some clean water into a gallipot, hold it below the tube. Insert the end of the tube into the water, if it bubbles, then it is wrongly placed in the trachea, remove the tube and repass (Note: If no bubbles, the tube may be correctly placed or kinked).
- Aspirate stomach contents with the syringe and place a drop on the strip of blue litmus paper (should turn blue litmus paper to pink due to gastric acid content if the tube is in the stomach)
- Always double check NGT placement when an X-ray is taken once possible
- nasogastric or oro-gastric tube should be left in situ for up to three (3) days but can be changed earlier if pulled out or blocked. Always test tube placement prior to feeds.
- When removing the tube, wait at least 2 hours following the feed, if not, aspirate prior to removal of the tube. Pinch the feeding tube with your thumb and forefinger when removing the tube. This prevents the milk from flowing into the baby's lungs.



Figures 18.3 *a and b: Show gavage nasogastric tube feeding by gravity*

c) Steps for gavage tube feeding

- Before starting a feed, wash hands thoroughly and check the position of the tube.

1. Remove the plunger of a 10 or 20 ml sterile syringe.
2. Connect the barrel of the syringe to the end of the gastric tube.
3. Fill the barrel of the syringe with the required volume of milk.
4. Let the milk run from the syringe through the gastric tube under gravity.
5. DO NOT force milk through the gastric tube by using the plunger of the syringe.
6. Hold the syringe 5-10 cm above the infant until the syringe is empty.
7. It should take a few minutes for the milk to flow into the infant's stomach. Changing the height of the syringe will also affect the speed of milk flow. Lowering the syringe slows the milk flow, raising the syringe makes the milk flow faster.
8. Observe the infant during the entire gastric tube feed. Do not leave the infant unattended. Stop the tube feed if the infant shows any of the following signs: breathing difficulty, colour change (looks blue), becomes floppy or vomits.
9. Cap the end of the gastric tube after the milk has been instilled. There is no need to rinse the tube with water. Keep tube capped between feeds.

It is of utmost importance to monitor the newborn closely as tube fed babies are prone to regurgitation and aspiration; but this risk is minimized if feeding is done by gravity; and feeds are not pushed in with syringe. Never use syringe to push down tube feeds.

Before the next feed, aspirate the stomach; and if the aspirate is more than the volume of the last feed, the baby should be evaluated for any illness. Make sure there is no abdominal distension. If any distension, the feeds may have to be decreased in volume or stopped and replaced with IV fluids.

d) Steps of cup feeding

Baby should be awake and held sitting semi-upright on caregiver's lap. Put a small cloth on the front of the chest to catch drips of milk.

1. Put a measured amount of milk in the cup.
2. Hold the cup so that the more pointed tip rests on the baby's lower lip.
3. Tilt the cup to pour a small amount of milk at a time into the baby's mouth.
4. Feed the baby slowly. Do not pour the milk.
5. Make sure that the baby has swallowed the milk before giving anymore.
6. When the baby has had enough, he or she will close her mouth and will not take anymore. Do not force the baby to feed.
7. Document the time and amount of feed that the baby received. (See Appendix 19.1 feeds/fluids monitoring chart)

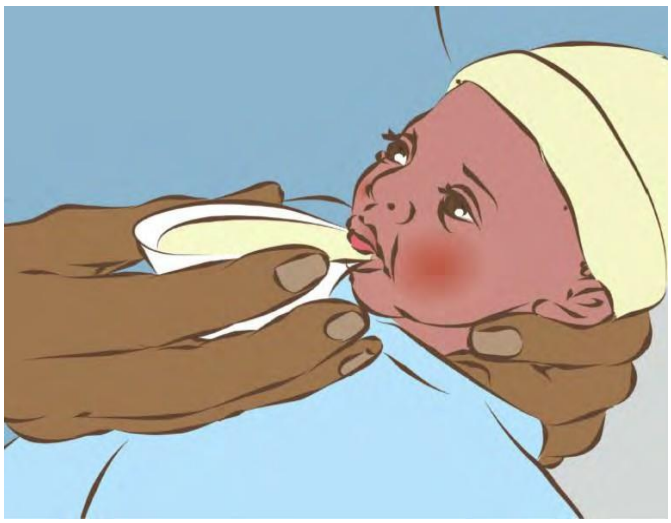


Figure 18.4: *Cup feeding a small baby using 'nifty cup'*

e. Transitioning to Direct Breast Feeding:

- This should be commenced as early as baby is ready; ideally from 34 weeks gestation with weight >1500g.
- Breast-feeding babies may be introduced straight from NGT to breast-feeds.
- The baby should have:
  - ✓ Intact suck and gag reflexes.
  - ✓ Be on full volume NG feeds.
- Introduce breastfeeds slowly 1-2 feeds per day, and expressed breast milk (EBM) feeding should be maintained every 3hrs
  - ✓ Assist and encourage mother; and ensure she maintains sufficient milk . Furthermore, for the newborns who are fed by gastric tube the mother should be advised to do lip and mouth care with breast milk each time before feeding via NGT (by swabbing lips and mouth with a small amount of milk by using her clean index finger). This supports the early sensory development and prevents dry mucous membranes.

f. Storing Breast Milk

At room temperature

- At 19-22 °C (66-72 ºF), up to 10 hours
- At 26 °C (78 °F), up to 6 hours
- If it is hotter than 26 °C (78 ºF), only 1-2 hours

In a refrigerator

- At 0-4 °C (32-39 °F), up to 24-48 hours

In a freezer

- If the freezer is inside a refrigerator (temperaturemay differ due to door opening frequently), up to2 weeks
- In a separate deep freezer at -18 °C (0 ºF),for up to 3 months

Feeding Intolerance

Feeding intolerance is the inability to digest enteral feedings; is a well-known phenomenon in the newborn units and is linked to morbidity and mortality especially in the premature infant.

- Common symptoms are gastric residuals, abdominal distention, vomiting, bloody stools associated with other clinical manifestations like apnea, bradycardia, temperature instability, and hypotension.

If a newborn has feeding intolerance with mild abdominal distension, gastric residuals that are greater than the volume of previous feeding, or vomiting, stop feeds and start IV fluids OR slow the advancement of feeds OR consider smaller feeds at increased frequency (such as every 2hours).

- Do not increase feeds if baby is having aspirates more than 50% of the previous feed.
- Note that CPAP usually causes abdominal distension (CPAP belly) that will be prevented by inserting an orogastric tube when commencing CPAP. This does not usually prevent standard feeding advancement in these babies.
- In all instances the diagnosis of necrotizing enterocolitis, sepsis and metabolic disorders as well as other illnesses should be suspected and effective management workups promptly instituted.
- Management will depend on the associated symptoms

CHAPTER 19: NUTRITION IN THE NEWBORN (PARENTERAL)

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 MANAGEMENT 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 also 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.

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 19.1: *Possible reasons for not feeding by mouth*

Medical	Surgical
• Recurrent apnoea • Severe respiratory distress • Frequent convulsions • Neonatal encephalopathy • Cardiorespiratory instability • 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 • 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 fluid depends on the age and gestational age of the newborn. Plain glucose infusion (10% without electolytes) is used for the first 48hours of life because the babies' kidneys are immature, still maintains the maternal electrolytes status, and do not effectively excrete electrolytes.

1) On Day 1 and Day 2

- Give 10% dextrose 80-90mls /kg for preterms and 60-70mls/kg in term babies in the first 48hrs; and 5% dextrose to ELBW (<1000g) newborns because the ELBW are not able to handle 10%D/W due to extreme immaturity.
- Increase fluids daily by 10 – 20mls /kg/day
- If under phototherapy or radiant warmer add extra 20-30mls/kg/day. Monitor closely.
- If baby had severe asphyxia and HIE commence with 40mls/kg/day until urine output is established, and then give normal maintenance for age.
- Add 3-4g/kg/day of amino acid (use trophamine 6% (6g in 100mls) or 10% (10g in 100mls) strength) or any prescribed neonatal brand from day 1.
- Commence buccal colostrum swab within 6hrs of birth (Chapter 18).
- Start oral trophic feeds (MEN) to prime the gut 10-20mls/kg/day (Chapter 18) starting from within 24hours of delivery.

2) From Day 3:

- 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) ie 10% Dextrose 80% of total calculated amount plus Ringer's lactate 20% of the total calculated amount.
- Continue amino acids if available at 3.5g/kg/24grs in the 10% D/W plus electrolytes + added calcium if baby is preterm, asphyxiated 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.

1. Suggested electrolyte management after the first 48 hours.
   After 48 hours of life, newborns require maintenance Na+ at 3 mEq/kg/day and K+ at 2mEq/kg/day.
   - 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.

2. Volume of fluids and gradual oral feeds to give
   - Tables 19.2 to 19.7 show approximate volumes of IVF and gradual oral feeds for newborns from <1000g to above 3000g weight by Day of Life (DOL) with 0 being first day of birth. Babies <1000g should be treated in a Level 3 tertiary centre.
   - 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.
   - All infants < 30 weeks GA/ < 1200 g must be placed into a plastic bag at delivery without drying , with the radiant warmer on, and the face exposed to prevent excessive fluid loss from evaporation.
   - Monitor that baby does not lose > 3% body weight per day, is not hypernatremic and is making urine >1ml/kg/hour. Monitor hydration status and urine specific gravity.
   - 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 19.2: *IV Fluids and gradual feeds for <1000g ELBW*

Birth Weight < 1.0 kg (ELBW) (Estimated as 0.9 kg for calculation)						
		Total Fluid: IV+PO	IV		Enteral	
DOL	IV Fluid	ml/Kg/day	ml/kg/24hrs	ml/hr	ml/kg/24hrs	ml/3hrs
0	G5%	80	80	3	buccal colostrum/trophic feeds	buccal colostrum/trophic feeds
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 Level 3 Centres

- 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. Calcium is recommended in the Starter Day 1 fluid in neonates <1500g and asphyxiated neonates.
- For Level 3 centres with expertise for central lines, aim to add Trophamine amino acid and other available neonatal preparations from day 1. Start with 3.5g/kg/day.
- 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 in Table 19.3 below.
- See Chapter 20 on hypoglycaemia for more details on GIR calculation.

Table 19.3: *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

Table 19.4.: *Fluids and gradual feeds for babies 1000g-1500g (VLBW)*

Birth Weight 1 - 1.5 kg (VLBW) (Estimated as 1.25 kg for calculation)						
		Total Fluid: IV+PO	IV		Enteral	
DOL	IV Fluid	ml/Kg/day	ml/kg/24hrs	ml/hr	ml/kg/24hrs	ml/3hrs
0	G10%	80	80	4	buccal colostrum/trophic feeds	buccal colostrum/trophic feeds
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 19.5: *Fluids and gradual feeds for 1.5kg-2.0kg*

Birth Weight 1.5 - 2 kg (LBW) (Estimated as 1.75 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO ml/Kg/day	IV		Enteral	
			ml/kg/24hrs	ml/hr	ml/kg/24hrs	ml/3hrs
0	G10%	60	60	4	buccal colostrum/trophic feeds	buccal colostrum/trophic feeds
1	G10%	80	50	4	30	7
2	G10%	100	40	3	60	13
3	G10%	120	30	2	90	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 19.6: *Fluids and gradual feeds for 2.0kg-2.5kg*

Birth Weight 2 – 2.5 kg unable to breastfeed (Estimated as 2.25 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO ml/Kg/day	IV		Enteral	
			ml/kg/24hrs	ml/hr	ml/kg/24hrs	ml/3hrs
0	G10%	60	60	6	buccal colostrum/trophic feeds	buccal colostrum/trophic feeds
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 19.7: *Fluids and gradual feeds for >3.0kg*

Birth Weight >3.0 kg unable to breastfeed (Estimated as 3.5 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO ml/Kg/day	IV		Enteral	
			ml/kg/24hrs	ml/hr	ml/kg/24hrs	ml/3hrs
0	G10%	60	60	9	buccal colostrum/trophic feeds	buccal colostrum/trophic feeds
1	G10%	90	40	6	50	22
2	G10%	120	20	3	100	44
3	n/a	150	0	0	150	66

Table 19.8: *Shows summary of IVF estimation in MLS/HOUR for neonates ONLY on IVF by weight and age for sick newborns for Day 1-3.*

Birth Weight (kg)	Day 1 60/kg/d (mls/hr)	Day 2 90/kg/ d(mls/ hr	Day 3 onwards 100/kg/d (mls/hr).
	10% dextrose		10% dextrose with Ringer's lactate (80%:20% ratio)
0.75 -0.99	2	3	4
1.00- 1.24	3	4	5
1.25 -1.49	3	5	6
1.5 - 1.74	4	6	7
1.75 – 1.9	5	7	8
2.0 - 2.24	5	8	9
2.25 -2.49	6	9	10
2.5 - 2.74	7	10	11
2.75 - 2.9	7	11	12
3.0 - 3.24	8	12	13
3.25 -3.49	8	13	14
3.5 - 3.74	9	14	15
3.75 - 3.9	10	15	16
4.0 - 4.24	10	15	17
4.25 -4.49	11	16	18
4.5 -4.74	12	17	19
4.75 - 5.0	12	18	20

- **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.**

Safe Administration of IV Fluids

- Use an infusion set with a micro dropper e.g. Burethrol/Soluset (where 1 ml = 60 microdrops)
- With the Burethrol/Soluset 5mls /hour =5 drops/minute
- Flow regulators, infusion or syringe pumps are advised for optimal care of the preterms.
- Before infusing IV fluid, check the following:
  - The expiry date of the fluid
  - That the seal of the infusion bottle or bag is not broken
  - That the fluid is clear and free from visible particles.

- 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.
- 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:
  = Volume to be given (in mls) X Drop factor
  Total infusion time (in minutes)
- 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 (Table 19.9).
- Label the infusion set with patients' parameters: Date and time, Patient's name, Type of fluid, Volume of fluid, Number of drops/minutes.

Table 19.9: *How to calculate rate of IVF and drop rates*

How to calculate the rate of an IV fluid infusion if no syringe pump is available.	
How many drops in one ml of fluid? Aim for paediatric giving sets (Burethrol) and NOT ADULT a) Microdropper/Burette: 1 ml of fluid = 60 drops With this, 5mls/hr=5drops/minute 15mls/hr=15drops/minute If this is not available, use: b) General giving set: 1 ml of fluid = 20 drops. Though,not ideal for newborns c) Blood set: 1 ml of fluid = 15 drops (for giving blood) NOTE: The plastic wrapper of the giving set tells you drops per ml.	Whenever possible use a burette (60 drops/ml giving set) 1) Calculate mls of fluid the baby needs in 24 hours: weight of baby (kg) x "ml/kg/day" = total for 24 hours 2) Calculate mls of fluid the baby needs in 6 hours: Total in 24 hours divide by 4= volume in 6 hrs 3) Calculate drop rate when using 60ml/hour giving set: mls per hour = drops per minute (THEY ARE THE SAME!) e.g. 8 ml per hour = 8 drops per minute **4)** Label burette with "baby's name", "type of fluid" and "drops per minute" prescribed **5)** Fill burette with 6 hourly amount of correct fluid and set drip rate. **6)** Refill the burette every 6 hours with the "6 hourly amount" of correct fluid **7)** Check drip rate is still correct **8)** Ensure burette is refilled every 6 hours

Example 1: for 2kg baby on Day 4:

- Total fluids on Day 4 = 125ml/kg/day = 125ml x 2kg = 250ml in 24 hours
- This includes milk and IV fluids. The suggested amount of milk by day 4 is 75ml/kg/day, leaving 50ml/kg/day to be given as IV fluids.
- 75ml/kg/day milk (75ml x 2kg = 150ml total = 12ml every 2 hours or 18mls every 3 hours pending unit protocols)
- Therefore, remaining 50ml/kg/day should be given as IV fluid. On Day 4 the fluid of choice is Fluid with electrolytes

  = 50ml/kg/day Fluid/Electrolytes

  = 50ml x 2kg = 100ml total fluid in 24 hours

  = 25ml fluid in a burette every 6 hours at 4 drops a minute

Example 2: A baby weighing 2.6kg is to receive 60mls/kg of IV fluid over 24hours using a Soluset. Calculate the drop rate.

To calculate number of drops of IV infusion to be given per minute:

$$= \frac{\text{Volume to be given (in mls) X Drop factor}}{\text{Total infusion time (in minutes)}}$$

To convert total infusion time to minutes = number of hours X 60

Total volume to be given = 60 X 2.6 = 156mls over 24hours

Drop factor for Soluset = 60

Infusion rate $= \frac{156 \text{ X } 60}{24 \text{ X } 60}$

= 7 drops per minute

Monitoring of baby on IV infusion

- Ideally give fluids through an in-line burette or syringe pump.
- The oral intake must be taken into account when calculating the IV rates.
- Use an IVF/Feeds Monitoring sheet. (Sample in appendix 19.1)
- Calculate the drip rate.
- Check the drip rate and volume infused every hour.
- Strict input /output chart. Weigh diapers. 1g=1ml after subtraction of weight of dry diaper.

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/hr thereafter.
- 6 wet nappies or more in a day indicate good urinary output
- Ill infants need urine output quantified 6hrly
- Aim for a minimum urine output of 0.5-1 ml/kg/hr
- 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.

Total Parenteral Nutrition

For Level 3 Centres

- Used to provide energy, fluids, amino acid, carbohydrate, lipids, vitamins, minerals and trace elements to neonates who cannot be fully fed by enteral route.
  - Preferably administered through central lines but may be administered peripherally through a large vein.

  Indications: commence TPN in :
  - ELBW <1000g at birth if facilities are available
  - Babies likely to be fasted for ≥5 days --notably babies receiving conservative treatment for necrotizing enterocolitis (NEC)
  - Babies that have undergone surgery for congenital and acquired gastrointestinal abnormalities both pre-surgical and post-surgical until they are able to establish enteral feeds.
  - Lipid calculation: Maximal lipid intake in parenteral nutrition should be limited to a maximum of 3-4 g/kg/day.

- **Use a new, sterile needle and syringe each time medication is withdrawn from a multi-use vial or container.**
- **Do not keep opened glass ampoules so that the drug can be used for multiple babies. The drug may not be stable, and taping ampoules shut will not prevent contamination.**
- **Discard diluents solutions (e.g. sterile water or normal saline) after 24 hours. Aim for 5ml saline flush ampoules.**
- **Change the IV infusion set and fluid bag every 24- 48 hours; even if the bag still contains IV fluid (they can be a major source of infection).**

SYRINGE PUMP EQUIPMENT

Syringe drivers are used for the controlled infusion of small volumes of intravenous fluids over minutes or hours.

*Fig 19.1: Syringe pump equipment (*Source: https://diacmedical.com/product/b-braun-perfusor-compact-s-syringe-pump)

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

CHAPTER 20: HYPOGLYCAEMIA AND HYPERGLYCAEMIA

HYPOGLYCAEMIA

The fetus depends largely on glucose for his/her energy requirements. Hypoglycaemia occurs in 10% of healthy neonates and >50% of sick newborns; and directly contributes to both morbidity, mortality and long-term neuro-disability.

Hypoglycaemia is blood glucose level less than 45mg/dl (2.6mmol/L)(WHO definition). It is a medical emergency and should be treated promptly to prevent brain damage or death.

Conversion factor:1mmol/L=18mg/dl e.g 10mmol/L=180mg/dl. Furthermore, the blood glucose levels (measured with reagent strips) are approximately 0.5mmol/l lower than serum levels (measured in the laboratory) due to the high PCV after birth.

Risk factors include:

- Feeding difficulty in baby/ill newborns
- Prematurity
- Small for gestational age
- Macrosomia
- Infant of diabetic mother
- Sepsis
- Hypothermia/hyperthermia
- Perinatal asphyxia
- Polycythaemia
- Hereditary defects in carbohydrate or amino acid metabolism

Clinical presentations of hypoglycaemia

Asymptomatic:

- Hypoglycaemia detected incidentally when screening neonates at risk but no symptoms.

Symptomatic:

- Low blood glucose (<45mg/dl) in presence of any of the following symptoms:
  - Jitteriness
  - Irritability
  - Lethargy
  - Sweating
  - Poor feeding
  - Hypotonia
  - Hypothermia
  - Respiratory distress
  - Apnoea

- Seizures
- Reduced level of consciousness

Treatment

- Early feeding in first hour of life and glucose monitoring if any risk factors within the first 2 hours of life.
- In an otherwise well baby give milk feeds and recheck in 30minutes.
- If low glucose persists, or baby is symptomatic, establish an IV line if one is not already in place. Give a bolus of 2 ml/kg body weight of 10% dextrose IV slowly over five minutes.
- Continue 10% dextrose infusion at the daily maintenance volume according to the baby's age and weight.
- Maintain initial glucose infusion rate (GIR) for term neonates at 4-6mg/kg/min while rates for preterms at 6-8mg/kg/min. It is important to maintain a normal GIR after initial correction of hypoglycaemia.

Do not use 50% concentration of Dextrose in newborns as intravenous fluid for correction of hypoglycaemia.

50% is hypertonic solution and causes fluid shifts and intracranial haemorrhage and seizures.

Table 20.1: *Methods of calculating GIR*

METHODS OF CALCULATING GIR (mg/kg/min)

GIR = % Dextrose being infused X rate of infusion (ml/hr) Body weight (kg) X 6

2. GIR = Rate of IV fluids (ml/kg/day) X % Dextrose / 144
3. GIR = Rate of IV fluid (ml/kg/day) X % Dextrose infused X 0.007

4. Another simplified method to calculate GIR

- Determine the desired fluid intake in ml/kg/day e.g. 80ml/kg/day
- Convert it into ml/kg/min by dividing the figure by 1440 (this is to determine the volume of fluid to be given per minute; since 24hr = 1440mins) e.g. 80/1440 = 0.055
- Multiply the answer above by the glucose concentration of the fluid e.g. 5% Dextrose = 50mg of glucose in 1ml
  10% Dextrose = 100mg in 1ml
  50% Dextrose = 500mg in 1ml
  4.3% Dextrose = 43mg in 1ml

For example, for the above calculation, if a baby is on 10% Dextrose, then 0.055 X 100 = 5.5mg/kg/min

HOW TO INCREASE GIR BY 1MG/KG/DAY

- Add 1ml/kg of 50% Dextrose to the volume of fluid to be infused over 8hours
  - 50% Dextrose has 500mg/ml of dextrose
  - 8hour period has 480minutes (8 X 60)

  So, 1ml/kg of 50% Dextrose will increase GIR by 500/480 = 1mg/kg/min

If an IV line cannot be established quickly, pass a nasogastric tube and give 2 ml/kg body weight of 10% glucose by the gastric tube.

e) Measure blood glucose 30 minutes after the bolus of glucose:

- If between 45mg/dl -150mg/dl, then measure blood glucose every three or four hours until it is 45 mg/dl or more on two consecutive measurements
- If it is < 45mg/dl, repeat correction for hypoglycaemia, ensure IV fluid is going at prescribed rate, and there may be need to increase GIR.
    - Ensure enteral feeding with EBM (or BMS if BM not available) is on-going if baby is stable.
    - Measure blood glucose after 30minutes,
    - If still less than 45mg/dl, repeat correction for hypoglycaemia, increase GIR, may go as high as 12mg/kg/min and repeat blood glucose after 30minutes,
    - In emergencies, IV/IM Glucagon 0.02mg/kg bolus can be given.
    - If still <45mg/dl (refractory hypoglycaemia), suspect a serious underlying cause, investigate and treat. Consult a paediatric endocrinologist.

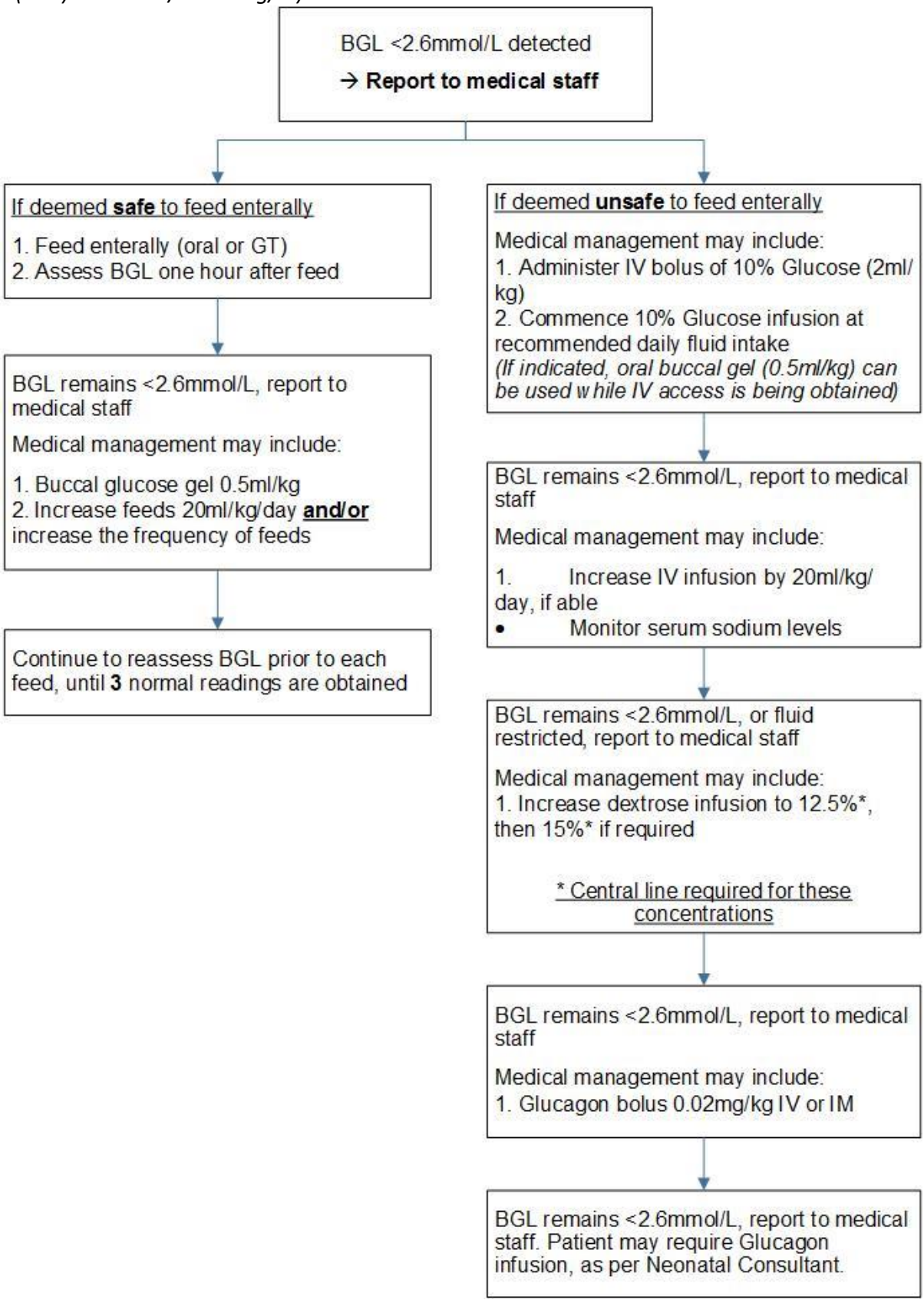
f) If baby requires >12mg/kg/min of glucose or more than 12.5% dextrose concentration to maintain normoglycaemia, a central venous line should be inserted to administer the higher concentration of glucose.

g) Once the blood glucose is 45 mg/dl or more 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 150mg/dl)

h) Allow the baby to begin breastfeeding. If the baby cannot be breastfed, give expressed breast milk using an alternate feeding method.

i) As the baby's ability to feed improves, slowly decrease (over one to two days) the volume of IV glucose while increasing the volume of oral feeds. Do not discontinue the glucose infusion abruptly.

Table 20.2: *Shows a flow chart for management of neonatal hypoglycaemia. (Note: Blood glucose level (BGL) 2.6 mmol/L = 45mg/dl)*



INFANTS OF DIABETIC MOTHERS

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

- It is worse in babies of poorly controlled maternal pre-existent diabetes with high levels of HbA1c. If postnatal hypoglycaemia is unrecognized and undiagnosed, there may be severe neurological lesions or death.

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

Other complications of babies born to diabetic mothers include; polycythaemia, birth traumas, , perinatal asphyxia, meconium aspiration, neonatal jaundice, , and congenital cardiac abnormalities which also leads to mortality. These babies need to be monitored closely and aim for early feeding and prompt correction of hypoglycaemia, if need arises.

Management

- Measure blood glucose at birth; 30minutes; 1hour; 2hour; 4hour; 8hour; 12hour and any period when symptoms suggestive of hypoglycaemia occur.
- Correct hypoglycaemia as indicated .
- The initiation of enteral feeding immediately after birth is the most important first step. Breastfeeding should be started during the 30 minutes of life with or without assistance in stable babies.
- Encourage and support early initiation of breastfeeding, at least eight to twelve times daily.
- Observe baby until the third day of age:
  - Measure blood glucose every six hours for 24 hours (after the first 12hours of life) and any moment when symptoms suggestive of hypoglycaemia occur OR until the blood glucose has been normal for two consecutive days.
  - If the blood glucose is less than 45 mg/dl (2.6 mmol/l) at any measurement, correct hypoglycaemia;
  - Discontinuation of the iv supplementation can occur when the enteral feeding is considered sufficient to maintain a correct glycaemic control.
  - If the blood glucose has been normal for 2-3 days, the baby is feeding well, and there are no other problems requiring hospitalization, discharge the baby and follow up closely.

HYPERGLYCAEMIA

- Neonatal hyperglycaemia is defined as a blood glucose of more than 145mg/dl (8mmol/L) regardless of body weight, gestational or postnatal age.
- The commonest cause is iatrogenic – from 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 because of the raised cortisol levels in response to the stressful situation.
- Sudden increase in blood glucose may be a sign of a new stressful problem such as infection, necrotizing enterocolitis (NEC), intraventricular haemorrhage (IVH), hypoxia, response to medications such as steroids, aminophylline or caffeine, phenytoin, surgical procedures, neonatal diabetes.
- Risk factors include sepsis, intrauterine growth restriction (IUGR), early use and high rate of intravenous lipid infusion and absence of enteral nutrition.
- Blood glucose should be monitored in all high-risk infants.

Diagnosis

- Symptoms are non – specific
- Can have hyperosmolaity, osmotic diuresis, dehydration and intracranial haemorrhage.
- Diagnosis is by evaluating blood glucose with a bedside glucometer and confirmed in the laboratory.

Treatment

1. Repeat the test to confirm if it is accurate (may want to use a different glucometer).
2. If on IV fluids, confirm that the fluids were correctly prepared and administered; and ensure that the infusion rate is appropriate for the age and weight (see infusion rates on the feeding charts and check prescription).
3. Assess baby for risk factors and address them.
4. If blood glucose >250 mg/dl (≥12 mmol/L), check urine for glycosuria (of ≥2+) and assess clinical hydration and fluid input/output.
5. Assess glucose infusion rate (GIR) in mg/kg/min using the formulae given in Table 20.1.
6. If glucose delivery rate (GIR) is >10 mg/kg/min, decrease glucose in decrements to GIR of 6– 10 mg/kg/min.
7. If glycosuria and hyperglycaemia >250 mg/dL (>12 mmol/L) persists despite a glucose infusion rate (GIR <4mg/kg/min), commence insulin therapy. Fall in glucose should be SLOW to prevent rapid fluid shifts in the brain.
8. Early introduction of parenteral nutrition (dextrose and amino acids with or without lipids) and early trophic enteral feeding will help reduce incidence of hyperglycaemia requiring insulin.
9. Insulin therapy is only necessary when other actions to treat or exclude any underlying causes of hyperglycaemia have been carried out.
10. Rarely patients may have insulin resistance or neonatal insulin dependent diabetes mellitus and such patient needs discussion and care at a tertiary level facility.
11. Level 2 facilities should refer baby to Level 3 facility if hyperglycaemia persists despite all initial therapy and levels >250mg/dl.

Insulin Therapy (FOR LEVEL 3 CENTRES)

- Commence exogenous insulin by intravenous infusion when glucose values exceed 250mg/dl despite all efforts. Use a separate infusion from that used for routine intravenous fluid or medications.
- Fall in glucose is desirable to be slow to avoid rapid fluid shifts and cerebral oedema.
- Pre-requisite: Prime the tubing with 3ml of the glucose insulin preparation (or 2 times the volume of the tube) before connecting it to the patient (insulin is adsorbed to the plastic tubing and will not reach the patient until the tube is saturated)
- Preparation:

-Take insulin with concentration 40iu/ml

Take 15 iu (0.15ml) of this and dilute with 29.85mls of Normal Saline to achieve concentration of 0.5 iu/ml.

- Bolus Vs Continous Infusion:
  a) For bolus insulin infusion, dose=0.05-0.1iu/kg/every 4-6 hours as needed. Time: over 15mins via syringe pump. Monitor blood sugar every 30mins to 1 hour. Monitor serum potassium levels
  b) Continous infusion is needed if sugar >200mg/dl after 3 boluses. Dose continuous = 0.05-0.2 iu/kg/hour (Start dose=0.05 iu/kg/hour) and titrate according to response.
  c) Flow rate (ml/hr) = $\frac{\text{Dose(iu/kg/hr) x weight (kg)}}{\text{Concentration (iu/ml)}}$
  d) Monitor glucose every 30 mins. If hypoglycaemia, stop insulin and give dextrose bolus.
  e) Subcutaneous insulin is rarely used except in neonatal diabetes (0.03 iu/kg for glucose >200mg at 3 hourly intervals subcutaneously). Monitor glucose hourly and potassium 6hrly initially.

Table 20.3: *Flow chart for management of hyperglycaemia*

Blood glucose > 180mg/dl (>10mmol/l) with glucometer. Then recheck

⇩

Confirm with a whole blood measurement in the laboratory

⇩

Assess infant for possible underlying cause and treat

- Sepsis especially
- Excess glucose intake
- Other illnesses, hypoxia, stress, pain
- Exogenous corticosteroids or inotropes, medications eg caffeine, aminophylline
- Intraventricular haemorrhage

⇩

Calculate the GIR glucose rate; if > 12 mg/kg/min: Reduce GIR and rate of flow

⇩

If still >250mg/dl
Discuss patient with senior clinician Consider to treat with insulin If:

- Blood glucose >250mg/dl. Recheck
- Glycosuria and

⇩

- Target blood glucose 100-180 mg/dl (5.5-9.9mmol/l)
- **Starting dose of insulin infusion 0.02 U/kg/hr**
- Avoid hypoglycaemia
- Initially glucose should be monitored every 30 min for first hour
- Hourly thereafter, once glucose stabilized measure 4 hourly
- **Do not flush insulin infusion**
- Change infusion every 24 hours

⇩

- If hyperglycaemia persists, discuss with endocrinologist
- Exclude neonatal diabetes (Transient/ or pancreatic agenesis)

Measurement of Glucose: Glucometer

Glucometers provide a rapid measurement of approximate whole blood glucose level to direct treatment for patients with mild to severe hypoglycaemia. Glucose levels in all neonatal patients should not fall below 2.5 mmol/L (45 mg/dL).

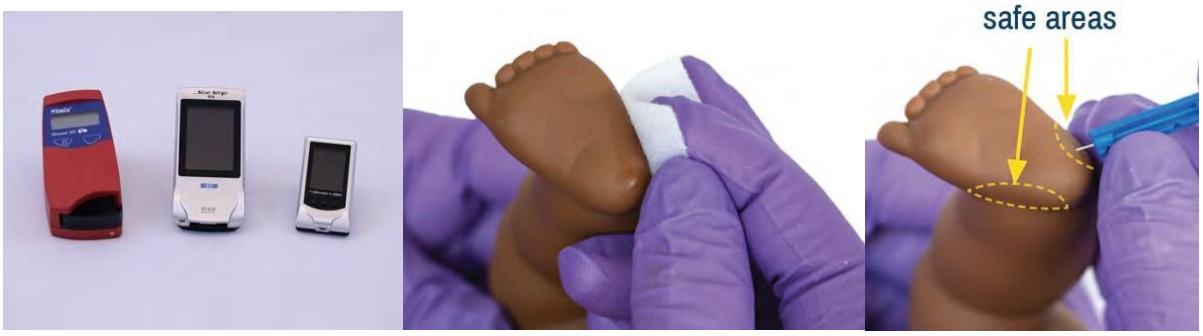


Figure 20.3: *Typical samples of glucometers. Clean area with alcohol and prick on outer edge of heel as shown.*

Glucometers use test strips with a glucose oxidase electrode. These strips generate a current proportional to the glucose in the blood that reacts to the glucose oxidase, which is then measured and analysed to determine an estimated blood glucose level.

Refer FMOH National Guidelines for Newborn Care Training Manual for details of glucometer use.

CHAPTER 21: ELECTROLYTE DERANGEMENTS

Electrolyte derangements are one of the common conditions encountered in the care of the small and sick newborns; and efforts must be made for routine monitoring, laboratory analysis and correction in SCBUs. Commonly are sodium, potassium, calcium, and then magnesium, phosphorous which can either be high or low.

Normal values:

Sodium: 135-145 mEq/L

(mmol/L) Potassium: 3.5-

5.5mEq/L (mmol/L) Calcium:

9-11 mg/dl (mmol/L)

HYPONATRAEMIA

Is serum sodium (Na) < 130mEq/L (<130 mmol/L)

This may be due to:

a) inadequate sodium intake (IV or Oral) and use of hypotonic fluids
b) excessive free water in the body leading to haemodilution (dilutional- SIADH, AKI)
c) excessive sodium loss (diuretic therapy)
d) combinations depending on case

Dangers: lethargy, oedema, hypotonia, apnoea, seizures, coma.

Baby may be asymptomatic or symptomatic with significant hyponatraemia.

Management

- Determine the underlying cause and treat appropriately
- Do not treat an isolated low Na – repeat the sample if possible
- Aim to correct slowly over 48 to 72hrs

For Dilutional Hyponatraemia

- Consider if baby hyponatraemic with excess weight gain or absence of weight loss. Check for oedema in dependent areas e.g. sacrum
- Establish the cause: may be secondary to renal dysfunction seen in prematurity and renal cortical necrosis due to asphyxia, cardiac failure, excessive water intake SIADH e.g. as in asphyxia, meningitis.
- Restrict fluid intake
- For SIADH, restrict fluids and give hypertonic saline (3% saline)

- For AKI, restrict fluids and give 0.18% saline
- For excessive loss replace losses.

For Sodium deficiency /excessive losses

- Consider if: hyponatraemic with weight loss
- Common cause: Diuretics, GI diarrhoea, or renal losses, polyuria, osmotic diuresis, pleural effusions, ascites, ileus seen in necrotizing enterocolitis.
- Manage cause, reduce sodium losses and replace sodium deficit

Sodium replacement formula

Total Na replacement = Desired Na (mEq) - Actual Na (mEq) × Weight (kg) × 0.6

i. **For asymptomatic:** Give 5% D/W with 0.45% to 0.9% saline solution IV in volumes equal to the calculated deficit.
ii. **For symptomatic hyponatraemia** (e.g., lethargy, confusion) and hyponatraemia less than 120mEq/L require emergency treatment to prevent or treat seizure or coma.
    - Give half replacement (over at least 6-8 hrs) in the maintenance IV fluid.
    - Check serum Na+ after the 1st replacement; if additional Na+ is needed, give the 2nd half over the next 16 hrs.
    - Correct by using hypertonic NaCl (3% saline which has 1 mEq in 2 mls) until the serum sodium has reached 120mEq/L, then use 5%D/W with 0.45% to 0.9% saline.

HYPERNATRAEMIA

Is serum sodium >145mmol/L (145mg/dl)

Hypernatremia reflects the deficiency of water relative to total body sodium. While the primary cause may be from water loss in excess of sodium or sodium excess, in the ill infant, the cause may be multi-factorial.

Grades vary: Mild: 146 – 149 mmol/l; Moderate: 150 -160 mmol/l and Severe: >160 mmol/l (especially with renal failure)

Dangers: weight loss, Irritability/high pitched cry, apnoea, intracellular dehydration and associated intracranial bleeds (subdural and cerebral), Lethargy/altered level of consciousness, cerebral venous sinus thrombosis, acute rehydration can lead to cerebral oedema and seizures; cognitive and motor deficits, Long-term developmental delay, and death.

Commonest causes

- Most common cause is inadequate breastfeeding and dehydration, poor feeding
- Excessive water loss
- Diarrhoea/vomiting
- Very preterm babies with excessive insensible water loss
- Improperly prepared formula
- Polyuria
- Excess sodium intake – common with sodium bicarbonate infusions and other medications/infusions

Management

- Interpret high sodium values in clinical context.
- Is the baby dehydrated?
- Are there ongoing fluid losses?
- Is the baby receiving medications or infusions that contain large amounts of sodium?
- Hypernatraemia + weight loss = water loss (e.g. dehydration)
- Increase fluid intake or reduce sodium intake appropriately.
- For extreme preterms, use thin transparent plastic wraps to increase the local humidity and limit air movement; and this is effective in reducing insensible water losses by up to 70%.
- Mild: breast feed, EBM NG or cup 100mls/kg/24hours. Monitor glucose for hypoglycaemia
- Chronic moderate to severe: hypernatraemia should be corrected slowly because of the slow dissipation of idiogenic osmols – rapid rehydration will result in brain oedema.
- Rehydrate and correct slowly over 48 hours.
- Severe: If in shock give NS 10mls /kg bolus till CRT is normal and urine output restored
- Start with 100mls/kg/day using 5% or 10% Dextrose with 0.18% saline. Aim for a correction rate of 0.5mmol/l and increase fluid intake daily by 20ml/kg.
- Start oral feeds as soon as stable and gradually wean off IV
- Monitor weight, strict input /output, heart rate, temperature, blood pressure closely.

HYPOKALEMIA

Is Potassium [K] <3.5mmol/l

Can be mild hypokalaemia (potassium 3-3.5 mmol/L); and significant hypokalaemia (serum level <3 mmol/L).

Causes:

- Occur in alkalosis (approximately 0.4 mmol/L fall in K^+ for every 0.1 unit rise in pH)
- Nasogastric or ileostomy losses, renal tubular disorders, iatrogenic in NPO babies, low concentration in IV fluids, Diarrhoea (Note: K^+ content of lower GI losses is >upper GI losses),
- Insulin administration
- Salbutamol administration (high dose, nebuliser/IV)
- Renal losses – diuretics, bicarbonate administration or renal tubular acidosis, Bartter syndrome

Clinical features:

- Patients may present with lethargy, ileus or arrhythmia.
- Muscle weakness and paralysis
- ECG changes: prolongation of PR interval, prominent U waves (best seen in precordial leads)
- Arrhythmias: sinus bradycardia, atrioventricular block

For Asymptomatic babies

- Potassium replacement given according to how baby is being fed:
  - For orally fed babies, oral supplementation should be given e.g. potassium chloride 1 mmol/kg 12-hrly check K level in 48 hours
  - For babies on intravenous fluids, correct in the IVF at 40mmol/L
  - Babies receiving parenteral nutrition (PN)
    - ☐ increase K^+ concentration in the PN to 3-5 mmol/kg/day
    - ☐ if modified PN not available run K^+ infusion 3-5 mmol/kg/day to run alongside current PN

For Symptomatic babies (explain clearer)

- Monitor K+ levels 2-4 hrly and assess cardiac function continuously
- If baby is on insulin, consider stopping
- If hypokalaemia is not responding well to replacement check magnesium level

HYPERKALEMIA

Hyperkalaemia is a potentially life-threatening condition because of effects on cardiac rhythm. It is most commonly seen in infants VLBW or in infants with impaired renal function. In premature infants the serum potassium usually reaches a peak at 24 hours of age and declines to normal values by 72 hours of age.

- Hyperkalaemia is plasma potassium >6 mmol/L
- Note that babies often tolerate levels up to 7.5–8.0 mmol/L without major ECG changes.

Causes

- Acute renal failure: most commonly perinatal asphyxia and hypoxic ischaemic encephalopathy, (hence do not add KCL for asphyxiated baby and monitor urine output);
- Sepsis and hypotension, or structural renal abnormalities
- Cellular injury with potassium release e.g. large intraventricular haemorrhage, haemolysis
- Very-low-birth-weight babies (extreme prematurity <28 weeks gestation) without renal failure (non-oliguric hyperkalaemia) in first 12–48 hrs
- Excess K^+ in IV solutions
- Double volume transfusion/use of "old blood" (Potassium rises after 4 days in stored blood)
- Haemolysed blood specimen may falsely elevate potassium. Repeat test repeat and send free-flowing venous or arterial sample if this is suspected. If ECG changes are present or expected result is delayed, institute treatment measures immediately.
- Endocrine (congenital adrenal hyperplasia)

Clinical Features:

- Cardiac arrest
- ECG abnormalities (see below):
  - ☐ Tall peaked Twave, widened QRS complex, prolonged PR interval, bradycardia, absent P wave
  - ☐ sine waves (widened QRS complex merging with T wave)

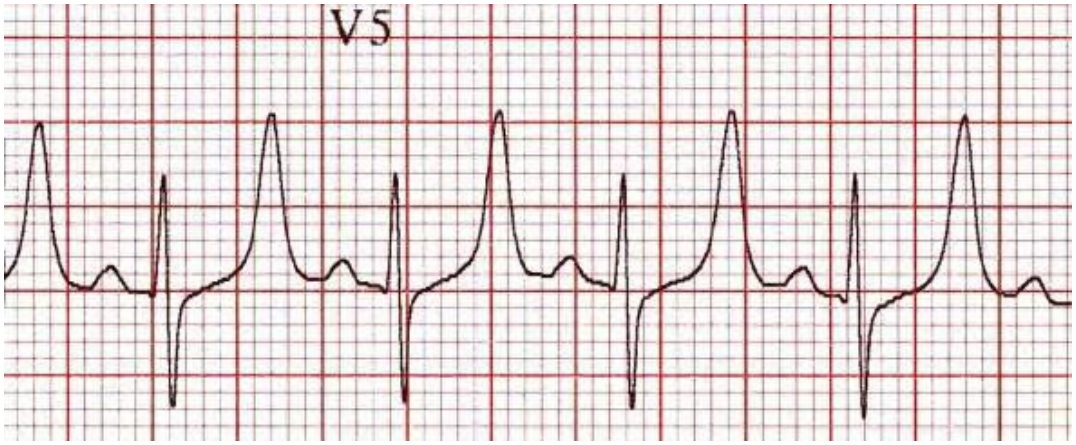


Figure 21.1: ECG hyperkalaemia showing Tall, peaked T wave, widening of QRS

Management

- Stop all potassium –containing fluids, oral supplements and potassium-sparing diuretics, and institute continuous ECG monitoring.
- If ECG changes or symptomatic, institute emergency measures.
- Give calcium gluconate 50mg/kg (0.5 mL/kg IV of 10% diluted given over 5–10 min)
- Flush line with sodium chloride 0.9% or preferably use a different line because NB: Calcium gluconate is incompatible with sodium bicarbonate.
- Then give sodium bicarbonate (1 mmol/kg IV over 2 mins). This is effective even in babies who are not acidotic (2 mL of sodium bicarbonate 4.2% = 1 mmol)
- If [K] rise persists:
  A. Salbutamol infusion 4µg/kg in 10% glucose over 10-15minutes (repeat as necessary effect evident within 30 min but sustained benefit may require repeat infusion after at least 2 hrs)
  B. Alternately 0.4mg/kg/dose nebulization 2 hourly if IV access difficult. Give furosemide 1 mg/kg IV.
- If serum potassium still >7.0 mmol/L, give soluble insulin 0.5 units/kg IV in glucose 10% (made up to 2.5 mL and given over 30 min): very effective and has an additive effect with salbutamol. Repeat insulin infusion as necessary until K^+<7.0 mmol/L)
- Monitor glucose after 30min, then hourly until stable.
- Correct acidosis if present with bicarbonate, Repeat E/Us
- Treat any underlying cause (e.g. renal failure)
- Monitor urine output and maintain good fluid balance
- If urine output <1 mL/kg/hr, unless baby volume depleted, give furosemide 1 mg/kg IV until volume corrected.

Further treatments: Refer to Level 3 if at Level 2 centre

- A cation-exchange resin, such as calcium resonium (500 mg/kg rectally, with removal by colonic irrigation after 8–12 hr, repeat every 12 hr. Dose can be doubled at least once to
- 1 g/kg in severe hyperkalaemia). Useful for sustained reduction in serum potassium but takes many hours to act and is best avoided in sick preterms at risk of necrotising enterocolitis.
- If severe hyperkalaemia persists despite above measures in term babies with otherwise good prognosis, contact renal team for consideration of dialysis
- Exchange transfusion using fresh blood or washed red blood cells. (see Exchange transfusion guideline).

In order to reduce the risk of intraventricular haemorrhage (IVH), avoid rapid sodium bicarbonate replacement in newborns. Give over one hour in infants born before 34 weeks.

And note calcium gluconate is incompatible with sodium bicarbonate and cannot be put together in an infusion as gives a white precipitate of calcium carbonate.

HYPOCALCAEMIA

Acute symptomatic hypocalcaemia may present within the first 72hours of birth (early hypocalcaemia) or after 72hours of birth (late hypocalcaemia) with apnoea, irritability, seizures, jitteriness or prolonged QTc interval on ECG.

Definition:

Term and preterm ≥ 1500g: Total serum [Ca] < 2mmol/l (8mg/dl) and ionized calcium (iCa) < 1.1mmolmmol/l (4.4mg/dl)

Preterms <1500g: Total serum Ca < 1.75mmol/l (7mg/dl) and ionised Ca< 1mmol/l (<4mg/dl)

Causes of hypocalcaemia

Early hypocalcaemia occurs within the first 2-3 days after birth and causes include:

- Prematurity
- Infants of diabetic mothers
- Birth asphyxia
- Intrauterine growth restriction

Late hypocalcaemia typically occurs at the end of the first week and causes include:

- Hypoparathyroidism
- DiGeorge syndrome
- Maternal hyperparathyroidism
- Hypomagnesaemia
- Diuretic therapy.
- Vit D insufficiency
- Acute renal failure + hyperphosphataemia
- Maternal hypercalcemia may result in hypocalcaemia in the newborn due to suppression of foetal parathyroid development.

Clinical manifestations

Most infants are asymptomatic Symptomatic features:

- jitteriness, muscle jerking and seizures
- Irritability, apnoea, high-pitched cry, seizures, stridor, tetany,
- Decreased myocardial function, or ECG abnormalities, carpopedal spasms

Diagnostic criteria – Do not use tourniquet to collect sample for calcium estimation

Treatment·

-Treat infants with symptomatic hypocalcaemia -Direct treatment towards the underlying disease

Acute treatment

- 10% Calcium gluconate 1 – 2 ml/kg (100–200 mg/kg/dose) infused over 10-15mins (dilute 1:1 with Normal saline or 5% dextrose). (1mL of 10% calcium gluconate = 100 mg calcium gluconate)
- Monitor for bradycardia; stop infusion if HR < 100bpm
- Repeat in 15 minutes if necessary and monitor. Can be repeated in 6-8hours.

Maintenance

- 10% calcium gluconate 5 ml/kg/day in IV fluids or same dose divided into 4-6 orally with feeds.
- If PO: dilute by at least 50% with feeds or water (IV solution may be used orally). Can induce gastrointestinal irritability and diarrhoea.
  - Monitor levels until deficits are reduced.
  - Consider hypomagnesaemia if hypocalcaemia is intractable. Administer magnesium sulphate 50%, IV 0.25 mL/kg.
- Do not mix calcium gluconate with bicarbonate or fluids containing phosphate as precipitation may occur.
- Extravasation of calcium can cause tissue necrosis.
  - Do not give intra-arterially or via lowly placed umbilical venous catheters placed inside the liver. Use appropriately positioned central catheters. See section on umbilical venous catheterization (UVC) placement in procedures.

CAUTION: NEVER give rapid infusion of calcium as causes bradycardia/dysrhythmias and cardiac arrest in systole. Electrocardiographic monitoring is advised. Monitor the heart rate.

HYPERCALCAEMIA

- Defined as serum Ca> 3 mmol/l (12mg/dl) or ionized Ca> 1.5mmol/l (6mg/dl)
- Hypercalcaemia is rare in infants

Causes:

- Hyperparathyroidism
  Williams syndrome Clinical features:;Subcutaneous fat necrosis -- Presents in the first weeks of life. Cutaneous violaceous rash with indurated painful nodules over the face, trunk, buttock, and arms.
- Vomiting, hypotonia and encephalopathy.
- Renal failure and neurological sequelae

Management

- 1st line investigations: PTH, PO_4, SEUC, ALP, serum and ionized Ca
- Establish underlying cause and lower Ca to prevent end organ damage
- Ensure adequate hydration. Furosemide to increase calcium excretion.
- Reduce calcium intake and avoid drugs which may cause hypercalcaemia
- Hyperhydration with 0.9% saline
- Furosemide to promote natriuresis and hypercalciuria
- Prednisolone useful in subcutaneos fat necrosis (SCFN)
- Consult with Endocrinology Team in Level 3 facility.

HYPOMAGNESAEMIA

Definition: Serum magnesium < 0.65mmol/L

Associated with intractable hypocalcaemia.

Management

- Treatment only required if symptomatic.
- Treatment is MgSO4 IM or SLOW IV over 15 - 30minute.
- 50% MgSO4 0.2ml/kg IV/IM 12 hourly x 2 doses.

HYPERMAGNESAEMIA

Serum magnesium > 1.2 mmol/l. Usually occurs secondary to magnesium treatment of the mother for pre-eclampsia.

Neonatal symptoms:

Hypotonia, hyporeflexia, apnoea, haemodynamic instability. The treatment is supportive until magnesium is excreted.

METABOLIC ACIDOSIS

Defined as a base deficit >5 mEq/L on the first day of life and >4 mEq/L thereafter OR Serum bicarbonate <18meq/l.

It occurs from:

- Loss of buffer (mainly bicarbonate – as occurs in diarrhoea) or
- Excess production of acid or decreased excretion of acid

The anion gap is a useful calculation in assessing metabolic acidosis.

- Anion gap = [Na+] – ([Cl-] + [HCO3 -])

Loss of buffer has no effect on anion gap. Accumulation of organic acid (e.g., lactic acid) causes an increase in anion gap. High anion gap occurs in severe dehydration.

Normal anion gap:

- 15 mEq/L in LBW infants (<2,500g)
- 18 mEq/L in ELBW infants (<1,000g)
- Newborn infants normally have a base deficit of 1 to 3 mEq/L.

Effects of metabolic acidosis:

Major physiological effects of metabolic acidosis include:

- Pulmonary vasoconstriction (with risk of persistent pulmonary hypertension)
- Depresses myocardial contractility
- Shift of oxygen-haemoglobin dissociation curve to right (reduced saturation at a given PO2)
- CNS damage occurs with severe acidosis
- Increased work of breathing as compensation for acidosis

Management of metabolic acidosis:

- Treat underlying cause when possible
- Do not treat metabolic acidosis by hyperventilation (other than briefly while preparing to give sodium bicarbonate). This may correct pH but has deleterious effects on cardiac output and pulmonary blood flow.
- Volume expansion (i.e. bolus 10 mL/kg of 0.9% NaCl) should not be used to treat acidosis unless there are signs indicative of hypovolaemia. Volume load is poorly tolerated in severe acidosis because of the depressed myocardial contractility.
- Alkali treatment should be used only if significant metabolic acidosis is present (e.g., pH <7.30 with base deficit >7)
- Dose of sodium bicarbonate for treatment of metabolic acidosis can be calculated by:
- Dose of sodium bicarbonate (mEq) = base deficit x 0.5 x body weight (kg)
- Administer sodium bicarbonate IV at a rate not exceeding 1 mEq/kg/min.
- The usual sodium bicarbonate used in newborns is NaHCO3 and the concentration is 0.5 mEq/mL, so it is hyperosmolar (900 mOsm/L)
- Do not give NaHCO3 unless the infant is breathing spontaneously or receiving assisted ventilation that is adequate. With inadequate ventilation, NaHCO3 will worsen acidosis because of the liberation of CO_2.

Complications of alkali administration include:

- Acute hyperosmolality with rapid shift of water from intracellular to extracellular space.
- Associated intracellular dehydration.
- Acute expansion of intravascular volume which increases the risk of intracranial haemorrhage.
- Decreased ionized calcium levels (Ca++).
- Shift of oxygen haemoglobin dissociation curve to left (increased binding of oxygen to haemoglobin).

CHAPTER 22: NEONATAL JAUNDICE

Jaundice is the yellowish discolouration of the skin and conjuctiva due to accumulation of bilirubin in the blood. Over 50% of term and 80% of preterm newborns have some jaundice, thus, all newborns should be monitored for the development of jaundice.

Unconjugated bilirubin is the breakdown product of haemoglobin. Unconjugated bilirubin is NOT water-soluble and cannot pass out of the body in the urine. First it must be transported to the liver to be conjugated. Once it is conjugated, the bilirubin becomes water-soluble and is secreted into the bile and then into the intestine.

WHY DO WE WORRY ABOUT JAUNDICE?

When the bilirubin level gets too high it can cross into the brain and cause brain damage (Kernicterus). This can lead to seizures and death and for those babies who survive can cause athetoid cerebral palsy.

Jaundice can be physiologic or pathologic.

NB: Bilirubin 1mg/dL= 17mmol/L

1) Diagnostic criteria

a) Pathologic jaundice:

- Appears on the first day of life
- Lasts > 14 days in term and > 21 days in preterm infants (Prolonged jaundice)
- The unconjugated and/or conjugated fractions of bilirubin are increased.
- The conjugated bilirubin level exceeds 20% of the total bilirubin value, or the conjugated bilirubin fraction is 2 mg/dL (34 µmol/L) or more.
- Total bilirubin concentration rises by more than 85 µmol /L/24 hours (5mg/dL/24hours) or more than 17 µmol /L/hour (1mg/dL/hour)
- There are signs and symptoms of illness in the baby.
- Severe jaundice: palms and soles of the infant become yellow
- Any jaundice associated with pale stool and dark urine

b) Physiologic jaundice:

- Appears after 24 hours of birth.
- Rarely lasts more than 10 days in the full-term infant and 14 days in the preterm infant.
- Only the unconjugated bilirubin fraction is increased.
- Total peak serum bilirubin concentration is usually below 275 micromol/L (16mg/dL) in the term infant.
- Total bilirubin concentration does not rise by more than 85 micromol/L/24 hours (5mg/dL/24 hours) or 17 micromol/L/hour (1mg/dL/hour).
- The baby thrives and shows no signs of illness or anaemia.

2) Approach to an infant with jaundice

a) Additional history to be taken

- In addition to the findings from the general history the following information should be obtained:
  - Age of onset.
  - Previous infants with jaundice, bilirubin encephalopathy (kernicterus), neonatal death, G6PD deficiency.
  - Mother's blood group (and father's blood group as well). ABO incompatibility (particularly if mother blood group O) and Rhesus disease (if Mother is negative and baby positive)
  - Gestation: the incidence of hyperbilirubinaemia increases with prematurity.
- Features suggestive of sepsis
  - Presence of abnormal symptoms such as abnormal posturing, abnormal cry, apnoea, poor suck/ unable to feed/feed intolerance and temperature instability.
- Family history of jaundice, anaemia.

b) While examining the baby, take note of the following

- Estimate the severity of jaundice:
  - Observe in good daylight with baby naked. Jaundice will look more severe if observed in artificial light and may be missed in poor light.
  - The sclera and/or gums may be yellow
  - Lightly press the skin (forehead/ tip of the nose) with a finger to reveal the underlying colour of the skin and subcutaneous tissue;
  - Blanche the skin by pressing the skin gently on the Five Zones to look for jaundice (Fig 22.1)
  - Always check palms and feet for jaundice
  - Estimate the severity of jaundice by day of life and the area of the body where jaundice is seen (Figure 22.1 below) The Kramer chart is used to clinically assess the severity of jaundice depending on the age in days and maturity of the baby.
  - It is not as accurate as a serum bilirubin level or transcutaneous bilirubin reading.
  - Clinical examination showing: Sepsis especially UTI, Large tongue, Umbilical hernia, Dry skin, Slow pulse, suggesting hypothyroidism, Biliary atresia, Urine colour dark , Stool colour pale, Large liver, Congenital infection, IUGR , Large liver or spleen, Rash at birth, Cataracts for congenital infections
  - Signs of acute bilirubin encephalopathy: lethargy, hypotonia, seizures, opisthotonus, high-pitched cry, sunset eye appearance (See the bilirubin induced neurological dysfunction (BIND) Score chart).

c) Communication/ Counselling:

- Document findings, inform and counsel parents on present effect of the jaundice on the baby, causes of jaundice and practices that could predispose to jaundice as well as management options.

Area of the Body	Level	Range of Serum Bilirubin	
		µmol/L	mg/dL
Head and neck	1	68 - 133	4 - 8
Upper trunk (above umbilicus)	2	85 - 204	5 - 12
Lower trunk and thighs (below umbilicus)	3	136 - 272	8 - 16
Arms and lower legs	4	187 - 306	11 - 18
Palms and soles	5	≥306	≥18

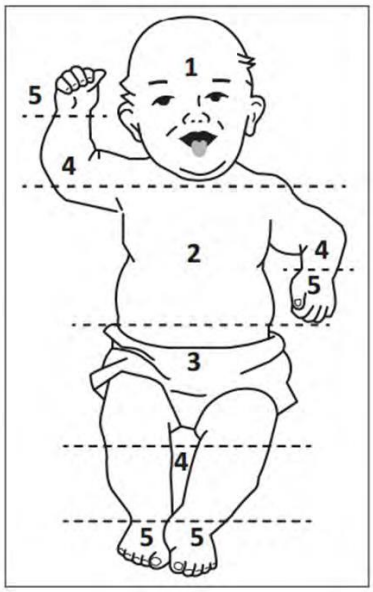


Figure 22.1: The Kramer Chart for visual estimation of jaundice

Clinical examination (e.g Kramer's chart) can be used in making the decision to start phototherapy (It should be known that visual estimation of jaundice is very unreliable especially in dark skinned infants). Aim to do blood estimation of bilirubin levels promptly.

Investigations

- Point of care bilirubin estimation (including transcutaneous bilirubinometer)
- Total serum bilirubin/ conjugated fraction
- G6PD assay
- Infant and mother's blood group and Rhesus
- Direct Coombs' test
- Full blood count, reticulocyte count, peripheral blood film
- Sepsis work-up (if infection is suspected)

Treatment

- Can be phototherapy or exchange blood transfusion. Avoid sunlight exposure as it delays early diagnosis and exposes to risk of dehydration and sunburn.

PHOTOTHERAPY

1. Mechanism

A newborn's immature liver is often unable to remove bilirubin quickly enough, causing an excess of unconjugated bilirubin and thus jaundice. Phototherapy acts on baby's skin to break down unconjugated bilirubin to a water-soluble, non-toxic form that can be easily excreted.

This allows it to pass out of the body in the urine. Phototherapy is not used for treatment of conjugated hyperbilirubinaemia.

2. Procedure

- Commence phototherapy based on the threshold charts by gestation age, postnatal age in hours/days and on the total bilirubin level.
- Phototherapy should be given 24 hours a day using a conventional phototherapy machine. Ensure availability of irradiance meters to measure the irradiance being given.
- The baby should be nursed naked under phototherapy except for a nappy and eyeshield
- The baby's eyes should be covered using a suitable opaque blindfold
- The baby's genitalia should be covered using a nappy or cloth
- Ensure that the baby is placed in the centre of the light source, no more than 30cm from the light source.

3. How phototherapy works and types of devices:

Phototherapy lights may be integrated into units with overhead, over- and under-body Figure 22.2 or flexible blanket lights (Figure 22.3). Phototherapy lights are most effective when providing blue light within 425 to 475 nm via LEDs, although other types of light are marginally effective.

(*See the FMOH National Comprehensive Newborn Care Training Manual for details on phototherapy device).*

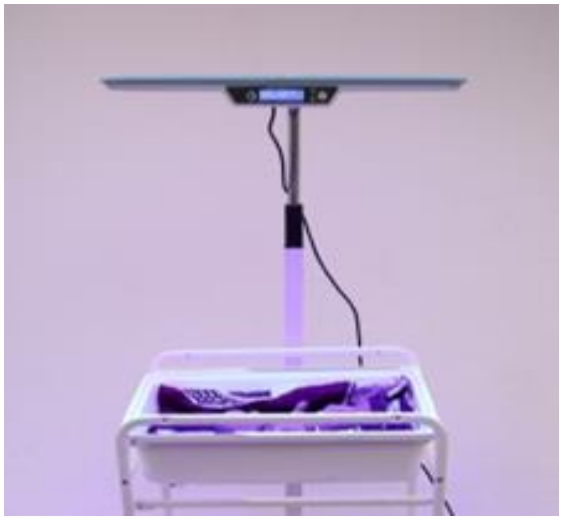


Figure 22.2: A typical phototherapy unit.

Figure 22.3: *Over- and under-body phototherapy unit.*

Figure 22.4: *Flexible phototherapy blanket.*

4. Preparing the phototherapy unit

- Connect the phototherapy unit to a power source and turn on the switch.
- Phototherapy lights should have a minimum irradiance of 15 µW/cm^2/nm. Measure intensity of phototherapy light periodically using irradiance meters.
- Do not place anything on the phototherapy devices. Lights and baby need to keep cool so do not block air vents / flow or light.
- Keep device clean - dust can reduce the intensity of the light and can carry bacteria.
- Make sure that each light source is working and emitting light.
- Light emitting diodes (LED) bulbs should be replaced if: more than 1-2 years in use (or usage time >20,000 hrs) and lights begin to flicker.

5. Giving phototherapy

- Place the baby under the phototherapy lights:
- If the baby weighs 2 kg or more, place the baby naked in the cot or bassinet. Babies weighing less than 2.0kg should be kept in an incubator if available; otherwise, they can be nursed in the cot or bassinet.
- Place the baby as close to the lights as the manufacturer's instructions allow, usually between 15-20cm using LED machine (Wrap round biliblankets for preterm babies in incubators) from top surface of the infant.

- Cover the baby's eyes with eye pad, ensuring that the pad does not block the baby's nostrils. Do not secure the pad in place with tape.
- Use white linens in the cot, bassinet, or incubator, and place white curtains around the area where the unit is located to reflect as much light as possible back to the baby.
- Turn the baby every three hours.
- The baby may require additional intravenous fluid, monitor weight and urine output carefully.
- Monitor vital signs and temperature at least 4 hourly to ensure the baby does not overheat
- Ensure that phototherapy unit is turned off during collection of blood for SB levels, as both conjugated and unconjugated bilirubin are photo-oxidized when exposed to white or ultraviolet light.
- Standard spectral irradiance (conventional phototherapy) is less than 30 µW/cm^2/nm (15-30)
- Babies with high levels of jaundice at presentation should be started on intensive phototherapy (spectral irradiance more than 30 µW/cm^2/nm). Monitor the irradiance using the radiometer (irradiance meter).

Figure 22.5: *Samples of eye pads*

6. Care of the baby receiving phototherapy

a) Feeding

- Ensure that the baby is fed regularly
- Encourage the mother to breastfeed on demand but at least every two to three hours. Breast feeds may need to be limited to 20 minutes if bilirubin level is high to minimize amount of time out of the lights
  - During feeding, remove the baby from the phototherapy unit and remove the eye pad.
  - If the baby is receiving IV fluid or expressed breast milk, increase the volume of fluid and/or milk by 10 – 20ml/kg/day for as long as the baby is under the phototherapy lights;
  - If the baby is receiving IV fluid or is being fed by gastric tube, do not remove the baby from the phototherapy lights.
  - Maintain a strict fluid balance chart, weigh baby daily and record numbers of wet diapers daily.

b) Temperature monitoring

- Measure the baby's temperature every two hours.

c) Bilirubin monitoring

- Transcutaneous bilirubin measurements daily or twice daily if an area of the skin has been protected by a patch earlier OR measure serum bilirubin level every 12

hours or at least daily.

- If the serum bilirubin is close to the level requiring exchange blood transfusion, take baby and mother's blood for cross-matching and do an exchange blood transfusion. If in a secondary facility where there is no expertise for performing exchange blood transfusion, organize transfer, and urgently refer the baby to a tertiary hospital or specialized centre for exchange blood transfusion.

d) Other care

- Keep the eyes and mouth clean and free from infection – remove eye pads while baby is being fed outside phototherapy and observe for any discharge, clean crusts from the mouth.
- Baby should be removed from the phototherapy unit only for procedures that cannot be performed while under the phototherapy lights.
- If the baby is receiving oxygen, briefly turn off the lights when observing the baby for central cyanosis (blue tongue and lips).
- Continue other prescribed treatment and tests
    - Early prophylactic phototherapy is recommended for the following: Extreme prematurity, Polycythaemia, Extravasation of blood (cephalhaematoma, subgaleal haemorrhage).

7. Discontinuing phototherapy

- Discontinue phototherapy when the serum bilirubin level is below that at which phototherapy was started or below 12mg/dl (204µmol/l) for a term baby, whichever is lower. Use routine charts to monitor.
- After phototherapy has been discontinued:
    - Observe the baby for 24 hours, and repeat the serum bilirubin measurement
    - If jaundice has returned to or is above the level at which phototherapy was started, recommence phototherapy.
- If phototherapy is no longer required, the baby is feeding well, and there are no other problems requiring hospitalization, discharge the baby.

8. Maintenance of the phototherapy unit

- Regular servicing and maintenance of the phototherapy unit should be according to original equipment manufacturer's guide.
- Bulbs are to be replaced as specified by the manufacturer or when the photo irradiance is lower than 15 $\mu W/cm^2/nm$
- Record the date the LEDs were replaced, and measure the total duration of use of the tubes.

9. Potential side effects of the phototherapy include:

- Overheating with the fluorescent tubes type– monitor neonate's temperature
- Water loss/dehydration
- Diarrhoea
- Rash
- Retinal damage
- 'bronzing' of neonates with conjugated hyperbilirubinaemia

Guideline Thresholds Charts for phototherapy

Figure 22.6 shows a chart to guide on decision to commence phototherapy in newborns ≥35 gestation based on the age of the baby and the age in hours/days.

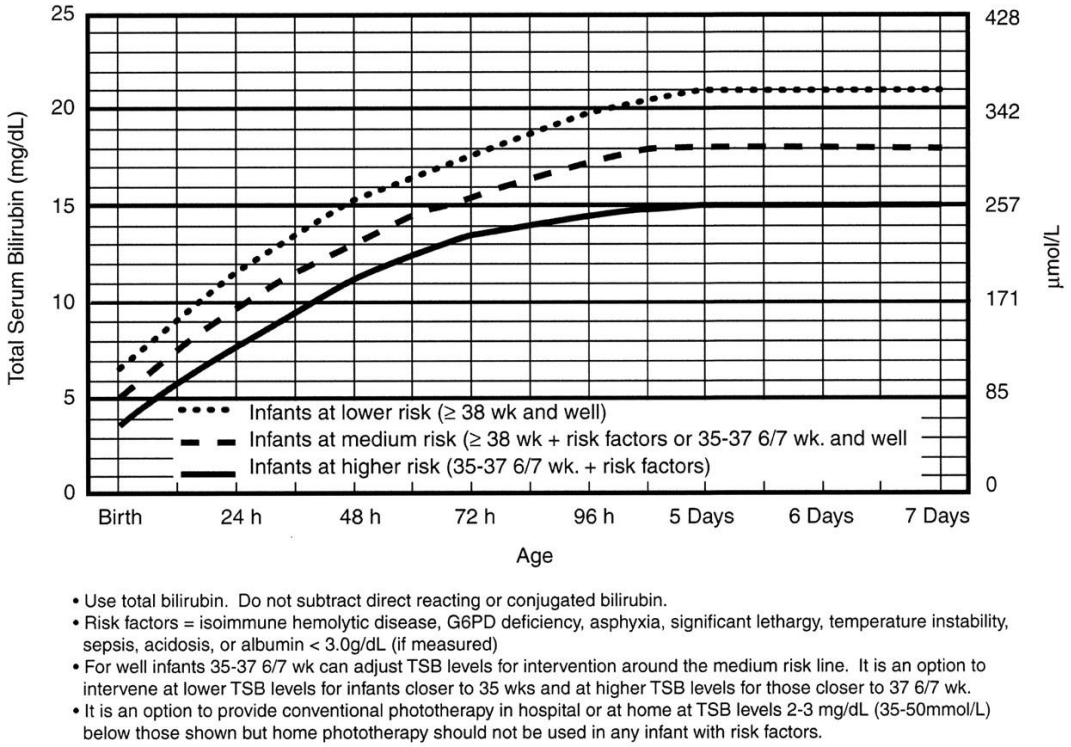


Figure 22.6: *Guidelines for phototherapy in newborns of ≥35weeks gestation. (Source: Bhutani Nomogram: AAP Clinical Practice Guidelines)*

Note to use the total bilirubin without subtracting the conjugated.

For neonates with risk factors, use the lower solid threshold curve as depicted in the charts.

Table 22.1: *Guidelines for initiating Phototherapy and EBT in newborns* less than 35 weeks gestation.

Gestational age	Phototherapy TSB (mg/dL)	Exchange blood transfusion TSB (mg/dl)
<28 0/7	5 -6	11-14
28 0/7–29 6/7	6 -8	12-14
30 0/7–31 6/7	8 -10	13-16
32 0/7–33 6/7	10-12	15-18
34 0/7–34 6/7	12-14	17-19

@Maisels et al.2012

- Note: use POSTMENSTRUAL AGE for phototherapy levels. For example, when a 29 0/7 week neonate is 7 days old, use the TSB level for 30 0/7 weeks
- Consider discontinuing phototherapy when TSB is at least 1-2 mg/dL below the phototherapy level for the infant's postmenstrual age.

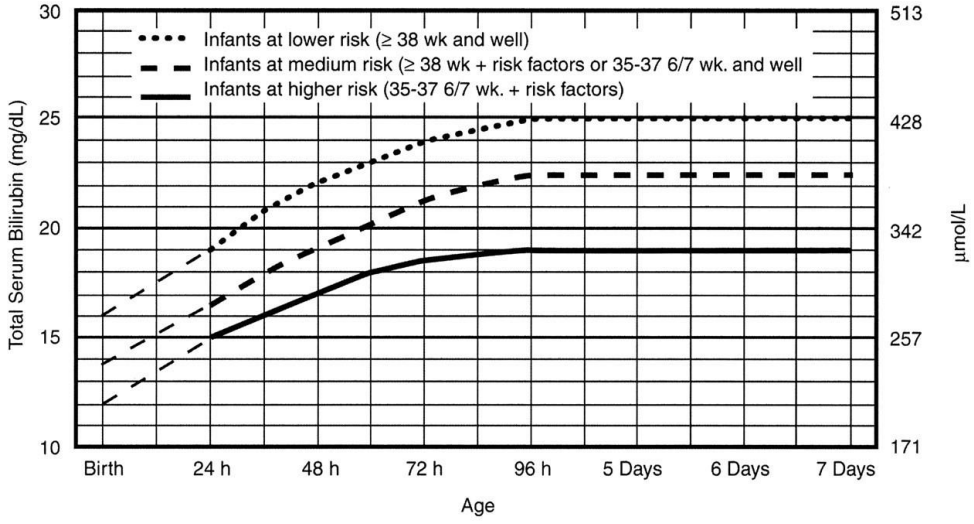
Exchange blood transfusion (EBT)

- Do EBT if the bilirubin level is rising at such a rate as would require EBT (see graph above).
- Use total bilirubin level, do not subtract direct or conjugated bilirubin.
    - See details of EBT in the Chapter on newborn procedures

Guideline Thresholds Charts for EBT

- Also use the total bilirubin without subtracting the conjugated fraction.
- For the high-risk babies use the lowermost threshold curve
- At all times, perform immediate EBT if baby shows clinical features of encephalopathy.

Figure 22.7: *shows the Guidelines for EBT in newborns of ≥35weeks gestation. (Source: Bhutani Nomogram: AAP Clinical Practice Guideline)*



- The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of responses to phototherapy.
- Immediate exchange transfusion is recommended if infant shows signs of acute bilirubin encephalopathy (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry) or if TSB is ≥5 mg/dL (85 µmol/L) above these lines.
- Risk factors - isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis.
- Measure serum albumin and calculate B/A ratio (See legend)
- Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin
- If infant is well and 35-37 6/7 wk (median risk) can individualize TSB levels for exchange based on actual gestational age.

PREVENTION OF NEONATAL JAUNDICE:

- Antenatal and postnatal strategies include:
- Health education on NNJ: Mothers are advised to bring their babies to the centre of delivery within 3-5th day of life for assessment for jaundice in view of early discharge.
- Identification of risk factors: Every mother must know her blood group and Rhesus during antenatal.
- Mothers should not use icterogenic agents like "camphor" naphthalene balls and mentholated balms for their babies.

- Early detection of NNJ: Pre-discharge screening in hospital using transcutaneous bilirubinometer if available. Centres to make efforts to procure this non invasive equipment.
- Proper immediate assessment of babies with NNJ and early referral for primary and tertiary centres as indicated.
- Mothers should be provided with verbal and written information during antenatal care and at postnatal discharge on the dangers of NNJ and need to urgently bring baby for assessment in health facility. And not to use unorthodox treatments like paw- paw water.

Follow up care:

- Neurodevelopmental follow up
- Auditory brainstem response monitoring to detect hearing affectation.

Table 22.2: *shows the Bilirubin Induced Neurological Dysfunction (BIND) Score. It is a 12point scoring system with scores 1-3, 4-6 and 7-12 representing mild, moderate and severe ABE respectively.*

CLINICAL SIGN	SCORE	SEVERITY	DATE/TIME
MENTAL STATUS			
▪ Normal	0		
▪ Sleepy but arousable ▪ Decreased feeding	1		
▪ Lethargy ▪ Poor suck and/or ▪ Irritable/jittery with short-term strong suck	2		
▪ Semi-coma ▪ Apnea ▪ Seizures ▪ Coma	3		
MUSCLE TONE			
▪ Normal	0		
▪ Persistent mild hypotonia	1		
▪ Moderate hypotonia ▪ Moderate hypertonia ▪ Increasing arching of neck and trunk on stimulation without spasms of arms and legs and without trismus	2		
▪ Persistent retrocollis ▪ Opisthotonus ▪ Crossing or scissoring of arms and legs but without spasms of arms and legs and without trismus.	3		

CRY PATTERN			
▪ Normal	0		
▪ High pitch	1		
▪ Shrill	2		
▪ Inconsolable crying or ▪ Cry weak or absent in a child with previous history of high pitched or shrill cry	3		
▪ OCCULOMOTOR OR EYE MOVEMENTS			
▪ Normal	0		
▪ Sun-setting ▪ Paralysis of upward gaze	3		
▪ Total ABE Score			

Prolonged Neonatal Jaundice

- Defined as jaundice lasting >14 days in term infant >21 days in a preterm infant.
- Determine whether it is unconjugated or conjugated hyperbilirubinaemia

Unconjugated hyperbilirubinaemia

- Determine whether or not the baby is breastfed regularly
- Collect urine for MCS and reducing substances to exclude galactosaemia
- Check liver enzymes
- Exclude hypothyroidism
- Exclude haemolysis, check reticulocytes and Hb.
- Hereditary enzyme defects such as Gilbert's and Crigler – Najjar syndromes are rare.

Conjugated hyperbilirubinaemia

- History and examination.
- Liver function tests and cholesterol.
- Examine stools daily. Acholic (pale, white) stools require urgent referral to exclude biliary atresia.
- Exclude infective causes.
- Exclude metabolic causes.
- Exclude genetic conditions.

National Guidelines
for Comprehensive Newborn Care

SECTION FOUR

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CHAPTER 23: NEONATAL SEPSIS

Neonatal sepsis refers to an infection involving the bloodstream in newborn infants less than 28 days old. It is divided into 2 groups based on the time of presentation after birth: early-onset sepsis (EOS) and late-onset sepsis (LOS).

EOS refers to sepsis in neonates at or before 72 hours of life

LOS is defined as sepsis occurring after 72 hours of life

Newborns have immature immune systems and have just been colonized with bacteria during their recent delivery. They are therefore prone to infections which are likely to cross barriers, for example between the lungs and blood, the gut and blood and meninges. Many newborn infections can be prevented by good hygiene at the time of birth, early and exclusive breastfeeding, appropriate umbilical cord care, appropriate eye care, using KMC and avoiding separation of the mother and infant.

Common systemic bacterial infections in young infants include sepsis, pneumonia, urinary tract infection, and meningitis and all these may present alike. Sepsis is a clinical syndrome of systemic illness accompanied by septicaemia (bacteria in the blood), with clinical symptoms.

1. EARLY ONSET NEONATAL SEPSIS: INFECTION IN FIRST 72 HOURS OF LIFE

a) Risk factors for infection

- Preterm births
- Suspected or confirmed rupture of membranes for >18 hrs
- Intrapartum fever >38°C
- confirmed/ suspected chorioamnionitis
- Mother given parenteral antibiotics for confirmed or suspected invasive bacterial infection (such as septicaemia) at any time during labour, or in the 48 hr periods before and after the birth.
- Suspected or confirmed infection in a co-twin
- Very low birth weight
- Invasive group B streptococcal infection in a previous baby
- Maternal group B streptococcal colonisation, bacteriuria or infection during pregnancy

b) Clinical indicators suggestive of Sepsis

Signs of sepsis can be very non-specific, and they include:

- **Fever**
  - Temperature of 38 °C on one occasion
  - Temperature > 37.5 °C on two occasions separated by at least one hour
  - This can cause difficulties in the hot season when the outside temperature is > 37 °C. If the Infant has a fever > 37.5°C but less than 38 °C and looks well, unwrap the infant put in the coolest part of the room – DO NOT give paracetamol. Recheck the temperature in 4 hours if the fever is >38 °C treat as neonatal sepsis.

- **Hypothermia**
  Temperature <36.5 °C

- **Shock**
  - Cold hands and feet
  - Capillary refill time (CRT) >3secs
  - Tachycardic

  Unexplained excessive bleeding, thrombocytopenia or abnormal coagulation
  - Oliguria persisting aged >24 hr
  - Hypoglycaemia/ hyperglycaemia
  - Metabolic acidosis (Base excess ≥10)

- **Respiratory distress**
  - Tachypnoeic (Respiratory Rate > 60 /min)
  - Chest indrawing
  - Tracheal Tug
  - Sternal recession
  - Head bobbing
  - Nasal flaring
  - Grunting
  - Cyanosis or $Sp0_2$ <90% on air

- **Apnoeas and slow breathing**
  - No breaths for 15 seconds; especially in a term baby or previously well preterm baby
  - Respiratory rate <20/min

- **Gastrointestinal**
  - Abdominal distension
  - Bilious vomiting
  - Bilious aspirates from NGT
    - Feeding difficulties (e.g. inability to suck and poor suck)

- **Neurological**
  - Lethargy or not waking for feeds
  - Reduced activity
  - Seizures
  - Abnormal posture i.e. opisthotonus
  - Floppy

- **Jaundice**
  - Yellow skin, sclera or mucous membranes

c) Clinical features of Meningitis

Meningitis is inflammation of the meninges.

Symptoms and Signs

- Suspect meningitis in a newborn with sepsis or if they present with the following clinical symptoms or signs:
- Drowsy, lethargy or unconscious
- Persistent irritability
- High pitched cry
- Apnoeic episode
- Convulsion
- Bulging fontanelle
- Note: Infants often do not have neck stiffness
- A lumbar puncture must be done once meningitis is suspected

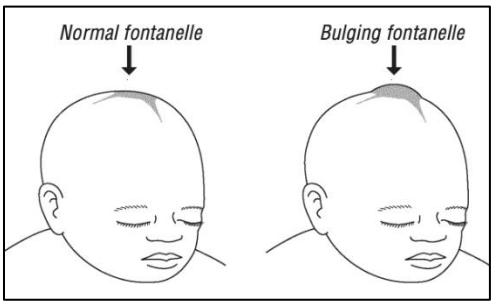


Figure 23.1: *Showing bulging fontanelle (WHO Pocket book)*

Table 23.1: *Red flag signs*

Red flag signs and clinical indicators suggestive of neonatal infection
Systemic antibiotics given to mother for suspected bacterial infection during labour or within 48 hr either side of birth
Suspected or confirmed infection in a co-twin
Respiratory distress starting >4 hr after birth
Seizures
Signs of shock
Need for mechanical ventilation in a term baby
Suspected or confirmed rupture of membranes for >18 hr
confirmed/ suspected chorioamnionitis
Lethargy, altered behaviour or responsiveness

Feed intolerance (e.g. abdominal distension, vomiting, excessive gastric aspirates)
Unexplained excessive bleeding, thrombocytopenia or abnormal coagulation

d) Actions if red flag signs are present

1. If there is any red flag sign, take samples for investigations for complete sepsis work- up and start antibiotics.
2. If there are no red flag signs but there are 2 or more other risk factors or clinical indicators take samples for investigations for complete sepsis work-up and start antibiotics.
3. If there are no red flag signs or clinical indicators but there is 1 risk factor, use clinical judgement and consider withholding antibiotics. However, take samples for investigations including complete sepsis work-up, and be guided by the laboratory investigation results.
4. Monitor baby for clinical indicators of possible infection. Monitoring should be done at 1 hr, 2hr and then 2-hrly for 10 hrs.
5. If further clinical concerns, perform investigations including blood cultures and start antibiotics.

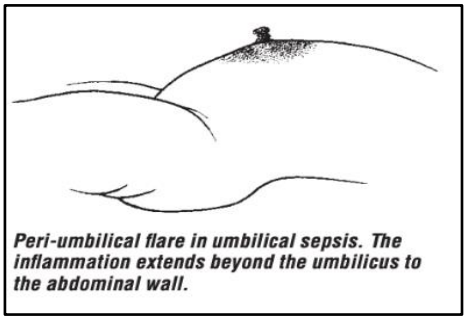


Figure 23.2: *Peri-umbilical flare in umbilical sepsis*

e) Investigations before starting antibiotics

- Blood culture
- Lumbar puncture for CSF analysis maintaining asepsis if thought safe to do, but do not delay antibiotics for LP
- Measure C-Reactive Protein at presentation and 18–24 hr after.
- Complete blood count and micro ESR
- Procalcitonin
- Take swabs when there is local infection.

f) Choice of antibiotics

- Use Penicillin and an aminoglycoside (gentamicin or amikacin) as first choice for empirical treatment of neonatal sepsis (local antibiotics susceptibility pattern should also be a guide).
- Second line can be cefotaxime (or ceftazidime) and amikacin.
- Review antibiotics treatment based on culture results.

g) Investigations during antibiotic treatment

- CRP: If possible, measure before starting antibiotics and 18–24 hrs after the first CRP test

- Consider LP if:
  - positive blood culture
  - CRP >10 mg/L
- Baby does not respond satisfactorily to antibiotics
- Procalcitonin can be done if available

Review treatment at 36 hrs

- Stop antibiotics if laboratory results and clinical examination are not suggestive of sepsis.

h) Usual duration of treatment

- If positive blood culture or clinical suggestion of infection treat for 7 - 10 days
- Continue treatment beyond 10 days if:
  - baby not fully recovered or
  - Expert microbiological advice based on blood culture result.

i) Meningitis

- If meningitis suspected but Gram stain is uninformative, use ampicillin, gentamycin and cefotaxime
- Review treatment decisions taking CSF results into account
- If CSF Gram stain suggests GBS, give benzylpenicillin 100 mg/kg 12-hrly and gentamicin 5 mg/kg/day
- If CSF culture confirms GBS, continue benzylpenicillin for at least 14 days and gentamicin for 5 days
- If CSF culture or Gram stain confirms Gram-negative infection, review antibiotics based on culture result.

2. LATE ONSET NEONATAL SEPSIS (LOS)

This refers to infection after first 72 hrs of life. Common organism implicated in LOS include coagulase-negative staphylococci (CoNS), Klebsiella, Serratia, Enterobacter, Pseudomonas, E. coli and Acinetobacter).

a) Risk factors

- Risk factors include need for invasive interventions e.g. prolonged ventilation, central venous access and parenteral nutrition, prolonged hospital stay.

b) Clinical features

- Can be vague and non-specific
- Respiratory distress
- Apnoea/ bradycardia
- Cyanosis or poor colour
- Poor perfusion (CRT >3 sec; toe-core temperature gap >2°C; mottling)
- Hypotension
- Tachycardia
- Temperature instability (high or low)
- Glucose instability
- Hypotonia
- Irritability

- Lethargy/ inactivity
- Poor feeding and poor suck
- Jaundice
- Seizures
- Vomiting
- Abdominal distension

c) Clinical Signs

Look for:

- Systemic signs of sepsis such as tachycardia, poor perfusion, reduced tone, reduced activity, lethargy, unsettled and crying/moaning
- Tachypnoea and intercostal and/or subcostal recession
- Bulging of the fontanelle suggesting raised intracranial pressure
- Abdominal distension and tenderness
- auscultate for bowel sounds; reduced or absent with infection (as a result of paralytic ileus) or NEC
- inspect stool for visible blood
- petechiae, bleeding diathesis
- Septic spots in eyes, umbilicus, nails and skin
- Reluctance to move or tenderness in joints and limbs suggestive of osteomyelitis or septic arthritis

d) Investigations (Aim to perform before starting antibiotics)

- **Swabs for culture**
  - Swab any suspicious lesion (e.g. skin, umbilicus or nails)
- **Blood cultures**
  - Asepsis for sample collection is very important to reduce risk of culturing CoNS skin contaminants
- **Full blood count**
  - A neutrophil count <2 or >15x10^9/L
  - Platelet count of <100 x10^9/L
  - Toxic granulation in neutrophils [or if measured, an immature:total (I:T) neutrophil ratio > 0.2].
- **Clotting profile**
  - If evidence of bleeding diathesis or in severe infection/ septicaemia
- **CRP**
  - Acute phase protein synthesized in the liver in response to inflammatory cytokines.
  - Generally, a delay of 24 hrs between onset of symptoms and rise in serum CRP
  - Take sample at presentation and a further sample 18–24 hr after first CRP sample
  - A rise may support diagnosis of infection but failure to rise does not exclude it where other findings are supportive
  - If blood culture negative and clinical condition satisfactory, failure of CRP to rise during first 48 hr is a useful indicator that antibiotics may be safely stopped.
- **Urine microscopy, culture and sensitivity**
  - Clean-catch or supra-pubic aspiration (SPA). Use ultrasound scan to check urine in bladder before SPA.

- Do not send urine collected in a bag for bacterial culture.

- **Lumbar puncture (LP)**
  - If baby unstable, 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
  - In critically ill baby, consider PCR for HSV, especially in term babies
- **Others**
  - Chest X-ray
  - If abdominal distension noted, abdominal X-ray
- **Documentation**
  - Always document symptoms and signs of infection at the time of taking blood culture, CSF cultures and abdominal radiographs

e) Empirical treatment

- Do not use oral antibiotics to treat infection in babies
- Consult local microbiology department for current recommendations. These may differ between units according to local resident flora.

f) Antibiotics for Late onset sepsis

- If decision made to give antibiotics, aim to start immediately.
- First line: empirical flucloxacillin and gentamicin unless microbiology isolates dictate otherwise.
- Second line: vancomycin + gentamicin or amikacin.
- Third line: meropenem +/- vancomycin.

PREVENTION OF SEPSIS

- Health workers in the neonatal unit to be bare below elbow, wear short sleeves.
- Remove jewellery 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 hrs 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 24: SHOCK AND HYPOTENSION IN THE NEWBORN

Shock, also called 'Circulatory Failure', can be defined as the acute life-threatening state in which circulatory function is inadequate to supply sufficient amounts of oxygen and other nutrients to tissues to meet metabolic demands. If left untreated, shock results in sustained multiple organ dysfunction, end-organ damage and death.

Hypotension (i.e. lower than expected blood pressure) frequently but not always accompanies shock. Hypotension is usually a late sign. Hypotension can be defined as a blood pressure (BP) < 5th centile for age – in the first week of life, this corresponds approximately to the gestational age of the infant.

Using the oscillometric measurements (using a cuff), beyond the first week of life, the lower limit of normal is appropriately equal to the corrected gestational age for preterm infants. In term infants the lower limit increases to 50mmHg by 6 weeks and 60 mmHg by 6 months.

This method may be marginally higher than indwelling arterial measurements. See Newborn BP reference chart in Appendix 6.1.

PREDISPOSING FACTORS

Common aetiological causes include hypovolaemia, low systemic vascular resistance or poor myocardial contractility. Commonest clinical causes are due to severe neonatal sepsis, necrotizing enterocolitis, blood loss, severe perinatal asphyxia and cardiac anomalies.

The key to management in the newborn is early identification and determination of aetiologies to provide appropriate care.

MARKERS OF CIRCULATORY FUNCTION

Blood pressure correlates poorly with cardiac output, systemic blood flow and cerebral blood flow.

The use of other signs, including capillary refill time, urine output and serum lactate level

improves the diagnostic accuracy of low blood pressure from low systemic blood flow.

ASSESS CIRCULATION FOR SIGNS OF SHOCK

The letters C in "ABCCCD" stand for Circulation, Coma and Convulsions.
All sick infants are assessed for Airway, Breathing, Circulation, Coma, Convulsions and severe Dehydration (ABCCCD). Efforts should be made to maintain normal blood glucose and a normal body temperature while managing ABCCCD.

After the airway and breathing has been assessed, check circulation.

Rapid assessment of circulation.

- Is the baby alert or lethargic?
- Are the hands cold?
- Is there a temperature gradient up the limbs?
- Is the capillary refill time (CRT) > 3 seconds?
- Is the pulse fast and weak?
- Is the baby pale?

Each of the signs listed is a sign of impaired (poor) circulation. Severely impaired circulation (shock) should be considered when 3 of the signs are present.

Also assess oxygen saturation, heart rate and blood pressure

Are there signs of dehydration - sunken eyes/decreased skin turgor?

How to Assess CRT

Is the Capillary Refill Time (CRT) longer than 3 seconds?

- Capillary refill: Capillary refill is a simple test that assesses how quickly blood returns to the skin after pressure is applied. A finger pulp or sternum should be gently pressed for 5 seconds to empty the capillaries of blood. When the pressure is released the time in seconds it takes for a normal pink colour to return is observed and recorded.
- It should be less than 3 seconds.
- If it is more than 3 seconds the child may be in shock. This sign is reliable except when the room temperature is low, as a cold environment can cause a delayed capillary refill. In such a situation check the pulses and decide about shock.

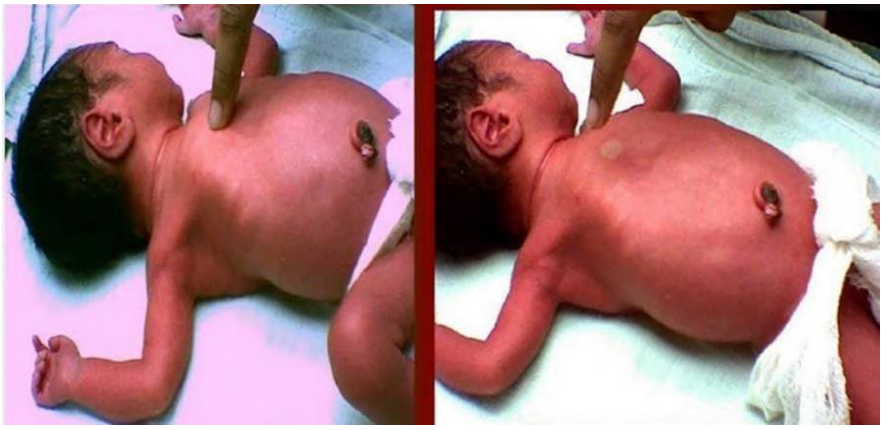


Figure 24.1: *Pronged capillary refill after pressure on the sternum. (Picture courtesy COIN manual, Malawi)*

Is the pulse weak and fast?

Evaluation of pulses is critical to the assessment of systemic perfusion. The radial pulse should be felt. If it is strong and not obviously fast (rate not greater than 160 bpm in a newborn), the pulse is adequate; no further assessment is needed.

In a newborn, if the radial pulse cannot be felt, palpate for the femoral pulses; and if a baby has a weak radial or femoral pulse, it is a worrying sign. Assess hydration status.

TREATMENT OF SHOCK

Treatment of shock requires teamwork. The following actions need to be started simultaneously. The Figure 24.2 shows a flow chart for assessment of shock and administration of fluid. If the baby is very ill, level 2 centres should stabilize and refer to a level 3 centre.

A. Chart with fluids for shock

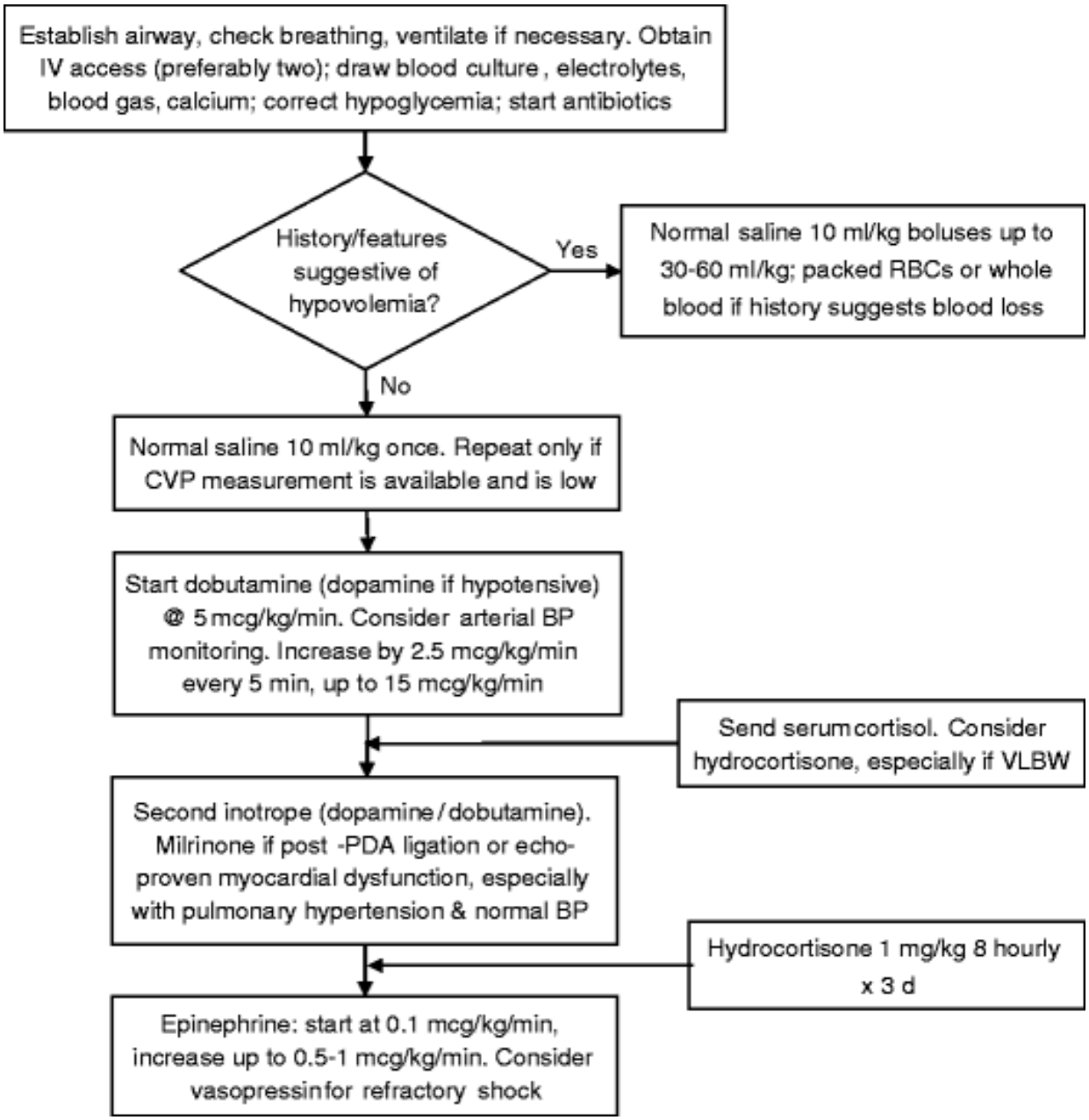


Figure 24.2: *Algorithm for management of shock in neonates*

Source: *Bhat, B.V., Plakkal, N. Management of Shock in Neonates. Indian J Pediatr 82, 923–929 (2015). https://doi.org/10.1007/s12098-015-1758-7*

B. Treatment outline based on BP cutoffs, aetiology and use of inotropes (Mostly for level 3 centres)

i. BP cutoffs

Preterm infants in the first week of life

Initiate treatment when:

- The mean BP is ≥ 5mmHg below cGA (corrected gestational age), Or
- Mean BP (mmHg) is <cGA, PLUS one or more of the following:
  - Urine output < 0.5ml/h
  - Delayed capillary refill > 3s
  - Lactate > 4mmol/l

Preterm infant with sepsis/NEC

Initiate treatment when the mean BP (mmHg) is <cGA

Term Neonates:

Initiate treatment when the mean BP (mmHg) is < 40 mmHg.

ii. Treatment outline based on aetiology and use of inotropes

- Acute Blood loss
  - Diagnostic indicators: history, low Hb, bleeding
  - Management: Normal Saline (NS) and/or emergency blood if available
  - 10ml/kg initially, consider repeat
  - Check coagulation status and platelets
  - Consider dopamine if hypotension persists after fluids resuscitation
- Sepsis/NEC
  - Consider hypovolaemia – give 10ml/kg NS and evaluate response
  - Dopamine 1st line
  - Consider Adrenaline 2nd line (wean dopamine if adrenaline effective)
  - Consider hydrocortisone 3rd line
- Myocardial Dysfunction
  - Avoid volume
  - Dobutamine 1st line
  - Dopamine 2nd line (not exceeding 15 mcg/kg/min)
  - Consider Adrenaline 3rd line (discontinue dopamine)
- Cause Unknown
  - Dopamine 1st line
  - Consider hypovolaemia – give 10ml/kg NS initially
  - Dobutamine 2nd line
  - Consider Adrenaline and/or Hydrocortisone 3rd line (wean dopamine if effective response)

Ideally therapy should be modified after assessing circulatory status using functional echocardiography to determine ventricular distension and systemic blood flow.

Table 24.1: *Dosage guide for inotropes and vasopressors*

Drug	Site of action (predominant receptors)	Dose range (micrograms/kg/min)	Haemodynamic effects
Dopamine	Dopaminergic (1 & 2) α adrenergic β adrenergic	1-4 4-10 11-20	Renal and mesenteric vasodilatation Inotrope Vasopressor, ↑SVR, ↑PVR
Dobutamine	β_1 & β_2 adrenergic minor α adrenergic effect	5-20	Inotrope, ↓SVR, ↑CO
Adrenaline (Epinephrine)	α_1 adrenergic β_1 & β_2 adrenergic	0.03-0.1 0.1-1.0	Inotrope, some ↓SVR Vasopressor, ↑SVR
Noradrenaline (Norepinephrine)	α_1 & α_2 adrenergic	0.1-1.0	Vasopressor, ↑↑SVR
Dopexamine	β adrenergic	1-6	Inotrope ↓SVR ↑splanchnic blood flow?
Vasopressin	V_1	0.0003-0.002 units/kg/min or 0.018-0.12 units/kg/hr	↑↑SVR (No inotropic effect)
Milrinone	Phosphodiesterase Inhibitor Produces effects at β_1 & β_2 receptors	Bolus 50-75 µg/kg Infusion 0.35-0.75	Inodilator, lusitropy ↑contractility and ↓SVR

Calculation of dopamine

Administration of dopamine in a newborn with haemodynamic compromise

--How to give dopamine

I ml of commercially available dopamine contains 40 mg of dopamine. ln a baby weighing 2.5 kg, to give dopamine at a rate of I0mcg/kg/min:

= 10x2.5 = 25 mcg/min = 25 x 60= 1500 mcg/hr= 1500 x 24=36000mcg/day

= 36 mg of dopamine in 24 hrs

It means if we add 0.9 ml of dopamine in 24 ml of fluid and give @ rate of I ml/hour with syringe pump or one microdrops per min (which is virtually impossible) with the micro drip set, we will give dopamine@ I0 mcg/kg/min

--Increment

If we want to increase dopamine to I5 mcg/kg/min then give the same fluid @ I.5 ml/hr

The above method is to give a separate infusion of dopamine; however, it could also be added to 24 hrs fluid as explained below:

For example, a 2.5 kg neonate in shock with a fluid requirement of I00 ml/kg/day, has received 2 fluid boluses of I0 ml/kg of normal saline, without any improvement.

Total fluid needed for this baby in 24 hr= I00 x 2.5 =250 ml/day

Fluid to be given every 8 hr = 85 ml. Let us learn how much dopamine to be added in 8 hr fluid, i.e.85 ml to be given at a rate of I0 mcg/kg/min

Amount of dopamine required in I min= 10x 2.5 =25 mcg

Amount of dopamine required in I hr= 25 x 60 = 1500 mcg

Amount of dopamine required in 8 hr = 1500 x 8 = 12000 ug= 12.0 mg

I ml of available dopamine preparation= 40 mg of dopamine

To make 12 mg of dopamine, we need 0.3 ml. Add this volume to 85 ml of fluid and give over 8 hr at a rate of I0 ml/hr or at a rate of I0 micro drops/min with a burette set, which will deliver dopamine at a rate of I0 mcg/kg/min.

CHAPTER 25: 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 12hours 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 (ie, 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 breast-feeding, 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 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 wks but is sputum smear positive
- Give isoniazid to the baby at 5 – 10mg/kg/day for 6months
- 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 (FMOH: national TB guideline)

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).
- 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.
- Newborns of mothers with HIV who are at high risk (refer to National HIV guidelines) 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.

Special situations for extended ARV prophylaxis for HIV exposed Infants at High Risk of MTCT

- Breastfed infants who are at high risk of acquiring HIV should continue infant prophylaxis for an additional 6 weeks (total of 12 weeks of infant prophylaxis) using AZT (twice daily) and NVP (once daily).
- 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

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 12 weeks after complete cessation of breastfeeding.

(For further details, see FMOH: National Guidelines for HIV Prevention Treatment and care. 2016)

4. COVID-19 INFECTION IN THE NEWBORN

- COVID-19 stands for coronavirus disease of 2019. COVID-19 is a disease caused by the SARS-CoV-2 virus which is a strain of coronavirus that causes severe acute respiratory syndrome (SARS).
- The disease was first described in Wuhan China in December 2019 and was declared a pandemic in March 2020 by WHO.

A. Management of infants of mothers with suspected or confirmed COVID 19 infection

--Delivery room preparation and precautions.

Standard precautions should be always practiced.

All health workers that attend any delivery must wear the minimum protective gadgets (PPE).

Minimum PPE includes: a mask (N95 preferably), hand gloves, eye protection and a gown.

All parts of the body must be covered.

--Delivery room care and resuscitation

- Limit number of people in the delivery room to the barest minimum to avoid undue exposure
- Routine delivery room care should be provided for the infants at birth as usual: dry, stimulate and keep warm with mother and commence breastfeeding as soon as possible (see National Guideline for COVID-19)

1. Routine newborn care should be carried out.
2. Routine neonatal resuscitation should be undertaken when indicated.
3. Suction only when necessary.
4. Intubations should avoid or be carried out when necessary, with utmost caution and by the most senior person at the delivery.
5. Several attempts at intubation are discouraged.

- Note that suctioning, manual ventilation, intubation, non-invasive positive-pressure ventilation, cardiopulmonary resuscitation, connecting/disconnecting a patient to or from a ventilator can ALL result in aerosolization. Perform these only when ABSOLUTELY necessary.

B. COVID-19 testing in newborns

- ✓ At birth, all exposed babies should have samples for COVID-19 taken from skin surface/umbilical swabs or the amniotic fluid. Blood, urine or stool samples should also be collected and send for testing though yield for COVID-19 is said not to be high compared to nasopharyngeal swabs
- ✓ Testing of nasopharyngeal swabs should be done after 24 h of life as yield is better.

C)Admission and further management

a. Routine isolation of exposed infants from the mother is not recommended

1. Babies with positive results who are symptomatic should be transferred to the designated neonatal isolation ward for COVID-19 babies.
2. Positive asymptomatic infants can be nursed and co-located with their asymptomatic mothers who should be educated on infection prevention methods (masks, hand washing, distancing).
3. They should be observed and then retested after 14 days.
4. Symptomatic infants should be retested after being afebrile for >3days or when symptoms improve or after 14 days (whichever is later)

Infants that tested negative at birth can be managed as follows:

1. The infant can be separated from a symptomatic COVID mother and nursed in a separate location by another caregiver (hospital staff if available or family designated) while mother expresses breast milk for feeding the baby if she is stable enough to do this.
2. If the mother is asymptomatic, she should be counselled on the modes of transmission; and baby will be co-located with mother but she must wear a mask for any interaction with the baby and observe hand hygiene and social distancing when appropriate.
3. If the mother is symptomatic, the baby should be discharged home to a family designated caregiver who should be counselled on hygiene and care of the baby.

D) Feeding

There is currently no evidence that COVID-19 can be transmitted through breast milk, therefore, COVID 19 infection is NOT a contra-indication to breast feeding.

- Asymptomatic mothers and those with mild symptoms should breastfeed.
  - Mothers must observe hand hygiene with soap and water or alcohol hand rub before touching the baby and must wear a mask while breastfeeding.
  - If mother is a confirmed/symptomatic case, she should be encouraged to breastfeed her baby. Ensure she wears a surgical/procedure mask when near the baby; practice good respiratory hygiene and perform hand hygiene before and after close contact with the baby
  - Infants of critically ill mothers should be fed with EBM or appropriate infant formula.

b. Referred Babies:

- ✓ Outborn babies referred to the hospital that were exposed or confirmed to have COVID-19 should be managed in the same

isolation ward as the inborn babies.

- ✓ They should be managed as outlined for inborn babies.

E) When to discharge

c. Positive asymptomatic infants can be discharged after at least two consecutive test results at >24-h sampling interval are negative.

d. Symptomatic infants can be discharged after symptoms have abated, have been afebrile for >3 days and at least two consecutive test results at >24-h sampling interval are negative.

e. All discharged newborns should be closely followed up following the unit protocol for discharged newborns.

CHAPTER 26: NEONATAL HAEMATOLOGIC CONDITIONS

1. ANAEMIA

Background

Newborns are delivered with a relatively high haematocrit due to relative hypoxia in utero. Normal haemoglobin for a newborn is 15–18 g/dL, normal haematocrit for newborn: 45–55%. (Conversion: Haemoglobin x 3 = Haematocrit).

- Over the first weeks of life, newborns develop a physiologic anaemia because erythropoietin and fetal hemoglobin production decreases in response to relatively rich oxygen supply.
  - Term newborns typically reach a physiologic nadir with hemoglobin of 9–11g/dL at 6–12 weeks of age.
  - Preterm newborns typically have an earlier and more severe physiologic nadir, reaching a hemoglobin of 8–10 g/dL at 4-8 weeks of age.
- The nadir results in insufficient oxygen delivery to tissues, prompting a rise in erythropoietin levels and haemoglobin production, and rarely requires treatment.

Pathologic Anaemia: some conditions can exaggerate the physiologic nadir to the point that treatment may be required. Such conditions include:

- Obstetric blood loss: early cord clamping, placental abruption, placenta previa, placental laceration during caesarian section
- Fetoplacental and feto-fetal bleeding
- Neonatal blood loss: cephalohematoma, subgaleal hemorrhage, intracranial hemorrhage, bleeding into abdominal organs
- Haemolysis
  - Immune (ABO, Rh or minor blood group incompatibility)
  - Hereditary red blood cell disorders (G6PD deficiency, red blood cell membrane defects, hemoglobinopathies)
  - Acquired coagulopathy (infection, DIC)
- Diminished red blood cell production: iron deficiency, infection, medications
- Repeated phlebotomy

Diagnosis

- History: Pregnancy, labour and delivery history, family history of bleeding and anaemia
- Investigation: Full blood count, reticulocyte count, blood film, Coombs test, G6PD assay, ultrasound.

Treatment (see blood transfusion protocol below)

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 (from about 2 weeks of age).
- At risk newborns:
  - Preterm: Minimize phlebotomy rate (use sampling charts), commencement of supplemental folate and iron, subcutaneous erythropoietin where indicated.

2. THE BLEEDING NEWBORN

Aetiology

- 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 dependent bleeding)
- Hereditary clotting factor deficiencies

Investigation

- FBC including platelet count, blood smear and coagulation studies if possible

Treatment

Apply specific treatments for specific conditions as listed.

- If Vitamin K- dependent bleeding, give:

  IV Vitamin K_1 1-2 mg IV. Additionally, fresh frozen plasma may be needed or if bleeding is severe and exceed 20% of blood volume, then transfuse with fresh whole blood.
- For treatment of bleeding secondary to DIC:
  a. The underlying cause should be treated (e.g sepsis, NEC, herpes)
  b. Confirm that vitamin K_1 has been given.
  c. Platelets and FFP are given as needed to keep the platelet count over 50,000/ml and to stop the bleeding. (FFP contains anticoagulant proteins which may slow down or stop ongoing consumption).
- For immune thrombocytopenia, administer platelets.
- For other hereditary clotting disorders, fresh frozen plasma or fresh whole blood may be required.

Table 26.1: *Differential diagnosis of bleeding in a Neonate @Cloherty Textbook of Neonatology*

Clinical evaluation	Platelets	PT (Prothrombin time)	PTT (partial thromboplastin time)	Likely diagnosis
"Sick"	↓	↑	↑	DIC
	↓	Normal	Normal	Platelet consumption (infection, NEC, renal vein thrombosis
	Normal	↑	↑	Liver disease
	Normal	Normal	Normal	Compromised vascular intergrity (associated with hypoxia, prematurity, acidosis, hyperosmolality
"Healthy"	↓	Normal	Normal	Immune thrombocytopaenia, occult infection, thrombosis, bone marrow hypoplasia(rare), or bone marrow infiltrative disease
	Normal	↑	↑	Haemorrhagic disease of the newborn (Vitamin K deficiency)
	Normal	Normal	↑	Hereditary clotting factor deficiencies
	Normal	Normal	Normal	Bleeding due to local factors (trauma, anatomic abnormalities); qualitative platelet abnormalities (rare); factor XIII deficiency (rare)

3. BLOOD TRANSFUSION

Approximately 85% of VLBW babies will be transfused blood or blood products while on admission

Blood is transfused only for a condition that cannot be managed effectively by other means. Health care facilities should be prepared for the urgent need for blood transfusion by having a functional blood bank where blood and blood products are kept, especially type O, Rh-negative blood.

Splitting units of blood into smaller blood bags (e.g. 50 ml, 100ml) suitable for babies can help prevent wasting blood and reduces the risk of transfusing too much blood.

Decision regarding need for transfusion includes:

- clinical condition of newborn,
- aetiology of anaemia,
- haematocrit value and trend over time

Indications

- Significant cardiorespiratory distress
- Blood loss more rapid than ability for newborn to generate red blood cells (e.g. rapid bleeding, severe haemolysis)
- Severe anaemia (haemoglobin <7g/dl) with poor reticulocytosis or impaired newborn growth (e.g. average of <10 gm/day) despite adequate nutrition.

Preparation

- Appropriate blood grouping and cross matching of mother and baby's blood
- IV Furosemide where indicated.
- Platelet should not be transfused using the blood giving set with micropore filter. Rhesus status to be compatible
- For FFP, adequate crossmatching should be done

Procedure

Determine the volume of blood to be transfused (Use fractionated blood component as needful)

- For whole blood: 20mls/kg
- For sedimented cells: 15mls/kg
- For packed cells: 10 mls/kg

Do not over-transfuse a baby as this will lead to fluid overload and may worsen the baby's condition.

As much as possible, use freshly donated blood or blood not older than one week in an emergency.

Before beginning the transfusion, check (with a second staff member, if possible) to ensure that the:

- blood is the correct type for the baby
- baby's information is clearly marked
- blood has been matched against the blood of the mother and the baby (in emergency situations, use type O, Rh negative blood)
- blood transfusion bag has not been opened and is not leaking
- blood bag has not been out of the refrigerator for more than two hours, the plasma is not pink, the sedimented blood does not look purple or black, and is not clotted
- Use a blood warming device (or warm sterile container and leave it to stand at room temperature to warm up)

Establish an IV line or if already established, ensure it is patent and the needle used is large enough (e.g. 22-gauge)

- Record the baby's pre-transfusion vital signs (temperature, heart rate and

respiratory rate).
- Remove the protective cover from the blood bag or bottle without touching the opening and attach a blood infusion set with the clamp closed.
- Open the clamp on the tubing of the blood infusion set, allow blood to run through to the end of tubing, and then close the clamp.
- Connect the tubing of the blood infusion set to the IV line.
- Transfuse the calculated volume of blood over the prescribed period
- Use an infusion device to control the rate of transfusion, if available.
- Ensure that the blood is flowing at the correct rate.
- Do not leave blood hanging for more than four hours

Monitoring a baby on blood transfusion

During transfusion, monitor the baby at the following stages:

- before starting the transfusion
- at the onset of the transfusion
- every five minutes for the first 15 minutes then every 15 minutes to the end of the transfusion after starting the transfusion and then every hour during the transfusion
- Every four hours for 24 hours after completing the transfusion.
- Document all these in a blood transfusion observation chart
- This will help to detect early signs of a transfusion reaction (fever, increase heart rate, increase respiratory rate, dyspnoea, passage of dark colour urine).

At each of these stages, record the following information on the baby's chart:

- general appearance
- vital signs (temperature, heart rate, respiratory rate)
- monitor fluid balance). In addition, record:
- the time the transfusion is started and completed
- the volume and type of blood transfused
- the unique donation numbers of blood transfused
- Any adverse effects.

4. PLATELET TRANSFUSION IN NEONATES

Definition:

Neonatal thrombocytopaenia is defined as a platelet count of <150 x 10^9/l

Figure 26.1 below shows diagnostic approach to the thrombocytopaenic newborn and Table 26.2 shows platelet transfusion thresholds in newborns.

Administration

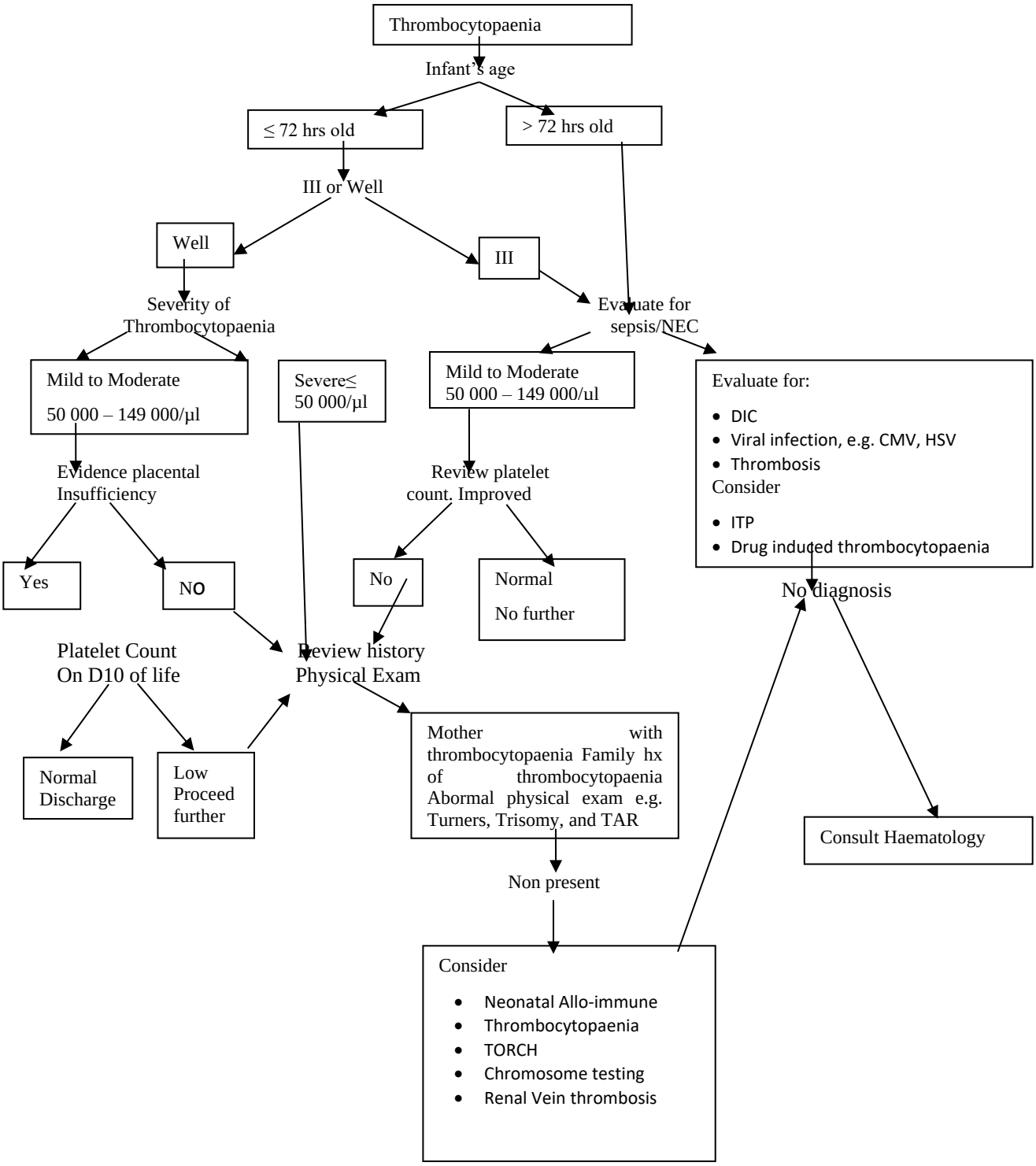
- Transfuse 15 ml/kg. Do not waste the entire unit
- Transfuse over 30 min using the platelet giving set that accompanies the platelets.
- Furosemide is not routinely administered

Table 26.2: *Platelet Transfusion thresholds in newborns*

*NAITP: neonatal alloimmune thrombocytopenia ** HPA: Human Platelet antigen

Platelet count (x 10^9/l)	**Non-bleeding neonate**	**Bleeding neonate**	***NAITP (proven or suspected)**
< 30	Consider transfusion in all patients	Transfuse	Transfuse with **HPA compatible platelets
30-49	Do not transfuse if clinically stable: Consider transfusion if: • <1000g & <1 week of age • Hypotension requiring inotropic support • Previous major bleeding tendency e.g Grade 3-4 IVH • Current minor bleed (e.g Petechiae, punctures, oozing) • Concurent coagulopathy • Respiratory disease requiring FiO_2> 40% or MAP >9cm • Seizures within last 72 hours • Requires exchange transfusion • Pre-surgery (within 24 hours) • Post surgery (within 5 days)	Transfuse	Transfuse with HPA compatible platelets
50-99	Do not transfuse	Transfuse	Transfuse with HPA** compatible platelets if major bleeding present
>99	Do not transfuse	Do not transfuse	Do not transfuse

Figure 26.1: *Diagnostic approach to the thrombocytopaenic neonate*



5. POLYCYTHAEMIA

Definition:

Haematocrit for newborn > 65% (Central) or 70% (capillary).

Seen in post term, small for gestational age, Infants of diabetic mother, twin-twin transfusion, Chromosomal anomalies, preterms. It may be symptomatic or asymptomatic.

Clinical signs:

Plethoric, irritable, tremulous, lethargy, tachycardia, tachypnoea, cyanosis, recurrent hypoglycaemia, jaundice, seizures, feeding difficulty.

Treatment:

Asymptomatic babies with haematocrit less than 70% should be observed closely for signs of deterioration: close monitoring (including glucose check), adequate enteral intake/ administration of Intravenous fluid, haematocrit to be reassessed in 12 – 24 hours

Partial exchange transfusion for all symptomatic babies and those with haematocrit >70%.

$$\text{Volume of exchange} = \frac{\text{blood volume X (observed haematocrit – expected haematocrit)}}{\text{Observed haematocrit}}$$

Choice of fluid:

Normal saline

6. 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 27: CARDIOVASCULAR EVALUATION IN THE NEWBORN

BACKGROUND

Congenital heart defects (CHD) are among the most common congenital malformations.

Major CHDs are defined as lesions requiring surgery or interventional catheter in the first year of life. Level 2 centres to refer these babies to Level 3 centres once suspected for specialist cardiologist's evaluation and expert management.

Critical CHDs are lesions requiring surgery or interventional catheter in the first 28days of life.

Pulse oximetry screening for CHDs has improved early diagnosis and reduced morbidity and mortality (See section on neonatal screening Chapter 28).

EVALUATION OF A NEWBORN WITH SUSPECTED CHD

- Physical examination
- Screening for CHD
- High index of suspicion

Prenatal diagnosis (foetal ECHO) may facilitate early diagnosis and interventions.

SIGNS AND SYMPTOMS OF SUSPECTED CHD

- Most infants are asymptomatic at birth, before physiologic transition has occurred. Hence, most infants with CHD are missed during the initial assessment.
- Figure 27.1 shows assessment of suspected CHD in a newborn with a murmur.
- Distinguishing cardiac disease from pulmonary disease or sepsis may be challenging
- Features include:
  - Cyanosis
  - Murmur
  - Congestive heart failure (tachypnoea, increased work of breathing, tachycardia, hepatomegaly)
  - Abnormal pedal pulses
  - Shock (hypotension, CRT >3secs) in ductus dependent lesions
  - ± failed CHD pulse oximetry screening test

INVESTIGATIONS

- Chest X-ray
- ECHO
- ECG
- Sepsis work up as indicated

INITIAL MEDICAL MANAGEMENT

- In the delivery room, provide resuscitation as indicated
- Transfer to NICU as soon as possible
- Commence cardiorespiratory and oxygen saturation monitoring
- Ensure intravenous access (peripheral/± central as indicated)
- Fluid restriction, NPO, mechanical ventilation as indicated
- For ductus dependent lesions:
  - Commence Prostaglandin PGE_1 infusion @ 10 nanograms/kg/min
- For PDA, options include:
  - IV Indomethacin 0.2mg/kg over 30mins, every 12hrs for 3 doses
  - Ibuprofen – oral 10mg/kg stat, then 5mg/kg every 24hrs for 2 doses
  - IV Ibuprofen 20mg/kg stat, then 10mg/kg every 24hrs for 2 doses
  - Acetaminophen IV or oral 10 – 15mg/kg every 6 – 8hrs for 3 to 7days.
- Paediatric Cardiologist consult

Definitive management

- Surgical intervention

Suspect a congenital heart abnormality in the presence of:

A respiratory rate more than 60 breaths per minute and

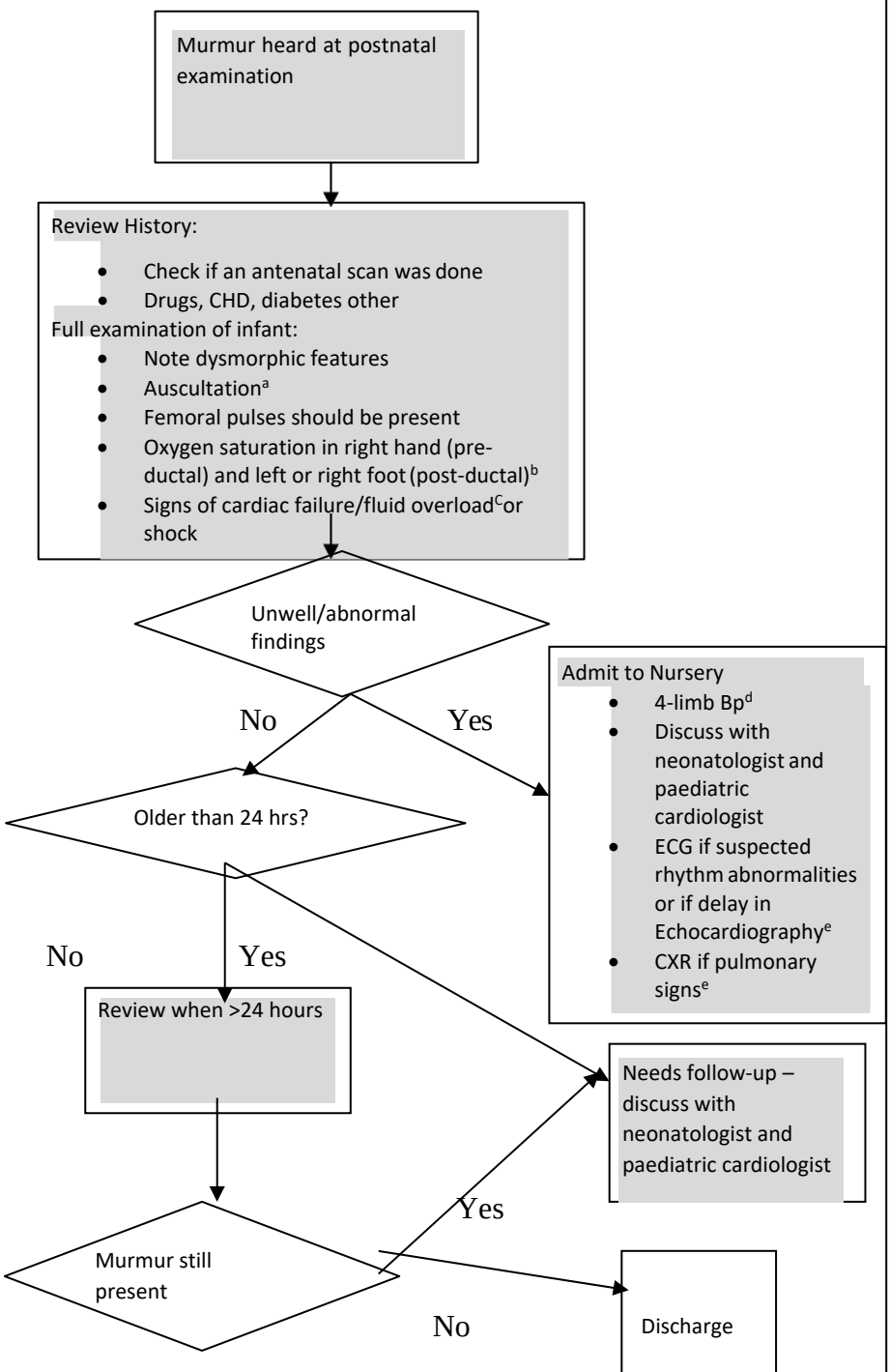
Central cyanosis (even if receiving oxygen at a high flow rate)

Minimal or +/- chest indrawing

Usually no grunting on expiration.

-

Figure 27.1: *Cardiac Murmur in a Well Term Infant*



a. S1 is heard best at the lowest left sternal border and is usually single.

S2 is heard best along the left upper sterna border –varies with respiration and audibly split in 80% by 48h.
An abnormal S2 requires investigation.
A murmur that is persistent, diastolic, loud or harsh in quality is abnormal and requires investigation.

b. Pulse oximetery is abnormal if, when measured after 24h, the oxygen saturation is < 90% in any extremity, oxygen saturation is persistently <95% in both extremities, or a >3% absolute difference in oxygen saturation between upper and lower extremity readings.

c. Signs of failure/fluid overload:

Respiratory distress, hepatomegaly, prominent precordial impulse, poor feeding

d. A BP persistently 20mmHg higher in the arms than in the legs may indicate coarctation or interrupted aortic arch.

e. CXR and ECG do not add sufficient information to change management emergently and are not cost effective if echocardiography is available. However, RVH may indicate Rt obstructive lesion: LVH may indicate Lt obstructive lesions: Rt or Lt axis deviation can indicate ASD or AV canal defect; and ASD can present as incomplete RBBB. dark lung fields on CXR are associated with Rt obstructive lesions

CHAPTER 28: NEWBORN SCREENING

INTRODUCTION

Newborn screening is recognized internationally as an essential, preventive public health program for early identification of disorders in newborn that can affect their long-term health.

Early detection, diagnosis, and treatment of certain genetic, metabolic, or infectious congenital disorders can lead to significant reductions of disease, associated disabilities and death.

CURRENT STATUS AND SCOPE

Routine spot blood tests for metabolic screens collected from newborn for most disorders are currently not available in the country. So, the role and scope of newborn screening will continue to expand in Nigeria.

AVAILABLE SCREENINGS

A. Critical Congenital Heart Disease (CCHD) and Pulse Oximetry Screening

Congenital heart disease (CHD) is the most common congenital malformation in newborn.

Critical CHD, defined as requiring surgery or catheter-based intervention in the first 28 days of life occurs in a high percentage of infants with CHD. The risk of morbidity and mortality increases in infants with critical cardiac lesions when there is a delay in diagnosis and timely referral to a tertiary center with expertise in treating these patients. The goal of critical CHD screening in newborn therefore is to reduce mortality and morbidity associated with delayed diagnosis by identifying infants with critical CHD in a timely manner. Universal screening with pulse oximetry improves the identification of patients with critical CHD compared with physical examination alone. This may lead to decreased infant mortality from critical CHD.

Targeted lesions

CHD lesions targeted by pulse oximetry screening include

1. Defects which require intervention in the first 28 days of life
2. Defects which present with hypoxaemia some or most of the time.

Procedure

- Pulse oximetry screening should be performed in all newborns after 24 hours of life or as late as possible if early discharge is planned.
- Pre-ductal oxygen saturation (SPO_2) should be measured in the right hand and Post-ductal oxygen saturation should be measured in any foot for comparison.
- Figure 28.1 shows algorithm for neonatal screening for CCHD using pulse oximetry.

1. Criteria for a positive screening test (Failed Screen)
2. SpO2 measurement <90 percent in right hand or any foot is abnormal
3. SpO2 measurement <95 percent in both upper and lower extremities on three measurements, each separated by one hour
4. SpO2 difference >3 percent between the upper and lower extremities on three measurements, each separated by one hour.

Recommended Action

1. Infants with positive screening results using pulse oximetry should undergo echocardiography evaluation to identify the cause of hypoxemia.
2. If critical CHD is identified on echocardiography, urgent consultation with a paediatric cardiologist and/or transfer to a medical facility with paediatric cardiology expertise is warranted.
3. Newborn with a negative screen may still have critical CHD because hypoxemia may not be present all of the time in some CHD lesions.
4. If there is clinical suspicion for critical CHD, additional evaluations should be pursued even in the setting of a normal pulse oximetry result.
5. The screening procedure to detect critical CHD in newborn may require modification in the certain settings such as high altitude where SPO_2 levels are normally lower, out-of-hospital births (i.e, home births and birth centers), and infants admitted to neonatal intensive care units (NICUs).
6. Out-of-hospital birth newborns should be screened at their first contact with a health facility.

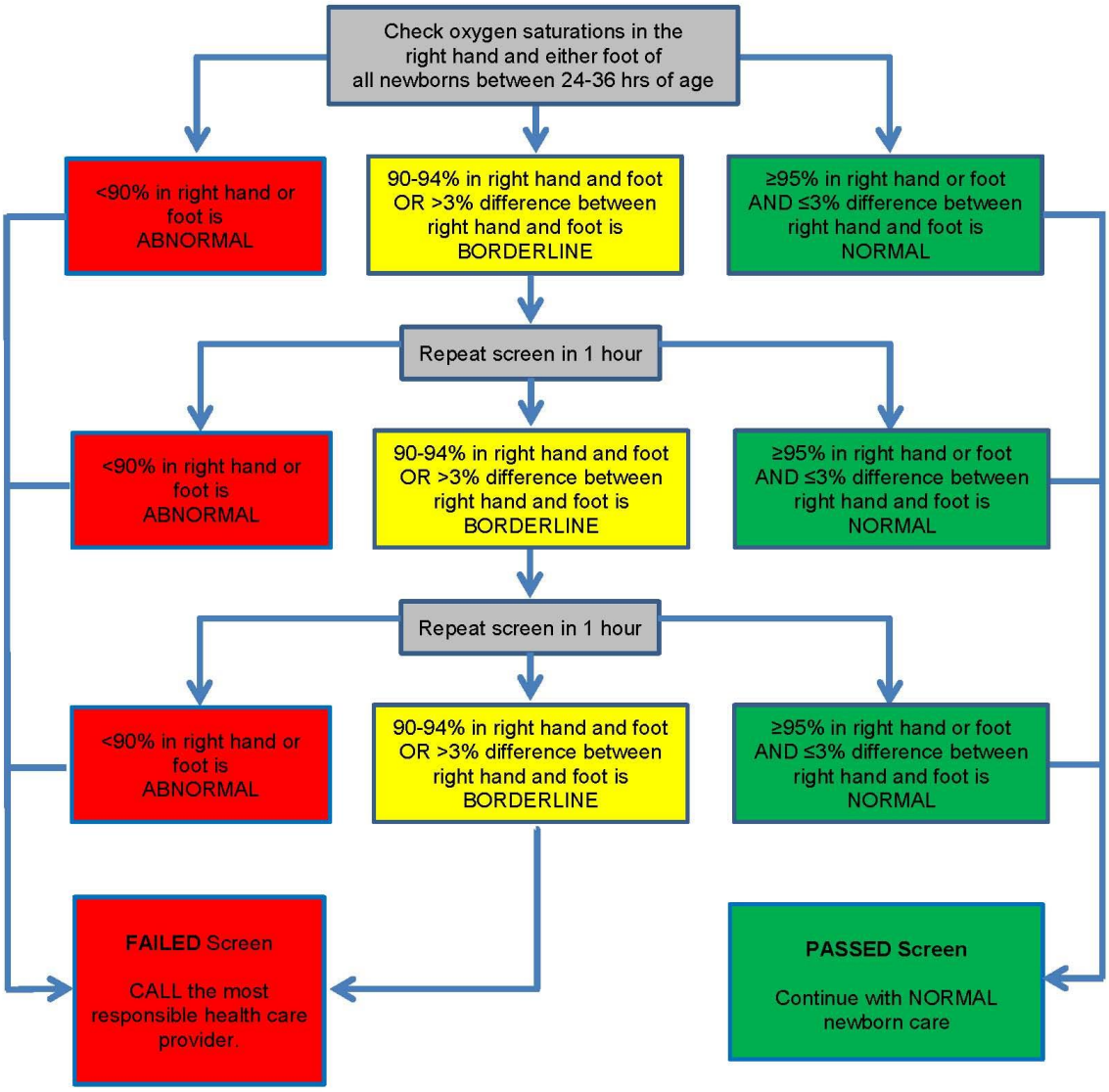


Figure 28.1: *Algorithm for Critical CHD (CCHD) screening using a pulse oximetry*

B. Retinopathy of Prematurity (ROP) Screening

Introduction:

- Retinopathy of prematurity (ROP) is one of the few causes of preventable childhood visual disability.
- Many extremely preterm babies will develop some degree of ROP especially following high oxygen exposures.
- In the majority, this never progresses beyond mild disease and resolves spontaneously without treatment.
- A small proportion develop potentially severe ROP which can be detected through retinal screening.
- If untreated, severe disease can result in serious visual impairment and consequently all babies at risk of sight threatening ROP should be screened.

Recommendations:

Screening Criteria

- All babies less than 32 weeks gestational age (or less than or equal to 1500g birthweight should be screened for ROP. The screening should be done by a Paediatric Ophthalmologist to be carried out in a tertiary centre.
- Appendix 28.1 shows the Nigerian Screening Protocol for ROP.

Screening Protocol

- For Babies born before 27 weeks gestational age, - the first ROP screening examination should be undertaken at 30 to 31 weeks post conceptional age.
- For Babies born between 27- and 32-weeks gestational age, - the first ROP screening examination should be undertaken between 4 to 5 weeks (i.e. 28-35 days) postnatal age.
- For Babies >32 weeks gestational age, but with birthweight < or equal to 1500 grams – the first ROP screening examination should be undertaken between 4 to 5 weeks (i.e. 28-35 days) postnatal age.

Minimum frequencies of screening should be weekly when: the vessels end in zone I or posterior zone II; or

- there is any plus or pre-plus disease or
- there is any stage 3 disease in any zone.
    1. Minimum frequencies of screening should be every 2 weeks: In all other circumstances until the criteria for termination have been reached.
    2. All babies <32 weeks gestational age or birthweight equal or <1500g should have their first ROP screening examination prior to discharge.

Screening Examination

- The screening examination can be stressful for both babies and care givers. The examination requires a well-dilated pupil, so the peripheral retina can be fully visualized.
- The parents should be well communicated with, and oral and written consent obtained.
- It is important that the periphery of the retina can be seen.
- This may be facilitated using an eyelid speculum and scleral indenter suitable for neonatal use.
- Ophthalmological notes should be made after each ROP examination, detailing zone, stage, and extent in terms of clock hours of any ROP and the presence of any pre-plus or plus disease.
- These notes should include a recommendation for the timing of the next examination (if any) and be kept with the baby's medical record.
- Comfort care techniques (e.g. administering sucrose solution, nesting, swaddling and/or the use of a pacifier) during the screening examination may be considered.

Termination of ROP screening

Screening can be stopped when a baby is no longer at risk of sight threatening ROP.

ROP Treatment

Timely treatment for ROP is effective at preventing severe visual impairment. This should be carried out by the Paediatric Ophthalmologist.

Table 28.1: *Stages of ROP*

Stages of ROP		
Stage 1	Mildly abnormal blood vessel growth.	Many children who dev this stage improved with no tx and eventually dev normal vision. Ds resolved on its own without further progression.
Stage 2	Moderately abnormal blood vessel growth.	
Stage 3	Severely abnormal bv growth. the abnormal bv grow towards the center of the eye instead of following their normal growth pattern along the surface of the retina.	Some infant would improve with no tx. However, if infant have stage 3 and plus ds, tx was considered. Plus disease – bv of the retina have become enlarged and twisted , indicate worsening of the ds. (tx at this point has a good chance of preventing retinal detachment)
Stage 4	Partially detach retina.	Traction from the scar produced by bleeding, abnormal vessel pulls the retina away from the wall of the eye.
Stage 5	Completely detach retina .	if left untreated, baby can have severe visual impairment and even blindness.

National Eye Institute

C. Screening for Sickle Cell Disease in Newborns

Introduction

Importance: Sickle cell anaemia (haemoglobin SS) affects 2-3% of the Nigerian population.

Without prompt diagnosis and the initiation of prophylactic antibiotics and pneumococcal conjugate vaccination by 2 months of age, children with sickle cell anaemia are vulnerable to life-threatening pneumococcal infections.

Benefits of early screening

1. Early detection of sickle cell anaemia
2. Early prophylactic oral penicillin
3. Reduction in the risk of serious infections during the first few years of life.
4. Early administration of pneumococcal conjugate vaccination
5. Early parental education about early warning signs of infection.
6. Counselling for family members about disease management and future reproductive decisions.

Screening tests:

- Use either thin-layer isoelectric focusing (IEF) or
- High performance liquid chromatography (HPLC) as the initial screening test.
- Both techniques are performed on capillary blood collected from a heel stick and absorbed onto filter paper
- They have extremely high sensitivity and specificity (approaches 100%) for sickle cell anemia.
- Specimens must be drawn prior to any blood transfusion due to the potential for a false negative result as a result of the transfusion.
- Extremely premature infants may have false positive results when adult haemoglobin is undetectable.

Timing of screening:

- Where possible, all newborns should undergo testing regardless of birth setting.
- Confirmatory testing should occur not later than 2 months of age.

Treatment:

Children with sickle cell anaemia should begin prophylactic penicillin by 2 months of age and receive pneumococcal immunizations as recommended by NPI.

Premarital testing and counselling

This is currently recommended for all aspiring couples in Nigeria to reduce the incidence of sickle cell anaemia.

D. Screening, Diagnosis, and Initial Management of Congenital Hypothyroidism (CH)

Objective:

The aim is to formulate practice guidelines for the diagnosis and initiation of management of congenital hypothyroidism (CH).

The benefits of congenital hypothyroidism screening

Early detection mostly before clinical symptoms and signs become evident through neonatal screening and initiation of treatment of congenital hypothyroidism (CH) prevents neurodevelopmental disability and optimizes developmental outcomes.Early detection and treatment of CH through neonatal screening prevent irreversible neurodevelopmental delay and optimize its developmental outcome.

The initial priority of neonatal screening for CH should be the detection of all forms of primary CH—mild, moderate, and severe. The most sensitive test for detecting primary CH is measurement of thyrotropin (TSH) When financial resources are available, total or free thyroxine (fT4) to TSH, to screen for central CH.

1. Special categories of neonates at risk of CH
   Some groups of children may have a false-negative neonatal screening result or have a high risk of mild CH not detected by neonatal screening, for instance premature, low birthweight, and sick babies; for these groups a post-screening strategy including collection of a second specimen 10 to 14 days of age may be considered. In patients with Down's syndrome, Measure TSH at the end of the neonatal period.

- Screening for primary CH should be introduced nationally
- The initial priority of neonatal screening for CH should be the detection of all forms of primary CH: mild, moderate, and severe.
- The most sensitive test for detecting primary CH is TSH determination
- The success of CH screening is important for normalizing the cognitive outcomes of children with severe primary CH
- The timing of the normalization of thyroid function may influence the final outcome.

Recommendations for screening in categories of neonates at risk of CH

- Screening for primary CH should be done with cord blood or blood collected after the age of 24 hours,
- The best "window" for testing is 48 to 72 hours of age.
- Blood is spotted onto filter paper, allowed to dry, and eluted into a buffer for TSH
- This method detects primary CH more effectively than primary T4 screening
- Primary T4 screening with confirmatory TSH testing entails a risk of missing some cases of mild forms of primary CH but can detect some cases of central CH (CCH)

1. TSH screening is the most sensitive test for primary CH detection and should be the single most important test in any screening program
2. A second screening should be considered for the following conditions:
   a. preterm neonates
   b. low-birth weight (LBW) neonates
   c. very low-birth weight (VLBW) neonates
   d. ill and preterm neonates admitted to neonatal intensive care units (NICU)
   e. specimen collection within the first 24 hours of life
   f. multiple births (particularly same-sex twins)
3. The repeat specimen should be collected at about 2 weeks of age, or 2 weeks after the first screening test was carried out. The interpretation of screening results should take into account the results of all specimens analyzed.

Reporting of screening result

- Initial TSH concentration of:
  - <10 mU/L: negative result – CH not suspected
  - ≥20 mU/L: positive result – CH suspected
  - ≥10 mU/L but <20 mU/L: borderline result. Repeat

Newborn screening laboratory will arrange a repeat sample to be collected and tested, If repeat sample result is:

- <10 mU/L: negative result – CH not suspected
- ≥10 mU/L: positive result – CH suspected

Criteria for decision to initiate treatment following positive screening result

- If capillary TSH concentration is ≥ 40 mU/L in whole blood, start treatment as soon as possible and refer to a paediatric endocrinologist
- A venous sample should be obtained on the same day as commencing treatment but do not wait for result of the venous blood test result for TFT (FT4) and refer to a paediatric endocrinologist
- If capillary TSH concentration is < 40 mU/l of whole blood, the clinician may wait for the results of venous TFT provided they should be available in the next 24 hours, but Refer to a Paediatric endocrinologist

Criteria for decision to initiate treatment following positive venous TFTs

- If venous free T4 (FT4) concentration is below norms for age, treatment should be started immediately.and refer to a paediatric endocrinologist.
- If venous TSH concentration is > 20 mU/L, treatment should be started, even if FT4 concentration is normal and refer to a paediatric endocrinologist.
- Treatment and monitoring of central CH
  In severe forms of central CH (fT4 < 5 pmol/L), Start LT4 treatment as soon as possible after birth at doses like in primary CH (10–15 lg/kg per day, to bring fT4 rapidly within the normal range.

Associated malformations and syndromes

- All neonates with high TSH concentrations should be examined carefully for congenital malformations (particularly cardiac) and for dysmorphic features.
- Communication of abnormal screening and confirmatory results
- An abnormal neonatal screening result should be communicated by an experienced professional (e.g., member of paediatric endocrine team, paediatrician, or general physician) either by telephone or face to face and supplemented with written information for the family.
  Knee X-ray may be performed to assess the severity of intrauterine hypothyroidism.

E. Developmental Dysplasia of the Hip (DDH)

Introduction:

- DDH ranges from mild acetabular dysplasia with a stable hip through more severe forms of dysplasia, often associated with neonatal hip instability, resulting in established hip dysplasia with/without later subluxation or dislocation.
- Delayed diagnosis requires more complex treatment and has a less successful outcome than dysplasia diagnosed early.
- Screening for DDH should be part of routine newborn examination.

DDH is more commonly seen in babies with:

- Family history of first degree relative with DDH
- Breech presentation during pregnancy
- Hip abnormality on clinical examination
- Structural foot abnormality
  - congenital calcaneo-valgus
  - fixed talipes equinovarus
- Significant intrauterine moulding
- Congenital torticollis
- Congenital plagiocephaly
- Birth weight >5 kg
- Oligohydramnios
- Multiple pregnancy
- Prematurity
- Neuromuscular disorders

Screening for DDH

- All babies should be offered a newborn examination to be completed by age 72 hrs
- Take appropriate history from parents to identify risk factors for DDH and conduct a

thorough examination for hip abnormalities

- Ortolani and Barlow tests help to detect an unstable hip, or hip that is dislocated or subluxed but will not detect an irreducible hip, which is best detected by identifying limited abduction of the flexed hip.

Barlow test (see Figure 28.2, right hip)

- Hip adducted and flexed to 90°
- Hold distal thigh and push posteriorly on hip joint
- Test is positive when the femoral head is felt to slide posteriorly as it dislocates

Ortolani test (see figure 28.2, left hip)

- Stabilize pelvis and examine each hip separately
- In a baby with limited hip abduction in flexion, hip is flexed to 90° and gently abducted while examiner's finger lifts the greater trochanter.
- Test is positive when the femoral head is felt in the acetabulum
- Enhanced screening is done through ultrasound of the hips in a referral system in all suspected cases.

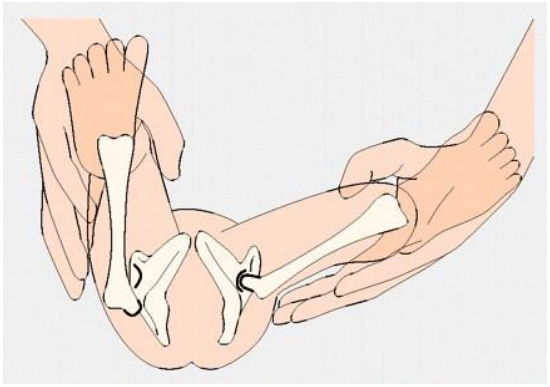


Figure 28.2: *Showing Barlow test on the Right leg, and Ortolani test on the Left leg.*

Criteria for urgent screening (≤2 weeks)

- Abnormal examination
- Difference in leg length
- Knees at different levels when hips and knees are bilaterally flexed
- Difficulty abducting hip to 90°
- Asymmetry of skin folds in the buttocks and posterior thighs when baby is in ventral suspension
- Palpable 'clunk' when undertaking Ortolani or Barlow manoeuvres.

Dislocated/dislocatable/unstable hip – positive Ortolani or Barlow test or limited hip abduction

- Review by specialist to confirm diagnosis.
- Inform parents of findings and plan for further investigation and management.
- Document findings and plan.
- Urgent referral for USS.
- Referral to Physiotherapy/Orthopaedic team.

F. NEWBORN HEARING SCREENING

Introduction

- Early intervention improves the outcome for babies with congenital/neonatal hearing deficit.

Risk factors/Indications

- Proven or possible congenital infection (CMV, rubella, toxoplasmosis)
- Babies with severe bilirubin encephalopathy
- Cranio-facial anomalies, cleft palate, deformed pinnae (not simple ear tags)
- Syndromes associated with hearing loss (Down's, Waardenburg, Alport, Usher etc.)
- Multiple abnormalities with neurodegenerative/neuro-developmental disorder
- Mechanical ventilation >5 days
- Family history of permanent hearing loss in childhood

Procedure

Consent

- Oral and written parental consent should be obtained

How

- Oto-Acoustic Emissions (OAE) +/- Automated Auditory Brainstem Response (AABR)

When

- Screen only when baby has reached 34 weeks (corrected age)

Where

- *Well babies*
  Screening is performed as an inpatient before discharge by an ENT surgeon
  Admitted babies in SCBU: Arrange screening as close to discharge as possible, when baby is well enough to test and preferably once major medical treatment, ototoxic or other drug treatments are completed.

CHAPTER 29: CONGENITAL ANOMALIES/SURGICAL EMERGENCIES IN THE NEWBORN

Congenital anomalies are structural or functional anomalies that occur during intrauterine life and may be identified before or at birth or later in life. They are also called birth defects, congenital disorders, or congenital malformations. An estimated 6% of babies worldwide are born with a congenital anomaly, resulting in hundreds of thousands of associated deaths.

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 and other chemicals, as well as certain medications, alcohol, tobacco, native concoctions, unorthodox drugs and radiation during pregnancy.
- Maternal Infections – e.g. Syphilis, Rubella
- Maternal nutritional status – folate deficiency

DETECTION

1. Preconception screening
2. Periconception screening
3. Neonatal screening

PREVENTION OF CONGENITAL ANOMALIES

- Health promotion activities
  - Cessation of smoking and alcohol consumption
  - Eat healthy diet
  - Avoid exposure to harmful substances (mothers not to take unprescribed drugs and native herbs during pregnancy)
  - Maintain healthy weight
- Folic acid supplementation
- Management of pre-existing medical conditions such as diabetes

Many of these anomalies present as emergencies, requiring immediate surgical intervention while others cause lifelong impacts (e.g. Down's syndrome). Such emergencies include:

4. Choanal atresia
5. Oesophageal atresia/Tracheoesophageal fistula
6. Intestinal obstruction:

Duodenal, jejunal, ileal, or colonic atresia, malrotation with mid gut volvulus, meconium ileus, meconium plug and imperforate anus

7. Abdominal wall defects (Omphalocoele/ Gastroschisis)
8. Diaphragmatic hernia
9. Posterior urethral valve with urinary retention
10. Spina bifida/Meningomyelocoele

Effective management of these require cooperation and communication between the paediatric/neonatology team and paediatric surgical team. A multidisciplinary approach is usually utilized. Once there is a clinical suspicion of surgical emergency, inform the paediatric surgical unit. If diagnosed pre- delivery and if possible, 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

- 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

2. OESOPHAGEAL ATRESIA/TRACHEOESOPHAGEAL FISTULA

- 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 stabilize 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.

Pre-operative care

- Passage of nasogastric tube for gastric decompression.
- Place 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 stabilize 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 Xray, Keep NPO until a senior clinician has reviewed the infant. Involve the paediatric surgical team.

5. OMPHALOCOELE AND GASTROSCHISIS

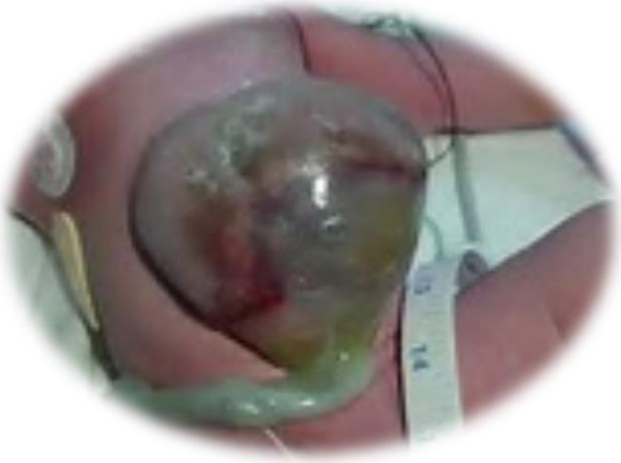


Figure 29.1: *Omphalocoele*

Figure 29.2: *Gastroschisis*

- 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 Fig 29.1).
- 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 Fig 29.2).

Preoperative management:

- 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 baby warm
- Pass nasogastric tube for decompression
- Level 2 centres to stabilize 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.
- The cardiothoracic 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 cardio-thoracic surgical team.

7. MENINGOMYELOCELE AND OTHER NEURAL TUBE DEFECTS (SPINA BIFIDA)

Figure 29.3: Meningomyelocoele (Spina bifida)

- During the first month of pregnancy, the two sides of the fetal spine join together 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 29.3).
- 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 skin:

- Cover with sterile gauze soaked in normal 0.9%saline
- Keep gauze moist at all times, and ensure that the baby is kept warm
- Level 2 centres to stabilize and refer to level 3 centre for specific care and management.

CHAPTER 30: COMMON NEONATAL PROCEDURES

1. VASCULAR ACCESS

- Venepuncture
- Peripheral vein cannulation
- Central cannulation

Indications

i. Collection of blood sample for investigations
ii. Intravenous fluid, drug and parenteral nutrition administration.
iii. Therapeutic procedures like exchange blood transfusion

Materials

- Good light source
- Vascular access tray containing the following;
  - Pairs of sterile gloves.
  - Sterile Swab or cotton-wool ball
  - Antiseptic solution (methylated spirit, 70% alcohol, cetrimide, povidone iodine)
  - Adhesive strapping (plaster)
  - Cannula (usually 22-26 gauge)
  - Infusion set (use a micro-dropper or soluset, infusion pump, syringe pump/driver)
  - IV fluids (refer to IVF/Nutrition guideline specific type required for the baby)
  - Arm board (or splint)
  - Vein finder
  - Scissors
  - Scalpel blade
  - Kidney dish and gallipot with covers
  - Syringes (2ml, 5ml, 10ml)
  - Receiver for used materials
  - Sharp box

In addition to above materials, the following will be needed for central or peripherally inserted central lines

- Sterile gloves, gown, mask and cap
- Sterile gauze and cotton wool pack
- Drapes
- Umbilical catheter tray
- Umbilical catheters (3.5F for <1200g; 5.0F for >1200g)/ NG tube3-way stop cock with Luer-lock
- Sterile saline + heparin or premixed heparin solution
- Suture (vicryl or silk 0, 1.0, 2.0)

- Instruments- toothed forceps/tissue forceps, artery forceps, needle holder, probe
- Restraints
- Syringes (5ml, 10ml, 20ml)

Sites

Common sites for venepuncture and peripheral vein cannulation are as shown in Figure 30.1

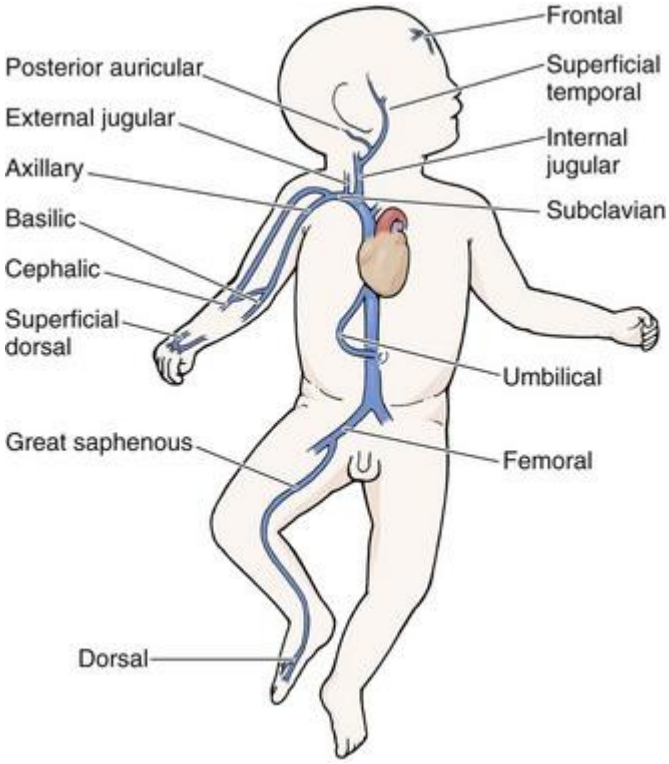


Figure 30.1: *Sites for venepuncture and peripheral vein cannulation*

Procedure

- Obtain required materials.
- Follow principles of infection prevention/strict asepsis
- If the cannulation is for intravenous fluid administration, prepare the solution to be infused, ensuring that the entire infusion set is filled with fluid and that there is no air in the infusion set. Wash hands and put on a pair of sterile gloves or clean examination gloves.
- Search for veins (usually on the dorsum of the hands, the feet/leg and the scalp)
- Prepare the skin over the vein using a swab or cotton-wool ball soaked in antiseptic solution and allow to dry.
- Have an assistant press on the skin near the vein to act as a tourniquet :(If using a vein on the hand, foot, arm, or leg, have the assistant use her/his forefinger and thumb to gently encircle the limb above the chosen site of insertion)
    - Insert the needle or cannula at a 15-degree angle through the skin, with the bevel of the needle facing upward, if using a cannula. Once blood fills the hub of the cannula, withdraw the needle partially while continuing to push the cannula forward into the vein.
    - When the hub of the cannula reaches the skin at the puncture site, withdraw the needle completely;

- Dispose of the needle according to recommended infection prevention procedures

- If the procedure is for blood sample collection, allow free flow of blood through the needle into the sample bottle until the desired volume is obtained. Remove the needle and dispose appropriately. Put a dry cotton wool swab at the site of venepuncture and apply some pressure to secure haemostasis. Once there is no more bleeding, dispose of the dry cotton wool swab appropriately. Connect the infusion set to the cannula and ensure that there are no air bubbles in the infusion set.
- Infuse fluid into the vein for a few seconds to make sure that the vein has been successfully cannulated. The fluid should run freely, and there should be no swelling around the site of the cannula;
  - If swelling develops around the site of infusion, withdraw the needle from the vein, ensure haemostasis and repeat the procedure using a different vein.
- If using a vein in the hand, arm, foot, or leg, immobilize the limb (e.g. using an arm board [or splint] and adhesive strapping)
- Secure the cannula in position using strips of adhesive tape
- Inspect the infusion site every hour:
  - Look for redness and swelling around the insertion site of the cannula, which indicate that the cannula is not in the vein and fluid is leaking into the subcutaneous tissue. If redness or swelling is seen at any time, stop the infusion, remove the needle, maintain haemostasis and establish a new IV line in a different vein

2. UMBILICAL VESSEL CATHETERIZATION

Indications:

- Umbilical Artery Catheterization
  i. Monitoring of arterial blood gasses or direct/invasive BP monitoring
- Umbilical Venous Catheterization
  i. Resuscitation ((low-lying about 4-5cm)
  ii. To monitor central venous pressure.
  iii. For exchange blood transfusion (low-lying about 4-5cm)
  iv. For IV fluid, drugs, parenteral nutrition administration (high placement)
  v. During transport when peripheral IV cannot be placed.

Procedure:

- Restrain the neonate
- Prepare catheter(s)
- Place stopcock at each lumen and flush each port with saline/heparin solution
- clean cord with antiseptic solution (Povidone Iodine)
- Drape the abdomen of the neonate
- Position sterile umbilical tape around base of cord and loosely tie (this can be pulled tight for haemostasis, should any bleeding occur)

- Cut the cord horizontally across with a scapel to leave approximately 1-2cm of umbilical cord
- Using a pair of forceps, pick up a side of umbilical stump (identify 2 arteries & 1 vein)
- Calculation of catheter length:

  - UAC:[BW(kg) x3] +9 OR perpendicular distance from infant's shoulder to level of umbilicus +2cm

  - UVC: [BW(kg) x 2]+5] OR 2/3 perpendicular distance from infant's shoulder to level of umbilicus +2cm ie Remember to add the length of the umbilical stump to the distance calculated (See Appendix 30.1 shoulder to umbilicus chart)
- Introduce catheter into vessel and advance gently.
- Never use force - gentle, constant pressure will overcome vessel spasm
- Follow the marks on the catheter
- Remember catheter can be pulled back if it is in too far but should not be re-advanced after the initial insertion to avoid infection.
  - Secure catheter with 4.0 silk suture
  - Verify placement of catheter with X-Ray
    - UAC: between T6-T9 if high or L3-L4 if low lying
    - UVC: between T8-T9 (at the level of the diaphragm). Do not use low lying UVC placements for IV drugs, IVfs and parenteral nutrition as these are all being infused into the liver.

Complications:

- UAC
  i. Mal-positioned catheter can lead to:
     - vessel perforation
     - peritoneal perforation
     - false aneurysm
  ii. Vascular accident
     - Thrombosis
     - infarction/embolism
     - Vasospasm leading to gangrene
     - hypertension
  iii. Haemorrhage
  iv. Infection
  v. Necrotizing Enterocolitis
  vi. Intraventricular Haemorrhage

- UVC
  i. Air embolism
  ii. Haemorrhage
  iii. Infection
  iv. False passage
  v. Renal vein thrombosis
  vi. Portal vein thrombosis

vii. Dysrhythmias
viii. Infective endocarditis

3. 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 Fig 30.2).

Procedure:

- 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.

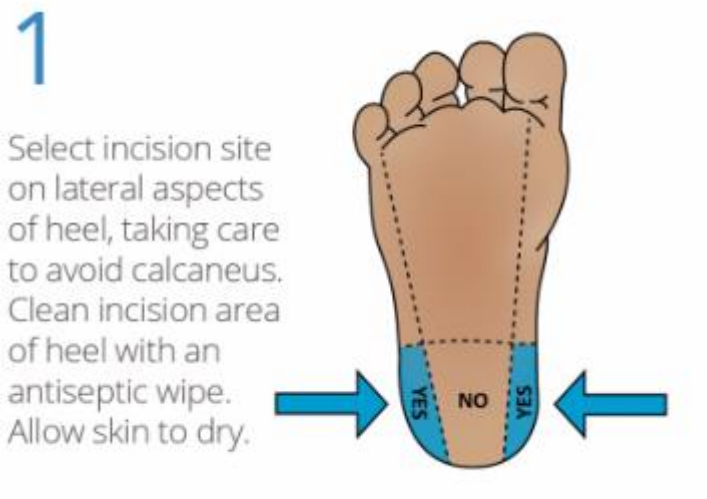


Figure 30.2: *Sites for heel prick*

4. ENDOTRACHEAL INTUBATION

Indications:

- To provide a secured airway for respiratory support
- Drug administration (Adrenaline and surfactant)

Materials:

- Appropriate 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 30.1: *Determination of endotracheal tube sizes and depth of insertion.*

Weight	GA	ETT Size	Laryngoscope blade	Depth of insertion (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)

Procedure

- 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% FiO_2 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 30.1)
- After intubation, auscultate for equal breath sounds in both lungs and over stomach or test with CO_2 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)

5. LUMBAR PUNCTURE (LP)

Indications:

To obtain cerebrospinal fluid for analysis, as part of sepsis workup and to confirm the diagnosis when the baby has signs suggestive of meningitis.

Contraindications

- Platelet count is less than 50 x 10-9/l
- Bleeding disorder
- Local infection over lower lumbar spine
- Be especially cautious in infants who have cardiorespiratory compromise

Materials

- Clean examination gloves
- Sterile gloves, gown, face mask and cap
- A sterile pack containing:
    - Sterile drapes
    - Sterile gauze and cotton-wool
    - Gallipot
    - Sponge forceps
- Antiseptic solution (methylated spirit, povidone iodine)
- Spinal needle or intravenous needle (22- to 24-gauge)
- Manometer
- Appropriate sample collection bottles (universal sterile bottle, fluoride oxalate)
- Adhesive plaster
- An assistant

Procedure

- Explain the procedure to the parents and obtain written consent
- Obtain necessary materials (as above)
- Place the baby under a radiant warmer, or on a flat, firm bed. Undress the baby only when ready to perform the procedure.
- Follow principles of infection prevention and aseptic technique.

Preparation:

- Wash your hands and aseptically put on sterile gloves.
- Prepare the skin over the area of the lumbar spine and then the remainder of the back by washing in an outward spiral motion with a sterile cotton-wool ball soaked in antiseptic solution (povidone iodine, then methylated spirit). Repeat two more times, using a new cotton-wool ball each time. Allow to dry.
- Identify the iliac crests, draw an imaginary line between the top of the iliac crests. This intersects the spine at the L3/L4 space.
- Place sterile drapes over the baby's body so that only the puncture site is exposed.

Position the baby:

- LP is performed with the baby lying on the side facing the assistant
- Have your assistant flex the baby (i.e. curl into foetal position). Do not over flex the neck to avoid respiratory compromise. Hold baby's shoulder and upper thighs; and not the head or neck (See Figure 30.3).

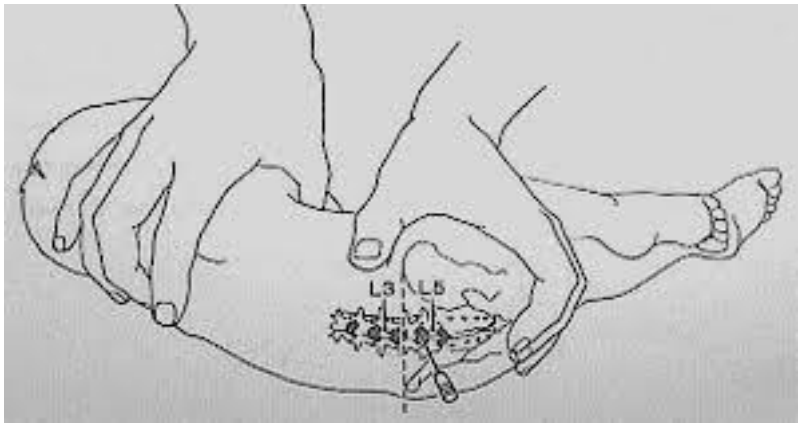


Figure 30.3: *Positioning of baby for lumbar puncture. Aim for between L4-L5.*

The procedure:

- Insert the needle in the midline of the vertebrae, angled towards the baby's umbilicus.
- Site of entry is between the 4th and 5th lumbar spinous processes, at the level of the iliac crests
- DO NOT attempt above the L3, as the neonatal spinal cord extends till L3
- Slowly advance the needle to a depth of about 1 cm (or less if the baby is small). A slight "give" may be felt as the needle enters the subarachnoid space.
- If using a spinal needle, remove the stylet.
- If bone is encountered, the needle cannot be redirected. Pull the needle back to just beneath the skin and reinsert the needle, directing it slightly upward while aiming for the baby's umbilicus.
- Once in the subarachnoid space, CSF will begin to flow through the needle.
- Collect the cerebrospinal fluid (CSF) - collect about 0.5 to 1 ml (about 6 to 10 drops) of CSF in each collection tube
- If CSF does not come out, rotate the needle slightly; if CSF still does not come out, remove the needle and reinsert it between the fourth and fifth lumbar space.
- If blood is seen in the CSF, the needle probably went through the spinal canal and caused bleeding. If the CSF does not clear, collect enough CSF for culture and sensitivity only.
- After the CSF is collected, remove the needle; apply sterile gauze and an adhesive plaster.
- Lie baby on the back and observe for 10minutes
- Return the baby to the cot.

6. EXCHANGE BLOOD TRANSFUSION

A procedure of removing patients' blood in aliquots and replacing with donor blood or 5% albumin or normal saline in order to remove abnormal blood components and/or circulating toxins while maintaining adequate circulating blood volume.

Indications:

- Severe neonatal jaundice
- Haemolytic disease of the newborn
    - Cord SB >5mg/dl
    - Cord blood PCV <30%
    - Positive cord blood direct coomb's test
- High SB value depending on weight and age (see section on neonatal jaundice)
- Rate of rise of SB >5mg/dl in 24 hours irrespective of the cause of jaundice.
- Severe anaemia PCV <25%
- Polycythaemia - PCV >/= 75% with or without symptoms OR >65% to 74% with symptoms (Blood should be a venous, not capillary sample)
- Adjunct to treatment of overwhelming sepsis
- Disseminated intravascular coagulopathy
- Antibodies in maternal alloimmune disease

Types

- Double volume EBT
    - 2 X [blood volume (ml) X baby's weight (kg)]
    - Exchanges 85 – 90% of blood volume and removes about 60% of bilirubin
    - Blood volume approximately 80mls X weight of baby eg 3 kg blood volume =3 x 80=240 x 2 (to be double blood volume)= 480mls of blood needed.
- Single volume EBT
    - Blood volume (ml) X baby's weight (kg)
    - Exchanges 60 – 75% of blood volume.
- Partial exchange transfusion
    - For polycythaemia
    - Volume exchanged = $\frac{\text{(infant's blood vol) X (actual PCV – desired PCV)}}{\text{actual PCV}}$
    - Blood replaced with normal saline or 5% albumin

Materials

- Sterile Pack with a tray containing
    - Aprons/gowns
    - Gloves
    - Drapes
    - Swabs/gauze
    - Syringes
    - Blood giving set
    - Sutures

- Others – Trolley, antiseptic solutions, eye goggles, face masks, tape measure, infant restrains, radiant warmer
- Resuscitation materials: Suction machine, bag and mask, 10% Calcium gluconate, 5-10% dextrose solution, IV frusemide
- Multiparameter monitoring, sample bottles, recording sheets
- Blood for EBT must be:
  - Freshly donated blood (preferably ≤72hours). (Negative for transfusion transmissible infections - Hepatitis B, C, HIV, CMV).
  - Cross-matched against baby and mother's blood.
  - Donor's PCV to be up to 40 – 60%.

Procedure

Double volume EBT

- The nurse/ assistant to wash hands, place infant under radiant warmer and put baby in crucifix
- Wash hand, wear sterile gloves, gown and mask
- Skin preparation with antiseptics
- Drape baby
- Cannulate the UVC as earlier described (Approximately 4-5cm depth)
- Measure CVP
- Attach 3-way tap/syringe/blood giving set
- Exchange in aliquots 10 – 20ml depending on weight of baby
- Withdraw first aliquot, hand over to assistant for SB, E/U Cr, Ca, FBC, RBG, ABG (PreEBT)
- Replace withdrawn volume
- Announce and document volume in/out per cycle
- Rotate blood bag every 10 - 15minutes
- Give 10% calcium gluconate 1ml after every 100mls of citrated exchanged blood. Give slowly IV over 10minutes.
- Intra procedure monitoring of HR, RR, Temperature, BP and SPO_2
  - +/- Top up transfusion
- Measure post - EBT CVP
- End of procedure
- Entire procedure should take 60-75 minutes.; do not rush the procedure
- Last sample taken out should be kept for post-EBT investigations -SB
- At end of procedure, UVC can be removed, if no longer needed. Remove as soon as possible because it is a source of infection.
- Watch for abdominal distension and check stools for blood

Post EBT monitoring

- Vital signs (including abdominal girth) – 1/4hrly X 1hr; 1/2hrly up to 6hrs
- SPO_2

- RBG – immediate post-EBT; 30mins; 1hr; 2hr
- SB – immediate post-EBT; 6hrs; 12hrs; 24hr
- Continue Phototherapy (as indicated)
- Place baby on NPO for 4 – 6hrs
- Provide Warmth
- IVF & other treatment continues

Table 30.2: *Sample Exchange transfusion record chart*

Name: _____ Hospital no. _____

Date: _____ Time EBT commenced:_____ Time EBT completed: _____

Volume exchanged : _____ Blood unit no's _____ _____

Time	Vol. out	Vol. in	Drugs given	HR	BP	Temp	BM	Remarks

Complications:

- *Procedural complications*
    - Visceral/ peritoneal perforation
    - Hypothermia
    - Dislodged cannula
    - Anaemia/ polycythaemia
    - Acidosis/alkalosis
    - Arrhythmias/cardiac arrest/ tamponade
    - Portal hypertension
- *Blood related complications* (ref to blood transfusion guideline)
- *Other complications*
    i. NEC
    ii. Electrolyte disturbances
    iii. Thrombus / emboli
    iv. Death

7. 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.

Procedure:

- 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.

Interpretation:

- 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 – 28days, it is elevated if result is greater than 15mm in first hour.

CHAPTER 31: DISCHARGE/ FOLLOW UP/ IMMUNIZATION

1. DISCHARGE

- Have a written policy on discharging all babies and to include KMC discharge (see KMC discharge readiness Table 17.4) for the low birth weight babies. Explain the policy to the mother and answer any questions she may have.
- Examine the baby and confirm that the baby meets the requirements for discharge. Follow the specific instructions for discharge in each chapter, as applicable.
- In general, discharge the baby when the:
  - Baby is breathing without difficulty and has no other ongoing problems that cannotbe managed on an outpatient basis.
  - Infant does not require intravenous fluids
  - Baby's body temperature is being maintained in the range of 36.5 °C to 37.5 °C
  - Mother is confident about her ability to feed and care for the baby at home
  - For preterm or low birth weight infants, no apnea for 3 days without caffeine or aminophylline
  - Infant is passing urine and stool normally
  - Baby is breastfeeding well or the mother is confident using an alternate feeding method;
  - Infant is receiving at least 8-12 feeds per day (i.e. 2-3 hourly feeds) of a total of more than 120ml/kg/day or is breast‐feeding well on demand.
  - Baby is gaining weight (at least 20g/day for terms; and 15g/kg/day for preterms)
  - For those with HIE and treated with anticonvulsants, no convulsions for 48 hours off anti‐convulsant therapy.
- Counsel the mother to return with the baby immediately if the baby has any danger signs (e.g. poor feeding, lethargy, breathing difficulty, jaundice, convulsions or abnormal body temperature).
- Plot the baby's weight, head circumference and length in the appropriate Growth Charts (WHO chart for term babies (Appendix 31.1) and Fenton chart for preterms (See attached in Appendix 31.2a for girls and 31.2b for boys)
- Ensure mother is proficient in
  - Hand washing,
  - Breastmilk expression/ Feeding EBM
  - Breastfeeding technique
  - Administration of oral medications
  - Recognizing danger signs
- Ensure that the baby has started the necessary immunizations
- Give the mother a sufficient supply of drugs to complete any treatment at home, or give a prescription for the drugs.

- Counsel mother not to buy drugs that are not prescribed
- Give her an appointment for a follow-up visit.
- Discuss with the mother support systems at home or in the community, especially if mother is adolescent, single, a first-time mother, or HIV positive.
- Complete the baby's clinical record with discharge information, including weight, discharge diagnosis, and the plan for follow-up.
- Complete a discharge form (See Table 31.1). And ensure completion of the National Road to Health Immunization Chart every month from birth. (Appendix 31.3)
- Give the mother the pictorial discharge leaflet (See appendix 6.1) which contain inform on newborn care and danger signs.

For Preterm Discharge

- Ensure the preterm babies have oral Iron, Vitamin D, Calcium (120-140mg/kg/day) and Phosphorous (60-90mg/kg/day) supplements as recommended by WHO (See section on preterm feeding Chapter 18). Always give Calcium and Phosphorous in combination. Do not give only one.
- Use KMC Pre-discharge readiness scoring sheet
- A total score of 20/20 should be achieved for breastfeeding mothers before discharge.
- Consider circumstances at home. If difficult social circumstances, be more conservative in

  discharge weight and don't discharge too early. Also applicable to teenage mothers.
- If criteria are met, an infant can be discharged if weight is ≥1500g.
- Some infants may be discharged at lower weight, in discussion with the senior clinician, KMC score, mother's proficiency and support she has at home.

Table 31.1: *Discharge card/Form*

Infant's Details:

Name: ----------

Sex: ----------

Address: ----------

Estimated/Gestation age at birth: ----------

Date of delivery: _____

Admission date:…….

Birth weight: ----------

Weight at discharge:----------

Head circumference at discharge:----------

Length at discharge: ----------

Age at discharge:……

Date of discharge:…….

Vaccination given:……

PCV at discharge ----------

Feeding:

Method of feeding (circle as appropriate):

Direct breastfeeding EBM with cup & spoon others

Volume of feeds:----------

Frequency of feeds:----------

Daily weight gain in last 3days: ----------

Medications:

Oral antibiotics Yes No

Haematinics Yes No

Any outstanding/abnormal result? ----------

Appointment for follow up ----------

2. FOLLOW-UP

- Ensure at least two follow-up visits within one week after discharge of babies who were seriously ill, very low birthweight, or fed using an alternate feeding method at the time of discharge.
- At each visit:
  - Assess the baby for the specific problem that required follow-up and ensure that the problem has been resolved;
  - Assess the baby's general condition;
  - Weigh the baby and assess growth;
  - Counsel on and/or manage any problems or concerns identified by the mother;
  - Assess breastfeeding and counsel the mother on exclusive breastfeeding;
  - Reinforce parental education in newborn care and danger signs;
  - Check baby's PCV
  - Promote the family's continued use of the primary health care facility;
  - Give immunizations if they are due or refer the baby and mother to the relevant service.
- If the mother is HIV positive (ensure early infant diagnosis (EID) for the baby at 6 weeks) or the baby is likely to have long-term problems ensure that the baby receives regular follow- up visits with the PMTCT clinic.

When to follow-up preterm neonates

- See all low birthweight (birthweight <2.5kg) in first available neonatal clinic after discharge
- See preterm neonates every 1 week until 1.5kg
- See every 2 weeks from 1.5kg until 2.5kg
- Monthly after 2.5kg if well and no on-going concerns
- Weight gain and length are the best parameters for assessing growth and development of a preterm.
- Review neurodevelopment at 3months, 6 months, 9months and 12 months corrected GA
- Ensure ROP and hearing screening for high risk babies

What to do at each clinic appointment.

Record all information in a follow up chart

a) Measure and record and plot anthropometry in a Growth Chart (See Chapter 32)
- Temperature
- Weight
- Head circumference

b) Ask caregiver about symptoms of infection
- Fever, hypothermia, lethargy, poor feeding, seizures, difficult breathing and apnoea

c) Ask caregiver about feeding
- Is the baby breastfeeding well? How many minutes? How often?
- How much EBM is she adding? How often?
- Passing urine (6-8 per day) and stool at least once a week
- Calculate average weight gain since last visit in g/kg/day

- Should be at least 15g/kg/day
- If weight gain poor, increase EBM advise mother and review in 1 week
- If no weight gain or weight loss, readmit baby for NGT/Cup feeding +/- antibiotics

d) Ask caregiver about temperature control at home

- Is caregiver doing Kangaroo Care at home – support and encourage
- Is she/he monitoring temperature at home and if so is it normal (36.5-37.5)
- About symptoms of milk reflux – if present give advice on holding baby up after feeds, positioning at head propped up at angle 30degrees, and consider starting domperidone syrup.

e) Ask about medications/discharge medicines

- Syrup iron, Calcium, Phosphate, Vitamin D – should be started before discharge, continue until 6 months postnatal age.
- Nevirapine syrup for those whose mothers are seropositive

f) Examine baby:

- Check the temperature recorded is normal (36.5-37.5)
- Check heart rate is normal (110-160) and respiratory rate is normal (30-60)
- Perform a routine newborn examination
- Check neurology, particularly for signs of hydrocephalus, if suspected refer neurosurgery
- Ensure there are NO signs of infection, if present readmit the neonate for treatment

g) Give advice

- Provide the caregiver with a summary of visit, an opportunity to ask any questions and to advise her on care of her preterm until next visit including:
- Which medications to continue/add
- To continue KMC at home until 2.0kg
- How to increase EBM if needed
- Hygiene and infection prevention at home
- The 8 danger signs and when and how to seek medical advice i.e. immediately attend Emergency Unit if possible, if not attend nearest clinic
- When to come for next follow-up clinic
- Encourage, praise and support mother/caregiver at all times to gain her confidence.

3. IMMUNIZATION

Immunization is the process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine. Vaccines stimulate the body's own immune system to protect the person against subsequent infection or disease. (WHO)

Routine immunization schedules vary from country to country. In Nigeria, the Expanded Programme on Immunization (EPI) was introduced in 1978 with the aim of providing routine immunization to children less than two years of age and a vision of eradicating the childhood

killer diseases. This programme has undergone series of reviews, with periodic addition of new vaccines. Routine immunization in Nigeria currently offers protection against diseases such as tuberculosis, poliomyelitis, hepatitis B, Rotavirus, diphtheria, pertusis, tetanus, haemophillus influenza type B, pneumococcal diseases, measles, yellow fever and meningitis; vitamin A is also given.

The current NPI schedule is as shown in the Figure 31.1 below:

Recommendations for Preterm Infants

- The preterm infants are at higher risk of vaccine-preventable diseases. Studies show that most preterm infants produce antibodies at chronological age even if this is slightly lower than their term counterparts.
- All international guidelines recommend vaccination at chronological postnatal age and not at corrected gestational age.
- BCG- defer until discharge of the infant
- All other vaccinations starting at age 6 weeks to be administered at the chronological age as per NPI schedule
- If infant is acutely unwell, defer vaccinations until recovered.
- NB: clinics are often reluctant to give vaccinations to small infants, so parental education and a letter to the clinic explaining the importance and safety of the vaccines is important.

Current NPI Schedule in Nigeria

Minimum Target Age of Child	Type of Vaccine	Dosage	Route of administration	Site
At birth	BCG	0.05ml	Intra dermal	Left Upper Arm
	*OPV0	2 drops	Oral	Mouth
	**Hep B birth	0.5ml	Intra muscular	Antero-lateral aspect of Right thigh
6 weeks	Pentavalent (DPT, Hep B and Hib) 1	0.5ml	Intra muscular	Antero- lateral aspect of left thigh
	Pnemococcal Conjugate Vaccine 1	0.5ml	Intra muscular	Antero- lateral aspect of Right thigh
	OPV1	2 drops	Oral	Mouth
	Rota 1	1ml	Oral	Mouth
10 weeks	Pentavalent (DPT, Hep B and Hib) 2	0.5ml	Intra muscular	Antero-lateral aspect of left thigh
	Pnemococcal Conjugate Vaccine 2	0.5ml	Intra muscular	Antero- lateral aspect of Right thigh
	OPV2	2 drops	Oral	Mouth
	Rota 2	1ml	Oral	Mouth
14 weeks	Pentavalent 3 (DPT, Hep B and Hib)	0.5ml	Intramuscular	Antero-lateral aspect of left thigh
	Pnemococcal Conjugate Vaccine 3	0.5ml	intra muscular	Antero- lateral aspect of Right thigh
	OPV3	2 drops	Oral	Mouth
	IPV	0.5ml	Intramuscular	Antero- lateral aspect of Right thigh (2.5cm apart from PCV)
6 months	Vitamin A 1st dose	100,000 IU	Oral	Mouth
9months	Measles 1st dose	0.5ml	Subcutaneous	Left upper arm
	Yellow Fever	0.5ml	Subcutaneous	Right upper arm
	Meningitis Vaccine	0.5ml	Intramuscular	Antero- lateral aspect of Left thigh
15 months	Vitamin A 2nd dose	200,000 IU	Oral	Mouth
	Measles 2 dose (MCV2)	0.5ml	Subcutaneous	Left upper arm

**OPV0 must be given before the age of two weeks **Hep B at birth should be given preferably within 24 hours of birth but can be given up to 14 days of birth. BCG should be given within two weeks of birth and can be given up until 11 months.*

Figure 31.1: *National Immunization schedule*

CHAPTER 32: GROWTH MONITORING AND EARLY DEVELOPMENTAL ASSESSMENT

GROWTH MONITORING

DEFINITION

- Routine accurate measurement and documentation of weight, length and occipitofrontal circumference (OFC)

AIM

- To detect any abnormal growth patterns, including faltering growth

INTRODUCTION

- Growth monitoring in newborns is fundamental to their health and development. This is highly dependent on nutrition in early life.
- Involve parents/care givers with all growth monitoring procedures

WEIGHT

- Weigh all infants on admission to Neonatal unit (NNU)
- Weigh at least 3 times/week while on admission
- Plan weighing schedules taking into account developmental care needs

LENGTH

- Measure all infants on admission to NNU and weekly thereafter coinciding with a day on which weight is also measured.

OFC

- Measure on admission to NNU and weekly thereafter coinciding with a day on which weight is also measured

DOCUMENTATION

- Plot measurements of weight, length and OFC on appropriate and gender specific growth chart to allow assessment of adequate and proportionate growth
- For the preterms, start with the Fenton preterm growth charts (Appendix 31.2a and 31.2b) and then to the WHO infant growth charts.
- Plot duly as stipulated so that any faltering is detected early.
- At each visit, counsel the parents about care for child development. Figure 32.1 shows recommendations for care for child development (WHO/UNICEF).

Figure 32.1: *Recommendations for care for child development (WHO/UNICEF)*

Early developmental assessment

- Developmental assessments are used to get information about infants' characteristics and abilities either through direct measurement, such as test administration, or observations of developmental skills (crawling, walking).
- Standardized assessments are administered and scored using identical procedures for every child. Training in administration of assessments is critical, and sometimes required by assessment developers, so that the same procedures are followed for all children for consistency.
- The five stages of child development include: the newborn, infant, toddler, preschool and school-age stages. Children undergo various changes in terms of physical, speech, intellectual and cognitive development gradually until adolescence. Specific changes occur at specific ages of life.

Features of developmental delay

- Hasn't shown any improvement in head control.
- Doesn't seem to respond to loud sounds.
- Doesn't smile at people or the sound of your voice.
- Doesn't follow moving objects with his or her eyes.
- Doesn't notice his or her hands.
- Doesn't grasp and hold objects.

Bayley's Neurodevelopmental Assessment Scale

- This is an individually administered instrument whose primary purposes are to identify children with developmental delay and to provide information for intervention planning.
- The Bayley-III (Bayley Scales of Infant and Toddler Development ®, Third Edition (Bayley-III®)
- is a comprehensive test that assesses language, cognition, fine motor, and gross motor development and takes 30–90 mins to administer, depending on the age and ability level of the child.
- All preterms and high risk neonates need to be followed up for neurodevelopmental assessment every 3 months (3 months, 6mths, 9 mths, 12 mths). Premature birth is a major risk factor for developmental delays, which may result in a diagnosis of cerebral palsy (CP) at 18–24 months of age or cognitive deficits.
- Earlier and more frequent screening using a test of developmental skills could potentially address the well-documented delay in referral in all high risk newborns; and begin to change the orientation to prevention instead of post hoc treatment.
- The Bayley–III assesses the five key developmental domains of cognition, language, social-emotional, motor and adaptive behavior. Can be used from 0ne month to 42 months.
- Figure 32.2 shows a summarized version of the Bayley Chart showing parameters for assessment.

Bayley Scales of Infant Development

Age	Mental Items	Motor Items
1 month	Infant quiets when lifted.	Infant makes postural adjustment when lifted.
2 months	Infant glances between two objects over crib.	Infant hold head steady when carried.
5 months	Infant transfers object between hands.	Infants attempts to pick up object out of reach.
8 months	Development of object permanence.	Infant raises him/herself into sitting position.
12 months	Infant imitates words that are spoken.	When requested, infants stands up.
14 – 16 months	Infant builds tower with two blocks.	Infant walks alone with good coordination.

Figure 32.2: *Bayley's Scales of infant development*

CHAPTER 33: COMMUNICATION AND EMOTIONAL SUPPORT

Emergency situations are often very disturbing for everyone involved and evoke a range of emotions that can have significant consequences. The need for the baby, whether sick or small, to be in the unfamiliar environment of a health care facility is a stressful and emotional experience for the family, especially the mother.

In addition to the family's fear of the baby dying, they may have feelings of guilt, anger, and denial. They may also be anxious about the costs for such care.

GENERAL PRINCIPLES OF EFFECTIVE COMMUNICATION

At all times, when communicating with the mother and family:

- Treat the family with dignity and respect at all times
- Listen to the family's concerns and encourage them to ask questions and express their emotions.
- Use simple and clear language when giving the family information about the baby's condition, progress, and treatment, and ensure that the family understands what you have told them.
- If you do not speak a language the family understands, use a sensitive translator.
- Respect the family's right to privacy and confidentiality
- Respect the family's cultural beliefs and customs, and accommodate the family's needs as much as possible
- Ensure that the family understands any instructions, and, if possible, give written information to family members who can read
- Obtain informed consent before performing procedures, if possible.
- Be aware of your own emotions as a provider
    - Health care providers may also feel anger, guilt, sorrow, pain, and frustration
    - Showing emotion is not a weakness, but should never interfere with the provision of respectful, professional care

EFFECTIVE COMMUNICATION

Experience of quality care requires effective communication—a woman (along with her family if appropriate) should feel that she understands what is happening to her and her baby and what to expect, and know her/their rights.

Dignity and respectful care are an integral part of health care services. All women and family members should have access to the social and emotional support of their choice.

The WHO quality standard 4 requires that communication with women and their families is effective and responds to their needs and preferences.

- All women and their families receive information about the care and have effective interactions with staff
- All women and their families experience coordinated care, with clear, accurate information exchange between relevant health and social care professionals

CHAPTER 34: 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 motivated 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 organization of services at the health facilities so that staff are not able to easily provide care that they know is important

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.

Four steps to practice quality improvement at health facility level:

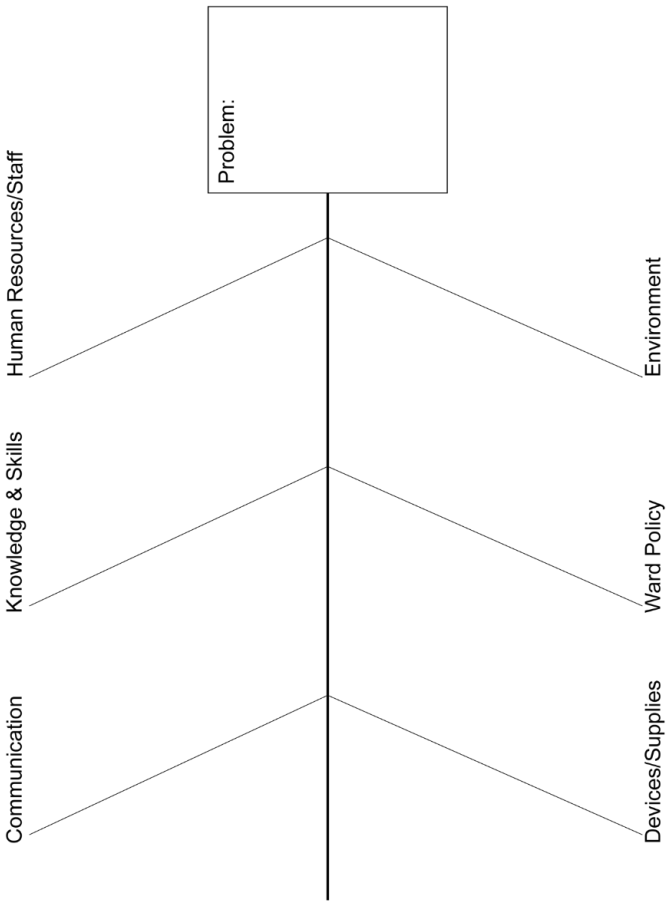
1) How to review data to identify problems
2) How to prioritize which problem to work on
3) How to form a team to work on that problem
4) How to write a clear aim statement

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 34.1)



b)--Five Whys Technique

One way to identify the root cause of a problem is to ask "Why?" five times. When a problem presents itself, ask "Why did this happen?" Then, don't stop at the answer to this first question. Ask "Why?" again and again 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 34.1: *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 plan 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 of 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 organization 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 a number of 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 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

    - The FMOH working with the stakeholders (@NEST360) are installing clinical skills laboratories in pilot facilities to facilitate pre-service trainings and build capacity for care of the small and sick newborns commencing with pilot facilities.

ON THE JOB UPDATES AND REFRESHERS

- To help ensure that providers have access to knowledge and skills updates is to make these updates 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 is held on-site so that participants may work part of the day or opt out during clinical emergencies; training schedules are therefore flexible.

One of the biggest advantages is minimal disruption to service delivery. Providers are not gone for days or weeks at a time in an already busy and short-staffed situation. A few examples of how on-site teaching and learning can take place follow.

- The low-dose, high frequency approach delivers clinical content during short simulation-based learning activities, spaced over time to optimize learning. It requires relatively little time out of a working day.
- Evening or night training sessions allow for staff on those shifts to benefit from training rather than adapting their work schedules to fit a daytime program. It is recognized, however, that there is often minimal staff in the later shifts, thus arrangements must be made for adequate staffing to ensure quality care whilst training is taking place.
- "On-call" sessions allow for brief training when clinical cases present themselves. Participants agreed to be on-call until and agreed-upon time in the late evening during the training week in case a laboring woman, sick newborn, or emergency situation presented.
- Peer chart review (review of patient's medical records/log books/forms)

- In this approach, an organized chart review is scheduled periodically and often implemented with a checklist or template to look for accuracy and completeness.
- It is done anonymously (i.e., identifying info of providers who completed the charts are not revealed) and not as a punitive measure, but used to see if documentation and record-keeping is according to standard and to help staff learn from any gaps or problems.
- Results of the review is usually presented in a group to discuss deficiencies anonymously and agree on how to address them.

- Case reviews
  - Team of providers discuss past cases to review management and learn approaches to clinical situations. Interesting cases from other institutions, the literature, or other countries may also be presented and discussed.
- "Near-miss" discussions
  - This is a form of case review and involves discussing 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 moving forward to improve care. It is also an opportunity to discuss any new evidence or guidance that may be relevant for this and future cases.
- 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 FMOH and the State MOHs have domiciled MPDSR and/or a QI teams in most tertiary and secondary facilities 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 Nigeria'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 QI teams and State QI Committees
in the States 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. Analyze results
4. Recommend solutions
5. Implement the recommendations
6. Evaluate and revise or refine the plan or recommendations

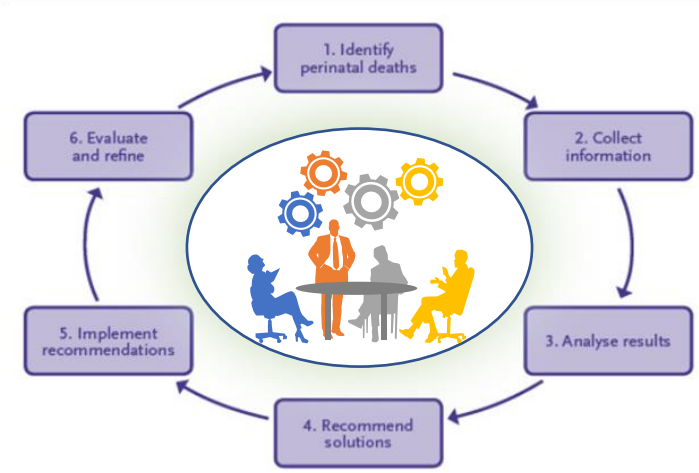


Figure 34.2: *Source: Making every baby count: audit and review of stillbirths and neonatal deaths, WHO*

WEB-BASED LEARNING

Computer and Wi-FI access is not common in most facilities, but some may have access for group use or in special situations such as organized training or seminars. There is a wealth of learning resources on the internet for virtually every clinical topic. Learners must ensure that the content source is reputable and reliable. Examples include but are not limited to:

- Videos – sites such as Osmosis (developed by doctors and medical students); Global Health Media and PedsCases.com offer tutorials, clinical overviews and step-by-step instruction on various clinical procedures.

- Global health sites such - as WHO, UNICEF, USAID, Save the Children, NEST 360 (Newborn Essential Solutions and Technologies), IHP, Jhpiego, Laerdal Global Health, national and international Neonatology/Paediatric/Nursing Professional Associations often offer information on relevant topics and links to literature.
- HINARI Program - set up by the WHO together with major journal publisher enables low and middle---income countries access to one of the largest collections of biomedical and health literature. Nearly 14,000 journals in 45 languages, more than 55,000 e---books and up to 120 other resources are available to health institutions in 115 countries and territories: http://www.who.int/hinari/en/
- BiliTool.org - is a website designed to help clinicians assess the risks toward the development of hyperbilirubinemia in newborns over 35 weeks gestational age. Required values include the age of the child in hours and the total bilirubin levels (in either mg/dl or µmol/L). The mobile platform is under development
- PediTools.org - the goal of this website is to provide medical calculators and links to references useful for the practicing pediatrician.

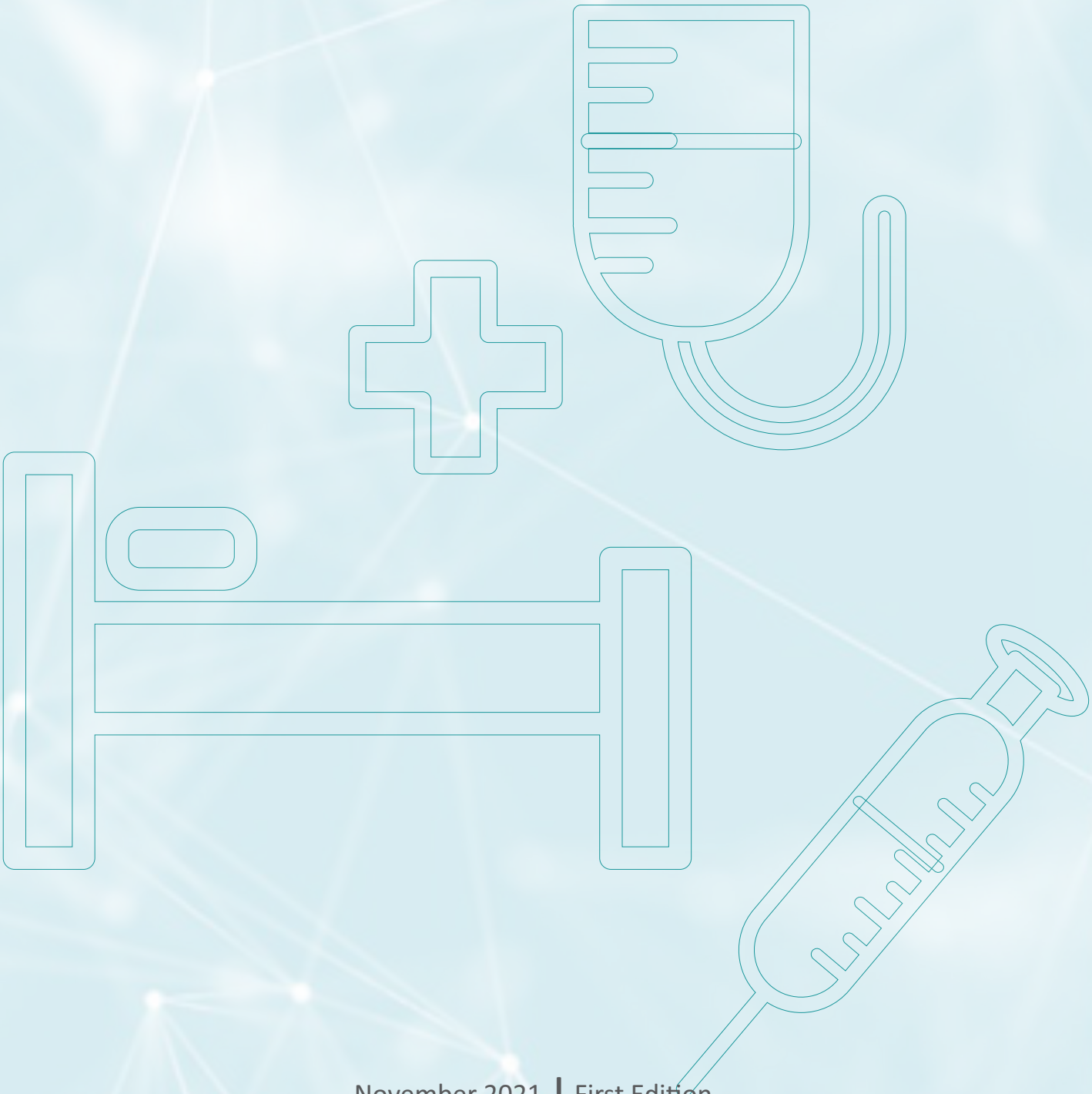
MOBILE APPS AND M-HEALTH

With the rapidly increasing use of smart---phones, numerous mobile apps have been developed to facilitate learning; offer support for clinical decision---making or simply communicate with peers and even parents.

- WhatsApp has been used to create discussion groups around a particular topic and to share information. Many teams in Nigeria use WhatsApp groups to keep each other updated and to organize training logistics.
- OMOMI is a health and social platform based on the WHO/UNICEF child survival strategies. It is designed for parents and helps them keep track of things like immunization dates. Through this app, parents can also get answers from their health providers.

National Guidelines
for Comprehensive Newborn Care

SECTION FIVE



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Appendix 3.1 shows the recommended National Essential Equipment List for all Levels of Newborn Care in Nigeria.

LIST OF MEDICAL DEVICES FOR NEONATAL HEALTHCARE SERVICE

		PRIMARY		SECONDARY		TERTIARY	
S/N	**CATEGORY OF SERVICE**	**NAME OF EQUIPMENT**	**CONSUMABLES**	**NAME OF EQUIPMENT**	**CONSUMABLES**	**NAME OF EQUIPMENT**	**CONSUMABLE S**
1	INFECTION PREVENTION, CONTROL AND MANAGEMENT	• Soap dispenser • Sanitizer dispensing unit • Disposable hand towel dispenser • Sterilizing unit • Dressing drums • Pedal Bins (for all waste categories)	• Liquid Soap • Sanitizer gel/liquids • Safety boxes (sharp containers) • Personal Protective Equipment (Face masks of different sizes, gloves etc) • Disposable paper towels/single use towels -Antiseptic solution (70-90% methylated spirit, Cetrimide, Chlorhexidine, Hibitane, povidone iodine) • Veronica bucket and plastic receptacle	• Soap dispenser • Sanitizer dispenser • Disposable hand towel dispenser • Sterilizers • Dressing drums • Pedal bin (for all categories of waste)	• Soap • Sanitizers gels/ liquid • Safety boxes (sharp containers) • Personal Protective Equipment (Cap, Face masks of different sizes, gloves etc) • Disposable paper towels • Anitseptic solutions (Methylated spirit 70-90%, Cetrimide, Hibitane) Sodium Hypochlorite	• Soap dispenser • Sanitizer dispenser • Disposable hand towel dispenser • Sterilizers • Dressing drums	• Soap • Hand Sanitizers • Safety boxes (sharp containers) • Personal Protective Equipment (Face masks of different sizes, gloves etc) • Disposable paper towels • Antiseptic solutions (Methylated spirit 70-90%, Cetrimide, Hibitane) Sodium Hypochlorite
2	NEONATAL RESUSCITATION AND RESPIRATORY MANAGEMENT	• Neonatal resuscitaire (with Overhead heater) • Bag mask valve devices (≥2) with 2	• Feeding tube, sizes 4, 5, 6, 8,10,12 • Oxygen	• *Oxygen concentrators* • Oxygen Cylinder with carrier, gauge & Flow meter • *Suction Machine*	• Neonatal Air Ways (Size 0, 00 and 000) • Oxygen Splitter	• *Oxygen concentrator* • Oxygen Cylinder with carrier, gauge & Flow meter • *Suction Machine*	• Neonatal Air Ways • Endo Tracheal Tubes (sizes 2.0, 2.5, 3.0 and

	DELIVERY – ROOM CARE	preterm and term babies face mask sizes • T-piece Resuscitator • Penguin suction, or single use Bulb syringe (sizes – 1, 2 ,5mls) • Baby Cots (Perspex) • *Radiant Warmers* • Pulse oximeters • Neonatalie • Oxygen concentrators • Oxygen splitters	tube • Cord clamps	*(Manual & Electric)* • Neonatal Resuscitaire (with Overhead warmer and Clock timer) • Transport Incubator • *Continuous Positive Airway Pressure machines (CPAP)- Bubble CPAP* • High flow nasal cannula • Endo Tracheal Tubes, introducers • *Radiant Warmers* • *Pulse Oximeters* • Sussex Resuscitator Kits • Apnoea Monitors • Multiparameter Monitors • Stethoscope – Neonatal • Bag mask Valve devices • Laryngoscope with 2 straight bladed of sizes 0 and 1 (with spare batteries and bulbs) • Head Box/ DDA Box • Neonatal Ventilator (For specialist centres) • Y connector • Humidifier Defibrillator	• Endo Tracheal Tubes (sizes 2.0, 2.5, 3.0 and 3.5mm) • Bulb Syringe (Sizes 1, 2, 5mls) • Towels • Blankets • Nasal prongs of various sizes • Facial masks of different sizes • Penguin suction	*(Manual & Electric)* • Neonatal Resuscitaire (with Overhead Warmer, Piped Oxygen, Manometer and Clock timer) • Transport Incubator • T-piece resuscitator (Neopuff) • *Continuous Positive Airway Pressure machines (CPAP)* • *Radiant Warmers* • *Pulse Oximeter* • Sussex Resuscitator Kits (Pre-term, Infant and child sizes of face mask) • Apnoea Monitors • Multi parameter Monitors • Stethoscope – Neonatal • Bag and mask device • Laryngoscope with blades of appropriate size • Head Box • Neonatal Ventilator • Arterial Blood Gas Analyser • Y connector • Humidifier Defibrillator	3.5mm) • Introducers • Penguin Suction Bulb Syringe (Sizes 1, 2, 5mls) • Towels • Blankets • Nasal prongs of various sizes • Facial masks of different sizes
3	JAUNDICE AND MANAGEMENT OF OTHER COMPLICATIONS	• Transcutaneous bilirubinometer • Icterometer • Bili sticks Point of care Bilirubinometer	• Swab sticks • Lancets • Capillary tube • Blood Sample containers	• Bilirubinometer • Transcutaneous bilirubin meter • *Phototherapy Machine best with LED/blue phototherapy lamps* • Irradiance meter • Exchange Blood	Eye mask	• Newborn Screening Variant (NBS) Machine • Bilirubinometer • *Phototherapy Machine best with LED/blue phototherapy lamps* • Irradiance meter • Exchange Blood	• Eye mask

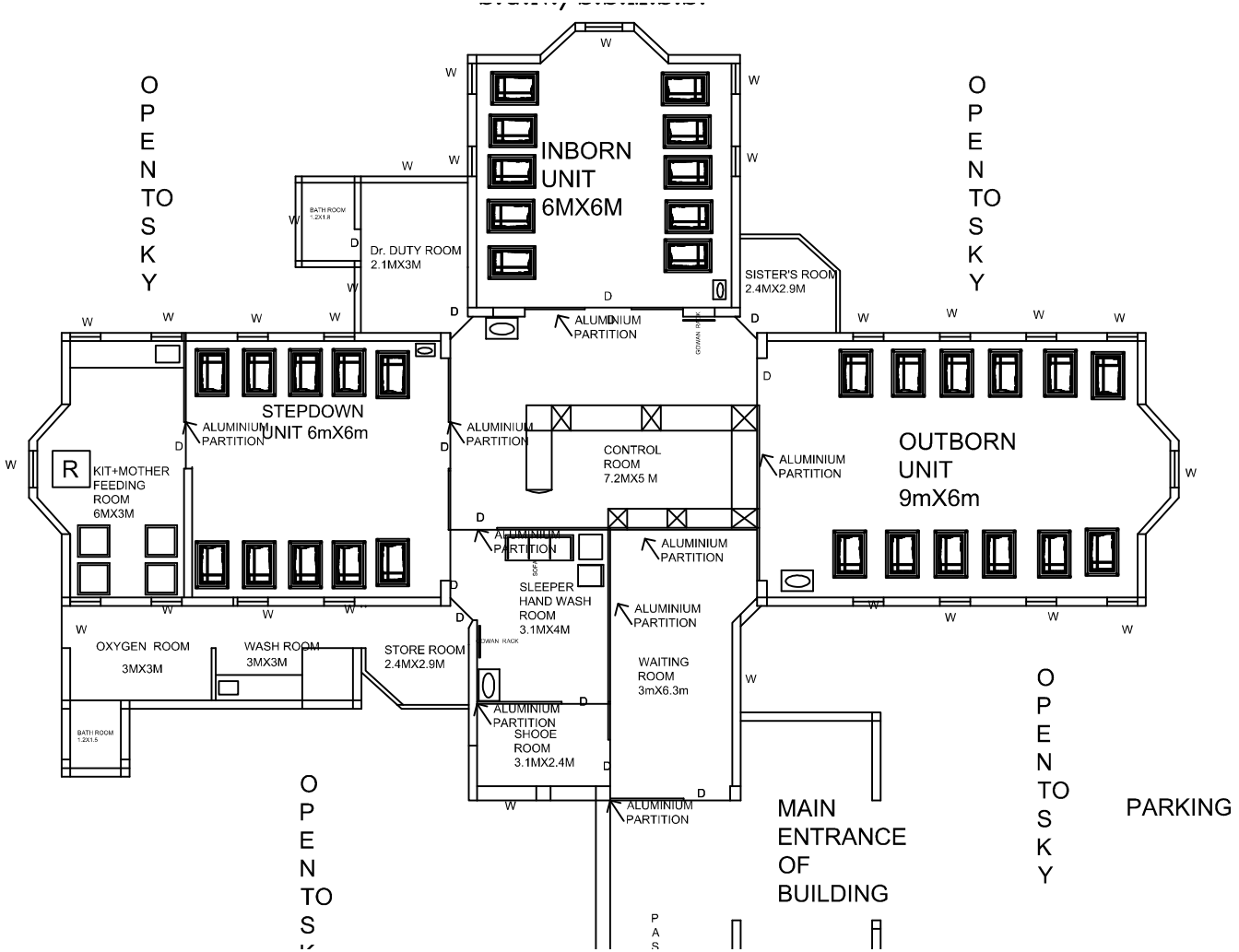
				Transfusion Kit • 3 way taps • Crucifix/ restraint • Point of care bilirubin estimator Bili blanket		Transfusion Kit • 3 way taps • Crucifix • Bili blanket	
4	NEONATAL NUTRITION	• Nasogastric tube (Sizes -5, 6, 8 and 10) • Infantometer with weighing scale (5kg) Infant weighing scale	• Feeding Utensils • Nifty cup • Feeding Cups Storage cups with cover	• Breast pumps • Refrigerator (Dedicated to breast milk storage) • Nasogastric tubes (Sizes 5, 6, 8 and 10) • Beam Type Weighing Scale • Digital Type Weighing Scale • Infantometer • Syringe pumps and drivers • Infusion pumps	• Feeding utensils • Cups • Nifty cups • Intravenous fluid and giving set • Soluset • IVF regulator • Feeding tube • IV Cannula • UVC/A Catheters • PICC catheters Amino acid infusion	• Breast pumps • Human breast milk bank support (autoclave, freezer and fridge) • Breast milk fridge • Nasogastric tubes • Beam Type Weighing Scale • Digital Type Weighing Scale • Infantometer Sterilizing tank for EBM containers	• Feeding utensils • Cups for EBM • Nifty cups • Cups for feeding • Cup with cover for milk storage Amino acid infusion
5	CARE OF PRETERM	• Portable Transport incubator/Supportive care of the preterm (KMC Unit/ bay,corner)	• Disposable incubator linen • KMC wraps,Chairs,wrapper etc refer to KMC operational guidelines	• Low Reading Thermometer • Neonatal Incubators • Baby Cots (Perspex) • KMC unit,bay,	• CPAP Accessories • ref Kmc guideline	• Low Reading Thermometer • Neonatal Incubators • KMC unit,bay, corner	• CPAP Accessories • Plastic resealable bags(zipper storage bags) /wrap Refer to KMC guidelines
6	OTHER ESSENTIAL EQUIPMENT	• Oxygen cylinder with carrier, gauge and flow meter • *Glucometer with test strips* • *Suction machine* • Pediatric cot and mattresses • Solar based	• Neonatal Register • Identification Tags • Measuring Tapes • Aprons • Disposable Latex	• Paediatric Cots & Mattress • Electronic BP monitors • Paediatric Sphygmomanometers with neonatal cuffs • Clinical Thermometer (Digital & Manual) • Multi-parameter	• Neonatal Registers • Identification Tags • Micro Solusets • Boots & Slippers • Measuring	• Paediatric Cots & Mattress • Baby Crib • Cot sheet /linen • Mosquito nets • Electronic BP monitors • Paediatric Sphygmomanometers with neonatal cuffs.	• Micro Solusets • Neonatal Registers • Identification Tags • Boots & Slippers • Measuring Tapes • Aprons • Foley's catheter

		Sterilizers • Paediatric sphygnomanometer with neonatal cuffs (Digital Automatic BP monitor) • Room thermometer (digital and manual) • Neonatal stethoscope • Gallipots • Kidney dishes • Chart holders • Electric kettle • Dressing Instruments • Sterilizing drums • Color TV set • Toys • Drip stand • Trolleys • Mosquito nets (LLIN) • Medication trolleys • Automatic/Electric/ Battery lamps • Solar rechargeable lamps • Dressing drums • Pediatric nasal prongs • Low reading thermometer • Refrigerator (electrical, solar) • Weighing scale (analog and digital) • Room heaters • Diagnostic sets • Cot sheet/ linen	Gloves • Face masks (Pre-term, Infant and Child sizes) • Suction Catheters (Size 5, 6, 8,10) • Needles and Syringes (Sizes 1, 2 5 and 10mls) • Cannular (21G, 23G) • Capillary tubes • Giving Sets • Test kits • Reagents • Glass Slides and cover slips • Laboratory Glasswares • Sample Tubes • Urinary Dipsticks • Capillary tubes • Needle and Lancets • Tourniquet • Filter paper • DBS Cards • Liquid soap and disinfectant • Pasteur pipette /	Monitors • Pulse oximeters • Infusion Pumps • *Infusion/ Syringe pumps* • Portable ECG (single or triple channel) machine • Portable EEG with provisions for auditory evoked brain stem measurement • Ultrasound Machine with appropriate probes • Ultrasonic cleaners • Sonic aid • Mobile X-Ray Machine • X-Ray Light Viewer • Mobile Echo Cardiography Machine • Angle Poised Lamps • Nebulizer • Blood giving set/Hemaset/Pediatric Blood bags • Refrigerator • Electric Kettle • Dressing Instruments • Galli pots • Kidney dishes • Autoclave • Drip Stand • Trolleys • Medication Trolleys • Room Heaters • Automatic Electric/ Battery Lamp/ Rechargeable lamps • Chart Holders • Sterilizing units • Placenta dish • *Glucometer with Test*	Tapes • Aprons • Foley's catheter • French feeding tubes • Umbilical catheters • Blood giving set • Blood bags-50,100,200ml • IV Giving set • Cut-down sets • Cannulas (23G) • Syringes • Plaster (3M,zinc oxide) • Cord clamps • Specimen bottles • Petri dish • Antibiotics sensitivity disc • Swab sticks • Stains and Reagents • DBS cards and test kits • Blood Culture bottles • Glass wares • Microplates • Pipette tips • ESR stand and tubes • Vacutainers • Sample tubes	• Clinical Thermometer (Digital & Manual) • Multi-parameter Monitors • Infusion Pump • *Infusion Syringe pumps* • Portable ECG (single or triple channel) machine • Portable EEG with provisions for auditory evoked brain stem measurement. • Ultrasound Machine with appropriate probes • Ultrasonic cleaners • Sonic aid Pulse oximeters • Mobile X-Ray Machine • X-Ray Light Viewer • Mobile Echo Cardiography Machine • Angle Poised Lamps • Nebulizer • Haematocrit reader • Haematocrit Centrifuge • Blood giving set/Hemaset/Pediatric and Neonatal Blood bags • Refrigerator • Electric Kettle • Dressing Instruments • Galli pots • Kidney dishes • Autoclave • Drip Stand • Trolleys • Medication Trolleys • Room Heaters	• French feeding tubes • Umbilical catheters • Blood giving set • Neonatal Blood bags (50,100,150,200 mls) • IV Giving set • Cut down Set • Cannulas (21, 23G) • Syringes • Plaster • Adhesive tapes • Cord clamps • Bio-hazard waste bags • Specimen bottles (1,2,5ml) • Petri dish • Antibiotics sensitivity disc • Swab sticks • Stains and Reagents • DBS cards and test kits • Blood Culture bottles • Glass wares • Surfactant Point-of-care (ISTAT) cartridge

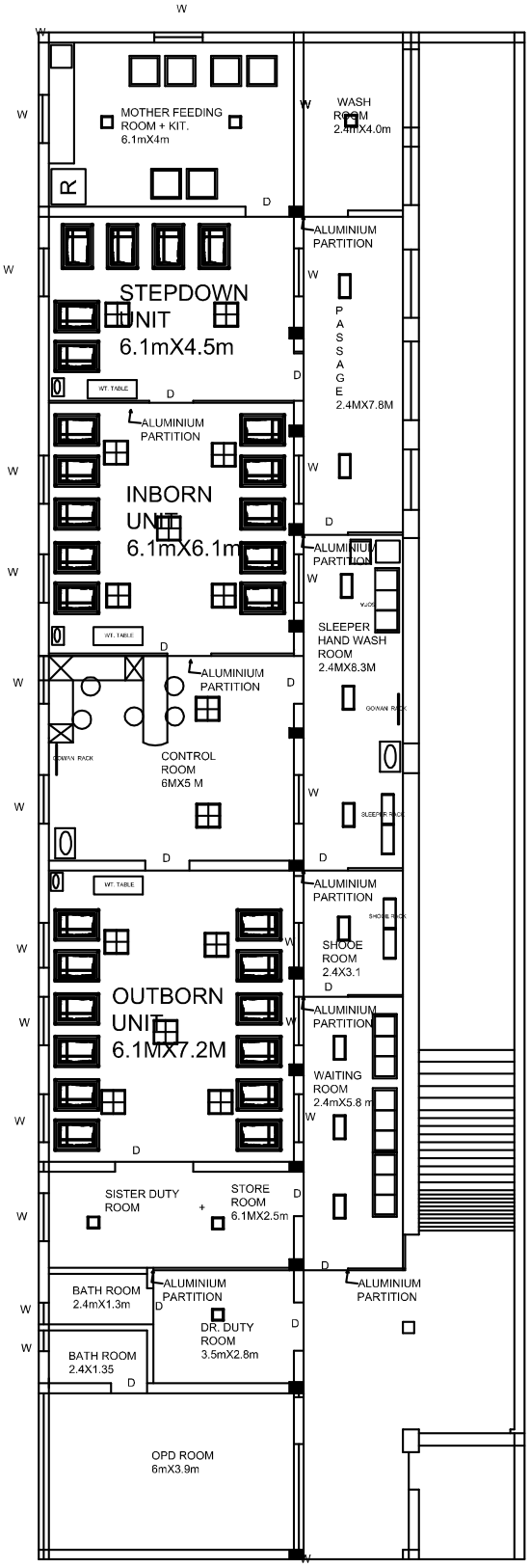
		• Vital signs monitor • Sonic Aid • Digital Baby/Toddler scale • Autoclaves • Angle poised lamps • *Pulse oximeters* • Cord clamps/ligatures/cord pack • Vaccine carrier/Cold box • Kerosene stove • Solar Power Pack • Haematocrit Centrifuge and reader • Haemoglobinometer • Centrifuge • Electrical binocular Microscopy • Hot air Oven / plate • Autoclave • Incubators at 80 • Water bath • Staining rack • Bunsen burner • Refrigerator (2- 8/ -20) /Cold Box • Thermometers (room, refrigerator, incubators) Ambulance	single auto pipette • Swab sticks Lancets	*Strips* • Colour TV set • Toys • Room thermometers • Diagnostic sets • Lumber puncture set • Vital signs monitor • Apnoea Alarm mattresses • Vaccine Carriers/Cold box • Binocular Microscope with slides • Chemistry Analyser • Haematology Analyser • Microbiological Analyser • Microbiological Incubators • Haematocrit Centrifuge / reader • Refrigerator -20^0 Freezer • Blood bank • Water bath • Hot air oven • Flow cytometry Machines • Spectrophotometer • Colorimeter • ELISA machine / EQUIPMENT SET • Autoclaves • Test tubes racks • Bunsen Burner • Auto- pipettes (single and multi channels) • Staining Racks • Slide standing racks and slide boxes • Bio-safety Cabinet (depending on class: 2	• Cot sheet /linen • Mosquito net	• Automatic Electric/ Battery Lamp/ Rechargeable lamps • Chart Holders • Sterilizing units • Placenta dish • Stoves • Glucometer with Test Strips - • Colour TV set • Toys • Blood warming device • Room thermometers • Diagnostic sets • Lumber puncture set • Vital signs monitor • Apnoea Alarm mattresses • Vaccine Carriers/Cold box • Needle destroyer • Bio-Hazard waste bins • Binocular Microscope with slides • Chemistry Analyser • Haematology Analyser • Microbiological Incubators • Haematocrit Centrifuge / reader • Refrigerator -20^0 Freezer • Blood bank • Water bath • Hot air oven • Flow cytometry Machines • Spectrophotometer • Colorimeter • ELISA machine / EQUIPMENT SET • Autoclaves	

				or enhanced 2 or 3) • Ceramic Sinks and Marble benchtop • Water distiller or deionizer • PCR suites • Electrical Binocular Microscopy • Fluorescence Microscopy (LED) • Refrigerated Centrifuge • Incubator CO2 • Water bath • Electronic Balance • Thermometers (Room, Refrigerator, Freezer, Incubators) Vein finder		• Test tubes racks • Bunsen Burner • Auto- pipettes (single and multi-channels) • Staining Racks • Slide standing racks and slide boxes • Bio-safety Cabinet (depending on class: 2 or enhanced 2 or 3) • Ceramic Sinks and Marble benchtop • Water distiller or deionizer • PCR suites • Electrical Binocular Microscopy • Fluorescence Microscopy (LED) • Refrigerated Centrifuge • Incubator CO2 • Waterbath • Electronic Weighing Balance • Thermometers (Room, Refrigerator, Freezer, Incubators) • Bio-safety Cabinet • Ceramic Sinks and Marble benchtops Point-of-care blood gas analyser-(ISTAT)	

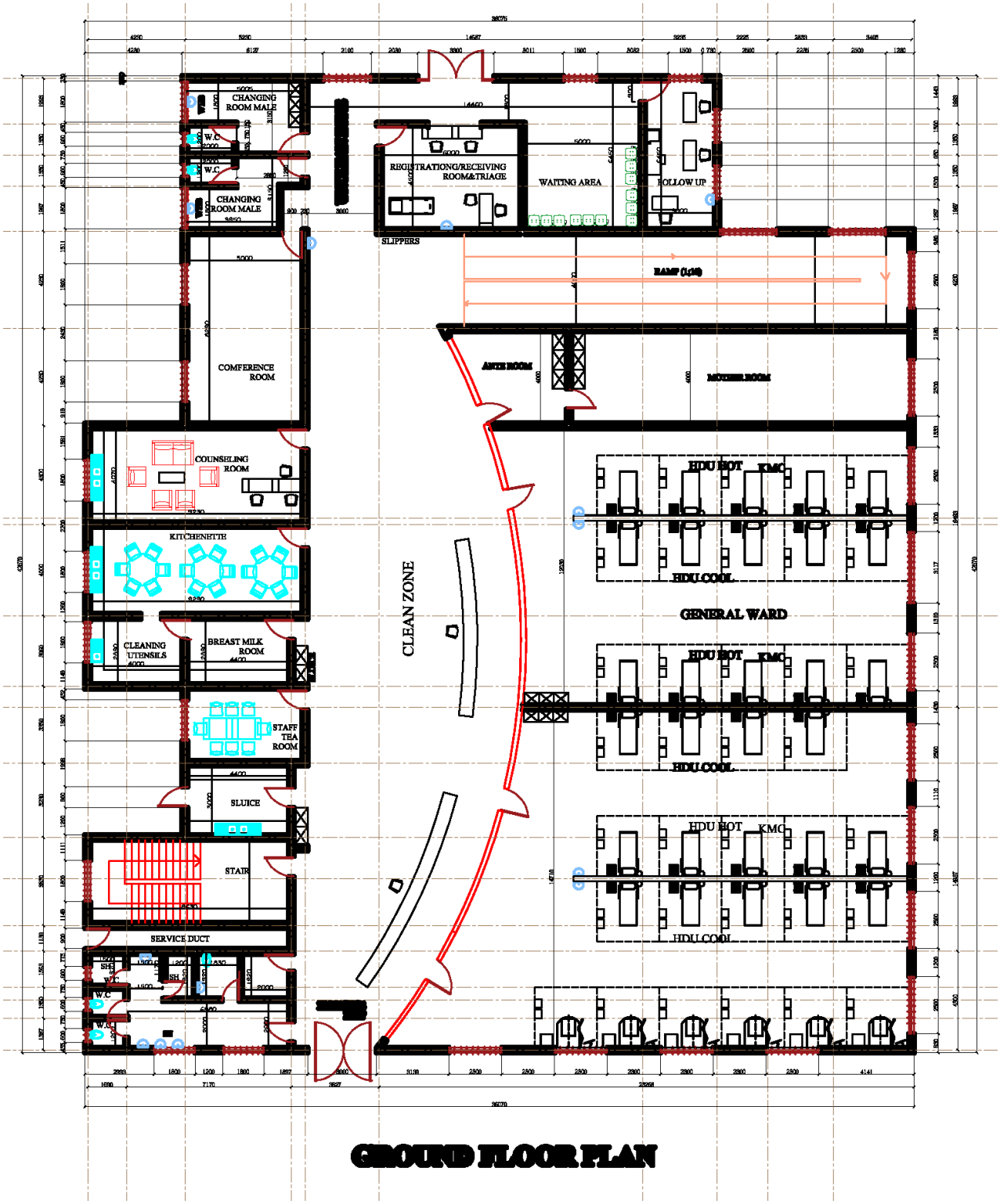
Appendix 3.2: *Sample floor plan A of a Level 2 General Hospital newborn unit depicting inborn and outborn sections (India – Murar Model)*



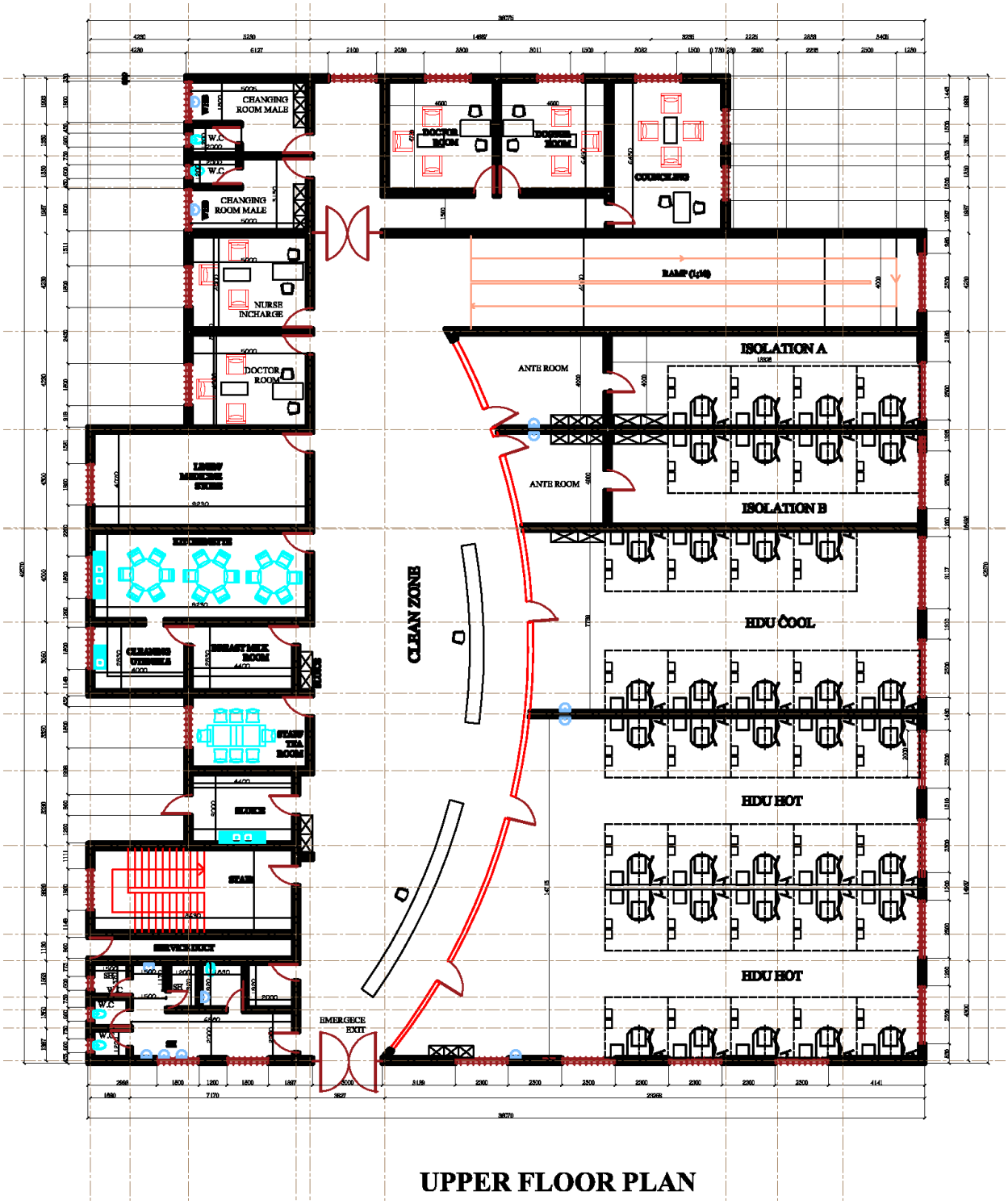
Appendix 3.3: Sample floor plan B of a Level 2 General Hospital newborn unit depicting inborn and outborn sections (India Shahdol Model)



Appendix 3.4: Shows sample Ground Level floor plan for a level 3 tertiary facility neonatal unit.



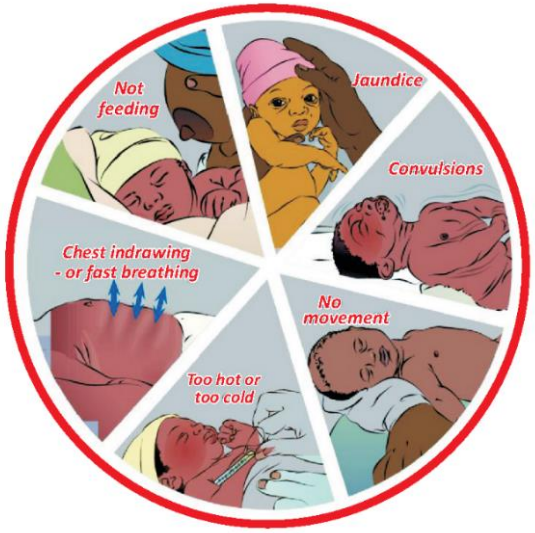
Appendix 3.5: Shows sample Upper Level floor plan for a level 3 tertiary facility neonatal unit.



Appendix 5.1: *National Pictorial Newborn Discharge Guide Information Leaflet for basic instructions*

Danger Signs

Seek Health Care Immediately!



Five things to do for baby: wash hands, feed only breast milk, apply chlorhexidine 4% gel to cord, give immunizations and go within 3 - 5 days after birth to the health center for jaundice check and general check up.

Adapted from the American Academy of Pediatrics

Sponsored by the Nigerian Society of Neonatal Medicine
Supported by Healthcare Trends
June 2016

NEWBORN DISCHARGE GUIDE

Help your baby survive

NOTES

Baby's name _____
Date of birth _____
Sex _____
Birth weight _____
Health facility _____
Health worker contact _____
Date of next appointment _____
Other notes _____

OBSERVATIONS & ADVICE

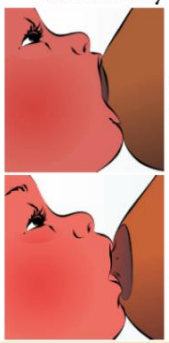
FEDERAL MINISTRY OF HEALTH

Help My Pikin

ESSENTIAL CARE

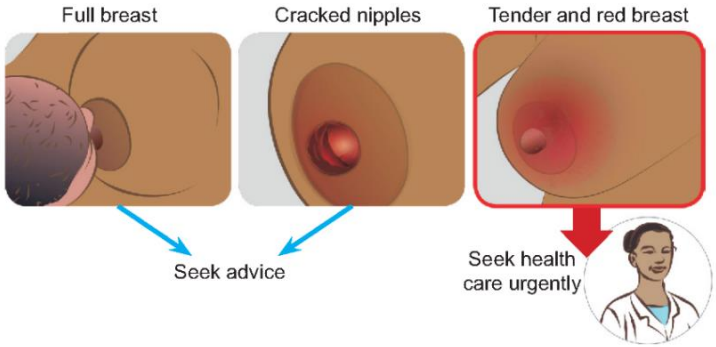
Feed only breast milk starting within 30 minutes of birth

Position baby well

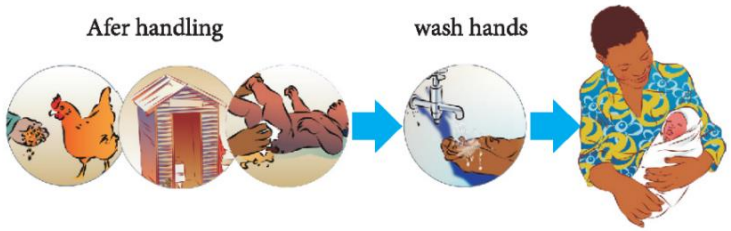


For a small baby, put skin to skin with mother to keep warm (Kangaroo Mother Care)

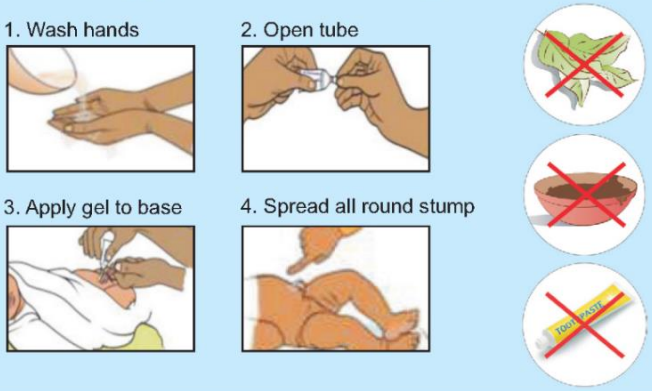
Manage common breast problems



TO PREVENT INFECTIONS



Apply ONLY 4% Chlorhexidine gel to cord daily



HAVE YOUR BABY IMMUNIZED

Age	*Vaccine*
Birth	BCG/OPV/HepB 0
6 Weeks	OPV1/PCV1/Rota1/Penta1 (HIB/DPT/HepB)
10 Weeks	OPV2/PCV2/Rota2/Penta2 (HIB/DPT/HepB)
14 Weeks	OPV3/PCV3/IPV/Penta3 (HIB/DPT/HepB)
6 Months	Vit A 1st dose
9 Months	Measles/Yellow Fever
12 Months	Vit A 2nd dose

Appendix 6.1: Newborn Normal Blood Pressure Centile Chart

Gestational age (week)	BP %	SBP (mmHg)	DBP (mmHg)	MAP (mmHg)
26-28	50th	55-60	30-38	38-45
	95th	72-75	50-50	57-58
	99th	77-80	54-56	63-63
30-32	50th	65-68	40-40	48-48
	95th	80-83	55-55	63-64
	99th	85-88	60-60	68-69
34-36	50th	70-72	40-50	50-57
	95th	85-87	55-65	65-72
	99th	90-92	60-70	70-71
38-40	50th	77-80	50-50	59-60
	95th	92-95	65-65	74-75
	99th	97-100	70-70	79-80
42-44	50th	85-88	50-50	62-63
	95th	98-105	65-68	76-80
	99th	102-110	70-73	81-85

Appendix 6.2: *Sample newborn examination record*

EXAMINATION OF THE NEW-BORN

Relevant history: Family/Ante-natal/Intrapartum: _____

_____

_____

HC (at time of exam): _____ BCG: given/not given

Baby's Blood Group: _____ DCT: _____

Feeding: _____ Konakion: given/not given — oral/intra muscular

	Comments		Comments
Skin		Upper Limbs	
Jaundice		Lower Limbs	
Skull		Spine	
Neck		Anus	
Face		Hips	
Eyes		Muscle Tone	
Palate/Lip		Moro Reflex	
Chest Movement		**Genitalia:–**	
Femorals		Penis	
Heart Sounds		Testes	
Abdomen		Vulva	
Umbilicus			

Meconium passed: Yes/No Urine passed: Yes/no

Abnormality or suspected abnormality: _____

_____

General Condition of baby and any other comments: _____

_____

_____

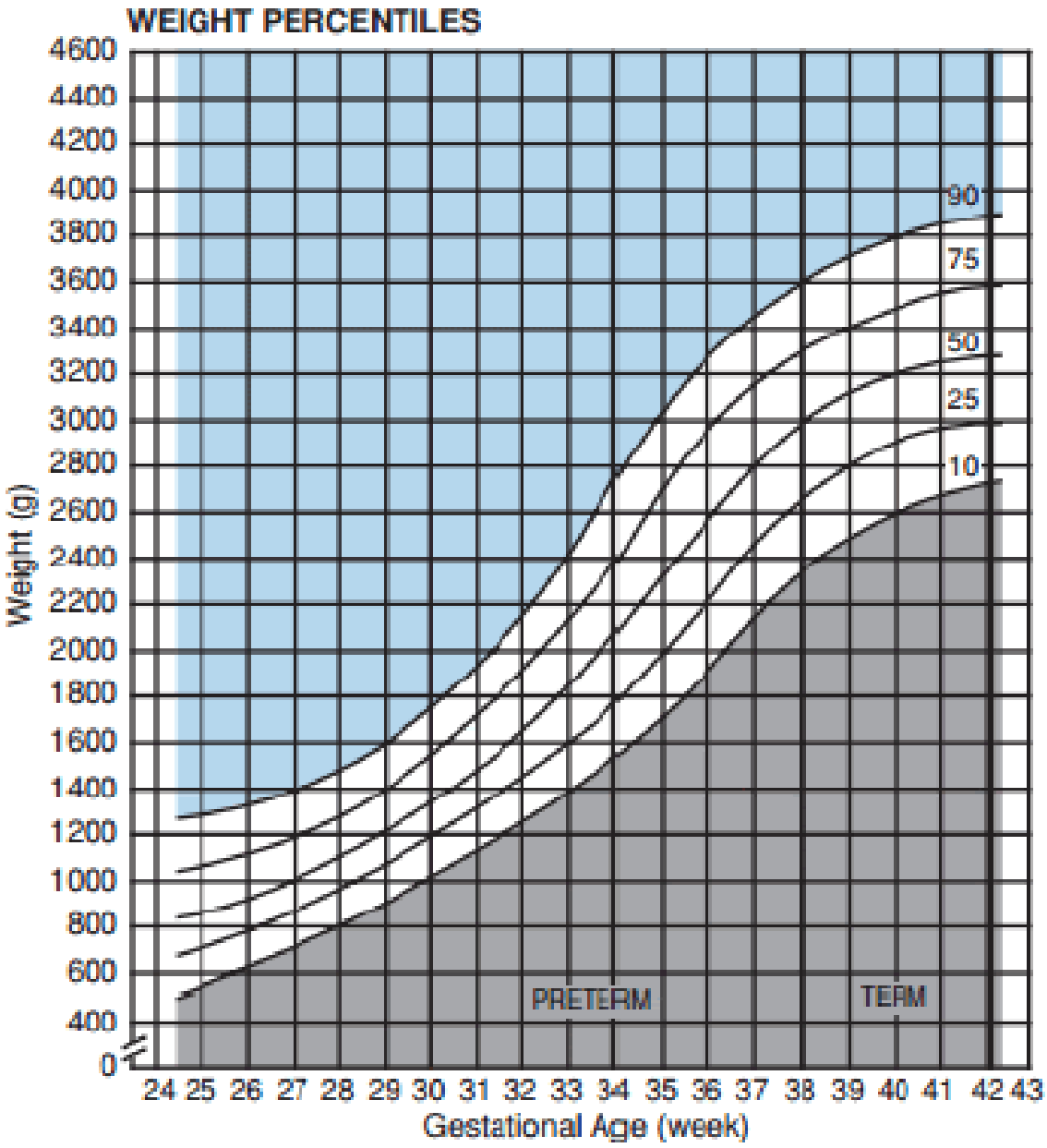
Fit for discharge: Yes/No **Follow-Up: Yes/No**

Date and time of examination: _____

Name and status of examiner: _____

Signature: _____

Appendix 6.3: *Lubchenco Chart (Weight/Gestational age) Centiles*



Appendix 6.4a and b: *Template newborn admission record forms*

Neonatal Registry Vital Data Collection Sheet

Admitting Dr._____ Admit Date (d/m/y) ___/___/___ Admit. time _____ Hospital #_____ Study#_____

Infants Demographics: Name_____	Sex: ☐ Female ☐Male ☐Ambiguous	DOB(d/m/y) ___/___/___ Birth Time _____

Parents Demographics: Maternal Age: _____ Paternal Age:_____

Gravidity:_____Parity:_____ # Alive: _____	Mat. Occupation: _____ Pat. Occupation: _____	Mat. Edu:_____ Pat. Edu:_____

Conception: ☐Natural ☐Assisted (☐IVF, ☐IUI). Maternal Outcome: ☐Alive ☐Died

Pregnancy and Birth History

GA _____ weeks, ___ Days Determined by ☐LMP ☐1st ☐2nd or 3rd Trim USS ☐Ballard exam ☐ Unknown	Birth Location: ☐Inborn Out-born: ☐Facility ☐Home Name of outborn hospital_____ Delivery taken by: ☐Obstetrician ☐ "Other"Medical doctor ☐ Nurse ☐Midwife ☐Other health care personnel ☐Non-medical attendant Transfer hospital different from birth hospital? ☐Yes ☐ No Specify if yes_____	Birth weight (g) _____ Birth Length (cm)_____ Birth OFC (cm)_____ Birth parameters Unknown ☐ Admit weight_____ Admit length (cm)_____ Admit OFC (cm)_____

Antenatal Care: ☐Yes ☐No. ANC at different hospital ☐Yes ☐No. If yes, specify_____	Received ☐Prenatal vitamin ☐Haematinics ☐Tetanus Toxoid ☐Malaria Prophylaxis	First ANC visit at _____ (weeks): Total # of visits: _____

Mode of Delivery: ☐NSVD ☐VD+ Forceps ☐VD+ Vacuum ☐Elective CS ☐Emergency CS
Specify Indication for CS: _____

Type of Labor: ☐ Spontaneous ☐Induced. Indication for induction_____
Duration of labor: _____ (hrs). Rupture of Membrane: ☐Spontaneous ☐Artificial. Duration (hours)___Liquor: ☐ Clear ☐ Meconium☐ Bloody ☐Foul smelling

Received Prenatal Steroids: ☐Yes ☐No. If yes which: ☐Dexamethasone: Total # of Doses_____ ☐Bethamethasone: Total # of Doses _____	Pregnancy conditions: ☐HIV ☐UTI ☐DM ☐GDM ☐PIH ☐Malaria ☐Chronic Hypertension ☐Placental previa ☐Abruption ☐Sickle cell ☐Preeclampsia ☐APH ☐Chorio ☐Uterine Rupture ☐PPROM Other specify_____

APGARs: 1min____, 5 min____, 10 min _____
Resuscitative measures: ☐ Dry & stimulation ☐Bag mask ☐ Intubation ☐Chest Compression ☐Adrenaline ☐Blood/IVF

Hospital Problem: Prematurity

Downs Respiratory Distress Scoring System

Respiratory Rate	Retractions	Cyanosis	Grunting	Air entry
☐<60 cycles/min	☐None	☐Absent	☐None	☐Good
☐60-80 cycles/min	☐Minimal	☐Relieved with O_2	☐Only on auscultation	☐Diminished
☐>80 cycles/min	☐Marked	☐Not relieved with O_2	☐Without auscultation	☐Absent

Temperature on admission_____ Use of Kangaroo mother care : ☐Yes ☐No
Admission SpO2: _____ Highest Respiratory Support: ☐Nasal cannula ☐ High flow nasal cannula ☐CPAP ☐ Ventilator

Date respiratory support started (d/m/y) _____/_____/_____ Date all respiratory support ended(d/m/y) ___/____/_____

Surfactant use: ☐Yes ☐No. If Yes, # of doses___
Post-natal steroid ☐Yes ☐No. If yes which, ☐Hydrocortisone ☐Dexamethasone. If yes, total number of doses_____
Diagnosis of: ☐IVH. If yes, what grade ☐0, ☐1, ☐2,☐3, ☐4 ☐ ☐NEC. If yes, stage ☐0, ☐1, ☐2, ☐3
☐PDA / Diagnosed by ☐ Physical Exam ☐Echo / Haemodynamically significant ☐Yes ☐No / Treated ☐Yes ☐No
☐Spontaneous closure ☐Acetaminophen ☐Ibuprofen ☐Indomethacin / Screened for ROP ☐Yes ☐No.

Week 1 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)	Week 7 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)
Week 2 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)	Week 8 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)
Week 3 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)	Week 9 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)
Week 4 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)	Week 10 Wt_____,Lt_____,OFC____Date(d___/m___/y___)
Week 5 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)	Week 11 Wt_____,Lt_____,OFC____Date(d___/m___/y___)
Week 6 Wt_____,Lt_____,OFC_____Date(d___/m___/y___)	Week 11 Wt_____,Lt_____,OFC____Date(d___/m___/y___)

Hospital Problem: Asphyxia:
Precipitating factors: ☐Prolonged labor ☐Obstructed Labor ☐CPD ☐Eclampsia ☐Meconium aspiration ☐Cord Prolapse ☐Uterine Rupture , Other (specify): _____

Sarnat & Sarnat Score

Consciousness	Spontaneous Activity	Tone	Posture	Primitive Reflexes	Pupillary Reflex
☐Normal	☐Normal	☐Normal	☐Normal	☐Present	☐Normal
☐Lethargic	☐Decreased	☐Hypotonia	☐Distal flexion/complete extension	☐Diminished	☐Constricted
☐Stupor/Coma	☐No Activity	☐Hypertonia	☐Decerebrate	☐Absent	☐Non-reactive

Presence of seizures ☐Yes ☐No. If yes, date Seizure noted(d/m/y) _____/_____/_____

Hospital Problem Hyperbilirubinemia: Likely cause: ☐Sepsis ☐ABO ☐Rh ☐Dehydration ☐G6PD ☐Physiologic
Other Specify_____ If G6PD, specify trigger_____

BIND SUCK	BIND CRY	BIND TONE	BIND MENTAL STATE	Seizures ☐Yes ☐No
☐Normal ☐Weak ☐Absent	☐Normal ☐High pitched ☐Shrill, very high pitched ☐Shrill/Inconsolable	☐Normal ☐Mild Hypotonia ☐Moderate hypo/hypertonia ☐Severe hypo/hypertonia, bicycling/opisthotonus	☐Normal ☐Sleepy, difficult to wake for feed ☐Lethargy, poor feeding ☐Semi-coma, apnea, seizure	Degree of bilirubin encephalopathy: ☐Mild ☐Moderate ☐Severe ☐No encephalopathy

Infants blood group: _____ Mat blood group: _____ Admission Bilirubin _____ Highest Bili _____ Bili at discharge _____

Phototherapy ☐Yes ☐No. Exchange blood transfusion ☐Yes ☐No, if yes how many_____

Hospital Problem Sepsis: Admitted on ABX ☐Yes ☐No Start Date____/_____/_____ End Date____/_____/_____
Specify ABX_____

Sepsis evaluation ☐Yes ☐No. If Yes, date antibiotics were started____/____/____ Time ABX was started ____/_____.

Antibiotics indication: ☐Maternal condition (eg. Chorio) ☐Local infection ☐Abnormal physical exam ☐Hypoglycemia ☐Elevated Inflammatory markers ☐ Probable Sepsis/ Risk for sepsis ☐ other
Specify other indication:_____

Culture drawn before antibiotics given ☐Yes ☐No. Date/Time culture drawn _____/_____/_____ and _____ am/pm
Culture Source ☐Blood ☐Urine ☐Swab ☐CSF Culture positive ☐Yes ☐No: If yes from ☐Blood ☐Urine ☐Swab ☐CSF
Organism_____
Positive Malaria Test/smear: ☐Yes ☐No. Falciparum noted ☐Yes ☐No. if yes, treatment_____

Antibiotic usage
1._____Start date___/___/___ Stop date___/___/___ 2_____Start date___/___/___ Stop date___/___/___
3_____ Start date___/___/___ Stop date___/___/___4_____Start date___/___/___ Stop date___/___/___
5_____Start date___/___/___ Stop date___/___/___

Hospital Problem: Surgical Diagnosis_____Surgery performed: ☐Yes☐ No

Hospital Outcome: ☐Discharged Home ☐DAMA ☐Died ☐Transferred to another facility. Date _____/_____/_____
Weight at discharge: _____(cm), Length at discharge: _____(cm) , OFC at discharge: _____(cm)

Admitting Diagnosis: 1) _____2)_____3)_____ 4) _____

Hosp. Problems 1)_____ 2)_____ 3)_____ 4)_____ 5)_____

Final Diagnosis: 1)_____ 2)_____3)_____

Primary Cause of Death*:_____. *cardiopulmonary arrest is not a cause of death

Newborn Unit Admission Record

Infant's details

Name		**Date of Admission**	dd/mm/yyyy	**IP No.**			
DOB		**Age**	days hrs	**Sex**	F☐ M☐ Indeterminate☐	**Gestation**	wks
ROM	<18h☐ >=18h☐ unkn.☐	**Delivery**	SVD ☐ CS☐ Breech☐ Forceps☐ Vacuum☐	***If CS, type***	Elective☐ Emergency☐		
Multiple Delivery	Y☐ N☐	***If YES number?***	=	**BVM Resus at birth?**	Y☐ N☐		
APGAR	1m 5m 10m	**Born outside this facility?**	Y☐ N☐	***if Yes, born where?***	Home/Roadside☐	Other facility☐	

Mother's details

Name		**IP No.**		**Age**		**Parity**	+
Blood Grp	A☐ B☐ AB☐ O☐ unkn.☐	**Rhesus**	Pos☐ Neg☐ unkn.☐	**VDRL**	Pos☐ Neg☐ unkn.☐		
PMTCT Status	Pos☐ Neg☐ unkn.☐	**Mother ARVs**	Y☐ N☐	**Diabetes**	Y☐ N☐ unkn.☐		
Hypertension in Pregnancy	Y☐ N☐ unkn.☐	**APH**	Y☐ N☐	**Prolonged 2nd Stage**	Y☐ N☐ unkn.☐		

Mother's problems during pregnancy / labour & relevant maternal treatment

Any maternal illness / fever? Any maternal treatment for TB or antibiotics in labour? (***Describe***)

Infant's Presenting Problems & any treatment given

When did problems start, how did they progress and what are problems now?

History & Examination

Vital Signs	**Temp(^{0}c)**		**Resp Rate**	bpm	**Pulse**	/min	**0_2 Sat** %
Anthropometry	**Birth wt**	grams	**Weight now**	grams			
	Head circumference	cm	**Length**	cm			

Time baby seen	am/pm	**Any other important history and family / social history?**

Fever	Y☐	N☐
Difficulty breathing	Y☐	N☐
Difficulty feeding	Y☐	N☐
Convulsions	Y☐	N☐
Apnoea	Y☐	N☐
Reduced/Absent movement	Y☐	N☐
Bloody stool	Y☐	N☐
Bilious Vomiting	Y☐	N☐

General Examination				
Skin	Bruising☐ Rash☐ Pustules☐ Mottling☐ Normal☐			
Jaundice	None☐	+☐	+++☐	
A & B	Cry	Normal☐ Weak/Absent☐ High pitched☐		
	Central Cyanosis		Y☐	N☐
	Indrawing	None/mild☐ Severe☐		
	Grunting		Y☐	N☐
	Good bilateral air entry		Y☐	N☐
	Crackles		Y☐	N☐
C	Cap Refill (Sternal)	secs		
	Pallor/Anaemia	None☐	+☐	+++☐
	Murmur		Y☐	N☐
	If murmur is YES, describe in free text			
D	Can breastfeed?		Y☐	N☐
	Bulging fontanelle		Y☐	N☐
	Irritable		Y☐	N☐
	Tone	Normal☐ Increased☐ Reduced☐		
Abd.	Distension		Y☐	N☐
	Umbilicus	Clean☐ Local pus☐ Pus+red skin☐ Others ☐		

Further Examination

Neuro'- Describe any abnormal posture / movement and check reflexes (Sucking; Rooting; Grasp; Moro)

Further examination of Resp / CVS / GIT / GU / Skin / Birth Trauma?(Specify any abnormality)

Birth defects? Y☐ N☐ ***if YES tick and describe***

Major GI Abnormality	☐	Neurotube defects/spina bifida	☐
Hydrocephalus	☐	Limb abnormalities	☐
Cleft lip/palate	☐	Birth Injury/abnormalities	☐
Microcephaly	☐		

Summary of Presentation and problems

List problems (most important **first**).

Investigations ordered-(record subsequent tests and all results in medical record)

Glucose	Y☐ N☐ =_____ mmol/l	**Bilirubin**	Y☐ N☐ =_____ ☐µmol/l / ☐mg/dl

List other Investigations ordered

Admission Diagnoses-Select ONE primary diagnosis (tick box indicating "1") and ANY secondary diagnoses (tick box indicating "2")

Birth asphyxia Severe/Encephalopathy☐ Mild/Moderate ☐	1☐	2☐	***Multiple Delivery***	1☐	2☐	***Other diagnoses (name below and indicate if primary diagnosis or secondary)***	
			Newborn RDS	1☐	2☐		1☐ 2☐
Preterm	1☐	2☐	***Jaundice***	1☐	2☐		1☐ 2☐
Neonatal sepsis	1☐	2☐	***Meningitis***	1☐	2☐		1☐ 2☐
Meconium aspiration	1☐	2☐	***Birth Wt <2kg***	1☐	2☐		1☐ 2☐

Clinician Name & Sign	**Time** am / pm	**Date** dd/mm/yyyy

Appendix 8.1: Sample Two -Way Referral Form

NEWBORN REFERRAL FORM

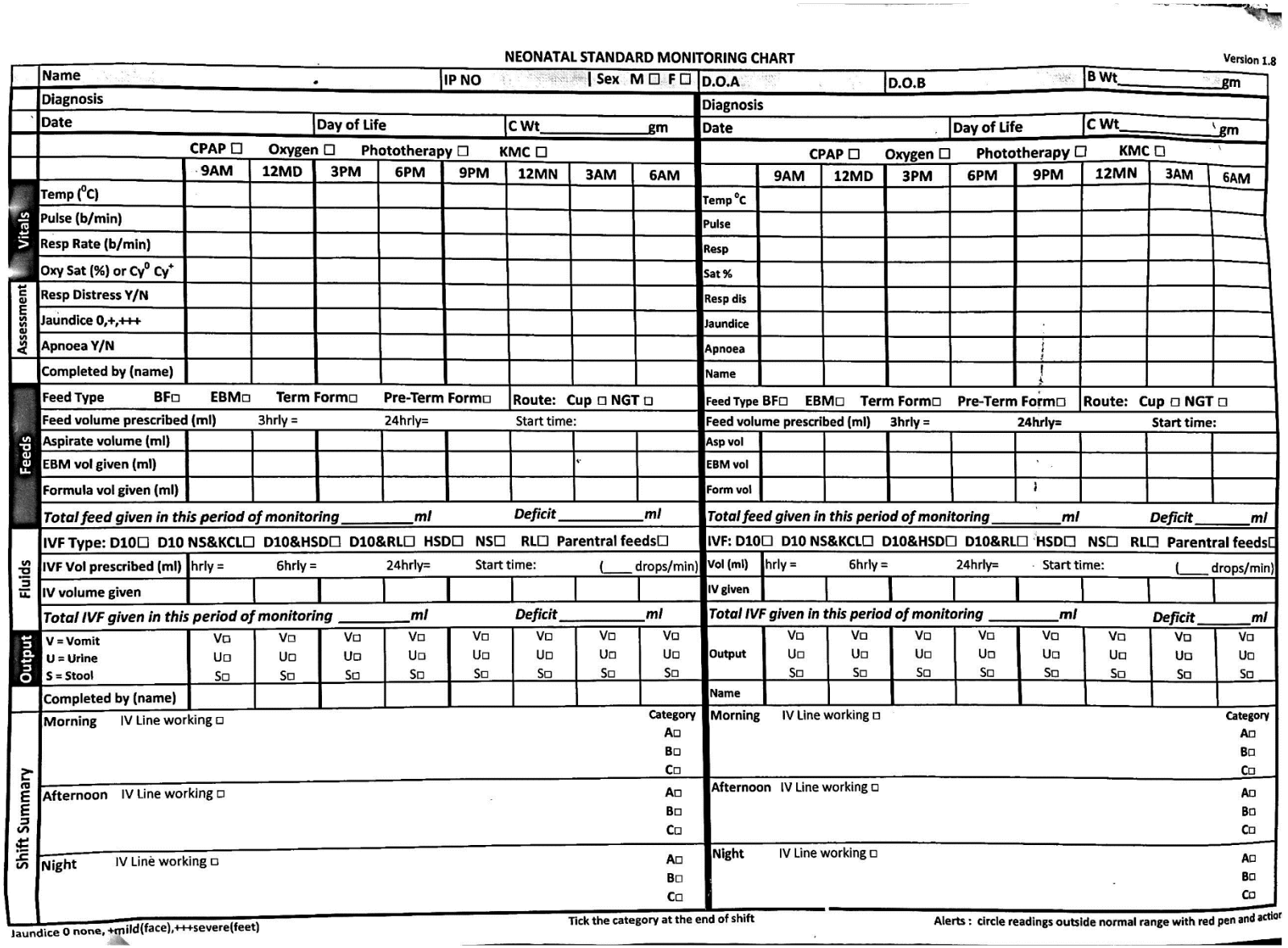
Instructions to Referring Agency:

Complete Section I. Forward two copies of the newborn Referral form. Retain a copy of the Patient Referral until a completed copy is returned to you by the referral center.

Complete Section II and return one copy back to the Referring hospital. Retain a copy for your records.

SECTION I - TO BE COMPLETED BY REFERRING FACILITY		
Name of Patient (or Mother)	Name of Referring Hospital	Name of Care Provider
Street Address	Street Address	Street Address
City, State, Local Government	City, State, Local Government	City, State, Local Government
Date of Birth	Telephone Number	Telephone Number
Presenting complaints Examination findings Diagnosis Interventions Reason for Referral		
Authorization is hereby given to the Care Provider to release their findings and recommendations to the Referral hospital		
Name of Parent or Guardian (Print)	Signature of Parent or Guardian	Date
Name of Witness (Print)	Signature of Witness	Date
Name of Health Care Provider (Print or Type)	Signature of Health Care Provider	Date
SECTION II- TO BE COMPLETED BY REFERRAL CENTRE (TERTIARY/SECONDARY)		
Findings Interventions Recommendations		
Name of Consultant/Doctor at Referral Centre	Signature of Consultant/Doctor at Referral Centre	Date

Appendix 10.1: *Sample Standard Newborn Monitoring Chart*

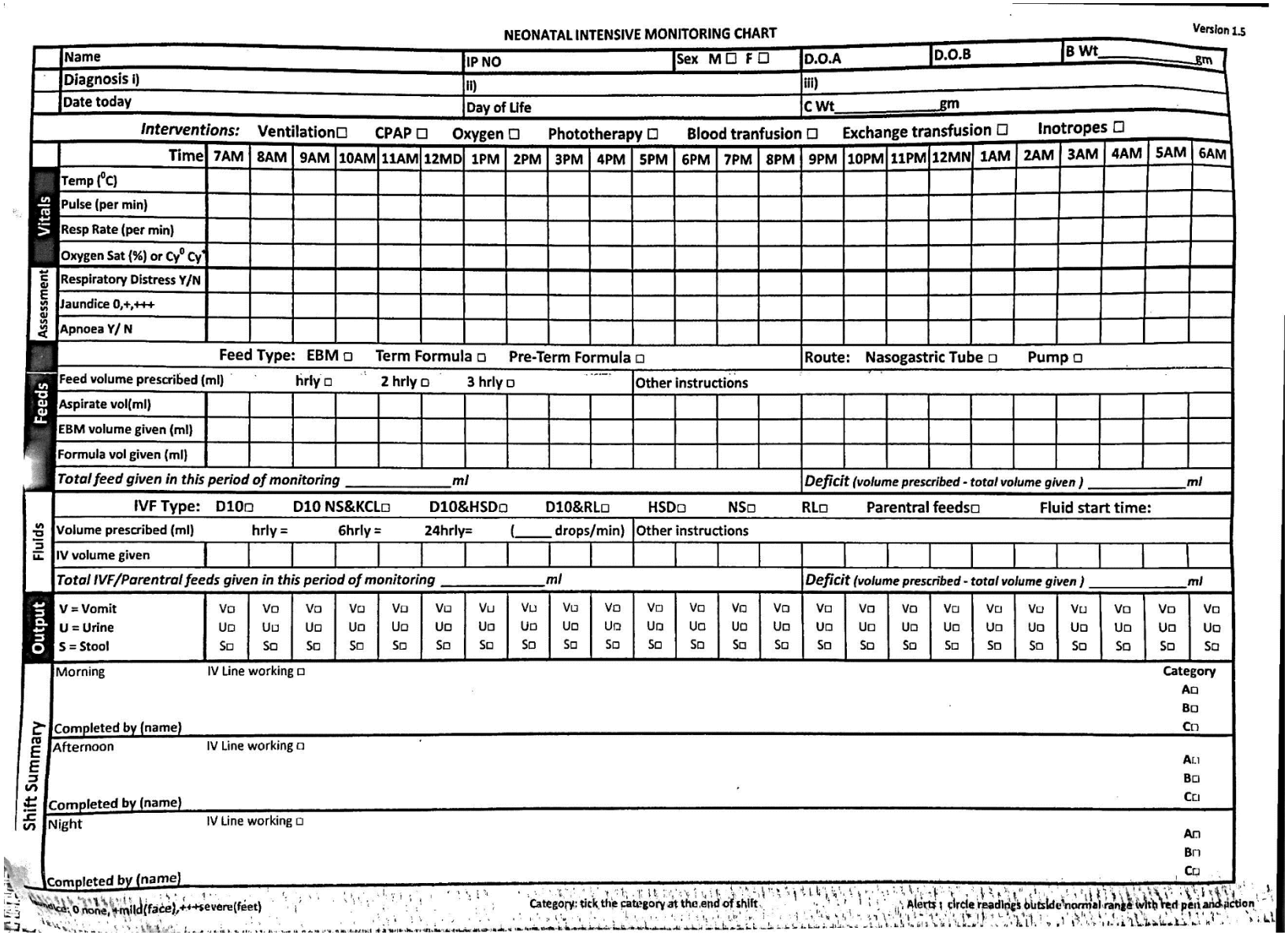


NEONATAL STANDARD MONITORING CHART Version 1.8

	Name			IP NO			Sex M ☐ F ☐	D.O.A		D.O.B		B Wt ____ gm				
	Diagnosis							Diagnosis								
	Date		Day of Life			C Wt ____ gm		Date		Day of Life		C Wt ____ gm				
		CPAP ☐ Oxygen ☐ Phototherapy ☐ KMC ☐								CPAP ☐ Oxygen ☐ Phototherapy ☐ KMC ☐						
		9AM	12MD	3PM	6PM	9PM	12MN	3AM	6AM	9AM	12MD	3PM	6PM	9PM	12MN	3AM	6AM
Vitals	Temp (°C)									Temp °C								
	Pulse (b/min)									Pulse								
	Resp Rate (b/min)									Resp								
	Oxy Sat (%) or Cy⁰ Cy⁺									Sat %								
Assessment	Resp Distress Y/N									Resp dis								
	Jaundice 0,+,+++									Jaundice								
	Apnoea Y/N									Apnoea								
	Completed by (name)									Name								
Feeds	Feed Type BF☐ EBM☐ Term Form☐ Pre-Term Form☐						Route: Cup ☐ NGT ☐			Feed Type BF☐ EBM☐ Term Form☐ Pre-Term Form☐					Route: Cup ☐ NGT ☐		
	Feed volume prescribed (ml)	3hrly =		24hrly=		Start time:				Feed volume prescribed (ml)	3hrly =		24hrly=		Start time:		
	Aspirate volume (ml)									Asp vol								
	EBM vol given (ml)									EBM vol								
	Formula vol given (ml)									Form vol								
	Total feed given in this period of monitoring ____ *ml*					*Deficit* ____ *ml*				*Total feed given in this period of monitoring* ____ *ml*					*Deficit* ____ *ml*		
Fluids	IVF Type: D10☐ D10 NS&KCL☐ D10&HSD☐ D10&RL☐ HSD☐ NS☐ RL☐ Parentral feeds☐									IVF: D10☐ D10 NS&KCL☐ D10&HSD☐ D10&RL☐ HSD☐ NS☐ RL☐ Parentral feeds☐							
	IVF Vol prescribed (ml)	hrly =	6hrly =	24hrly=	Start time:	(____ drops/min)				Vol (ml)	hrly =	6hrly =	24hrly=	Start time:	(____ drops/min)		
	IV volume given									IV given							
	Total IVF given in this period of monitoring ____ *ml*					*Deficit* ____ *ml*				*Total IVF given in this period of monitoring* ____ *ml*					*Deficit* ____ *ml*		
Output	V = Vomit	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐		V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐
	U = Urine	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	Output	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐
	S = Stool	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐		S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐
	Completed by (name)									Name								
Shift Summary	Morning IV Line working ☐								Category A☐ B☐ C☐	Morning IV Line working ☐								Category A☐ B☐ C☐
	Afternoon IV Line working ☐								A☐ B☐ C☐	Afternoon IV Line working ☐								A☐ B☐ C☐
	Night IV Line working ☐								A☐ B☐ C☐	Night IV Line working ☐								A☐ B☐ C☐

Jaundice 0 none, +mild(face),+++severe(feet) Tick the category at the end of shift Alerts : circle readings outside normal range with red pen and actior

Appendix 10.2: *Sample Intensive Critical Care Monitoring Chart*



NEONATAL INTENSIVE MONITORING CHART Version 1.5

Name	IP NO	Sex M☐ F☐	D.O.A	D.O.B	B Wt_____gm	
Diagnosis i)	ii)		iii)			
Date today	Day of Life		C Wt_____gm			

Interventions: Ventilation☐ CPAP ☐ Oxygen ☐ Phototherapy ☐ Blood tranfusion ☐ Exchange transfusion ☐ Inotropes ☐

	Time	7AM	8AM	9AM	10AM	11AM	12MD	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM	11PM	12MN	1AM	2AM	3AM	4AM	5AM	6AM
Vitals	Temp (^{0}C)																								
	Pulse (per min)																								
	Resp Rate (per min)																								
	Oxygen Sat (%) or Cy^0 Cy*																								
Assessment	Respiratory Distress Y/N																								
	Jaundice 0,+,+++																								
	Apnoea Y/ N																								

Feeds — Feed Type: EBM ☐ Term Formula ☐ Pre-Term Formula ☐ Route: Nasogastric Tube ☐ Pump ☐

Feed volume prescribed (ml) hrly ☐ 2 hrly ☐ 3 hrly ☐											Other instructions														
Aspirate vol(ml)																									
EBM volume given (ml)																									
Formula vol given (ml)																									

Total feed given in this period of monitoring _____ *ml* *Deficit (volume prescribed - total volume given)* _____ *ml*

Fluids — IVF Type: D10☐ D10 NS&KCL☐ D10&HSD☐ D10&RL☐ HSD☐ NS☐ RL☐ Parentral feeds☐ Fluid start time:

Volume prescribed (ml) hrly = 6hrly = 24hrly= (_____ drops/min)											Other instructions														
IV volume given																									

Total IVF/Parentral feeds given in this period of monitoring _____ *ml* *Deficit (volume prescribed - total volume given)* _____ *ml*

Output																										
V = Vomit	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐	V☐
U = Urine	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐	U☐
S = Stool	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐	S☐

Shift Summary

Morning	IV Line working ☐	Category A☐ B☐ C☐
Completed by (name)		
Afternoon	IV Line working ☐	A☐ B☐ C☐
Completed by (name)		
Night	IV Line working ☐	A☐ B☐ C☐
Completed by (name)		

Edema: 0 none, +mild(face), ++severe(feet) Category: tick the category at the end of shift Alerts : circle readings outside normal range with red pen and action

Appendix 10.3: *Newborn Early Warning Chart for close monitoring*

NEWBORN EARLY WARNING CHART

Name: _____ MR No. _____ DOB: _____

TOB: _____ GA: _____ B. Wt. _____ Diagnosis: _____

Risk factors: _____ MOB: _____

Date													
Time													
TEMP	≥ 39.0												
	38.0												
	37.0												
	36.0												
	≤ 35.0												
PERIPHERIES (> 1 Hour old)	WARM / PINK												
	COLD / BLUE / DUSKY												
RESPIRATION	≥ 70												
	65												
	60												
	55												
	50												
	45												
	40												
	35												
	≤ 30												
GRUNTING	RETRACTIONS												
HEART RATE	200												
	190												
	180												
	170												
	160												
	150												
	140												
	130												
	120												
	110												
	100												
	90												
	80												
	70												
	60												
SpO_2	>95%												
	90-95%												
	<90%												
NEURO	ACTIVE / WAKES TO FEED												
	JITTERY / IRRITABLE												
	FLOPPY / DIFF TO AROUSE												
	SEIZURES												
IV SITE	NORMAL												
	SWOLLEN												
Nurses' Name													
Ward													
Breastfeeding													
Skin-to-Skin													

RESPONSE		
	ALL OBSERVATIONS IN WHITE	CONTINUE OBSERVATIONS 4 HOURLY OR AS REQUESTED
	ONE IN AMBER	CONTACT DOCTOR
	TWO IN AMBER OR **ONE** IN RED	**IMMEDIATE REVIEW**

SH/Chart/Obs/NewbornEarlyWarningChart/358/Ver1/Feb2020

Appendix 19.1: *Sample IVF/Feeds Record form*

FLUID INPUT (ml)

	ENTERAL FLUID				INTRAVENOUS FLUID & MEDICINES* *Include volume of infused medicines									
	ORAL		Iw TUBE NG tube		20G Right hand		20G Left hand		No. 3 Site		No. 4 Site		Hourly Amount IN	Grand Total IN
	Fluid Type		Fluid Type		Fluid Type		Fluid Type		Fluid Type		Fluid Type			
	Amount	Total	Amount	Total	Amount	Total	Amount	Total	Amount	Total	Amount	Total		
08.00														
09.00														
10.00														
11.00														
12.00														
13.00														
14.00														
15.00														
16.00														
17.00														
18.00														
19.00														
20.00														
21.00														
22.00														
23.00														
24.00														
01.00														
02.00														
03.00														
04.00														
05.00														
06.00														
07.00														

- Record
  - Site
  - Type of fluid
  - Amount received
  - Total volume
- for each type of fluid
- every hour

Appendix 28.1: ROP Screening Protocol

Nigerian Retinopathy of Prematurity Screening Protocol
ROP Evaluation Form

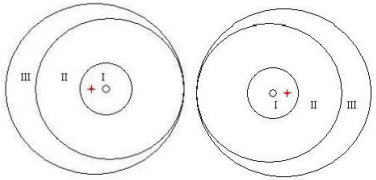
Date:…… Serial No:…… Name:…… Hospital No:……
M☐ F☐ Birth Weight:……Kg Address:……
Mother Educ/Occupation……/…… Phone No:……
Father Educ/Occupation……/…… Phone No:……
Gestational Age:……Weeks Age since birth: ……Weeks…… Days

Risk Factors			Risk Factors**		
Antenatal steroid used	Yes	Yes	**No of days Oxygen therapy**	……	No
Surfactant	Yes	No	**No of Apnoeic episodes**	……	No
Twin/Triplet/More(…)	Yes	No	**No of Blood transfusion**	……	No
Haemoglobin Sgm	Yes	No	**Thrombocytopaenia**	Yes	No
O2 Saturation (%)	Yes	No	**Respiratory distress syndrome**	Yes	No
			Intraventricular Haemorrhage	Yes	No
			Sepsis	Yes	No

FIRST SCREENING Date_____

	Right eye				**Left eye**			
Iris: dilated vessels	Yes	No			Yes	No		
Pupil: poor dilation	Yes	No			Yes	No		
Lens: opacity	Yes	No			Yes	No		
Immature retinal vessels	No	Zone I	Zone II	Zone III	No	Zone I	Zone II	Zone III
ROP								
Stage	None 1	2	3	4a 4b 5a 5b	None 1	2	3	4a 4b 5a 5b
Zone	None 1	2	3		None 1	2	3	
Clock hours involved (0-12)								
Retinal vessels	No ROP	No pre/plus	preplus	plus	No ROP	No pre/plus	preplus	plus
APROP	No ROP	Yes	No		No ROP	Yes	No	
ROP regressing	Yes	No			Yes	No		

Management decision Tick one box
No further screening needed ☐
Screen again ☐ Date of next screening_____
Urgent treatment required ☐

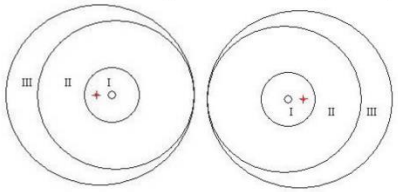


Date: ☐ **Examined by: R/SR/Consultant** **Name&Sign:**

SCREENING NO: 2 Date_____

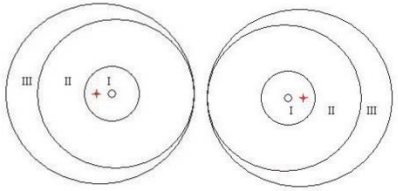
	Right eye				**Left eye**			
Iris: dilated vessels	Yes	No			Yes	No		
Pupil: poor dilation	Yes	No			Yes	No		
Lens: opacity	Yes	No			Yes	No		
Immature retinal vessels	No	Zone I	Zone II	Zone III	No	Zone I	Zone II	Zone III
ROP								
Stage	None 1	2	3	4a 4b 5a 5b	None 1	2	3	4a 4b 5a 5b
Zone	None 1	2	3		None 1	2	3	
Clock hours involved (0-12)								
Retinal vessels	No ROP	No pre/plus	preplus	plus	No ROP	No pre/plus	preplus	plus
APROP	No ROP	Yes	No		No ROP	Yes	No	
ROP regressing	Yes	No			Yes	No		
Retinal Mature	Yes	No			Yes	No		

Management decision Tick one box
No further screening needed ☐
Screen again ☐ Date of next screening_____
Urgent treatment required ☐



Date: ☐ **Examined by: R/SR/Consultant** **Follow-up:** ☐ **Sign:**

Screening No:3

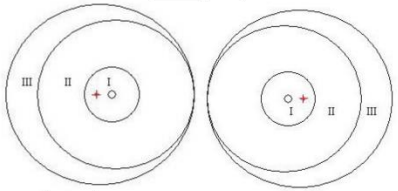


Findings:

Management decision
No further screening needed ☐
Screen again(when) ☐
Urgent treatment required ☐

Date: ☐ **Examined by: R/SR/Consultant** **Name&Sign:**

Screening No:4



Findings:

Management decision
No further screening needed ☐
Screen again(when) ☐
Urgent treatment required ☐

Date: ☐ **Examined by: R/SR/Consultant** **Name&Sign:**

ROP SCREENING CRITERIA

Babies to be identified by NICU staff if:
A. ≤34* weeks Gestation Age, <2.0*kg
B. *Older and Bigger babies up till 37 weeks in the presence of
1.Risk factors**(Prolonged Oxygen, Multiple Apnoea, Blood transfusion, RDS, Intraventricular Haemorrhage, Sepsis)
2. Gestational age Unknown
3. Paediatricians has high index of suspicion because of stormy postnatal events.

When to Screen?- first screening at 3-4 weeks post delivery or any time before discharge (whichever comes first) in the **NICU/SCBU**.
Follow-up screening schedule (see below) in Clinic preferably same day as Neonatologists follow up review
Screening day: Agree with NICU on specific days and time for first eye exam and follow up.

Materials
Indirect Ophthalmoscope, 20D/28/30D Lenses(whichever you are most familiar with in adults)
Dilating drops- see below
Topical anaesthetic agent
Lid speculum- appropriate for age
24% Sucrose suck / Express breast milk to tip of tongue drop 2min prior to ROP screening

How to Screen

1. Identify and register ALL babies to be screened for ROP preferably on admission
2. Register baby and write on sticky note or front of hospital folder when due for eye exam
3. Be present for eye exam as scheduled
4. Counsel care givers and obtain consent
5. Take general history as in protocol
6. NICU staff to pre-dilate pupil before ophthalmologists arrive
7. Prepare baby by instilling : **one drop of eye drops to each eye (Teach Specific NICU Staff)**
   - **2.5%** Phenylephrine **+0.5-1%** Tropicamide (Mydriacyl)
   - **Both drops (2 instillations 5minute apart 30-45 minutes before Examination**
     Wipe excess drops off baby's Eyelid
8. Confirm for pupillary dilation
9. Instill one drop of Topical anaesthetic agent(Proparacaine/ Amethocaine etc),
10. Gently part eyelids open with 2 fingers to examine anterior segment with the Convex lens and the posterior segment for plus disease
10. Insert appropriate size lid Speculum
11. Identify the vessels in Zone I and trace anteriorly towards the ora, look out for abnormal branching pattern up to where it terminates and look out for ROP stage.
    28/30D lens have wider field of view, 20D lens has better magnification

Document your findings on form, patient folder and register.

Inform both NICU staff and care givers about findings and next follow up or treatment if indicated.

If child is to be referred to another centre, document referral and get caregiver to sign, give caregiver a letter to the next hospital. Follow up with colleagues is good.

Keep track of babies who missed ROP Screening

Make patient information materials available to caregivers and NICU staff.

Retinal Findings, Follow up Schedule and Treatment Decisions

Retina	Mature	Immature	Immature zone 1	Type 1	Type 2
Follow-up	3month	Bi-weekly	Weekly	Rx Immediately	Weekly till it regresses or progress to type1

Type 1 ROP

- **Zone I, Any stage with plus**
- **Zone I,-stage 3 without plus**
- **Zone II,-stage 2- 3 with plus**

Type 2 ROP

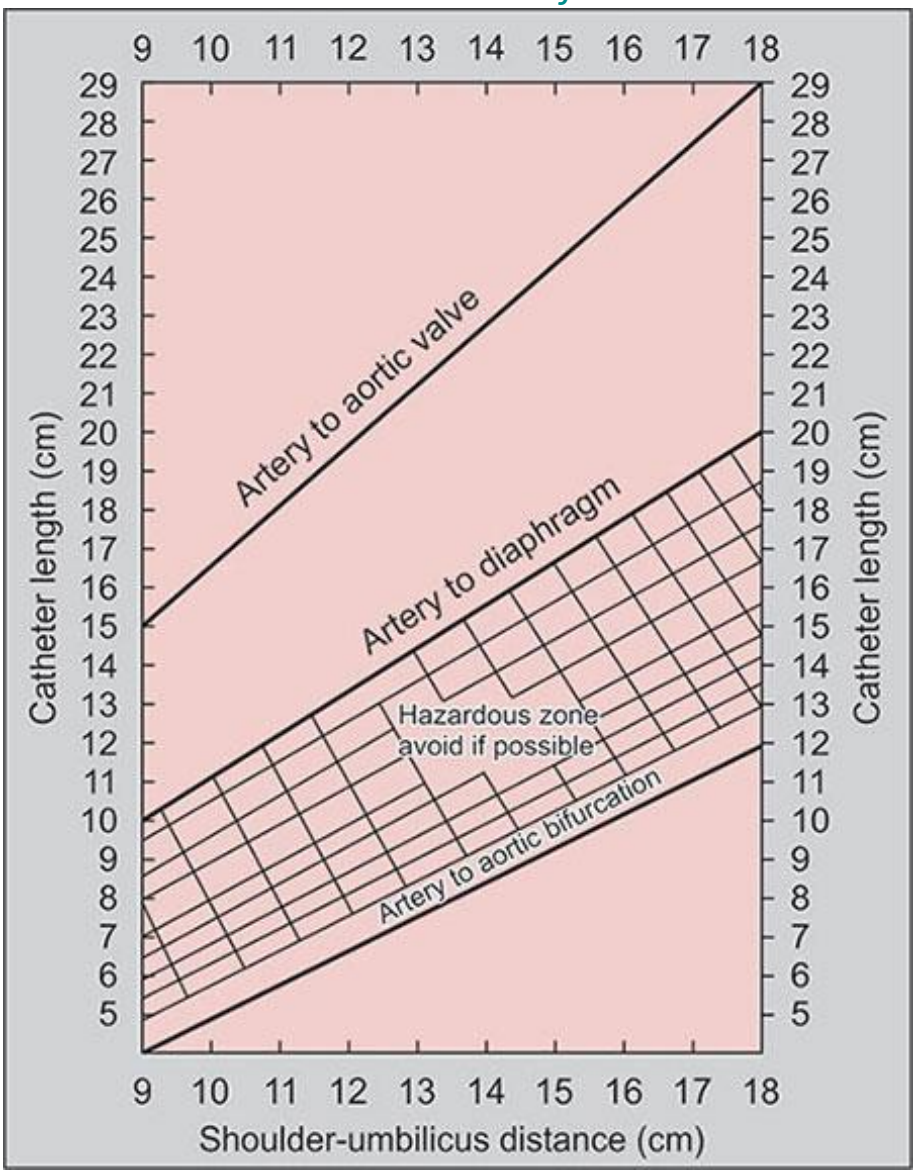
- **Zone I, stage 1-2 No plus**
- **Zone II, Stage 3 No plus**

Neonatologist/NICU staff Role During ROP Screening

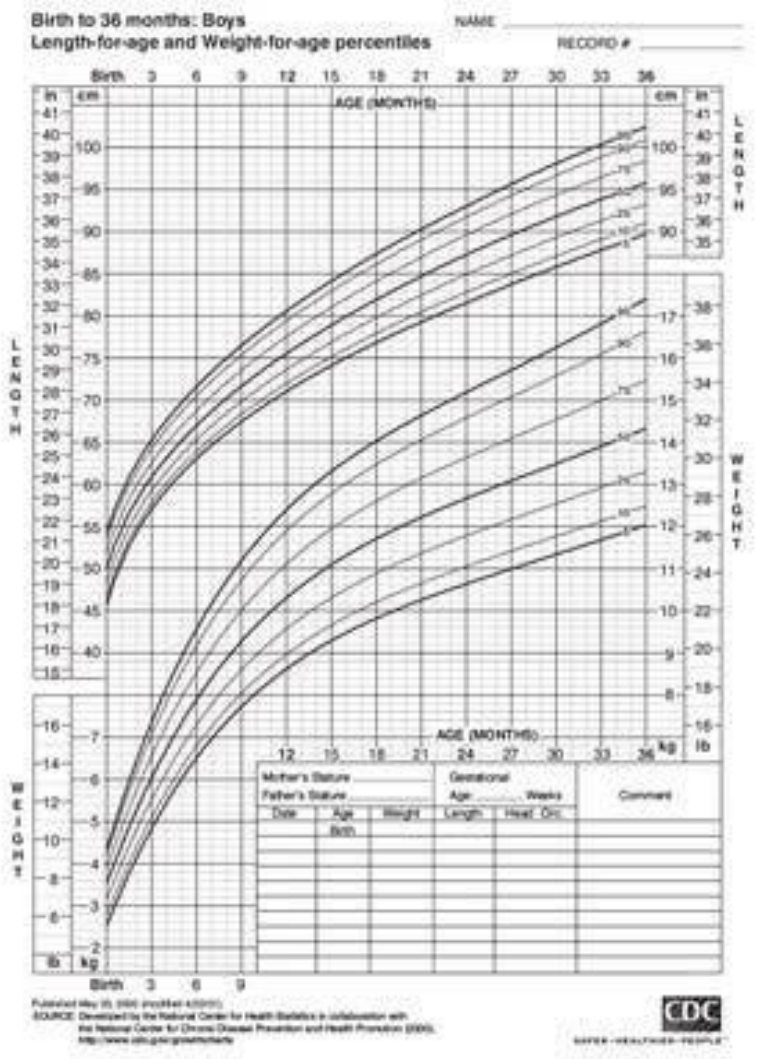
1. Register all babies
2. Identify all babies who need to have screening based on screening criteria
3. Counsel parents/family on need for ROP screening
4. Ensure baby is clinically stable
5. Instill eyedrops to eyes to dilate pupils.
6. Baby to be given adequate pain relieving measures before procedure (Baby to be swaddled/wrapped, keeping baby in flexed posture, 24% sucrose or expressed Breast Milk to tip of tongue 2 min prior to ROP screening)
7. Do not send home immediately after screening (in case of babies coming for screening as out-patient basis), rather monitor for at least 1-2hr to look for any adverse events
8. Ensure asepsis maintained during screening

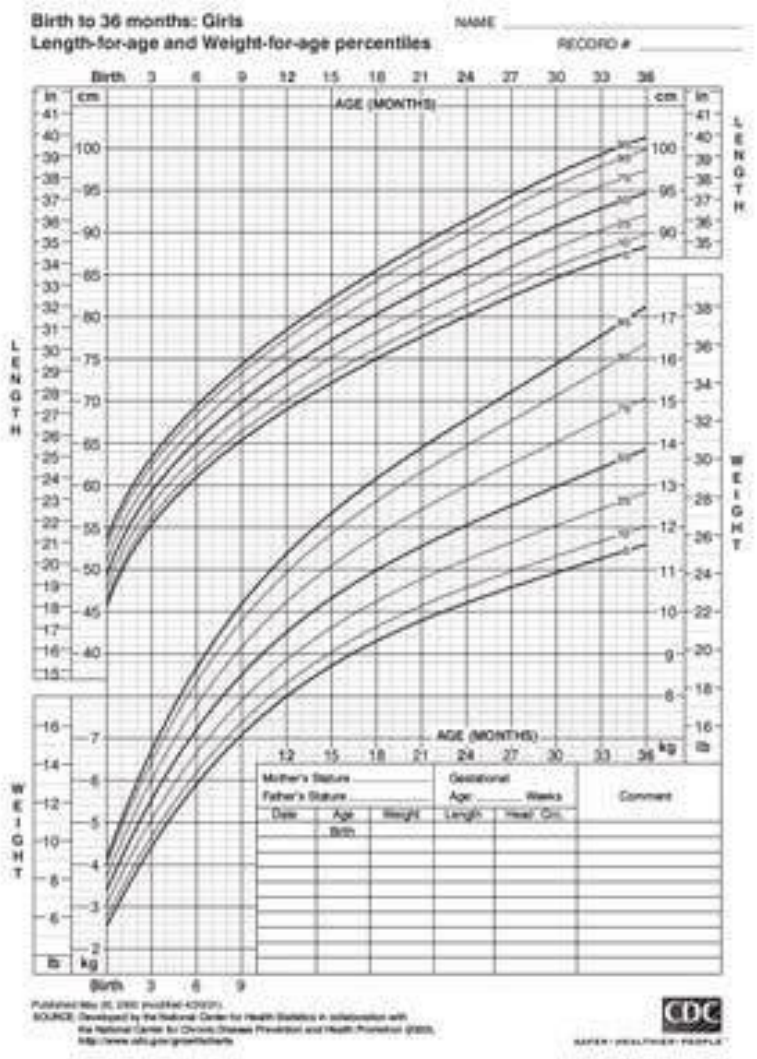
Ensure no baby miss ROP screening in NICU and during Follow up

Appendix 30.1: *Shoulder to umbilicus chart for UVC measurement*

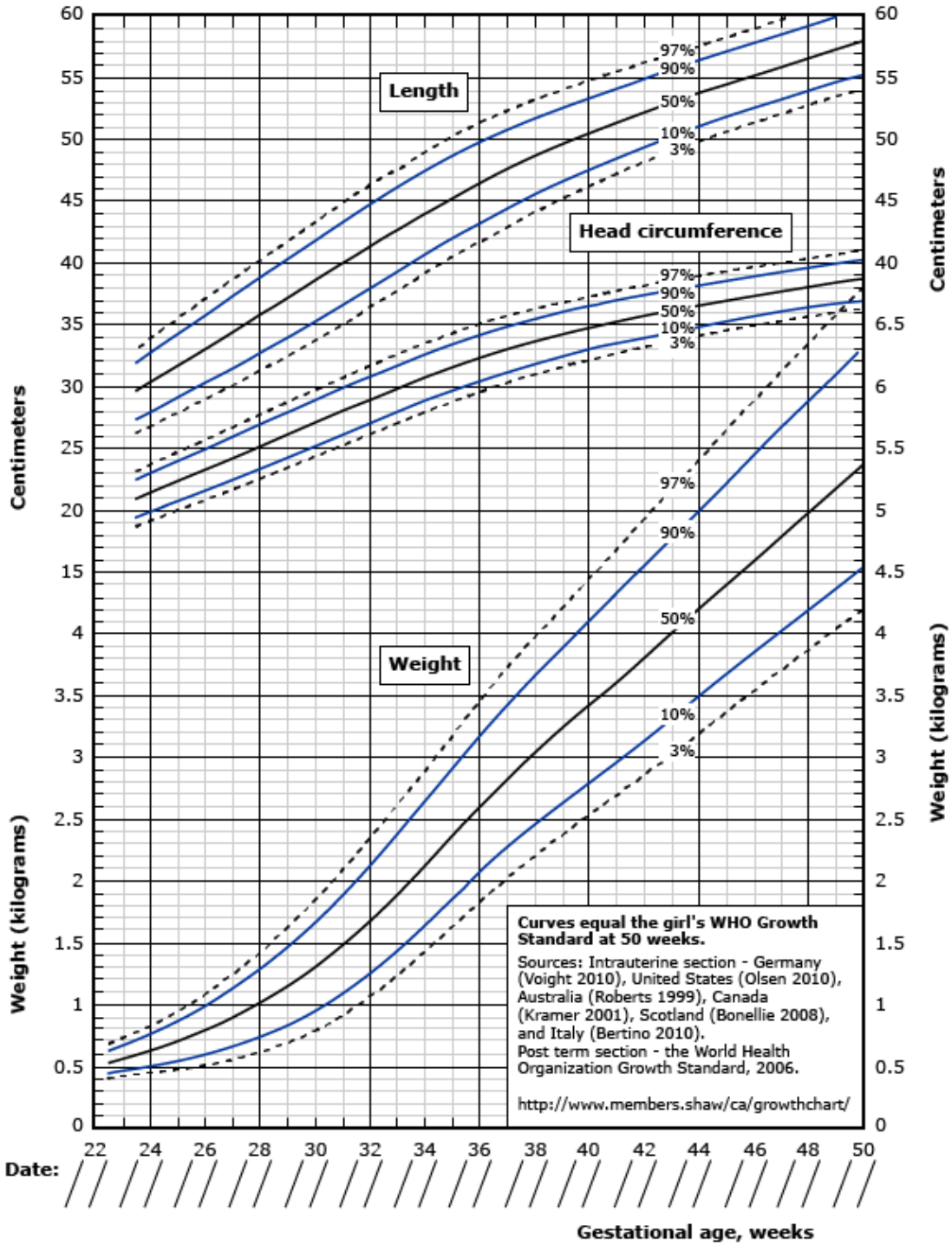


Appendix 31.1: *Infant Growth Chart CDC (boys and girls)*

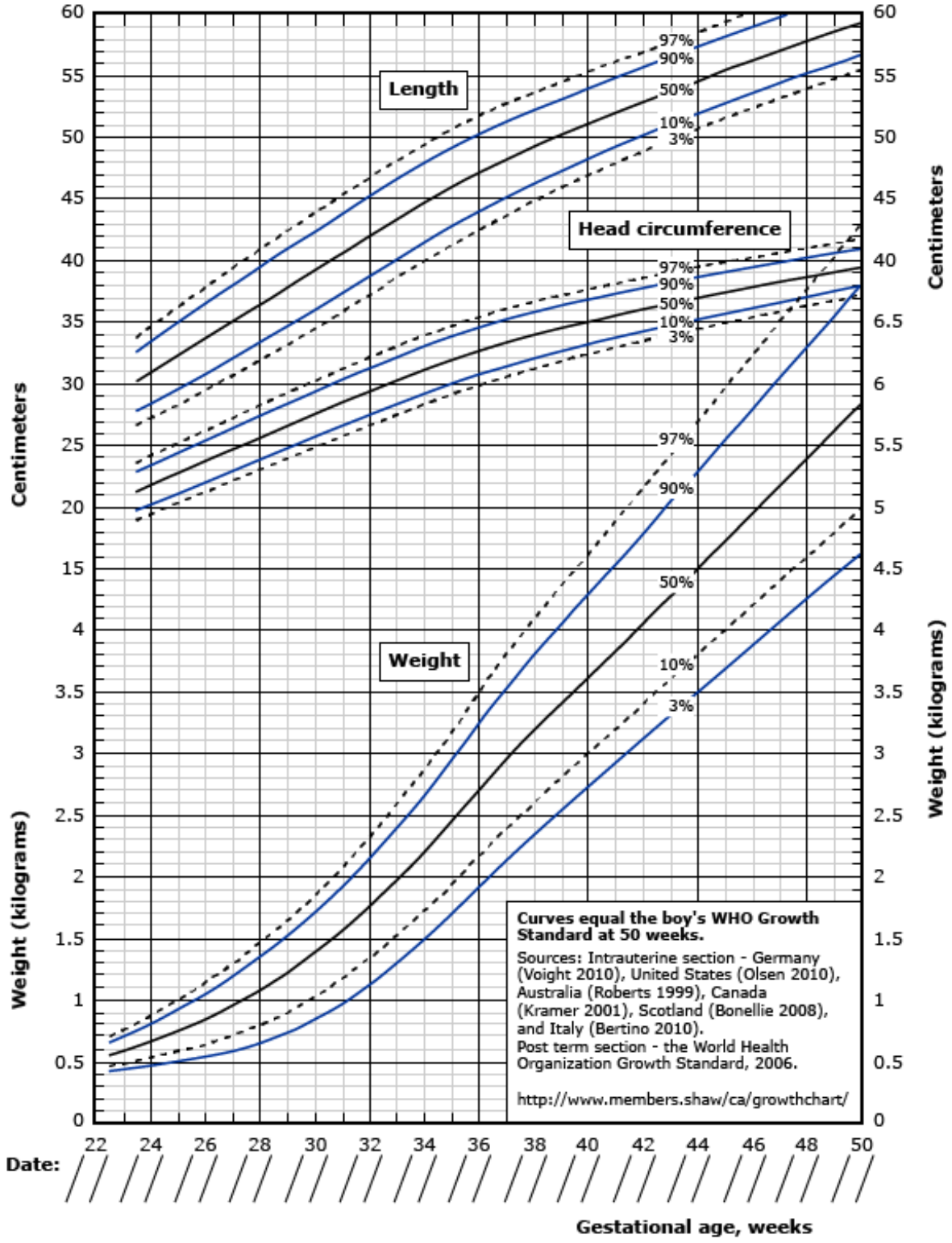




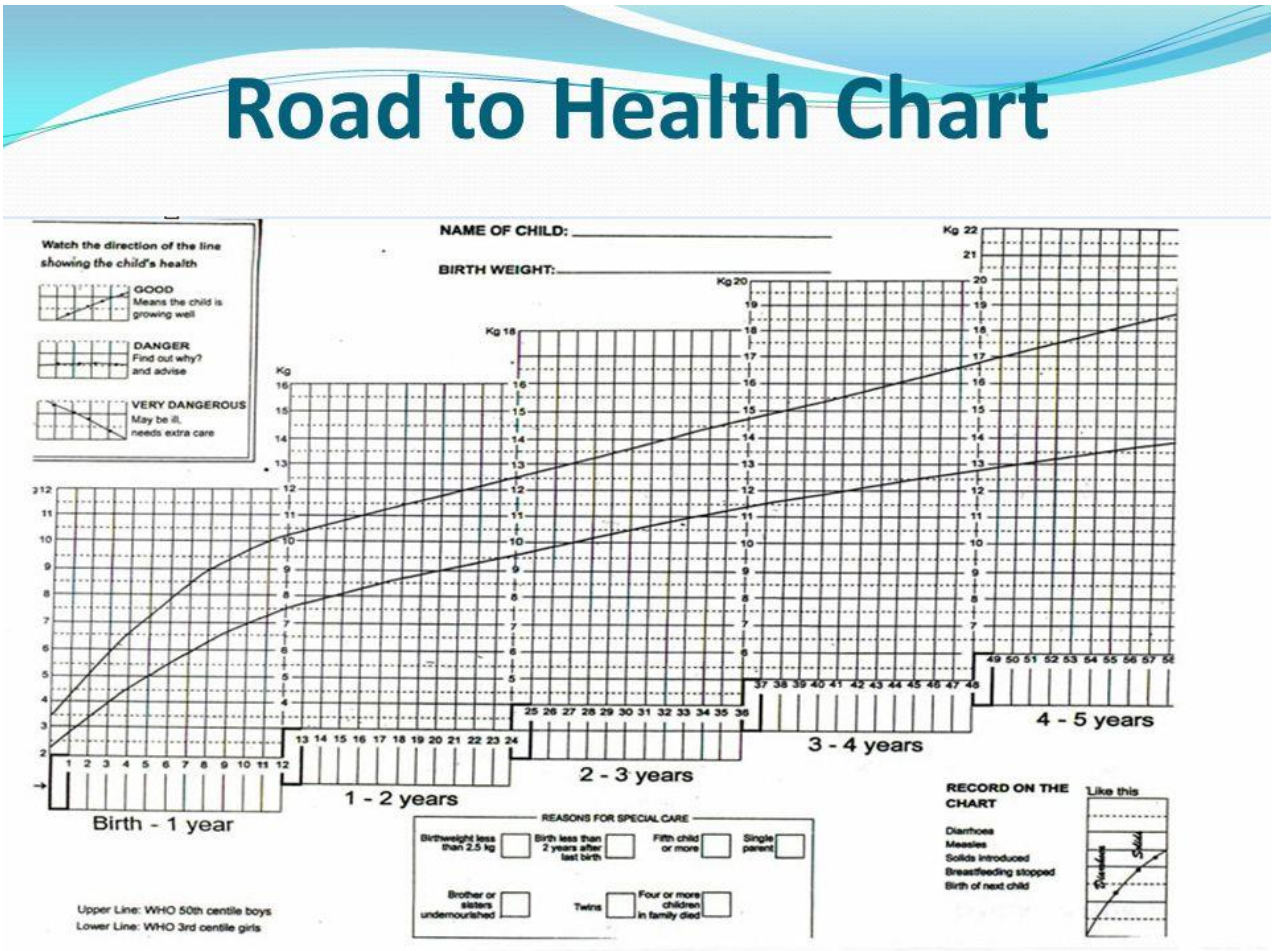
Appendix 31.2a: *Fenton preterm growth chart (Girls)*



Appendix 31.2b: *Fenton preterm growth chart (Boys)*



Appendix 31.3: *National Road to Health Chart*



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LEARNING WEB LINK RESOURCES

- https://nest360.org/project/training-videos/
- https://www.newbornwhocc.org/teaching.html
- https://www.who.int/gpsc/tools/GPSC-HandRub-Wash.pdf
- https://images.app.goo.gl/45o1gTY7ZnMAYYxQ8
- Prevent Sepsis – Wash Your Hands
- http://www.who.int/gpsc/5may/en/
- Decontamination and reprocessing of medical devices for health-care facilities: http://www.who.int/infection-prevention/publications/decontamination/en/
- https://pediatrics.aappublications.org/content/146/Supplement_2/S165
- https://play.google.com/store/apps/details?id=edu.uw.med.neonatology.ehbbmob
- https://play.google.com/store/apps/details?id=edu.uw.med.neonatology.ehbbvr
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2849391/
- Health care without avoidable infections- peoples' lives depend on it (WHO video) This 2-minute video outlines the critical role of IPC. Access it here: https://youtu.be/K-2XWtEjfl8 or at: http://www.who.int/infection-prevention/en/
- Outlines the issues around health care-associated infections (HAIs) and can be accessed here: http://www.who.int/infection-prevention/publications/ipc-role/en/
- Global health media the cold baby https://youtu.be/-6T7f40EB9E
- Global health media Taking a heel blood sample https://youtu.be/MieKJa5YJd4
- Global health media Feeding with a gastric tube https://youtu.be/kytWVZqaaYA
- Global health media. Breathing problems. https://youtu.be/MYCFuEP6Gd4
- Global health media. Sepsis https://youtu.be/MdDD9n7Cz-o
- Global health media. Skin infections https://youtu.be/0mUlyeTIQ_8
- Global health media. Umbilical infections https://youtu.be/N4zL1BS95sw
- Neonatal jaundice https://youtu.be/p_GG4OddRRU
- Inserting an IV - https://youtu.be/v3Udt0p6jVo
- Lumbar puncture in neonates: the basics. MPROvE. https://youtu.be/DuKjOdso9aU
- Jaundice: causes, treatment, pathology: https://youtu.be/gIACp5js4MU
- Omphalocele https://youtu.be/1vaoR8HYJxI
- Pyloric stenosis https://youtu.be/AFMtilrmLYk
- Spina bifida: https://youtu.be/jlDZA2PNW2o
- Global health media- Providing essential care at birth. https://youtu.be/M79WxV7aeJU
- Global health media Feeding with a nasogastric tube. https://youtu.be/aTjymWCGHdc
- Global health media Cup feeding. https://youtu.be/OkhSJ16FHfY
- Lumbar puncture in neonates. traumatic tap and tips https://youtu.be/ggoHkKFG1_8
- An approach to lumbar puncture. Pedscases.com. https://youtu.be/eEyl5g4kUm4
- Setting up an IV line -- https://youtu.be/rb5pz--0Q5II

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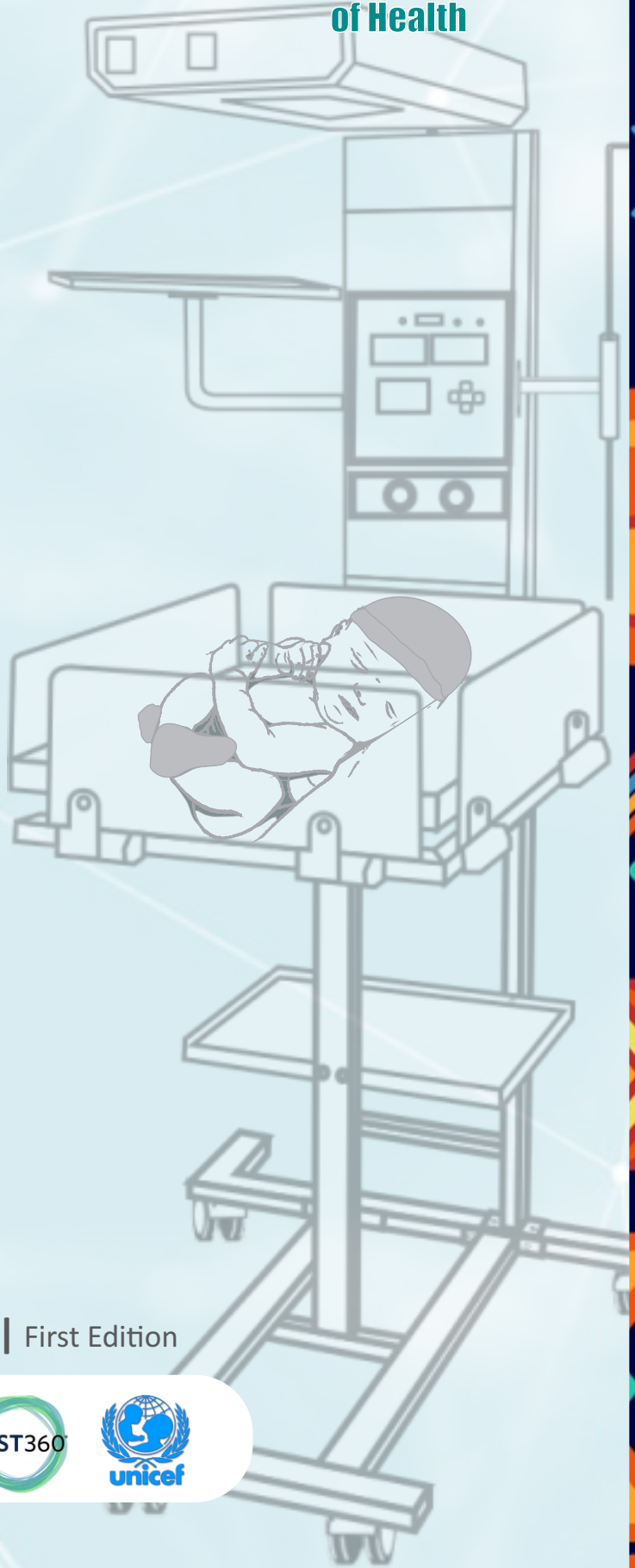
National Guidelines for Comprehensive Newborn Care

Federal Ministry of Health



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