Neonatal protocols

Republic of Rwanda
Ministry of Health
FOREWORD

Despite numerous advances in decreasing the toll of childhood mortality, neonatal mortality remains one of the largest contributors to under-five mortality in the developing world. Neonatal health and survival remain a major challenge in the Sub-Saharan Africa.

In September 2000, world leaders gathered for the United Nations Millennium Summit where they agreed upon ten goals for improving lives around the world. One of these Millennium Development Goals is to reduce the deaths of children under five years old by two-thirds before 2015. This goal is only attainable if we address the unique set of risks faced by newborn infants.

In a setting such as Rwanda, there is a unique opportunity to develop and implement best practices in care for those in the earliest stage of life. The Ministry of Health has strongly prioritized decreasing maternal and neonatal mortality, and this impetus has led to the creation of these protocols.

The following guidelines offer the first national standardization of neonatal care in Rwanda. The knowledge and guidance found within these protocols offers those caring for newborns important resources and methods for reducing mortality and morbidity in the first month of life.
There remains much to be done in improving the quality of care provided to newborns and their mothers in order to achieve the needed reduction in infant mortality and morbidity and improvement in overall neonatal health. May this publication contribute to improving awareness and knowledge around neonatal care for all those in the health sector, and to improving the lives of Rwanda’s population as a whole.

Dr. Agnes BINAGWAHO
Minister of Health
ACKNOWLEDGEMENTS

The Ministry of Health is grateful to all organizations and individuals who contributed to the development of this first set of national guidelines for neonatal care in Rwanda.

These guidelines would not have been finalized without the generous support of all who are involved in the domain of providing neonatal care in Rwanda.

We offer our sincere gratitude and appreciation for the guidance and feedback from the following people and organizations for leading and coordinating the effort to develop these protocols

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- To Pr Cyprien Baribwira (AIDS Relief Maryland university) for his technical support
- To Pr Ousmane Ndiaye for his technical support
● To Dr Tom Lissauer for his technical support
● To Dr Félix Sayinzoga, chair of the MCH technical working group
● To Dr Fidèle Ngabo, Director of MCH

Our appreciation also goes towards all persons, who, from near or far, contributed to the realization of these guidelines.
# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW</td>
<td>Birth Weight</td>
</tr>
<tr>
<td>CBC</td>
<td>Complete Blood Count</td>
</tr>
<tr>
<td>CRP</td>
<td>C-reactive protein</td>
</tr>
<tr>
<td>CXR</td>
<td>Chest X-Ray</td>
</tr>
<tr>
<td>DIC</td>
<td>Disseminated Intravascular Coagulopathy</td>
</tr>
<tr>
<td>DOL</td>
<td>Day of Life</td>
</tr>
<tr>
<td>ELBW</td>
<td>Extremely Low Birth Weight</td>
</tr>
<tr>
<td>FBC</td>
<td>Full blood count</td>
</tr>
<tr>
<td>HR</td>
<td>Heart Rate</td>
</tr>
<tr>
<td>HSV</td>
<td>Herpes Simplex Virus</td>
</tr>
<tr>
<td>IV</td>
<td>Intravenous</td>
</tr>
<tr>
<td>IVH</td>
<td>Intraventricular Hemorrhage</td>
</tr>
<tr>
<td>KMC</td>
<td>Kangaroo Mother Care</td>
</tr>
<tr>
<td>LBW</td>
<td>Low Birth Weight</td>
</tr>
<tr>
<td>LMP</td>
<td>Last Menstrual Period</td>
</tr>
<tr>
<td>IUGR</td>
<td>Intrauterine growth restriction</td>
</tr>
<tr>
<td>LR</td>
<td>Lactated Ringers Solution</td>
</tr>
<tr>
<td>LBW</td>
<td>Low Birth Weight</td>
</tr>
<tr>
<td>NG</td>
<td>Nasogastric</td>
</tr>
<tr>
<td>NGT</td>
<td>Nasogastric Tube</td>
</tr>
</tbody>
</table>
NPO : Nothing by Mouth / Nil Per Os
NS  : Normal Saline
NVP : Nevirapine
PHH : Posthemorrhagic Hydrocephalus
PO  : By Mouth / Per Os
RR  : Respiratory Rate
SBI : Serious Bacterial Infection
VLBW: Very Low Birth Weight
ELBW: Extremely Low Birth Weight
WBC : White Blood Cell Count
WHO : World Health Organization
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UNIT 1.

ROUTINE CARE OF THE NEWBORN

1. Protection against hypothermia

1.1. General considerations

Temperature regulation is fundamental immediately after birth. Hypothermia can cause increased oxygen and energy consumption resulting in hypoxia, metabolic acidosis and hypoglycemia, apnea, neonatal cold injury, reduced blood coagulability, failure to gain weight and increased mortality.

1.2. How newborn infants lose heat?

- **Evaporation**: heat loss when water evaporates from skin or breath
- **Conduction**: direct heat loss to solid surfaces with which they are in contact
- **Convection**: heat is lost to currents of air
- **Radiation**: heat loss via electromagnetic waves from skin to surrounding surfaces
1.3. How to prevent hypothermia in the newborn infant?

- At birth, when skin is wet, drying and wrapping in a warm towel
- Providing skin to skin contact
- Clothing the infant
- Raising the temperature of ambient air
- Avoiding drafts

2. Breastfeeding
Immediately feed the newborn after birth (within 1 hour of birth). Refer to PMTCT chart for HIV + mothers

3. Umbilical cord care
Always wash hands with hand gel or clean water and soap before handling umbilical cord. Keep cord dry and exposed to air.
4. **Eye prophylaxis**
Give tetracycline 1% eye drops within 1 hour of birth;

5. **Vitamin K administration**
Single dose of Vitamin K to all newborns by intramuscular injection 1mg for birth weight >1500gm and 0.5mg for birth weight < 1500gm

6. **Review maternal history, conduct newborn physical examination, identification and registration.**
UNIT 2.

GENERAL NEONATAL CARE GUIDELINES

1. Immediate assessment on admission
   - All infants should be assessed by nurse with weight and vital signs, including temperature, documented within 30 minutes of admission.
   - All infants should be examined and have orders written by a doctor as soon as possible after admission.
   - The infant’s due date can be calculated from the date of the last menstrual period (LMP) by subtracting 3 months and adding one week (e.g. an LMP of October 21th = due date of July 28th).
   - Definitions
     — Gestational age: time from last menstrual period (LMP) to birth
     — Chronologic age: age since birth
     — Post Menstrual Age (PMA) = gestational age + chronologic age
   - “Weight for calculations” is the birth weight (BW) until current weight > BW
2. Additional considerations for LBW (< 2.5 kg) infants

- Low Birth Weight (LBW) infants may be premature or small for gestational age, or both.
- Infants who weigh <2.5kg are defined as low birth weight (LBW), <1.5 kg are very low birth weight (VLBW), and <1.0kg are extremely low birth weight (ELBW).
- LBW infants are at risk for respiratory distress, apnea and bradycardia, sepsis, hypoglycemia, feeding intolerance, hyperbilirubinemia and hypothermia.
- Calculate gestational age for all LBW infants.
  - Calculate by LMP if known.
  - If LMP is unknown, perform the Ballard test to determine gestational age.
  - Use LMP unless it differs from Ballard by > 2 weeks
**BALLARD score**


**Neuromuscular maturity**
# Physical maturity

<table>
<thead>
<tr>
<th>Score</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>Sticky friable, transparent</td>
<td>Gelationous, red, translucent</td>
<td>Smooth, pink; visible veins</td>
<td>Superficial peeling and/or rash few veins</td>
<td>Cracking, pale areas; rare veins</td>
<td>Parchment deep cracking; no vessels</td>
<td>Leathery, cracked, wrinkled</td>
</tr>
<tr>
<td>Lanugo</td>
<td>None</td>
<td>Sparse</td>
<td>Abundant</td>
<td>Thinning</td>
<td>Bald areas</td>
<td>Mostly bald</td>
<td></td>
</tr>
<tr>
<td>Plantar surface</td>
<td>Heel -toe 40-50 mm: -1 &lt; 40 mm: -2</td>
<td>&gt; 50 mm, no crease</td>
<td>Faint red marks</td>
<td>Anterior transverse crease only</td>
<td>Creases anterior 2/3</td>
<td>Creases over entire sole</td>
<td></td>
</tr>
<tr>
<td>Breast</td>
<td>Imperceptible</td>
<td>Barely perceptible</td>
<td>Flat areola, no bud</td>
<td>Stippled areola, 1-2 mm bud</td>
<td>Raised areola, 3-4 mm bud</td>
<td>Full areola 5-10 mm bud</td>
<td></td>
</tr>
<tr>
<td>Eye/Ear</td>
<td>Lids fused loosely: -1 tightly: -2</td>
<td>Lids open, pinna flat stays folded</td>
<td>Slightly curved pinna, soft; slow recoil</td>
<td>Well curved pinna; soft but ready recoil</td>
<td>Formed and firm instant recoil</td>
<td>Thick cartilage, ear stiff</td>
<td></td>
</tr>
<tr>
<td>Genitals (male)</td>
<td>Scrotum flat, smooth</td>
<td>Scrotum empty, faint rugae</td>
<td>Testes in upper canal rare rugae</td>
<td>Testes descending, few rugae</td>
<td>Testes down, good rugae</td>
<td>Testes pendulous, deep rugae</td>
<td></td>
</tr>
<tr>
<td>Genitals (female)</td>
<td>Clitoris prominent, labia flat</td>
<td>Clitoris prominent, small labia minora</td>
<td>Clitoris prominent, enlarging minora</td>
<td>Majora and minora equally prominent</td>
<td>Majora large, minora small</td>
<td>Majora cover clitoris and minora</td>
<td></td>
</tr>
</tbody>
</table>

## Maturity rating

<table>
<thead>
<tr>
<th>Score</th>
<th>10</th>
<th>20</th>
<th>22</th>
<th>24</th>
<th>28</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-5</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
<td>44</td>
</tr>
</tbody>
</table>
3. Thermoregulation

- Measure axillary temperature immediately upon admission. Normal temperature is 36.5-37.5 °C.
- If hypothermic (Temp < 36.0 °C), begin Kangaroo Mother Care (KMC), or use an incubator or warming lamp if available.
- Avoid hyperthermia if risk of birth asphyxia, as exacerbates brain injury
- Refer to HYPOTHERMIA PROTOCOL.

4. Bacterial Infection and Infection Control

- CBC (NFS) and/or CRP for all infants with concerns for sepsis
- Chest X-ray if infant has respiratory distress
- Administer antibiotics as soon as possible if there is any concern for sepsis
  Maternal HIV serological test if not done. If infant is HIV exposed, confirm what PMTCT the mother received, and give the infant antiretroviral prophylaxis per national protocol.

Risk is assessed on the basis of:

- HISTORY: Perinatal risk factors: Maternal fever > 38°C during labor or within 24 hours after delivery, membrane rupture >18 hours prior to delivery, foul smelling amniotic fluid, uterine
tenderness, obstetric diagnosis of chorioamnionitis, or preterm labor which can be precipitated by chorioamnionitis.

- PHYSICAL EXAM: Lethargy or irritability, hypotension/poor perfusion, respiratory distress, abdominal distension, temperature instability, full fontanel. Consider congenital syphilis if splenomegaly.

- LABORATORY TESTING: WBC < 5,000 or > 20,000, granulocyte >70%, CRP positive, or CXR consistent with pneumonia.

- Refer to BACTERIAL INFECTION AND SEPSIS PROTOCOL for details.

Patients with community acquired viral infections should not be placed near newborns due to risk of transmission.

5. Respiratory

- Assess for signs of respiratory distress: grunting, flaring, retractions and tachypnea.
  Categorize severity of respiratory symptoms:
  - Score < 4: Mild  5-7: Moderate  8-10: Severe
  - Useful to determine urgency of intervention, trend over time, and efficacy of treatment.
Silverman-Anderson Index

<table>
<thead>
<tr>
<th>Feature</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest movement</td>
<td>Equal</td>
<td>respiratory lag</td>
<td>seesaw respiration</td>
</tr>
<tr>
<td>Intercostal retraction</td>
<td>None</td>
<td>Minimal</td>
<td>marked</td>
</tr>
<tr>
<td>Xiphoid retraction</td>
<td>None</td>
<td>Minimal</td>
<td>marked</td>
</tr>
<tr>
<td>Nasal flaring</td>
<td>None</td>
<td>Minimal</td>
<td>marked</td>
</tr>
<tr>
<td>Expiratory grunt</td>
<td>None</td>
<td>audible with stethoscope</td>
<td>audible</td>
</tr>
</tbody>
</table>

— Measure O2 saturation immediately on admission. (If not available, check tongue color for cyanosis.)

— If < 90%, start O2 by nasal cannula s (0.5-1L) or face mask (4-6L)

— Provide supplemental O2 to keep O2 saturation 90-97% in preterm infants, 90-100% in term infants

— If in room air, O2 saturation should be 90-100%

— Monitor for danger signs of respiratory distress: grunting, flaring, retracting, tachypnea, apnea, cyanosisAll infants <1.5 kg and <33 weeks gestation should be treated with caffeine or aminophylline
6. Hypoglycemia

- Measure glucose if possible for all infants admitted to neonatal unit. Goal glucose is >2.5 mmol/L (45 mg/dL). If hypoglycemic glucose < 2.5 mmol/L (45 mg/dL), refer to HYPOGLYCEMIA PROTOCOL.

7. Fluids and Nutrition

- Most newborns with BW <1.5 kg and with cardiorespiratory instability, asphyxia, or moderate to severe respiratory distress should be started on IV fluids and should not receive enteral feedings.
- Newborns that require IV fluids on day of birth should be started on G10% at 80 mL/kg/day.
  - Exception: Those at risk for cerebral edema should be fluid restricted to G10% at 60 mL/kg/day.
- Refer to FLUID AND NUTRITION PROTOCOL for details.

8. Hyperbilirubinemia

- Measure serum bilirubin for all infants with visible jaundice on day of birth and all infants with clinical
jaundice involving more than the face and chest (inspect palms and soles).
- Refer to HYPERBILIRUBINEMIA PROTOCOL for details.

9. Neurology

- Preterm infants (<32 weeks gestation) are at risk for intraventricular hemorrhage
- Infants of all gestational ages can develop Hypoxic Ischemic Encephalopathy (HIE).
  - All newborns with delayed first breath or cry, need resuscitation
  - All newborns with 5 minute Apgar <5 and abnormal neurological examination should be monitored closely for seizures.
  - Avoid hyperthermia, goal temperature < 37.5°C
- Refer to ASPHYXIA PROTOCOL for details.

10. Routine Health Care Maintenance

- Vitamin K
  - Should be given to all infants to prevent hemorrhagic disease of the newborn
  - If infant was born at health center or home and no record of having received it, give Vitamin K 1mg IM x1
— If infant born at hospital, confirm that Vitamin K was given by maternity

- Antibiotic eye ointment
  — Should be given to all infants to prevent eye infections
  — If infant was born at health center or home and no record of having received eye ointment, give on admission
  — If infant born at hospital, confirm that eye ointment was given in maternity

- Immunizations
  — Per national guidelines
  — No live vaccines if current weight < 2 kg
UNIT 3.

NEONATAL RESUSCITATION, ASPHYXIA AND SEIZURES

1. Neonatal Resuscitation.

A newborn infant should be placed in a warm environment (under radiant warmer and warming lamp), dried, suctioned and stimulated. Then the infant should be assessed regarding need for resuscitation based on the three most important signs:

- Respiration or cry
- Heart rate
- Color

Preterm infants are also at increased risk of needing resuscitation.

If an infant has adequate respiratory effort, HR > 100 beats/minute and transitions to a pink color (check mucous membranes), then no further resuscitation is necessary. Apgar scores can be assigned.
The **Apgar score** is used to describe the newborns condition during the first few minutes of life.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heart rate</strong></td>
<td>Absent</td>
<td>&lt;100 beats/min</td>
<td>&gt;100 beats/min</td>
</tr>
<tr>
<td><strong>Respiration</strong></td>
<td>Absent</td>
<td>Slow, irregular</td>
<td>Good, crying</td>
</tr>
<tr>
<td><strong>Muscle tone</strong></td>
<td>Limp</td>
<td>Some flexion of extremities</td>
<td>Active motion</td>
</tr>
<tr>
<td><strong>Reflex/irritability</strong></td>
<td>No response</td>
<td>Grimace</td>
<td>Cough</td>
</tr>
<tr>
<td>(response to stimulation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>Blue or pale</td>
<td>Body pink, blue extremities</td>
<td>Pink</td>
</tr>
</tbody>
</table>

**Note:** The Apgar score is not used to determine the need for resuscitation.

If the infant has inadequate respiratory effort, HR < 100 or remains cyanotic, neonatal resuscitation is required. This is a rapid sequence of steps to be initiated if a baby’s breathing or circulation is impaired. The aim is to optimize the airway, breathing, and circulation as quickly as possible.

Effectiveness of resuscitation is assessed every thirty seconds based on improvement in breathing, HR and color.
Newborn Life Support

Dry the baby
Remove any wet towels and cover
Start the clock or note the time

Assess (tone), breathing and heart rate

If gasping or not breathing:
Open the airway
Give 5 inflation breaths
Consider SpO₂ monitoring

Re-assess
If no increase in heart rate
look for chest movement

If chest not moving:
Recheck head position
Consider 2-person airway control
and other airway manoeuvres
Repeat inflation breaths
Consider SpO₂ monitoring
Look for a response

If no increase in heart rate
look for chest movement

When the chest is moving:
If heart rate is not detectable
or slow (<60 min⁻¹)
Start chest compressions
3 compressions to each breath

Reassess heart rate every 30 s
If heart rate is not detectable
or slow (<60 min⁻¹)
consider venous access and drugs

Acceptable pre-ductal SpO₂
2 min 60%
3 min 70%
4 min 80%
5 min 85%
10 min 90%
Memo:
A: Airway (clear airway)
B: Breathing (stimulate and provide positive-pressure ventilation)
C: Circulation (administer chest compressions)
D: Drugs (administer adrenaline and/or volume)

Drugs for neonatal resuscitation

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Concentration</th>
<th>Route/Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline</td>
<td>1:10000</td>
<td>IV: 0.1-0.3 ml/kg</td>
</tr>
<tr>
<td>Volume expander</td>
<td>Normal saline (SS 0.9%); Whole blood</td>
<td>IV: 10 ml/kg</td>
</tr>
<tr>
<td>Dextrose</td>
<td>10%</td>
<td>IV: 3ml/kg (300 mg/kg)</td>
</tr>
</tbody>
</table>

2. Asphyxia

Definition

Asphyxia is defined as inadequate delivery of oxygen to meet metabolic demand. This can occur perinatally due to fetal, maternal and/or placental etiology

Risk factors and conditions associated with neonatal asphyxia
<table>
<thead>
<tr>
<th>Fetal</th>
<th>Maternal</th>
<th>Placental</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Preterm and post-dates</td>
<td>- General anesthetic</td>
<td>- Chorioamnionitis</td>
</tr>
<tr>
<td>- Multiple births</td>
<td>- Maternal drug therapy</td>
<td>- Placenta previa</td>
</tr>
<tr>
<td>- Forceps or vacuum–assisted delivery</td>
<td>- Pregnancy-induced Hypertension</td>
<td>- Placental abruption</td>
</tr>
<tr>
<td>- Abnormal presentation</td>
<td>- Chronic hypertension</td>
<td>- Cord prolapse</td>
</tr>
<tr>
<td>- Emergency caesarean section</td>
<td>- Maternal infection</td>
<td>- Polyhydramnios</td>
</tr>
<tr>
<td>- Intrauterine growth restriction (IUGR)</td>
<td>- Maternal diabetes mellitus</td>
<td>- Ligohydramnios</td>
</tr>
<tr>
<td>- Meconium–stained amniotic fluid</td>
<td>- Hemorrhage</td>
<td></td>
</tr>
<tr>
<td>- Abnormal fetal heart rate trace</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Congenital malformations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Anemia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Infection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hypoxic Ischemic Encephalopathy**

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

<table>
<thead>
<tr>
<th>Stage**</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of consciousness</strong></td>
<td>Hyperalert</td>
<td>Lethargic or obtunded</td>
<td>Stupor or coma</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td>Normal</td>
<td>Decreased</td>
<td>absent</td>
</tr>
</tbody>
</table>

### Neuromuscular control

<table>
<thead>
<tr>
<th>Muscle tone</th>
<th>Normal</th>
<th>Mild hypotonia</th>
<th>Flaccid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Posture</strong></td>
<td>Mild and distal flexion</td>
<td>Strong distal flexion</td>
<td>Intermittent decerebration (extension)</td>
</tr>
<tr>
<td><strong>Stretch reflexes</strong></td>
<td>Overactive</td>
<td>Overactive</td>
<td>Decreased or absent</td>
</tr>
</tbody>
</table>

### Complex/Primitive reflexes

<table>
<thead>
<tr>
<th>Suck</th>
<th>Weak</th>
<th>Weak or absent</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moro (Startle)</td>
<td>Strong, low threshold</td>
<td>Weak, incomplete, high threshold</td>
<td>Absent</td>
</tr>
<tr>
<td>Tonic neck</td>
<td>Slight</td>
<td>Strong</td>
<td>absent</td>
</tr>
</tbody>
</table>

### Autonomic function

<table>
<thead>
<tr>
<th>Pupils</th>
<th>Mydriasis</th>
<th>Miosis</th>
<th>Variable, often unequal; poor light reflex, fixed, dilated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>Tachycardia</td>
<td>Bradycardia</td>
<td>Variable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Seizures</th>
<th>None</th>
<th>Common, focal or multifocal</th>
<th>Uncommon (excluding decerebration)</th>
</tr>
</thead>
</table>

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**Stage 0 = Normal**
Treatment: Avoid hyperthermia (temp should remain < 37.5); no bundling, no incubator

- Supportive care: Start supplemental oxygen if respiratory distress or O2 sat < 90%.
- NPO if respiratory distress, seizures or Sarnat Stage 3.
- IV fluid: G10% at 60 mL/kg/day to avoid cerebral edema.
- Monitor and normalize glucose, electrolytes, and calcium.
- Monitor and treat seizures.

3. Seizures

- Aggressively diagnose and manage seizures: Frequent vital signs, close general observation

  - Diagnosis: neonatal seizures can be subtle compared to older patients: Non-extinguishable twitching or jitteriness, rhythmic lip or jaw movements, staring or eye twitching, extension of extremities, clenching of fists, and changes in vital signs including apnea.

  - Treatment:
    - Phenobarbital:
      - Loading dose: 20 mg/kg IV slow push.
        May repeat 10 mg/kg after 20-30 minutes if seizures continue.
Maintenance: 3-5 mg/kg/day IV if seizures persist.

→ Consider Phenytoin if seizures persist after Phenobarbital:
  o Loading dose: 20 mg/kg/dose IV
  o Maintenance dose: 5 mg/kg/dose IV every 24 hours

→ Anticonvulsants can cause apnea, especially at high doses and in combination; monitor closely.

- Ongoing monitoring: If infant is given anticonvulsant, observe for at least 48 hours after last dose to ensure that seizures do not recur. If infant has HIE, especially if seizures during hospitalization, arrange RDV after discharge to home. Frequency and duration of follow up depends on severity of HIE.
UNIT 4.

HYPOTHERMIA AND KANGAROO MOTHER CARE

Immediately after birth or arrival to hospital:
• Dry infant and keep under warming light.
• Obtain temperature within first hour of life.
• Normal temperature range 36.5-37.5°C.

1. Kangaroo mother care (KMC) for low birth weight (LBW) infants

• Encourage all mothers with LBW babies to KMC.
• KMC transfers heat from mother to baby by conduction.
• Advantages: Prevents hypothermia, enables frequent breast feeding and allows earlier hospital discharge.
1. Transfer infant to Neonatal Unit if elsewhere
2. No enteral feeds until temp > 35°C, initiate IV fluid if temp not > 35°C in 3 hours.
3. Begin kangaroo mother care (KMC) to re-warm infant
4. Minimize heat loss by ensuring that infant is dry and wearing hat, windows and curtains are closed
5. Recheck temp every hour until >36.5°C
6. If unable to achieve normal temperature use radiant warmer, heating lamp or incubator if available (see incubator guidelines)
7. If not available, use warm (42°C) water bottles wrapped in towels to prevent burns
8. Maintain temperature between 36.5–37.5°C

1. Begin kangaroo mother care (KMC) once the infant’s condition is stable and the mother is able
2. Place infant on mother’s chest for skin to skin contact
3. Ensure that the mother and infant are away from drafty windows
4. Cloth the infant with a blanket and hat
5. Check the infant’s temperature every 3 hours
6. Allow the infant to breast or bottle feed if ready, or otherwise start nasogastric feeds.
- **Method**
  - Skin to skin on chest of family member
  - Face should not be covered
  - Can be intermittent or continuous
  - Phototherapy: If causes hypothermia, consider alternating with KMC
  - Good hand hygiene to prevent infection

- **Criteria**
  - Stable newborn
  - Mild respiratory distress in nasal cannula acceptable

- **Contraindications**
  - Moderate to severe respiratory distress
  - Hemodynamic instability
  - Systemic signs of sepsis

- **Procedure**
  - Vital signs per doctor’s orders
  - If hypothermic at initiation of KMC, measure temperature one hour after starting KMC to ensure normothermia

- **Discharge criteria**
  - KMC method well tolerated by infant and mother
  - Temperature (and remainder of vital signs) stable for at least 3 days
Breast feeding and gaining birth weight plus gaining weight well (10-15 gm/day for 3 days) and within 10% of birth weight

- Follow up: All infants with BW <2 kg should have RDV to assess temperature and weight gain within the week after discharge.

- Readmission criteria
  - Unable to continue KMC for an infant <2 kg
  - <10 gm/day weight gain
  - Presence of any danger signs

2. Incubator guidelines for low birth weight infants

2.1 Initial incubator management

a) Ensure that the incubator is functioning properly, has been cleaned, and is correctly connected to power source with voltage transformer if needed. Do not use humidification option.

b) Place naked infant in the incubator if meets one of the following criteria:
  - Too unstable to remain in KMC (because of respiratory distress or another reason)
  - Weighs <1.5 kg (very low birth weight).
● Unable to keep temperature >36.5°C using warming lights, KMC, or bundling (because of VLBW or another reason)
● Poor weight gain

c) Set the incubator ambient air temperature according to the following WHO recommendations:

<table>
<thead>
<tr>
<th>Weight of infant</th>
<th>Recommended Incubator Ambient Air Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.5 kg</td>
<td>If infant is 0-10 days old</td>
</tr>
<tr>
<td>1.5 to 2.0 kg</td>
<td>Regardless of age</td>
</tr>
<tr>
<td></td>
<td>36 °C</td>
</tr>
<tr>
<td></td>
<td>35 °C</td>
</tr>
</tbody>
</table>

d) After placing infant in incubator, check axillary temperature every hour until > 36.5°C.

e) If unable to reach temperature > 36.5°C, then increase the ambient air temperature of the incubator by 1°C increments every hour until the infant temperature reaches >36.5°C. Goal temperature is 36.5–37.5°C.
2.2 Ongoing incubator management

- Any infant placed in the incubator must have manual axillary temperature checked every 3 hours.
- If infant’s temperature is < 36.5°C, increase incubator temperature by 1°C and check temperature after 1 hour.
- If infant’s temperature is >37.5°C, decrease incubator temperature by 1°C and check temperature after 1 hour.

Once infant is clinically stable, wrap in blanket and hat and turn incubator temperature down by 2°C and recheck temperature in 1 hour. Adjust incubator temperature as above.

If the infant temperature reaches >38°C or there is any concern that the incubator is not functioning properly, remove the infant from the incubator immediately.

2.3 Weaning incubator

- When infant's temperate rises to > 37.5 °C, wean incubator temperature by 0.5 °C and recheck axillary temp in 1 hour
- When infant has stable temperature in normal range with incubator temperature of < 30°C, then transition to Kangaroo Mother Care.
1. Definition

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

2. Suspect bacterial infection if:

- The infant has one or more of the following danger signs:
  - Abnormal vital signs
  - Fever (temp >38 °C), hypothermia (temp <36 ºC) or temperature instability
  - Tachycardia (HR > 180) or bradycardia (HR <80)
  - Tachypnea (RR > 60) or bradypnea (RR < 30) including apnea
  - Poor perfusion: capillary refill time > 3 seconds, hypotension
— Abnormal breathing: gasping, grunting, severe chest indrawing, nasal flaring or apnea
— Abnormal color: cyanotic, pale, grey, mottled, jaundiced, erythematous including umbilical flare
— Abnormal activity: tremors, irritability, seizures, floppiness, stiffness or minimal response to stimulation, lethargy
— Abnormal feeding: poor feeding, abdominal distention, recurrent vomiting, diarrhea, otherwise unexplained hypo- or hyperglycemia
— History of convulsions
— Jaundice
— Bulging fontanelle
— If the infant has signs or risk factors for sepsis, immediately notify the doctor, obtain blood for laboratory testing and start IV antibiotics.

● Premature or low birth weight <2.0 kg
● There are maternal risk factors for infection
  — Maternal fever (temp >38ºC) during labor or within 24 hours after delivery
  — Maternal urinary tract infection in current pregnancy or bacteriuria
  — Duration of membrane rupture > 18 hours before delivery
  — Uterine tenderness or foul smelling amniotic fluid
  — Obstetric diagnosis of chorioamnionitis
  — Meconium stained amniotic fluid
— Resuscitation at birth
— Invasive procedures
— Home delivery

3. Laboratory and studies

● CBC (complete blood count with differential).
  Concern for sepsis if:
  — Total WBC is abnormal (<5,000 or >20,000)
  — Differential with granulocytes >70%.
● CRP. Concern for sepsis if positive.
● Consider urinalysis and gram stain if symptoms of urinary tract infection or more general concerns for sepsis in infant >1 week old
● Consider lumbar puncture if concern for meningitis (lethargy, irritability, convulsions, bulging fontanel, meningismus).
● Consider chest x-ray if respiratory distress or oxygen desaturation

4. Recommended antibiotic therapy (adapted from WHO guidelines)

● Sepsis evaluation: Ampicillin + Gentamicin
● Suspected sepsis, pneumonia or UTI, first-line therapy: Ampicillin + Gentamicin
- Suspected meningitis, first-line therapy: Ampicillin + Cefotaxime (preferred) or Ceftriaxone
  - Antibiotics that cover gram positive and negative organisms must be given together for the same duration to ensure adequate treatment.
  - The first line choice is Ampicillin and Gentamicin. Gentamicin has been proven to be safe and effective with therapeutic peaks and troughs, and without renal complications in neonates with normal renal function at the prescribed once-daily doses.
    - If the infant has adequate urine output, do NOT stop Gentamicin before Ampicillin.
    - If the infant does not have adequate urine output, use a third generation cephalosporin (Cefotaxime or Ceftriaxone) instead of Gentamicin.
## Antibiotic Dosing Chart for Newborns

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose/Frequency</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 14 days</td>
<td>&gt; 14 days</td>
</tr>
<tr>
<td></td>
<td>≤ 35 weeks PMA* (if PMA not known use current weight ≤ 2.0 kg)</td>
<td>&gt; 35 weeks PMA* (if PMA not known use current weight &gt; 2.0 kg)</td>
</tr>
<tr>
<td>Ampicillin or Cloxacillin</td>
<td>150 mg/kg IV every 12 hours If meningitis ruled out: 50 mg/kg IV every 12 hours</td>
<td>50 mg/kg IV every 6 hours Meningitis: 100 mg/kg IV every 6hr.</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>3 mg/kg IV once a day</td>
<td>&gt; 1 month: 7.5 mg/kg IV once a day</td>
</tr>
<tr>
<td>Cefotaxime¹</td>
<td>50 mg/kg IV every 12 hours</td>
<td>Preferred over Ceftriaxone due to improved safety profile</td>
</tr>
<tr>
<td>Ceftriaxone²</td>
<td>50 mg/kg IV every 12 hours for sepsis/meningitis: 50 mg/kg x1 IM for pus draining from eye For IM injection, dilute to 350 mg/mL. Max dose ½ mL = 175 mg</td>
<td>Contraindicated in setting of jaundice or within 48 hours of IV calcium administration</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>7.5 mg/kg IV every 24 hours</td>
<td>Anaerobic coverage including treatment of necrotizing enterocolitis</td>
</tr>
<tr>
<td>Acyclovir</td>
<td>20 mg/kg IV every 12 hrs</td>
<td>Treatment of herpes simplex infection: 14 days if localized, 21 days if disseminated</td>
</tr>
</tbody>
</table>

**Note:** See next notes about PMA, cefotaxime and ceftriaxone
*PMA: Post Menstrual Age*

1. **CEFOTAXIME**: To replace gentamicin in the treatment of sepsis in the setting of renal dysfunction, or to treat presumed meningitis due to poor CNS penetration of gentamicin, preferred to Ceftriaxone, especially in setting of hyperbilirubinemia.

2. **CEFTRIAXONE**: Do not use in setting of hyperbilirubinemia because displaces bilirubin from albumin, do not administer within 48 hours of IV calcium in infants < 28 days of age due to risk of lethal precipitation.

**Duration of antibiotic therapy:**

Course of antibiotics is determined by decision regarding diagnosis. There are three general categories of diagnoses to be considered in newborns being evaluated for bacterial infection.

- Negative sepsis evaluation. An infant is initially considered for sepsis, but evaluation is determined to be negative.
  - Few perinatal risk factors for sepsis.
  - Clinical course mild with infant asymptomatic at 48 hours.
  - Laboratory testing reassuring with total WBC between 5,000 and 20,000, granulocyte <70% and/or CRP negative.
  - Antibiotic therapy should be discontinued after 48 hours. If there are residual concerns about the evaluation, the infant should be observed for 1–2 days off of antibiotics to monitor for signs and symptoms of partially treated sepsis.
- Presumed sepsis/pneumonia. An infant’s overall course is consistent with a true bacterial infection, not involving the meninges
  - Multiple perinatal risk factors for sepsis
  - Clinical course more severe and still symptomatic at 48 hours
  - Laboratory testing (+/- CXR) supportive of sepsis with total WBC <5,000 or >20,000, differential with > 70% granulocytes and/or CRP positive.
  Antibiotics should be continued for 7 days.
  If poor response after 48 hours, change Gentamicin to third generation cephalosporin (Cefotaxime or Ceftriaxone)
  If symptoms persist after a week, antibiotics should be continued for up to 14 days or until symptoms resolve.
  If no improvement, consider bacterial process resistant to current antibiotic and other diagnoses (viral process, malaria, tuberculosis, atypical pneumonia such as Chlamydia)
  Infant should have a lumbar puncture to assess for meningitis because of high risk of dissemination

- Meningitis: An infant’s overall course is concerning by clinical signs or lumbar puncture.
  - Meets criteria for sepsis above
  - CSF with >30 WBC, abnormal neurological exam: seizures, abnormal tone and full fontanelle
Antibiotic therapy should be 14 days for gram positive organisms and 21 days for gram negative organisms. If specific organism is identified, tailor antibiotic coverage accordingly. If the etiology of the meningitis is not known, determine duration of treatment by clinical judgment, normalization of CSF, CBC and CRP.
# Antibiotic Coverage Summary by Condition for infants < 1 month of age

<table>
<thead>
<tr>
<th>Condition</th>
<th>Clinical Condition</th>
<th>Laboratory Results</th>
<th>Treatment recommends</th>
<th>Therapy Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sepsis Evaluation: negative</strong></td>
<td>Normal vital signs, well appearing</td>
<td>Normal WBC, differential, CRP, CXR</td>
<td>Ampicillin Gentamicin</td>
<td>48 hours</td>
<td></td>
</tr>
<tr>
<td><strong>Sepsis/ Pneumonia</strong></td>
<td>Abnormal vital signs, ill appearing</td>
<td>Abnormal WBC, differential, CRP, CXR</td>
<td>Ampicillin Gentamicin</td>
<td>7 days</td>
<td></td>
</tr>
<tr>
<td><strong>Sepsis/ Pneumonia: Not improving</strong></td>
<td>Abnormal vital signs, ill appearing, poor response to antibiotics after 48 hrs</td>
<td>Abnormal WBC, differential, CRP, CXR</td>
<td>Ampicillin Cephalosporin</td>
<td>7-14 days</td>
<td>Cefotaxime preferred over ceftriaxone</td>
</tr>
<tr>
<td><strong>Meningitis</strong></td>
<td>Abnormal vital signs, ill appearing, abnormal neurological exam</td>
<td>Abnormal WBC, differential, CRP, CXR, CSF</td>
<td>Ampicillin Cephalosporin</td>
<td>14 days if gram + 21 days if gram -</td>
<td>Cefotaxime preferred over ceftriaxone</td>
</tr>
<tr>
<td><strong>Urinary Tract Infection</strong></td>
<td>Abnormal vital signs, ill appearing</td>
<td>Urinalysis concerning for urinary tract infection</td>
<td>Ampicillin Gentamicin</td>
<td>7 days</td>
<td>Generally considered in infants ≥ 7 days</td>
</tr>
</tbody>
</table>
Assume that blood and body substances of all patients are potential sources of infection, regardless of diagnosis or presumed infectious status.

1. **Standard precautions include the following:**
   - Hand washing and antisepsis (hand hygiene)
   - Use of personal protective equipment (i.e. gloves) when handling blood and other body substances
   - Appropriate handling of patient care equipment and soiled linen
   - Prevention of needle stick/ sharps injuries
   - Environmental cleaning
   - Appropriate handling of waste

2. **Additional precautions**

   Additional precautions (transmission-based) are needed for diseases transmitted by air, droplets and contact
   - Precautions vary by disease
- Patients with a viral illness should not be placed near patients with compromised immune system including neonates.

3. **Hand hygiene**

- Simplest and most cost effective way of preventing transmission of infection and reducing incidence of healthcare associated infections
- 2 methods of hand hygiene:
  - **Hand-rub with waterless antiseptic solution**
    - Alcohol hand-rubs are appropriate for rapid hand decontamination between patient contacts
      If alcohol hand-rub not available: Mix alcohol and glycerin solution: 2ml of glycerin + 100 ml of alcohol 70-90%; clean hands with 3 to 5 ml of solution.
    - Not a substitute for hand washing if hands are soiled
  - **Hand wash**
    - Dry hands with clean towel after washing
    - Common towels must not be used as they facilitate transmission of infection when:
      - Unit staff and parents: Prior to entry to neonatal care
      - Before touching a patient
      - Before a clean/ aseptic procedure
→ After handling any blood, body fluid or contaminated items
→ After touching a patient
→ After touching patient surroundings

4. Equipment cleaning

- Any equipment that can be dedicated to patient and not staff should remain at the bedside
  - Stethoscope, thermometer
- Equipment that is shared must be cleaned between patients
  - Glucose monitor, oxygen saturation monitor, scale
- All surfaces in patient care areas should be cleaned daily
  - Countertops and tables, medication cart
    - 0.5% Chlorine or 70% alcohol solution should be used to clean surfaces and equipment.
  - Allow to dry before use on another patient
    - Chlorhexidine 2% is intended for skin preparation or hand cleaning; not intended for cleaning surfaces
    - For cleaning surfaces and material: use chlorine solution (eau de javel) 0.5%. for reconstitution: water to add in ml = [concentration of the chlorine solution in %/0.5%]-1
5. Personal attire

- Staff of neonatal unit: Leave white coats outside unit and replace with unit specific coats
- Parents: Wear washable multi-use gown over street clothes.
UNIT 7.

APNEA AND BRADYCARDIA

Apnea and bradycardia for LBW (<1500 kg) or premature (<33 weeks gestation) infants

Premature infants are susceptible to apnea and bradycardia of prematurity due to immaturity of their cardio-respiratory drive. Pharmacological therapy with a methylxanthine stimulant (caffeine or aminophylline) decreases apnea and bradycardia of prematurity and is a crucial intervention to improve the outcome of premature infants.

1. Definition

- **Apnea**: Pause in breathing for > 20 seconds
- **Bradycardia**: Abnormally slow HR; <100 beats/minute in the preterm infant

2. Significance

- A slowing of RR or HR causes decreased oxygen and blood supply to vital organs potentially causing repetitive hypoxic ischemic end organ injury, including brain injury
- Usually due to immaturity of cardio-respiratory drive
- May be caused by gastro-esophageal reflux
● If new onset or worsened frequency/severity, may indicate other problems such as infection, hypothermia or seizures

3. Assessment

● Monitor with cardiovascular and/or O2 saturation monitor if available.
● If not available, assess by physical exam for color change: pallor, cyanosis or mottling. In mild cases of apnea/bradycardia, there may be no associated physical examination findings.
● If new onset apnea and bradycardia, or worsened frequency or severity:
  — Conduct thorough physical exam looking for signs/symptoms of sepsis (hypotension, poor perfusion, pallor, respiratory distress, abdominal distention, lethargy)
  — Consider laboratory evaluation: CBC and CXR
  — Consider starting antibiotics based on above evaluation
● Treatment:
  — All infants with birth weight <1.5 kg or GA <33 weeks should be started on a methylxanthine stimulant (caffeine or aminophylline) on admission or DOL 1.
  — Caffeine:
    o Loading dose: 20 mg/kg caffeine citrate NG/PO x1 on day of initiation.
- Maintenance dose (subsequent day and onward): 10 mg/kg/day caffeine citrate NG/PO, given as once daily dose in morning.
- Caffeine is currently only available for enteral administration in Rwanda. May give by enteral route even if baby is still on IV fluids

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**Or Aminophylline:**

- Loading dose: 10mg/kg IV x1 on day of initiation.
- Maintenance dose (subsequent day and onward):
  
  \[
  \begin{align*}
  \leq 7 \text{ days of age} & : 2.5 \text{ mg/kg/dose IV or NG/PO Q12hrs} \\
  \geq 7 \text{ days of age} & : 4 \text{ mg/kg/dose IV or NG/PO Q12hrs}
  \end{align*}
  \]
- Contraindication: Severe vomiting, convulsions
- Give aminophylline by IV if infant is still receiving IV fluids, then give by NG/PO.
- Caffeine is for enteral administration only. Can give enterally even if infant is still on IV fluids.

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- If infant develops tachycardia and agitation, assess the risk/benefit ratio and consider decreasing dose within recommended range.

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

*Note:* Infants should NOT be discharged to home on caffeine or aminophylline because it is difficult to safely discontinue the medication in the outpatient setting.
1. Moderate Hypoglycemia Protocol:
Glucose 1.4 – 2.5 mmol/L (25 - 45 mg/dL)

(See moderate hypoglycemia protocol on next page)

Notes:
- Glucose conversion: 1mmol/L = 18 mg/dL
- If unable to measure blood sugar for high risk but asymptomatic newborn, follow moderate hypoglycemia protocol.
  - High risk: Required resuscitation, concern for sepsis, premature (< 35 weeks) or LBW (<2kg), poor feeding
- If unable to measure blood sugar for infant with symptoms of hypoglycemia, follow severe hypoglycemia protocol
  - Symptoms of hypoglycemia: Jittery, lethargic, seizures
- If breastmilk not available, use artificial milk. If neither breast nor artificial milk is available, G10% IV fluid may be given enterally

If glucose falls below 1.4 mmol/L, then refer to severe hypoglycemia protocol

Safe to Feed?
( e.g. no respiratory distress, RR < 70)

Yes

No
2. Severe Hypoglycemia Protocol:
Glucose < 1.4 mmol/L (25 mg/dL)

(See severe hypoglycemia protocol on next page)
**Notes:**

- Glucose conversion: 1 mmol/L = 18 mg/dL
- If unable to measure blood sugar for high risk but asymptomatic newborn, follow moderate hypoglycemia protocol
  - High risk: Required resuscitation, concern for sepsis, premature (<35 weeks) or LBW (<2kg), poor feeding
- If unable to measure blood sugar for infant with symptoms of hypoglycemia, follow severe hypoglycemia protocol
  - Symptoms of hypoglycemia: Jittery, lethargic, seizures
- If breastmilk not available, use artificial milk. If neither breast nor artificial milk is available, G10% IV fluid may be given enterally
**UNIT 9.**

**FLUIDS & NUTRITION**

**Respiratory distress**

**RR > 70?**

**Glucose > 2.6 mmol/dL**

- **Yes**
  - Provide maintenance glucose

- **No**
  - Recheck glucose 30 minutes after bolus

**Start enteral nutrition**

- **Yes**
  - Breast or bottle feed. If breast, supplement with bottle if < 3 days old
  - Give enteral feeds

- **No**
  - Give feeds by NG 10 mL/kg

- **Re-measure glucose ½ hour after feeding.**
- **If glucose still < 25 mg/dL,** give additional enteral feeds and/or re-attempt IV access.
- **If glucose 25-45 mg/dL,** follow moderate hypoglycemia protocol
Infants admitted to the neonatal care who are stable from cardio-respiratory standpoint and have a BW of ≥1.5 kg can be offered ad lib PO feeds.

1. **Fluid Guideline for Infants**

- Infants require higher daily fluid amounts and dextrose concentrations than older children due to high caloric and fluid requirements.
- Low birth weight (LBW) infants have high fluid requirement due to their large body surface area.
- “Weight for calculations” is the birth weight (BW) until current weight is >BW.
- Infants with BW < 1.5 kg and those with cardio-respiratory instability including those at risk for brain injury should not receive enteral feedings on Day 0 (day of birth). Instead, they should be given G10% at the appropriate volume based on Total IV Fluid chart.

<table>
<thead>
<tr>
<th>Days</th>
<th>IV Fluid</th>
<th>&lt; 1.5 kg</th>
<th>&gt; 1.5 kg</th>
<th>Brain injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 0</td>
<td>G10%</td>
<td>80</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>Day 1</td>
<td>G10%</td>
<td>100</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>Day 2+</td>
<td>G10% ¼ RL</td>
<td>120</td>
<td>100</td>
<td>80</td>
</tr>
</tbody>
</table>
**Note:** Day of birth is "day 0"

- Newborns (DOL 0) should always be started on G10%, never G5%. If an infant is persistently hyperglycemic on G10% despite minimizing volume of infusion while supporting hydration, change to G5% and monitor glucose closely. This situation occurs most frequently in the ELBW (< 1000 gm) infant.
- On day of life 0 and 1, infants do not need supplemental electrolytes due to higher baseline total body sodium content and decreased renal function.
- By day of life 2, infants require maintenance Na+ at 3 mEq/kg/day and K+ at 2 mEq/kg/day.
  - Usually this is in the form of milk if feedings are started. Therefore, infants can remain on G10% as they advance off of IVF as they are increasing their enteral volume.
  - If feeding is not established by day of life 2, infant is requiring prolonged IV fluids and electrolytes (ions). If concern for hyperkalemia or alkalosis, IV fluid should be G10% ¼ NS.
- Infants should not receive high amounts of sodium (do not use ½ NS)
- Infants require increased total fluid administration if they have increased losses
— Infants receiving phototherapy should be given an additional 20 mL/kg/day of total fluids to account for increased insensible losses due to evaporation.
— Other reasons for increased losses include fever, vomiting, diarrhea
- See IV fluid recipes in appendix

2. **Enteral Fluid Guidelines**

- When infants are stable they can start receiving enteral feeds. LBW infants should start feeding on day of life 1 if they are otherwise well.
  — Most infants <1.5 kg will have an immature suck reflex; therefore they usually need to start with NG tube feeds after IV fluids 10% dextrose first 24 hours.
  — If infant is >1.5 kg, has mature suck and demonstrates interest in feeding, start with oral feeds (breastfeeding, bottle or syringe). If unable to take full volume enterally, give remainder of volume by NGT.
  — NG feeds should be given by gravity, not pushed through syringe.
  — If temperature < 35°C, enteral feedings should not be given until infant has been rewarmed.
In contrast to IV fluids, enteral fluids are not entirely absorbed into the vascular space. Therefore infants need higher fluid volume if being enterally fed than if on IV fluids.

Follow the “Recommended IV and Enteral Feeding Rates for Infants in Neonatal Care” below to increase the total fluids daily by increasing the enteral feeding rate if tolerated (no vomiting or distension) and decreasing IV fluid rate.

- Total fluids = IV fluids + Enteral fluids

- When infant achieves full volume feeds, increase 150 mL/kg/day volume weekly based on weight gain. If not gaining adequately, ideally 15 gm/kg/day, increase total enteral volume by 10 mL/kg/day every other day as tolerated to optimize weight gain. Most infants will tolerate 160 mL/kg/day, and some will tolerate higher volumes.

---

**Recommended IV and enteral Feeding Rates for Infants in Neonatal Unit**

| Birth Weight < 1.0 kg (ELBW) (Estimated as 0.9 kg for calculation) |
|-------------------------|-----------------|-----------------|-----------------|
| DOL | IV Fluid | Total Fluid: IV+PO | IV | Enteral |

---

_Neonatal protocols_
<table>
<thead>
<tr>
<th>DOL</th>
<th>IV Fluid</th>
<th>Total Fluid: IV+PO ml/kg/day</th>
<th>IV ml/kg/24hrs</th>
<th>ml/24 hrs</th>
<th>ml/kg/24hrs</th>
<th>ml/3hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>G10%</td>
<td>80</td>
<td>80</td>
<td>70</td>
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<td>90</td>
<td>80</td>
<td>10</td>
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</tr>
<tr>
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<td>90</td>
<td>80</td>
<td>30</td>
<td>3</td>
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<tr>
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<td>G10%</td>
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<td>90</td>
<td>80</td>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>G10%</td>
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<td>80</td>
<td>70</td>
<td>70</td>
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<tr>
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<td>G10%</td>
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<td>55</td>
<td>50</td>
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<tr>
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**Birth Weight 1.0 – 1.5 kg (VLBW)**
(Estimated as 1.25 kg for calculation)

<table>
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<th>DOL</th>
<th>IV Fluid</th>
<th>Total Fluid: IV+PO ml/kg/day</th>
<th>IV ml/kg/24hrs</th>
<th>ml/24 hrs</th>
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<tr>
<td>3</td>
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<td>90</td>
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<td>11</td>
</tr>
<tr>
<td>4</td>
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<td>50</td>
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<tr>
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<td>G10%</td>
<td>150</td>
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<td>0</td>
<td>150</td>
<td>25(full)</td>
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**Birth Weight 1.5 – 2.0 kg (LBW)**
(Estimated as 1.75 kg for calculation)
3. Feeding intolerance and necrotizing enterocolitis

- If infant has feeding intolerance as indicated by mild abdominal distension, gastric residuals of > volume of previous feeding, or vomiting, hold feedings (start IV fluids), slow the advancement of feeds or consider smaller feeds at increased frequency (such as every 2 hours).

- If the infant has bloody stool, marked abdominal distension, visible loops of bowel, discoloration of the abdominal wall, especially if accompanied by signs and symptoms of sepsis, consider the diagnosis of necrotizing enterocolitis (NEC).
in the bowel wall (pneumatosis) on abdominal X ray is diagnostic.

— Infants with NEC should be referred for a higher level of care

**Management of NEC:**

— Stop all enteral feedings, leave NGT open to air to vent stomach
— Start IV fluids G10% ¼ RL or G12.5 ¼ LR at 150 mL/kg/day to maximize caloric intake. (See IV fluid recipes in appendix )
— Due to fluid losses into the bowel, infants may need higher IV fluid volume or normal saline boluses.
— The infant should receive broad spectrum antibiotics: ampicillin, gentamicin, metronidazole

→ Metronidazole dose:
  
  o <35 weeks corrected age: 7.5 mg/kg IV Q24 hrs
  o >35 weeks corrected age: 15 mg/kg IV Q12 hrs
— Duration of bowel rest and antibiotic therapy: 7 to 14 days. Recommended course: 10 days.
— Infants may need medication for pain control. Use morphine with caution because can cause hypotension and decreased bowel motility
— After course of bowel rest and broad spectrum antibiotics, slowly reintroduce enteral feeds, watching closely for intolerance, malabsorption and obstruction due to strictures.
### Phototherapy treatment thresholds
(Based on WHO recommendations)

<table>
<thead>
<tr>
<th>Days</th>
<th>≤ 2 kg, ≤37 weeks gestation, sepsis, hemolysis, poor feeding</th>
<th>&gt; 2 kg, &gt; 37 weeks gestation, healthy (no risk factors)</th>
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<tbody>
<tr>
<td>Day 0</td>
<td>Any visible jaundice*</td>
<td></td>
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<tr>
<td>Day 1</td>
<td>220 µmol/L = 13 mg/dL</td>
<td>260 µmol/L = 15 mg/dL</td>
</tr>
<tr>
<td>Day 2</td>
<td>270 µmol/L = 16 mg/dL</td>
<td>310 µmol/L = 18 mg/dL</td>
</tr>
<tr>
<td>Day ≥ 3</td>
<td>290 µmol/L = 17 mg/dL</td>
<td>340 µmol/L = 20 mg/dL</td>
</tr>
</tbody>
</table>

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

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

If evidence of moderate to severe jaundice by physical exam, start phototherapy regardless of serum bilirubin laboratori measurement. Jaundice of palms and soles is consistent with a bilirubin level of at least 340 µmol/L = 20 mg/dL.
1. Phototherapy

Method:
- Place infant in bassinet, or incubator if available and infant is low birth weight (< 2 kg)
- Ensure that the infant is wearing protective eyewear at all times
- Infant should be otherwise naked (except for a diaper)
- Position phototherapy source at appropriate distance above infant's body (varies based on type of light source)
- Phototherapy should be continuous without any interruptions, except during feedings

Monitoring:
- Monitor closely during phototherapy:
  - Temperature: check temperature every 3 hours to ensure that it stays within the normal range of 36.5-37.5°C
  - Hydration status:
    - Phototherapy causes increased evaporative fluid losses.
    - Ensure that infant is feeding well (7-8 times per day) or on IV fluids, and that infant is urinating well (at least 6 voids per day)
  - Repeat labs: Total and direct bilirubin.
    - If initial total bilirubin > 340 µmol/L (20 mg/dL), repeat in 6-12 hours.
→ If initial total bilirubin < 340 µmol/L (20 mg/dL) with infant NOT on full volume feeds, repeat in 12 hours.
   — With infant on full volume feeds, repeat in 24 hours.

2. Rising bilirubin despite phototherapy

- If bilirubin rises to > 340 µmol/L (20 mg/dL) despite phototherapy, consider the following
  — Feed baby under phototherapy lights
  — Ensure that baby is naked with no hat, blanket or clothing covering skin
  — Ensure that all skin exposed to phototherapy. This may require additional lights
  — Increase IV hydration with boluses or maintenance fluid rates. Phototherapy increases insensible fluid losses and dehydration hemoconcentrates bilirubin.
  — Erect reflective surface around infant with material such as aluminum foil if available.

- If bilirubin level is > 425 µmol/L (25 mg/dL)
  — Apply above measures
  — Give 10 – 20 mL/kg normal saline bolus
  — Stop breast feeding and give formula until bilirubin level < 425 µmol/L (25 mg/dL)
Mother manually expresses breast milk for later use

- If not orally feeding well, place NGT and give ~150 mL/kg/day of formula

Exchange transfusion is a treatment for extreme hyperbilirubinemia; If bilirubin level is \( \geq 425 \) µmol/L (25 mg/dL) and continues to rise despite above measures, consider referral.

3. Discontinuation of Phototherapy

- Phototherapy should be discontinued once total serum bilirubin level falls below the treatment thresholds outlined above.
- After discontinuing phototherapy, recheck total bilirubin level after 24 hours. If bilirubin is above the treatment threshold, restart phototherapy and follow protocol above.
Infants are born with a physiologic polycythemia due to relative hypoxia in utero. Normal hemoglobin for a neonate is 15-18, normal hematocrit for neonate: 45-55.

(Conversion: Hemoglobin x 3 = Hematocrit).

1. Anemia

1.1 Physiological background

Over the first weeks of life, infants develop a physiologic anemia because erythropoietin and fetal hemoglobin production decreases in response to relatively rich oxygen supply.

- Term infants typically reach a physiologic nadir with hemoglobin of 9-11 at 6-12 weeks of age.
- Premature infants typically have an earlier and more severe physiologic nadir, reaching hemoglobins of 8-10 at 5-10 weeks of age.
- The nadir results in insufficient oxygen delivery to tissues, prompting a rise in erythropoietin levels rise and adult hemoglobin production. Therefore physiologic anemia rarely requires medical treatment.
1.2 Pathologic Anemia and etiology

The physiologic nadir can be exaggerated by numerous conditions:

- Obstetric blood loss: placental abruption, placenta previa, incision of placenta during caesarian.
- Fetoplacental bleeding
- Neonatal blood loss: phlebotomy, cephalohematoma, subgaleal hemorrhage, intracranial hemorrhage, bleeding into abdominal organs
- Hemolysis
  - Immune (ABO, Rh or minor blood group incompatibility)
  - Maternal diseases (lupus)
  - Hereditary red blood cell disorders (G6PD deficiency, red blood cell membrane defects, hemoglobinopathies)
  - Acquired hemolysis (infection, DIC)
- Diminished red blood cell production: iron deficiency, infection, medications

1.3 Diagnosis

Family history, laboratory testing may include NFS/CBC, reticulocyte count, smear, Coombs test
1.4 Treatment

Decision regarding need of red blood transfusion includes clinical condition of infant, etiology of anemia, hematocrit value and trend over time

Indications for red blood cell transfusion

- Significant cardiorespiratory distress
- Blood loss more rapid than ability for infant to generate red blood cells (e.g. rapid bleeding, severe hemolysis)
- Severe anemia (hemoglobin <7) with poor reticulocytosis or impaired infant growth (e.g. average of <10 gm/day) despite adequate nutrition.

Volume of transfusion depends on

- Current and goal hematocrit
- Ongoing blood loss and expected tolerance of transfusion (e.g. whether circulating volume is diminished (as with acute blood loss) vs normal (as with chronic anemia)
- Presence of chronic lung disease or other conditions in which transient fluid overloaded is poorly tolerated.

Transfusion Procedure:

- Typical transfusion is 10ml/kg given over 3 to 4 hours.
- May need second transfusion (preferably from same donor) if anemia not adequately corrected.
To calculate volume based on observed and desired hematocrit, estimated blood volume of 80 mg/kg

\[
\text{Calculation: } \frac{(\text{Desired hematocrit} - \text{Observed hematocrit})}{\text{Hematocrit of blood to be given}}
\]

Wait at least 6 hours after completion of transfusion if post-transfusion hematocrit needed in order to allow time for re-equilibration.

- Whole blood should be given to correct the anemia of rapid blood loss
- If hematocrit is not available: give 10ml/kg, monitor

**1.5 Prevention**

Infants at risk of iron deficiency should receive supplemental iron (2-4 mg of elemental iron/kg/day) once they are tolerating full enteral feeds. At risk infants include prematures and those with substantial blood loss via bleeding or phlebotomy.

**2. Bleeding**

**2.1 Etiology**

Bleeding can be due to many causes including
- Deficiency of clotting factors
- Inherited clotting abnormalities
- Low or poorly functioning platelets
It is important to distinguish whether an infant with a bleeding disorder is otherwise sick or well.

- **Sick** infants tend to have
  - Disseminated intravascular coagulopathy (DIC)
  - Platelet consumption
  - Liver dysfunction
- **Well** infants tend to have
  - Immune thrombocytopenia
  - Hemorrhagic disease of the newborn (vitamin k deficiency)
  - Hereditary clotting factor deficiencies.

### 2.2 Diagnosis

CBC including platelet count, smear and coagulation studies if possible.

### 2.3 Treatment

Vitamin K 1 mg IM if not given after birth, or if unclear documentation.
- Administer platelets and/or fresh frozen plasma if available.
3. **Polycythemia**

3.1 **Definition**

Polycythemia in the neonate is defined as a venous hemoglobin >22 or hematocrit >65%.

3.2 **Etiology**

- Placental red blood cell transfusion (e.g. delayed cord clamping, maternal fetal hemorrhage)
- Placental insufficiency (maternal hypertension syndromes, postmature and small for gestational age infants, high altitude, maternal conditions causing chronic hypoxia; cardiovascular, pulmonary, smoking)
- Infant of diabetic mother
- Some maternal medications
- Hemoconcentration due to dehydration

3.3 **Symptoms**

Are due to increased viscosity of blood

- CNS: poor feeding, lethargy, seizures
- Cardiorespiratory: cyanosis, tachypnea/respiratory distress, pulmonary hypertension
- Other: jaundice, thrombosis, hematuria, proteinuria, hypoglycemia
### 3.4 Treatment

Partial exchange transfusion. Give if:
- Hematocrit >65% and symptomatic:
- Hematocrit >70% and asymptomatic:

**Volume:** Typically 15 – 20 mL/kg body weight; depends on observed and desired hematocrit:

\[
\text{Calculation: } \frac{(\text{Desired hematocrit} - \text{Observed hematocrit}) \times \text{Body weight (kg)} \times 80}{\text{Observed hematocrit}}
\]

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

\[
\text{Calculation: } \frac{(70 - 50) \times 2.5 \times 80}{70} = 57 \text{ ml}
\]

- Slowly withdraw the calculated volume of blood and replace with normal saline.
UNIT 12.

PAIN CONTROL

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

- Preterm infants have less ability to demonstrate symptoms of pain
- Repeated painful procedures have been proven to cause adverse, long term neurologic effects
- For minor procedures e.g. blood draw, IV placement, lumbar puncture
  - Give sugar water (1 teaspoon sugar in 20 ml clean water), breast feeding, comfort measures, holding, and swaddling
- For major procedures (e.g. intubation, chest tube insertion)
  - Give morphine 0.02 mg/kg IV, may repeat x1.
    → May cause dose related respiratory depression.
- For palliative care
  - Give morphine 0.1 mg/kg IV, may repeat as needed.

Infants who have a devastating neurologic prognosis from congenital or acquired conditions require special consideration. The severity of the expected outcome must be explained to the family honestly and clearly.
I. IV fluid recipes

**G10% IV fluid from G5% and G50%**
*(Use premixed G10% if available, *if not use the recipe below*)
1. Remove 28 ml from 250ml bag of G5%
2. Add 28 ml G50% to bag in step 1
3. Mix bag to make G10%

**G10% ¼ Ringers Lactate (RL) from G5%, G50% and RL**
1. Remove 95 ml from 250ml bag of G5%
2. Add 35 ml G50% to bag in step 1
3. Add 60 ml RL to bag in step 2
4. Mix bag to make G10% ¼ Ringers lactate

**G10% ¼ Ringers Lactate (RL) from G5%, G50% and RL**
1. Remove 75 ml from 250ml bag of G5%
2. Add 15 ml G50% to bag in step 1
3. Add 60 ml RL to bag in step 2
4. Mix bag to make G10% ¼ Ringers lactate

**G10% ¼ Normal Saline (NS) from G5%, G50% and NS**
1. Remove 95 ml from 250ml bag of G5%
2. Add 35 ml G50% to bag in step 1
3. Add 60 ml NS to bag in step 2
4. Mix bag to make G10% ¼ Normal saline

**G10% ¼ Normal Saline (NS) from G10%, G50% and NS**
1. Remove 75 ml from 250ml bag of G5%
2. Add 15 ml G50% to bag in step 1
3. Add 60 ml NS to bag in step 2
4. Mix bag to make G10% ¼ Normal saline
G12.5% ¼ Ringers Lactate (RL) from G5%, G50% and RL

1. Remove 108 ml from 250ml bag of G5%
2. Add 48 ml G50% to bag in step 1
3. Add 60 ml NS to bag in step 2
4. Mix bag to make G12.5% ¼ Ringers Lactate

G12.5% ¼ Ringers Lactate (RL) from G5%, G50% and RL

1. Remove 90 ml from 250ml bag of G5%
2. Add 30 ml G50% to bag in step 1
3. Add 60 ml NS to bag in step 2
4. Mix bag to make G12.5% ¼ Ringers Lactate
## II. Management of inverted or flat nipples

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<th>Step</th>
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<td>1)</td>
<td>Cut off the tip of the syringe off with a razor blade or scalpel</td>
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<tr>
<td>2)</td>
<td>Insert the plunger from the side where the syringe was cut</td>
</tr>
<tr>
<td>3)</td>
<td>Place the open part of the syringe against the breast and pull out the nipple gently</td>
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*Note:* Use a 10 - 20 ml syringe
III. Intra-uterine growth curve

![Birth weight graph](image)

- Percentage parameters of birth weight

**Birth weight**

Weight parameters

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IV. References


7 www.helpingbabiesbreathe.org

8 WHO, Dept of reproductive health and Research (2004). Kangaroo Mother Care : a pratical guide ; ref number : WS 410 2003KA.
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Cover picture: BANANGE Jean Chris