

NATIONAL GUIDELINES FOR NEWBORN CARE

VOLUME II

- Neonatal jaundice
- Respiratory distress in newborn
- Neonatal sepsis and antibiotic therapy in newborns

MINISTRY OF HEALTH
2014



Family Health Bureau



World Health
Organization



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Statement of Intent

The main purpose of these guidelines is to improve the quality of clinical care provided by the health care providers at all levels. These parameters of practice should be considered recommendations only. The ultimate judgment regarding a particular clinical procedure or a treatment plan must be made by the clinician in light of the clinical data gathered from the patient and the diagnosis and treatment options available.

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Preface

As the year 2015 is around the corner, we are focusing our attention on reaching targets beyond the Millennium Development Goals and the goals set by the Every Newborn Action Plan of 2014. This national guideline on neonatal care is very well timed as a greater emphasis is being given for improving the quality of neonatal care services for further reduction of neonatal morbidity and mortality in Sri Lanka. Some of the guidelines are adopted from SAARC Development Fund Facility Based Care of the Sick Newborn training guidelines and some sections include newly developed guidelines. This is an attempt to improve the quality and uniformity of clinical care with efficiency, cost effectiveness and accountability.

I highly appreciate the contribution made by the Consultant Paediatricians and Consultant Neonatologists from the Sri Lanka College of Paediatricians and Consultant Community Physicians of the Family Health Bureau in adopting and developing these guidelines. Further these guidelines have been developed considering the national policy, strategies and standards as well as facilities and resources available in the country. As such this set of guidelines are national guidelines for the conditions described.

Dr P.G. Mahipala

Director General of Health Services,
Ministry of Health,
Sri Lanka.

Message from the President of Sri Lanka College of Paediatricians

Sri Lanka emerged from a 30 year old war in 2009 and five years have elapsed since then. It is not late even today to plan for long term development of the health sector like roads and townships. The health service also has improved but not clearly in a planned manner.

Our Neonatal Mortality Rate has declined to be around 5.9/1000 live births. Yet it accounts for over 70% of under 5 mortality of our children. Global average contribution of neonatal mortality to under 5 mortality is 45%. Therefore it is appropriate that we focus on improving neonatal care. Care of the preterm remains a serious challenge. 12% still die of perinatal asphyxia. 20% of deaths are due to congenital abnormalities. Sepsis remain a serious threat to even healthy term low risk babies discharged from the hospital. This is despite a lot of effort put into training of human resources and improving infrastructure. Focusing on the neonate specifically in these areas is a priority which cannot be postponed.

Simple interventions like preconception folic acid, antenatal corticosteroids for preterm delivery, preventing inadvertent oxygen administration and using a pulse oxymeter for neonatal resuscitation, delayed cord clamping, delivery onto abdomen of the mother, using plastic bags for preterm babies, preventing hypothermia, simple inflation and ventilation breaths by the midwife or nurse in unexpected situations, passive head cooling for asphyxia, promotion of exclusive breast feeding on demand could be practiced in low resource settings. Truth is these simple interventions will reduce our NMR further if the coverage could be improved to over 90%.

A team of Consultant Paediatricians, Consultant Neonatologists and Consultant Community Physicians have been working on these newborn care guidelines for several months. These guidelines for newborn care will go a long way to bring uniformity in standards of neonatal care across the country. The health care providers in different

parts of this country should be able to care for newborns in the same way using the best standards of care where ever they are. These newborn care guidelines will help them in doing so. It is not difficult, especially to provide basic care and reduce morbidity and mortality using these guidelines even in a low resource setting.

I express my sincere gratitude towards all who worked hard to publish this and congratulate the FHB and the team for their achievement. I am certain that, this booklet will go a long way to reduce mortality and both short and long term morbidity of newborns in Sri Lanka.

Prof Sujeewa Amarasena

President,

Sri Lanka College of Paediatricians

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List of Abbreviations

AC	– Assist control
ACD	– Acid citrate dextrose
ANC	– Absolute neutrophil count
BNF	– British National Formulary
CFL	– Compact fluorescent lamp
CNS	– Central nervous system
CONS	– Coagulase negative staphylococcus
CPAP	– Continuous positive airway pressure
CPD	– Citrate phosphate dextrose
CRP	– C-reactive protein
CRT	– Capillary refill time
CSF	– Cerebro- spinal fluid
CTG	– Cardiotocography
CVP	– Central venous pressure
CXR	– Chest X –Ray
DAT	– Direct antibody test
DCT	– Direct Coomb’s test
DIC	– Disseminated intravascular coagulation
EOS	– Early onset sepsis
ESR	– Erythrocyte sedimentation rate
FBC	– Full blood count
FFP	– Fresh frozen plasma
FiO ₂	– Fraction of inspired oxygen
G6PD	– Glucose 6 phosphate dehydrogenase
GBS	– Group B Streptococci
IC	– Intercostal
IL	– Interleukin
INR	– International normalised ratio
ITR	– Immature neutrophils / Total neutrophils ratio
IV	– Intra venous

IVIG	– Intravenous Immunoglobulin
LED	– Light emitting diode
LOS	– Late onset sepsis
LP	– Lumbar puncture
MAS	– Meconium aspiration syndrome
MRSA	– Methicillin resistant <i>Staphylococcus aureus</i>
MSAF	– Meconium stained amniotic fluid
NG	– Nasogastric
NIPPV	– Non – invasive positive pressure ventilation
PCO ₂	– Partial pressure of carbondioxide
PEEP	– Positive end-expiratory pressure
PPHN	– Persistent pulmonary hypertension of the newborn
PT	– Prothombin time
RDS	– Respiratory distress syndrome
ROM	– Rupture of membranes
SIMV	– Synchronised Intermittent positive pressure ventilation
SIPPV	– Synchronised intermittent positive airway pressure ventilation
SPO ₂	– Percentage of haemoglobin saturated with oxygen
T4	– Thyroxine
TCL	– Total Leukocyte Count
TORCH	– Toxoplasma, other Rubella, Cytomegalovirus, Herpes, Syphilis
TSB	– Total serum bilirubin
TSH	– Thyroid stimulating hormone
TTNB	– Transient Tachypnoea of newborn
US	– Ultra sound
UTI	– Urinary tract infection
VZIG	– Varicella zoster immunoglobulin
WBC	– White blood cells

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Disclaimer

These guidelines are based on current best available evidence and consensus opinion of the Consultants involved in the development of Guidelines. They are neither intended to replace the process of critical evaluation of every case and nor is it intended to dictate an exclusive course of management or treatment. It must be interpreted with reference to individual patient needs, available resources and limitations unique to the institution and variations in local populations.

This guideline on Neonatal Care has been developed based on the best available evidence at the time of preparation. It is the responsibility of the users of the guideline to keep updated with the latest evidence relevant to the management of patients under their care.

Introduction

Clinical guidelines are systematically developed statements which assist clinicians in making decisions about appropriate treatment for specific conditions based on the best scientific evidence at the time of development. Guidelines are not intended to limit the clinical freedom. However, clinicians are expected to follow these recommendations as the basis for their decision making. Availability of resources, the existing situations and the expectations of individual families under their care need to be considered by the clinicians.

These guidelines are developed by the group of consultants in the guidelines development committee. The sources of information that were used as references in preparing the guidelines included the UK NICE (National Institute for Clinical Excellence) guidelines, American Academy of Pediatrics guidelines, SDF Facility Based Care for the Sick Newborn manual, Robertson's Text book of Neonatology, and relevant research papers from peer reviewed journals. The information from these sources were combined with our local expert opinion and knowledge of available technical facilities in the country when formulating the guidelines. The latest available scientific evidence based recommendations have been made as far as possible. The draft guidelines were presented to the wider forum of paediatricians and neonatologists, in order to obtain feedback after which a consensus was arrived at. The guidelines were then presented to the Technical Advisory Committee on Newborn and Child Health of the Ministry of Health and consensus was arrived at with the participation of a multi-disciplinary team including medical administrators, provincial health authorities, representatives of the Sri Lanka College of Paediatricians and other relevant professional colleges and national programme managers and senior nursing officers.

Scope

The guidelines are intended to assist all health care professionals at all levels of institutions where newborn care is being provided, in the clinical management of normal and sick newborns.

NEONATAL JAUNDICE

Chapter 7

NEONATAL JAUNDICE

7.1 Introduction

Jaundice is yellow discoloration of skin and sclera. Neonatal jaundice is a common problem which often does not require intervention. However, jaundice in the newborn sometimes might signal a serious, but potentially treatable illness which may cause neurological damage (bilirubin encephalopathy with subsequent kernicterus), if the bilirubin level is significantly elevated.

7.2 Physiological and pathological jaundice

Jaundice can be seen in 60% of term infants and 80% of preterm infants. It is mostly physiological.

Features of physiological jaundice (all of the following)

- Jaundice that first appears between 24-72 hours of age
- Maximum intensity is seen on 4-5th day in term and 7th day in preterm neonates
- Does not exceed 15 mg/dl (255µmol/l)
- Clinically undetectable after 14 days

Physiological jaundice is a diagnosis by exclusion. No treatment is required but baby should be observed closely for signs of worsening jaundice.

Features of pathological jaundice (any of the following)

- Clinical jaundice within 24 hours of birth.
- Total serum bilirubin > 15mg/dl (255µmol/l) after 24 hours of life
- Total serum bilirubin (TSB) increasing by > 5mg/dl/day (85 µmol/l/day) or 0.5 mg/dl/hr (8.5µmol/l/hr)

- Conjugated serum bilirubin >20% of total serum bilirubin level
- Clinical jaundice persisting for > 2 week* in full term and >3 weeks in preterm neonates (prolonged jaundice). (*NB: except in the cases of breast milk jaundice)

7.3 Causes of jaundice

Hyperbilirubinaemia in the first week of life is usually of the unconjugated(indirect) variety. Although conjugated hyperbilirubinemia(direct) occurs less commonly, it is always pathological.

Causes of jaundice are usually classified based on the time of onset of jaundice.

Appearing within 24 hours of age

- Haemolytic disease of newborn: Rh, ABO and minor blood group incompatibility
- Infections: Intrauterine infections and perinatal sepsis
- Hereditary haemolytic anaemias: congenital spherocytosis, G6PD deficiency

Appearing after 24 hours of life

- All of the above
- Physiological
- Polycythaemia
- Concealed haemorrhages: cephalhaematoma, subaponeurotic/ subarachnoid / intraventricular haemorrhage.
- Neonatal hepatitis eg. TORCH infection
- Metabolic disorders eg. Galactosaemia, Crigler Najjar Syndrome

Prolonged jaundice

Prolonged unconjugated hyperbilirubinaemia

New/ persisting sepsis eg. urinary tract infection

Metabolic - Hypothyroidism, galactosaemia

Persisting haemolysis

Breast milk jaundice

Prolonged conjugated hyperbilirubinaemia

Neonatal hepatitis :– Congenital infections, α_1 - Antitrypsin deficiency

Extra hepatic biliary atresia

Choledochal cyst

7.4 Approach to a jaundiced baby

The following questions need to be addressed

- What is the gestation?
- What is the birth weight and current weight?
- What is the postnatal age in hours?
- Is the baby clinically ill or well?
- What is the severity of jaundice? (clinical visual perception; Fig 7.1)

After the initial evaluation decide whether;

- The baby needs investigation for jaundice?
- The baby needs phototherapy / exchange transfusion?
- The baby has features of encephalopathy?

7.5 Assessment of a jaundiced neonate

In the assessment of a jaundiced neonate, the history and examination are directed towards assessing the severity, complications and determining the aetiology of jaundice.

Severity of jaundice

When a neonate is clinically jaundiced, the total serum bilirubin (TSB) is usually >5 mg/dl ($85 \mu\text{mol/l}$). Jaundice in the newborn progresses in the cephalo-caudal direction and thus the extent of yellowness of the skin is useful to assess the level of bilirubin. Kramer's criteria are used to clinically estimate severity (Figure 7.1).

However this can be unreliable in identifying those babies who require specific management, especially once the baby is under phototherapy or is jaundiced below the nipple line. Therefore if facilities are available a bilirubin level should be checked.

NB: Once baby is under phototherapy visual assessment is inaccurate

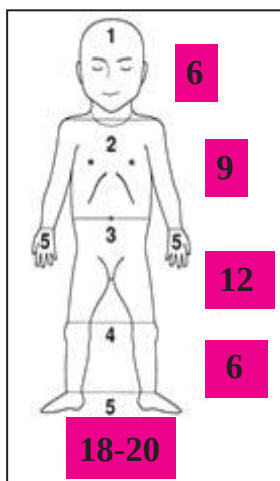


Figure 7.1: Estimation severity of jaundice (in mg/dl) by visual perception, Kramer 1969

Jaundice restricted to Face & trunk - TSB < 12mg/dl (204µmol/l); On Hand & Feet - TSB > 15 mg/dl (255µmol/l)

Features of acute bilirubin encephalopathy

The baby needs to be assessed for features of acute bilirubin encephalopathy. These features range from hypotonia, lethargy, poor feeding and irritability to hypertonia of extensor muscles, opisthotonus, respiratory distress, shrill high pitched cry, apnoea, loss of moro reflex, seizures and coma.

Laboratory testing

All babies visibly jaundiced within first 24 hrs or > 2 in Fig 7.1 after 24 hours should have a blood sample for total serum bilirubin (TSB) with direct & indirect fraction estimation.

Plot the TSB value on the treatment threshold graph and decide about intervention. (The treatment threshold graphs are available at the end of the chapter).

NB: Treatment threshold graphs are based on the total serum bilirubin value and not the unconjugated bilirubin value.

Babies needing phototherapy / exchange transfusion should have a jaundice workup which includes,

- Haemoglobin, reticulocyte count, blood picture for evidence of haemolysis
- Blood group: Mother and baby
- DCT (Coomb's test)
- Septic screen if sepsis is suspected

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

The follow-up plan may be devised based on individual assessment.

7.6 Management

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

1. Reduction of bilirubin is achieved by phototherapy and/or exchange transfusion.
2. Hyperbilirubinaemia due to dehydration may be prevented by early and frequent feeding.

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

7.6.1 Phototherapy

Preparation for phototherapy

- This involves exposure of the naked baby to blue light / CFL/LED of wave length 450-460nm
- Keep babies at the distance recommended by the manufacturer for the phototherapy lights to be maximally effective and safe (avoid hyperthermia). In case of fluorescent light phototherapy machines baby should be kept about 18 inches away from the light.
- Ideal irradiance: Use of intensive phototherapy with irradiance in blue-green spectrum of at least 20-30 μ W/cm²/nm and delivered to as much of the infant's surface area as possible.
- The light waves convert the bilirubin to water soluble nontoxic forms which are then easily excreted.
- Advantages of phototherapy: non-invasive, effective, inexpensive and easy to use
- Frequent feeding, every 2-3 hours and change of posture should be promoted in an infant receiving phototherapy.

- Eye shades should be fixed.
- External genitalia should be covered to prevent soiling from urine and stools. The nappy should cover only a minimum area of body surface of the baby.

Provision of phototherapy

- Generally single phototherapy is initiated.
- Initiate continuous multiple phototherapy if any of the following apply:
 - TSB level is rising $> 0.5\text{mg/dl/hr}$ ($8.5\mu\text{mol/l/hr}$)
 - TSB is at a level within 3mg/dl ($50\mu\text{mol/l}$) below the level for which exchange transfusion is indicated
 - TSB level fails to respond to single phototherapy (i.e. bilirubin continues to rise, or does not fall, within 6 hours of starting single phototherapy)
 - When bilirubin level falls during continuous multiple phototherapy to a level $\geq 3\text{mg/dl}$ ($50\mu\text{mol/l}$) below the threshold level for which exchange transfusion is indicated, step down to single phototherapy.
- Repeat serum bilirubin measurement 4–6 hours after initiating phototherapy.
- Repeat levels 4-6 hourly if serum bilirubin is rising or is not falling while under phototherapy.
- Repeat serum bilirubin measurement every 12-24 hours when the serum bilirubin level is stable or falling.
- Stop phototherapy once bilirubin levels are below the phototherapy level by $2-3\text{mg/dl}$ ($35-50\mu\text{mol/l}$) as per postnatal age.
- In case of haemolytic jaundice, check bilirubin levels after 12 hours of stopping phototherapy to check for rebound increase.

- Baby will appear bleached when under phototherapy and hence clinical assessment of jaundice is not reliable. Serum bilirubin must be monitored.
- Prophylactic phototherapy does not offer any clinical benefit in the course of hyperbilirubinaemia
- Do not use sunlight as treatment for jaundice.

Side effects of phototherapy

- Increased insensible water loss when providing phototherapy in cots: breastfeed more frequently / provide adequate fluids to avoid dehydration
- Loose green stools: weigh often and compensate with breast milk.
- Skin rashes: harmless, no need to discontinue phototherapy;
- Bronze baby syndrome: occurs if baby has conjugated hyperbilirubinaemia. If so, discontinue phototherapy
- Hypo or hyperthermia: monitor temperature frequently.

NB: These side effects are reversible

7.6.2 Exchange transfusion

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

When referring a baby with jaundice, make sure that either the mother is referred or mother's blood sample is sent.

- Use a double-volume exchange transfusion (2 x 80 ml / kg)
- Umbilical vessels are the preferred access method for performing an exchange transfusion
- Use acid citrate dextrose (ACD) or citrate phosphate dextrose (CPD) blood less than 2 to 5 days old.
- Electrolytes, blood gases and vital signs should be monitored during exchange transfusion

Type of blood:

In ‘Rh’ isoimmunisation, the best choice would be O negative packed cells suspended in AB positive plasma. O negative whole blood or cross-matched baby’s blood group (but Rh negative) may also be used.

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

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

Following exchange transfusion:

- Maintain continuous multiple phototherapy
- Measure serum bilirubin level within 2 hours and manage according to threshold graphs

7.7 Role of additional therapies for treatment of jaundice

- IVIG (0.5g/kg over 4 hours), for decreasing the need for exchange transfusion in neonates with Rhesus or ABO haemolytic disease when the serum bilirubin continues to rise > 8.5 µmol/l/hr

- Do not use any of the following to treat hyperbilirubinaemia
- albumin, barbiturates, cholestyramine, metalloporphyrins.

7.8 Care of babies with prolonged jaundice

In babies with a gestational age of 37 weeks or more with jaundice lasting more than 14 days and in babies with a gestational age of less than 37 weeks with jaundice lasting more than 21 days:

- look for pale chalky stools and/or dark urine that stains the nappy – seen in conjugated hyperbilirubinaemia

Following investigations are indicated in prolonged jaundice:

- Total bilirubin and conjugated bilirubin
- Full blood count, blood picture, reticulocyte count
- Blood group determination (mother and baby) and DAT (Coombs' test)
- Urine culture
- Routine metabolic screening including screening for congenital hypothyroidism (T4, TSH), galactosaemia (urine reducing substances)

If all the above investigations are not suggestive of a pathological cause the diagnosis of breast milk jaundice may be considered. Baby should be reviewed until the jaundice disappears.

Follow expert advice about care of babies with a conjugated bilirubin level greater than 20% of total bilirubin because this may indicate serious liver disease.

7.9 Conjugated hyperbilirubinaemia

This is rare in the newborn period and is defined as a direct bilirubin

level of > 20% of total bilirubin. It is important to identify the cause as it is never physiological

Approach

The following questions need to be answered

- Are the stools white or clay coloured?
- Is the urine dark coloured?
- Are liver and spleen enlarged?

Baby should be investigated to find the aetiology;

- Serum bilirubin with direct fraction
- US scan abdomen
Absence of the gall bladder after 4 hours of fasting is suggestive of biliary atresia
Altered echogenicity of liver parenchyma is suggestive of congenital hepatitis
Presence of Choledocal cyst
- Liver function tests – enzymes, alkaline phosphatase, PT /INR
- Urine for reducing substance
- Urine culture
- TORCH screen (toxoplasma, rubella, cytomegalovirus, herpes, syphilis)

Rule out or establish the diagnosis of extra hepatic biliary atresia as early as possible (within eight weeks of life) when it is still surgically correctable.

Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

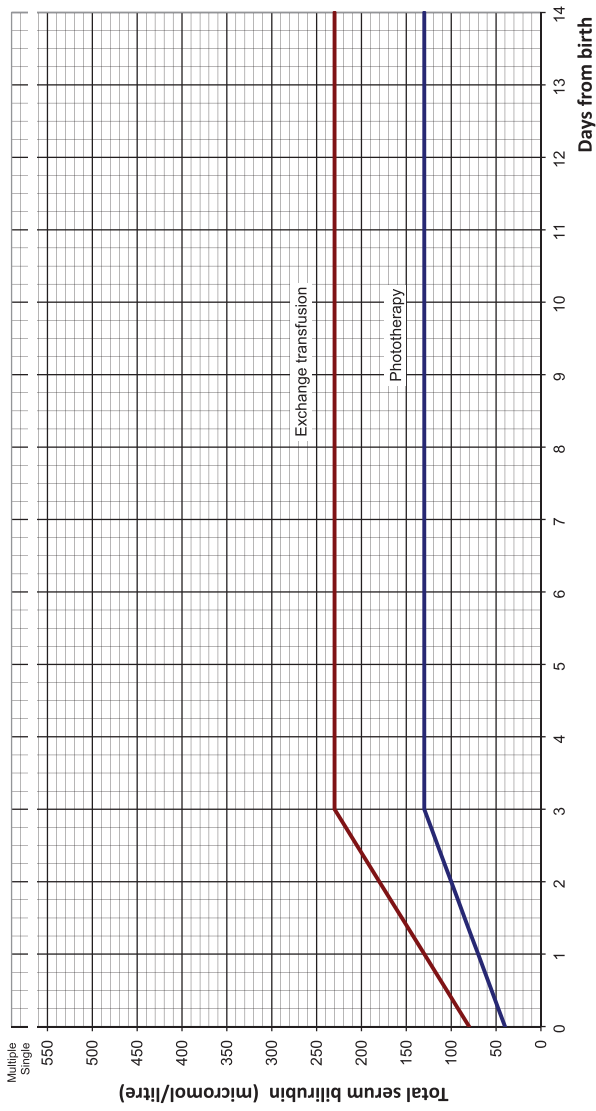
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

23 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

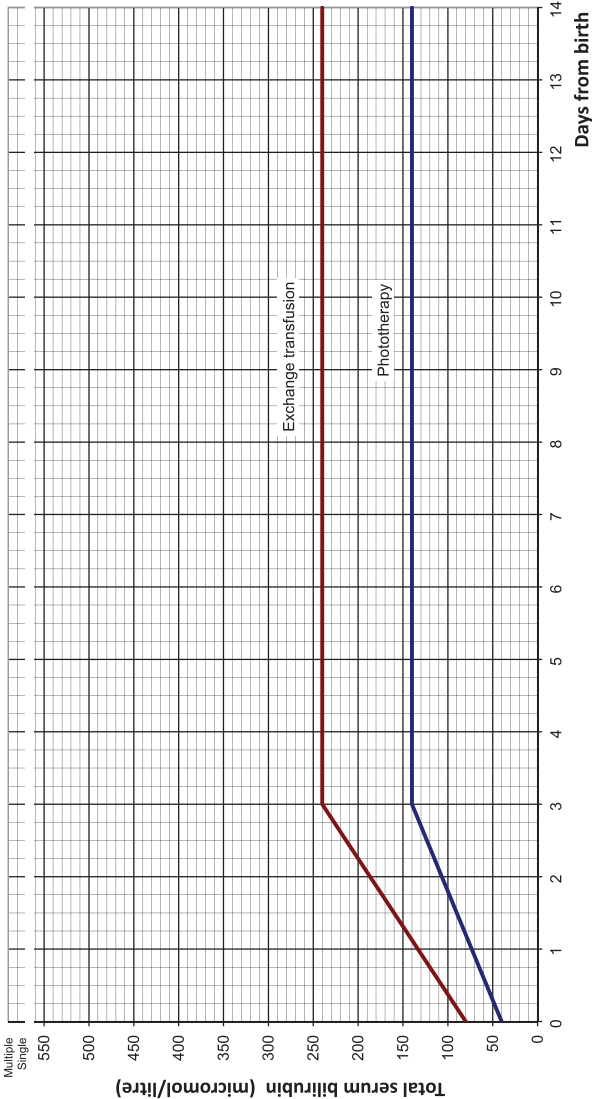
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

24 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

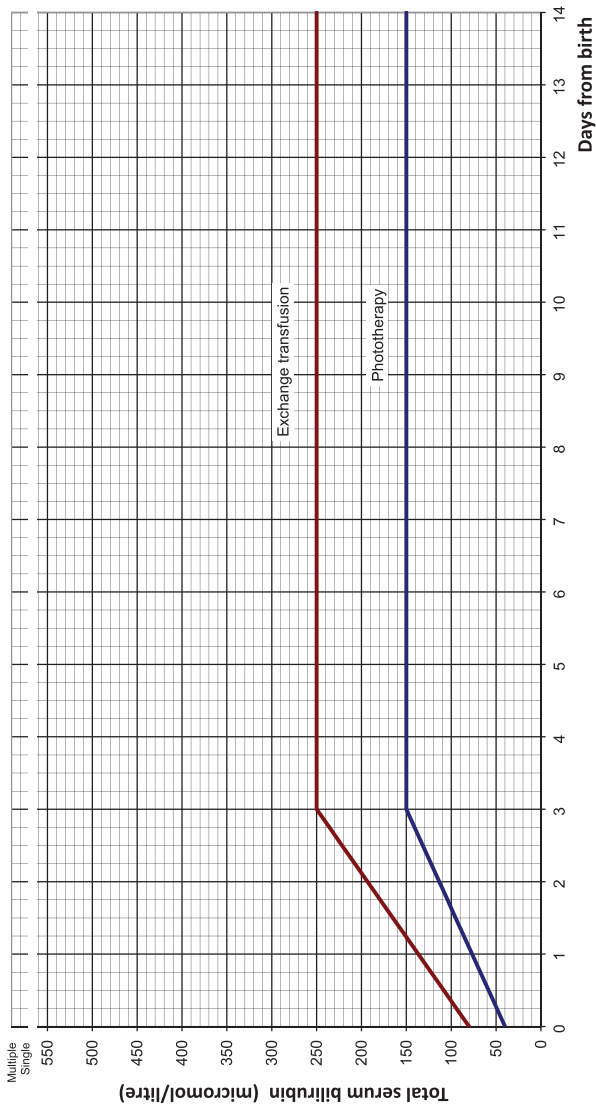
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

25 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

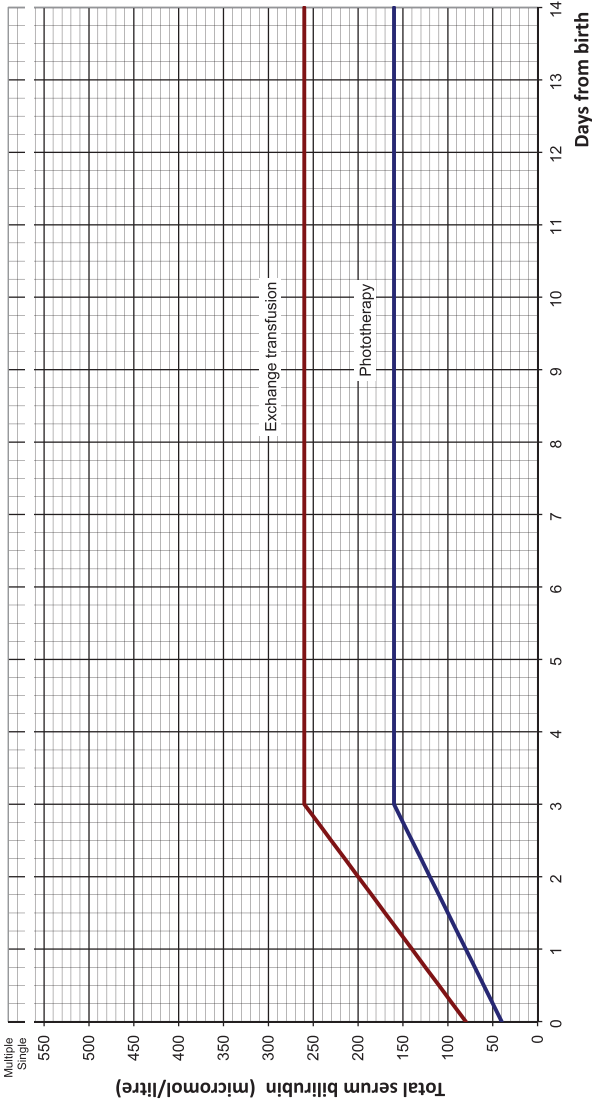
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

26 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

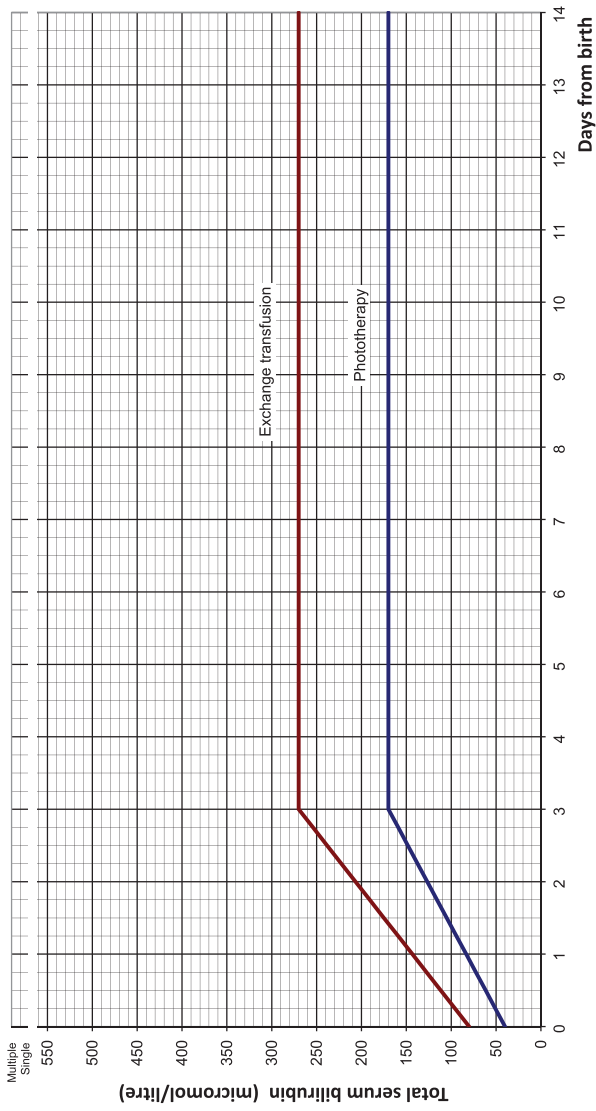
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

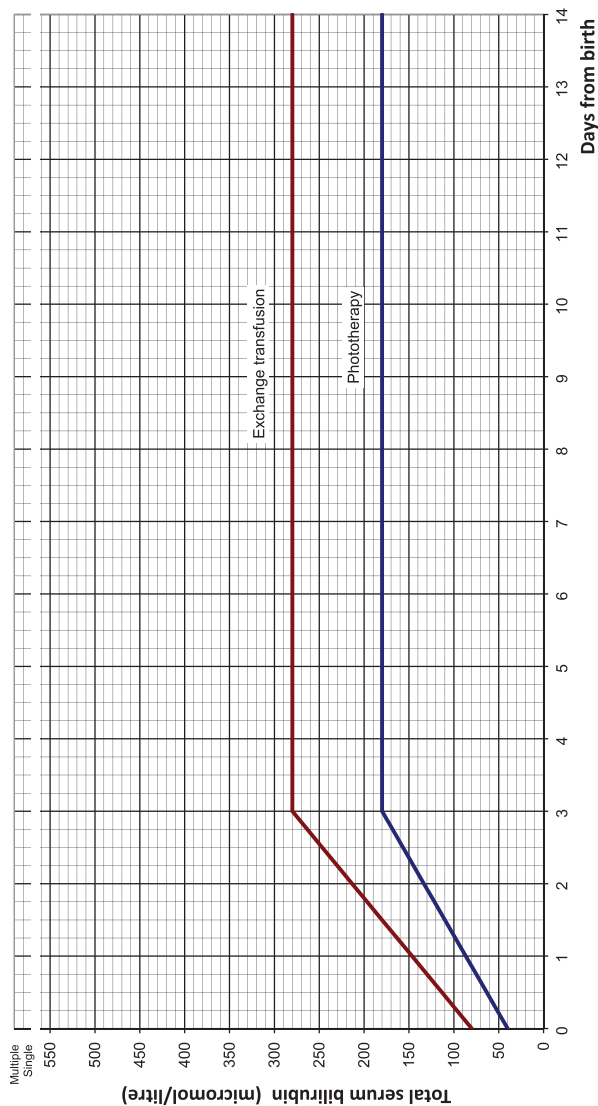
27 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name _____ Date of birth _____
 Hospital number _____ Time of birth _____ Direct Antiglobulin Test _____
 Shade for phototherapy _____ Baby's blood group _____ Mother's blood group _____

28 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

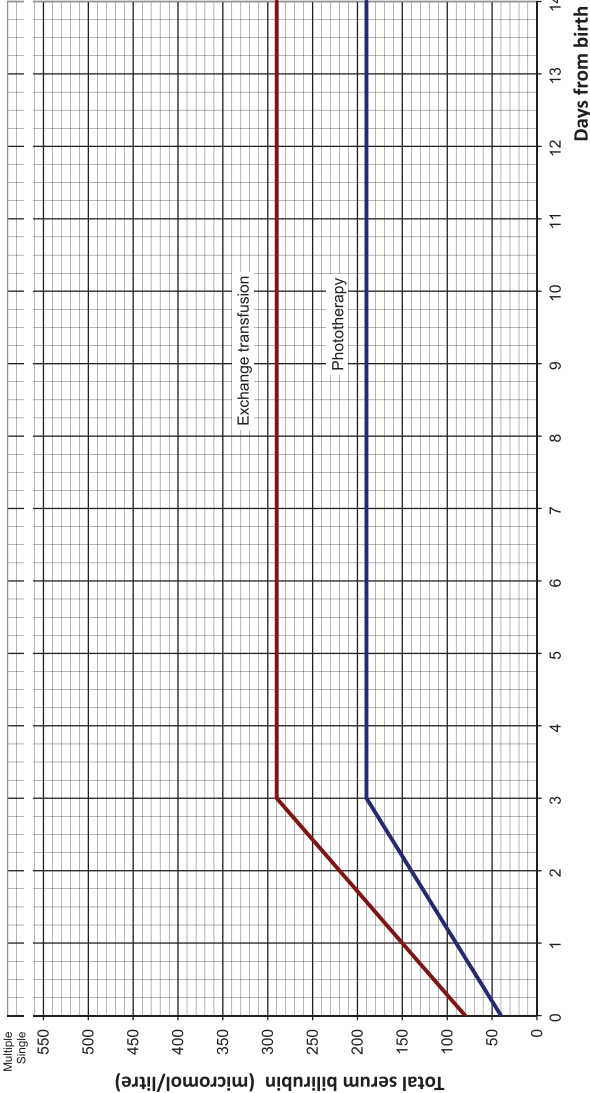
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

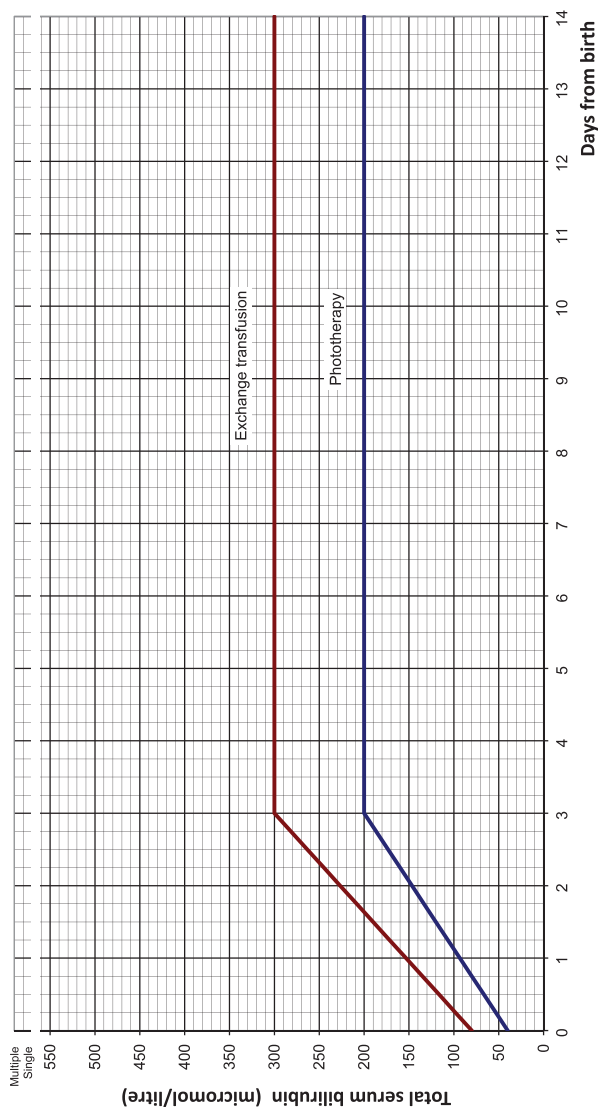
Mother's blood group

29 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name
 Date of birth
 Hospital number
 Time of birth
 Direct Antiglobulin Test
 Shade for phototherapy
 Baby's blood group
 Mother's blood group
 30 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

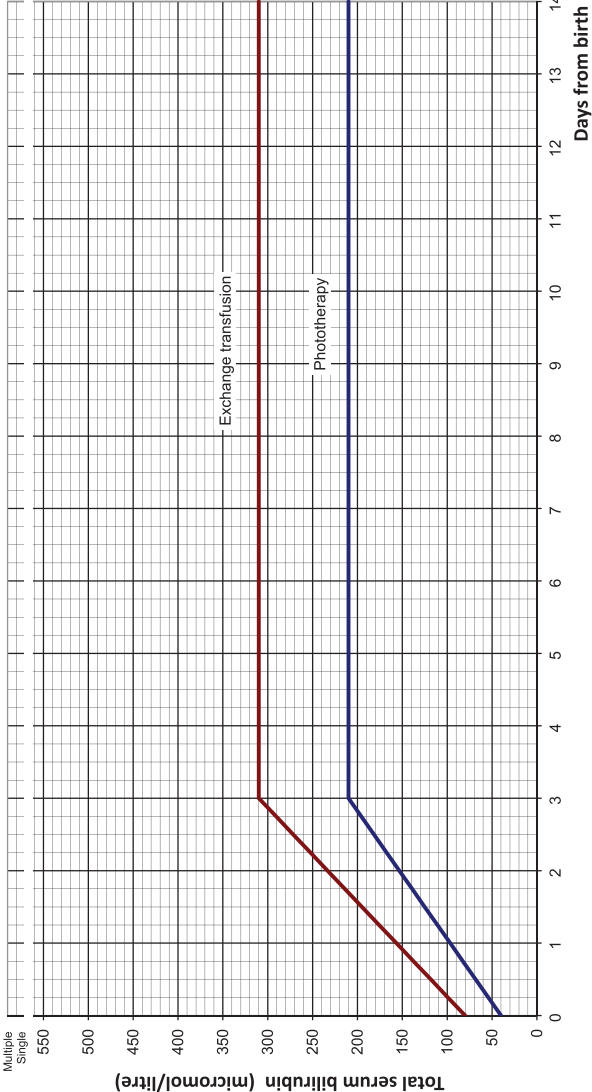
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

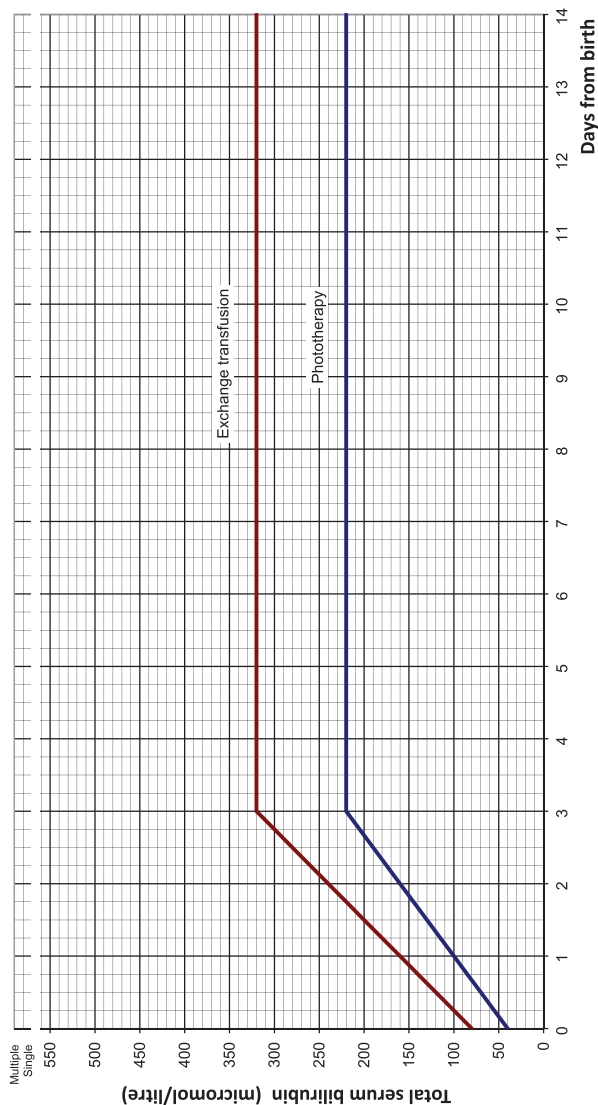
31 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name
 Hospital number
 Date of birth
 Time of birth
 Direct Antiglobulin Test
 Baby's blood group
 Mother's blood group
 Shade for phototherapy

32 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

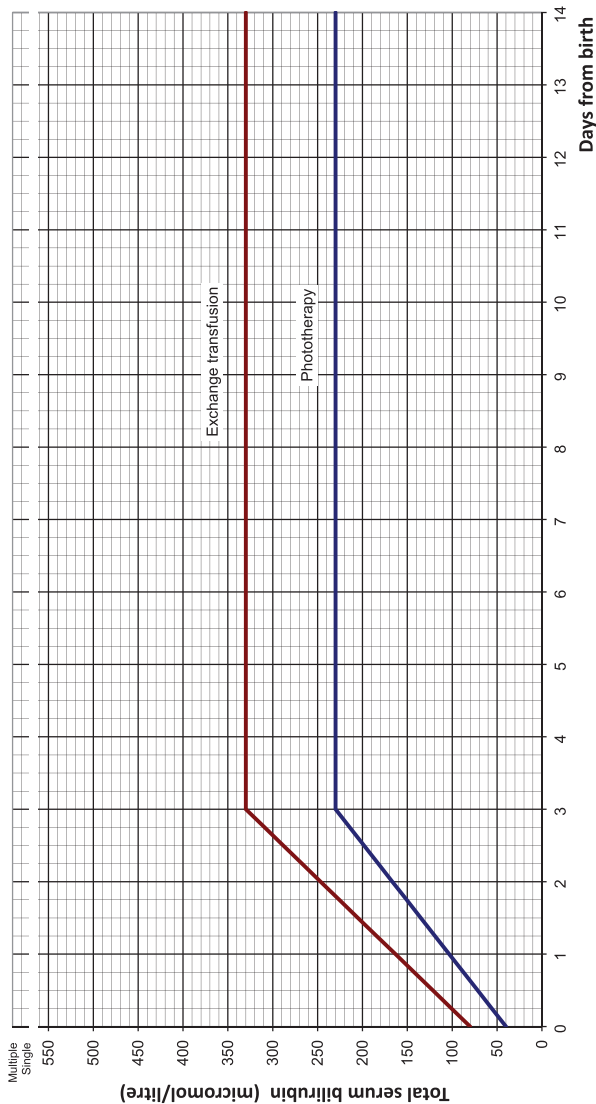
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

33 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

Direct Antiglobulin Test

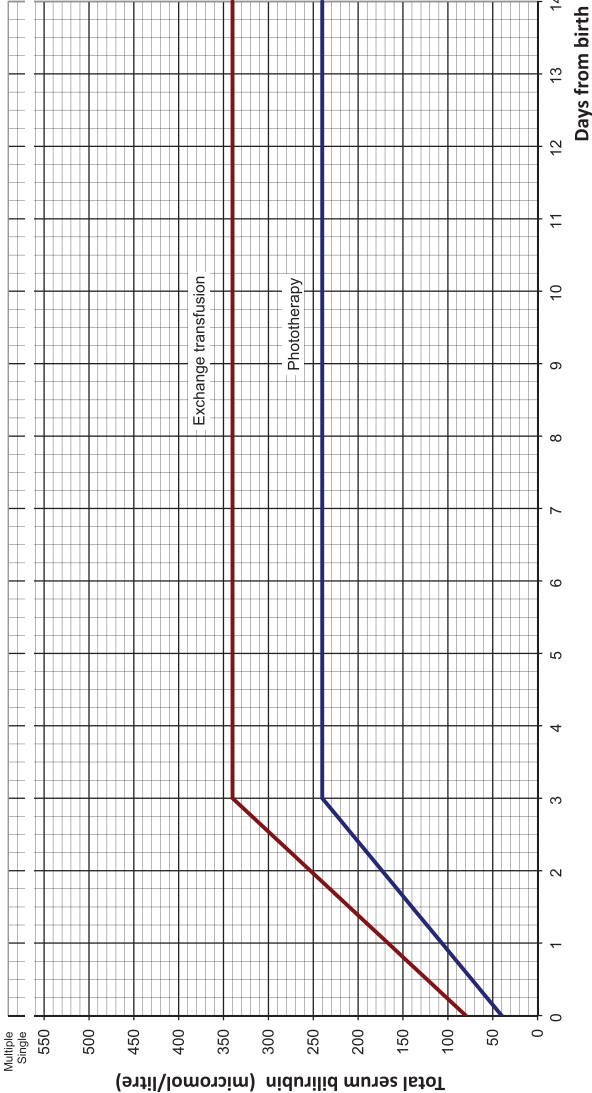
Shade for phototherapy

Baby's blood group

Mother's blood group

34

weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

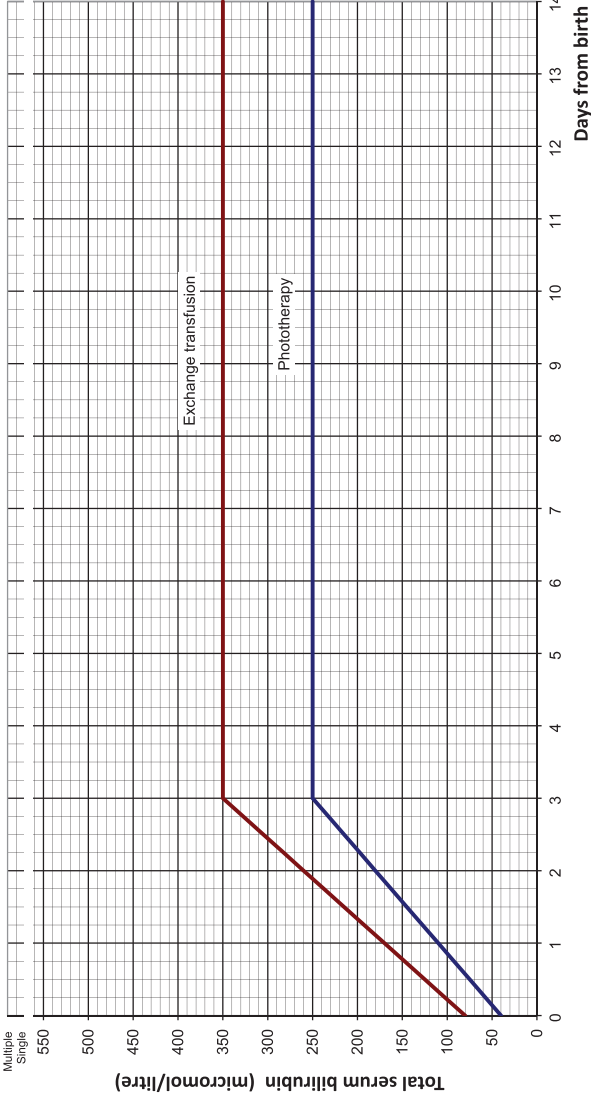
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

35 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

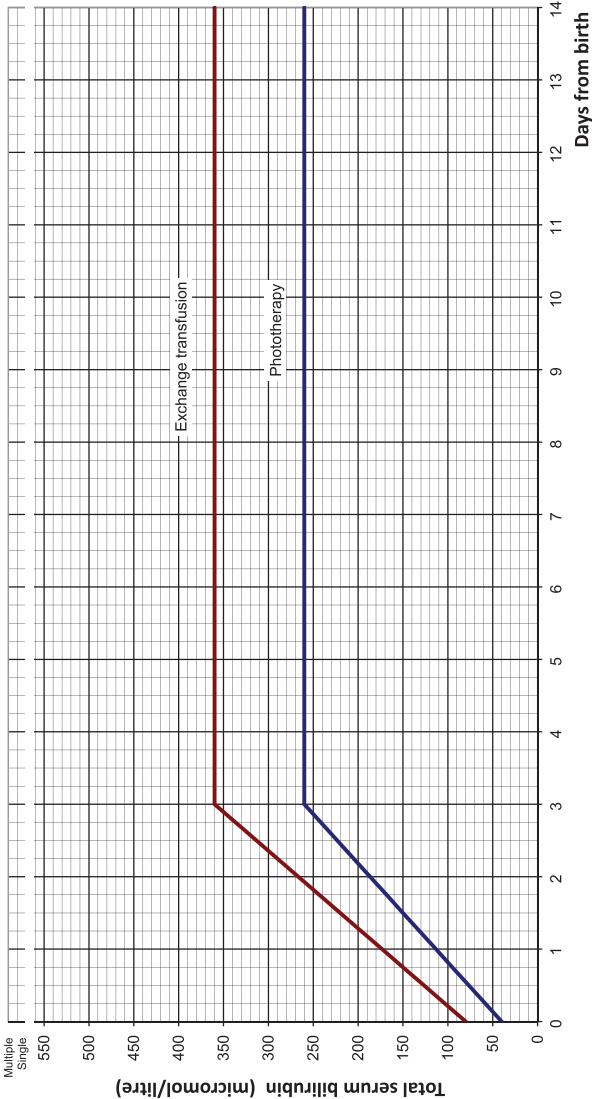
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

36 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

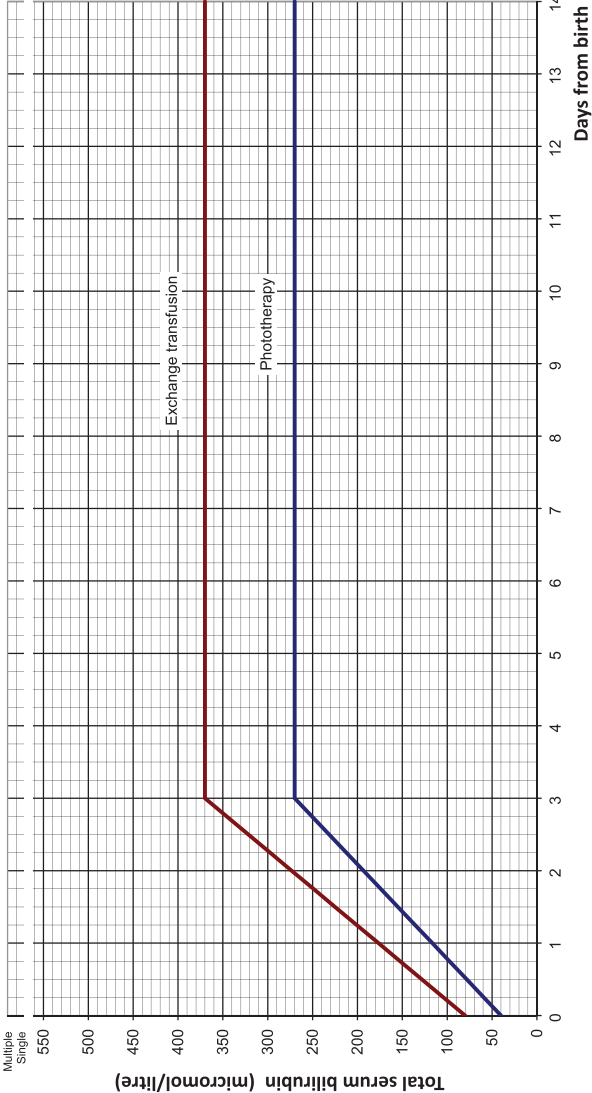
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

37 weeks gestation



Treatment threshold graph for babies with neonatal jaundice

Baby's name

Date of birth

Hospital number

Time of birth

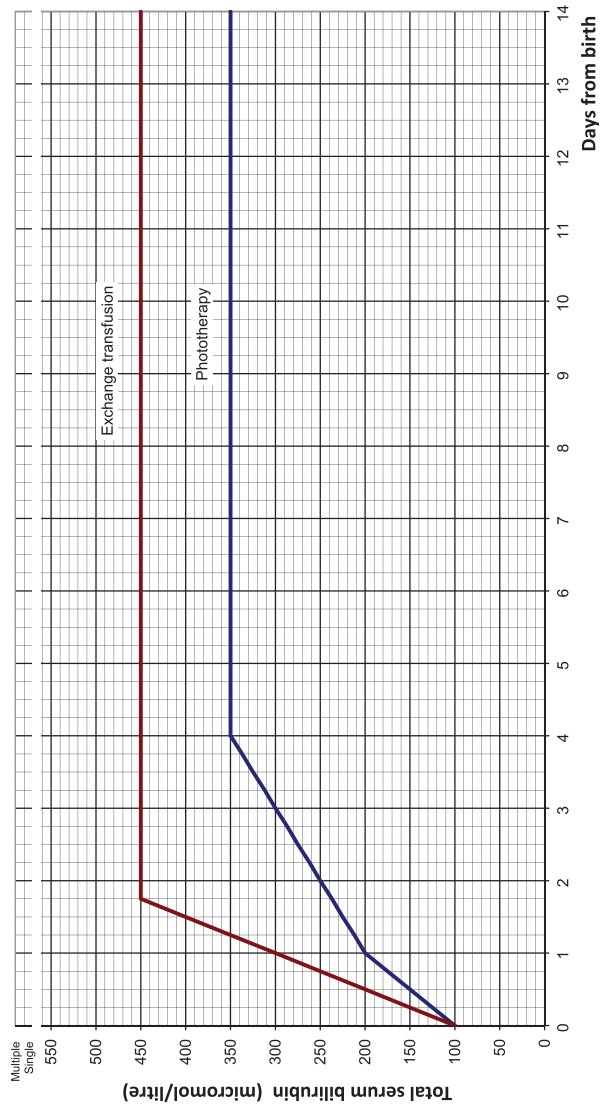
Direct Antiglobulin Test

Shade for phototherapy

Baby's blood group

Mother's blood group

>=38 weeks gestation



RESPIRATORY DISTRESS IN THE NEWBORN

The first part of the paper discusses the importance of understanding the cultural context of the research. It highlights the need for researchers to be sensitive to the values and beliefs of the communities they are studying. This is particularly important in the field of education, where cultural differences can significantly impact learning outcomes.

The second part of the paper focuses on the methodology used in the study. It describes the qualitative approach adopted, which involves in-depth interviews and focus group discussions. The researchers aimed to explore the experiences and perceptions of the participants, rather than testing a specific hypothesis.

The third part of the paper presents the findings of the study. It discusses the themes that emerged from the data, such as the role of family in education and the influence of community norms. The researchers found that there were significant differences in the way that different cultural groups viewed education and learning.

The fourth part of the paper discusses the implications of the findings for practice. It suggests that educators and policymakers should take into account the cultural context of their students when designing educational programs. This could involve providing additional support for students from disadvantaged backgrounds or incorporating culturally relevant content into the curriculum.

The final part of the paper concludes the study and offers some thoughts for future research. It suggests that further exploration of the cultural context of education is needed, particularly in the area of teacher education and curriculum development.

Chapter 8

RESPIRATORY DISTRESS IN THE NEWBORN

8.1 Introduction

Respiratory distress accounts for significant morbidity and mortality in neonates. It occurs in 4 to 6 percent of neonates. Preterm neonates are at higher risk of developing respiratory distress. Many of the conditions causing respiratory distress are preventable. Early recognition and prompt management are required. The aims of managing respiratory distress are to identify and treat the underlying cause, maintain oxygenation and ventilation. Delayed or inappropriate management may result in hypoxic respiratory failure which has high mortality and morbidity.

8.2 Definition

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

- Respiratory rate > 60 breaths per minute
- Severe chest in-drawing / recessions (subcostal or intercostal)
- Grunting / nasal flaring
- Apnoea (not breathing) or gasping

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

8.3 Common causes of respiratory distress

Preterm baby

- Surfactant deficient lung disease
- Congenital pneumonia / septicaemia
- Miscellaneous causes: hypothermia, hypoglycaemia

Term baby

- Transient tachypnoea of newborn (TTNB)
- Meconium aspiration syndrome
- Congenital pneumonia / septicaemia
- Hypoxic ischaemic encephalopathy

Surgical causes (in preterm or term)

- Diaphragmatic hernia
- Tracheo-esophageal fistula
- Bilateral choanal atresia

Other causes

- Cardiac: congenital heart disease
- Metabolic: Inborn errors of metabolism

8.4 Approach to respiratory distress

History

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

- Gestation
- Onset of distress / breathing difficulty
- Previous preterm babies with respiratory distress
- Antenatal steroid prophylaxis if preterm delivery
- Rupture of membranes > 18 hours, maternal intrapartum fever, foul smelling liquor
- Prolonged labour / assisted delivery
- Meconium stained amniotic fluid (MSAF)

- Fetal distress during labour (eg. CTG abnormalities)
- Maternal diabetes mellitus
- Poor feeding, lethargy, convulsions
- History of excessive frothing

Examination

- Severity of respiratory distress as assessed by the score given below
- Neurological status: activity, altered sensorium
- CRT (Capillary refill time)/skin colour
- Axillary temperature
- Hepatomegaly
- Central cyanosis or low oxygen saturations on pulse oximetry
- Features of sepsis like umbilical sepsis, pustules
- Look for evidence of malformations / dysmorphism

8.5 Assessment of severity of respiratory distress

The Downe's score¹ is used to obtain an objective measurement of the severity of respiratory distress.

Table 8.1 Downe's score and its interpretation

Score	Cyanosis	Retractions	Grunting	Air entry	Respiratory rate/min
0	None	None	None	Clear	<60
1	In room air	Mild	Audible with stethoscope	Decreased or delayed	60 – 80
2	In FiO ₂ 40%	Severe	Audible without stethoscope	Barely audible	>80 or apnoea

Interpretation

Score >4	: clinical respiratory distress
Score 5 – 7	: severe respiratory disease
Score ≥ 8	: impending respiratory failure

8.6 Investigations

The diagnosis is based on the history, clinical examination, x-ray findings and the sepsis screen.

8.6.1 Chest x-ray

When to do chest x-ray?

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



Figure 8.1: Surfactant deficient lung disease
Bilaterally hazy lungs with air bronchogram



Figure 8.2: Meconium aspiration syndrome
Fluffy shadows in lungs bilaterally

What to look for in a chest X-ray

- Respiratory Distress Syndrome (RDS) - Air bronchogram, decreased lung volume and hazy lungs / whiteout lungs
- Meconium Aspiration Syndrome (MAS)- Bilateral fluffy shadows with hyperinflation.
- Pneumonia – Infiltrates
- Pulmonary haemorrhage – multilobar infiltrates
- Other malformations eg; Diaphragmatic hernia

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

8.6.2 Sepsis screen and blood culture: (Refer Chapter 9)

Sepsis / congenital pneumonia are causes for respiratory distress

Situations where a sepsis screen should be done in babies with respiratory distress

1. Respiratory distress lasting for more than 4 hours from birth

2. Unexplained preterm delivery
3. Maternal risk factors for sepsis: Intrapartum fever, urinary tract infection, chorioamnionitis, prolonged labour, prolonged rupture of membranes (>18hrs)
4. Meconium aspiration syndrome (babies born through MSAF and having respiratory distress)

8.7 Management

8.7.1 Supportive management

- Maintain normal body temperature (Chapter 2)
- Monitor heart rate, oxygen saturation, respiratory rate and effort, blood sugar, blood pressure
- Give oxygen with oxygen hood or nasal prongs to achieve appropriate oxygen saturation for gestation. E.g. titrate oxygen delivery ideally using a oxygen blender, targeting oxygen saturations of 90-94%, for a preterm infant
- If the respiratory distress persists or worsens or is moderately severe, initially start on CPAP or invasive ventilation.
- Give IV fluids if the baby does not accept breastfeeds or has severe respiratory distress
 - Expressed breast milk by gavage feeding may be given to stable neonates with mild to moderate respiratory distress.
 - Watch for feeding intolerance (Chapter 4)
- Maintain adequate perfusion (capillary refilling time < 3 seconds and gestation appropriate mean blood pressure (Refer Chapter 10)
- Monitor blood glucose, if low treat hypoglycaemia
- If baby has apnoea

- Stimulate to breathe by rubbing the back or flicking the sole
- If baby does not begin to breathe immediately provide positive-pressure ventilation with bag and mask
- Caffeine / Aminophylline if baby is preterm
- If recurrent apnoeic spells, obtain sepsis screen along with blood culture and initiate treatment for sepsis. If available start nasal CPAP / non-invasive positive pressure ventilation and assess. If still apnoeic commence invasive positive pressure ventilation (intubate and ventilate via a T- piece device, ambu bag or ventilator if available)
- organise transfer to a specialised centre for assisted ventilation if not available locally.

8.7.2 *Specific management*

Mild breathing difficulty (Downe's score 1-4)

- Monitor for respiratory distress and oxygen saturation and give oxygen if needed.
- If the respiratory distress persists for more than 4 hours or there are risk factors start antibiotics after taking a full blood count, CRP and blood culture. Once respiratory distress settles, if the sepsis screen and culture are negative (at 48 hours) antibiotics maybe omitted.
- Allow breastfeeds, if not accepting, give expressed breast milk by oro-gastric tube.
- All babies with mild and transient respiratory distress do not need antibiotics

Moderate to severe breathing difficulty (Downe's Score 5 – 7 and ≥8)

- Commence respiratory support with continuous positive airway pressure (CPAP) delivering system or if severe

breathing difficulty (score >8) intubate and ventilate.

- Monitor and record the baby's respiratory rate, saturation and presence of chest in-drawing and grunting on expiration and episodes of apnoea
- Insert an oro-gastric tube to empty the stomach of air and secretions (important for all babies with respiratory distress)
- After taking blood for FBC, CRP and blood culture start antibiotics. (Refer Chapter 9)

8.7.3 Oxygen therapy

1. Oxygen is a drug and should only be used if the baby has hypoxia, as it is harmful to eyes, brain and lungs, especially in preterm babies.
2. Pulse oximeter should be used to monitor oxygen saturations, which should be maintained in the range of 90 – 94% for preterm infants.
3. Saturation below 90% should be treated with oxygen supplementation. However, transient drops in saturation below this level, specially when the baby is moving or crying, and improving spontaneously should be ignored.
4. At no time should preterm babies receiving supplemental oxygen have saturations above 95% (unless for a very specific indication).
5. Oxygen delivered via nasal prongs without the use of an oxygen blender would give 100% oxygen when the flow rate is >0.3L/min for a 1kg baby. Therefore even nasal prong oxygen should be used judiciously.

**Pulse oximetry: Maintain oxygen saturation of 90– 94%
in preterm infants**

How to administer oxygen via nasal prongs

- This is a useful method of delivering oxygen.
- Appropriate size prongs, which fit the neonate well, should be used. If a large size of the nasal cannula is used, it may cause blanching of the alae nasi and injure the nose.
- Adjust flow of oxygen (0.5 – 2.0 L/min) to achieve target saturation.
- Should ideally be used with an oxygen blender

How to use a head box

- Place a head box over the baby's head.
- Ensure that the baby's head stays within the head box, even when the baby moves.
- Adjust the flow of oxygen (3 – 5 L/min) to achieve the desired oxygen saturation.

Do not use face masks to deliver oxygen. They are not appropriate for use in neonates.

8.7.4 Continuous positive airway pressure

Definition

Maintenance of an increased (positive) airway pressure during the inspiratory and expiratory phases of respiration with the patient breathing spontaneously.

Pulmonary physiological advantages

- Splints open airway – including upper airway; ↓ airway resistance and thereby ↓ work of breathing
- Increases functional residual capacity and ↑ tidal volume

- Decreases ventilation/perfusion mismatch
- Conserves surfactant and ↑ lung compliance
- Lung damage is much less than when positive pressure ventilation via endotracheal tube is used

Use of CPAP

- Administered via CPAP nasal prongs or special CPAP masks using an appropriate sized CPAP hat to stabilise
- Different types of nasal prongs (commonly used) and nasopharyngeal (rarely used) CPAP is available
- An orogastric tube on open drainage should always be used with CPAP to decompress the stomach
- Use of CPAP requires training of staff
- Fixing of prongs and stabilisation of circuit should be done in a manner to minimise nasal trauma and subsequent head shape abnormalities
- Available CPAP delivery devices include conventional ventilators, infant flow drivers, bubble CPAP
- Baby's vital signs and nasal septal condition should be monitored regularly.

When not to use CPAP

- Diaphragmatic hernia
- Tracheo-oesophageal fistula
- Minimal respiratory efforts or recurrent apnoea

8.7.5 *Non-invasive (nasal) positive airway pressure - NIPPV*

- NIPPV uses nasal CPAP prongs to deliver intermittent positive pressure breaths in addition to the continuous positive end expiratory pressure.

- Current evidence indicates that NIPPV after extubation of very premature infants reduces the rate of re-intubation. Its mechanism of action is not very clear but it may improve pulmonary mechanisms, tidal volume and minute ventilation and there is some evidence that NIPPV marginally improves gas exchange².

Failure of CPAP/NIPPV

- Needing $>60\%$ FiO_2 and $\text{PEEP} > 8$ to maintain satisfactory SpO_2 (90-94%)
- $\text{PCO}_2 > 55$ mmHg on maximum settings
- Unsettled respiratory distress (recessions/grunting / tachypnoea)
- Respiratory exhaustion
- Apnoeic attacks

If any one or more of the above occurs proceed to assisted ventilation and transfer if necessary.

8.7.6 Invasive positive pressure ventilation

- This requires endotracheal intubation – generally done orally (nasal also possible)
- Conventional ventilation includes either pressure control or volume control modes.
- In Sri Lanka currently pressure control ventilator modes are the most commonly available
- The pressure control modes include invasive CPAP, pressure support, controlled intermittent mandatory ventilation, synchronised intermittent positive pressure ventilation (SIMV), assist control (AC) / synchronised intermittent positive airway pressure ventilation (SIPPV).
- During invasive ventilation blood gases should be monitored to achieve optimal oxygenation and carbon

dioxide status while ensuring avoidance of over-ventilation leading to hypocapnia.

8.7.7 High frequency oscillatory ventilation

- Available in Sri Lanka
- Useful when conventional ventilatory methods are failing to achieve adequate oxygenation or ventilation.
- Some authorities believe it causes less lung injury.
- Especially useful in babies with persistent pulmonary hypertension and air leaks such as pulmonary interstitial emphysema in preterm infants and pneumothorax.

8.8 Management of improving baby

- When the baby's oxygen saturation is acceptable (90-94%), gradually wean from oxygen.
- If ventilated, gradually reduce ventilatory pressures and rates as guided by blood gases and clinical condition.
- When the baby begins to show signs of improvement:
 - Give expressed breast milk by nasogastric tube if intubated and ventilated and oro-gastric tube if using nasal prong oxygen or nasal-CPAP.
 - Once baby is not intubated and the respiratory distress is settling baby can be allowed to begin breastfeeding if overall clinical condition and maturity warrants it. Baby can be put on to the breast with continuous monitoring when using nasal cannulae.
 - If the baby cannot breastfed, but doesnot need a gastric tube for feeding, give expressed breast milk using a cup.
- When the baby has no difficulty breathing and is feeding well, discharge the baby.

8.9 Apnoea

Apnoea is defined as spontaneous cessation of breathing for more than 20 seconds or any cessation associated with desaturations / cyanosis / pallor and / or bradycardia (heart rate less than 100).

Apnoea can be due to;

- An underlying disease which should be managed appropriately eg; respiratory distress, meconium aspiration, sepsis etc
- Apnoea of prematurity
- Obstructive apnoea (floppy or preterm baby)

Management of an apnoeic episode

- Ensure patent airway
- Provide tactile stimulation
- Give positive pressure ventilation with bag and mask ventilation until spontaneous breathing occurs; recurrent apnoeic spells may require NIPPV or invasive ventilation
- Identify the cause and treat
 - Check blood glucose
 - Check temperature
- In apnoea of prematurity
 - Give caffeine citrate / aminophylline for recurrent apnoeic spells

(IV aminophylline can be given in a dose of 6mg/kg as a loading dose over 30 minutes followed 12-24 hours later by 3mg/kg/ dose 12 hourly. Give aminophylline orally once baby is on oral feeds.

Caffeine citrate: available as oral or IV preparations; 20mg/kg as loading dose (1ml = 20mg of caffeine citrate or 10mg

of caffeine base). Start maintenance caffeine citrate 10 mg/kg (range 5-15mg/kg) once a day, 24 hours after loading dose.

Caffeine or aminophylline should be stopped once the neonate is apnoea free for at least 1 week and may be continued till 34 – 35 wks gestation.)

8.10 Referral is required in following situations

- Baby with breathing difficulty is worsening while on the maximal respiratory support available at your unit
- Persistent central cyanosis or low oxygen saturations despite oxygen supplementation (for cardiology opinion)
- You suspect / diagnose an associated abnormality – e.g. diaphragmatic hernia – that requires specialist management

Always stabilize before transport

8.11 Discharge advice and follow-up

Babies with respiratory distress should be followed up at 48hrs by the Public health midwife. Detailed advice regarding exclusive breast feeding, temperature maintenance and immunization should be provided.

8.12 Prevention of RDS

- Antenatal corticosteroid therapy is a simple and effective therapy that prevents severity of RDS which occurs due to surfactant deficiency in preterm infants. (Please refer Chapter 5)

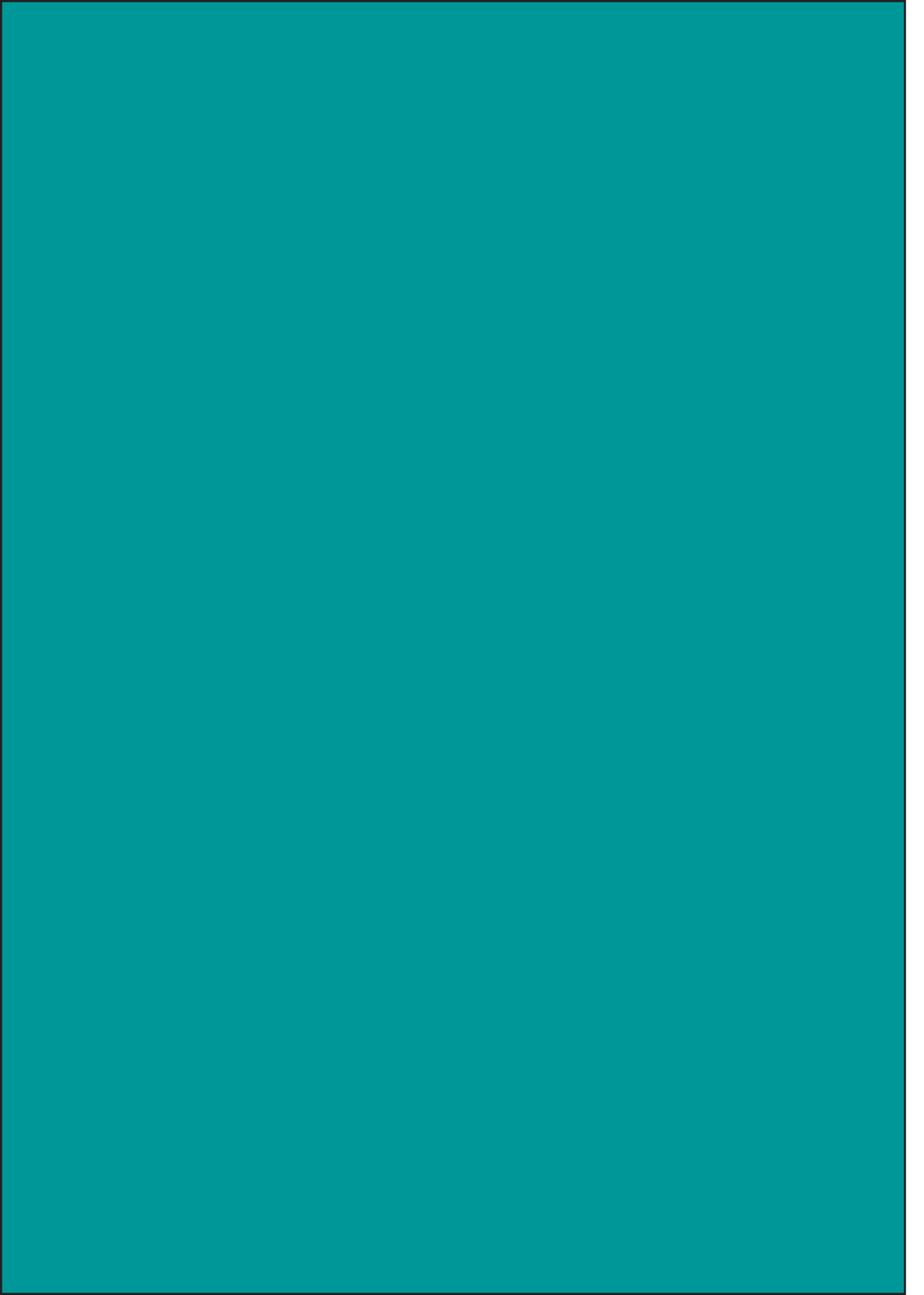
Summary

- Respiratory distress is common in neonates
- Early identification and timely appropriate management is the key to good outcome
- Use oxygen with caution and maintain oxygen saturations between 90 – 94%, in preterm infants
- Perform sepsis screen with blood culture if you suspect sepsis
- Do not use antibiotics in all cases

References

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2. Louise S Owen, Colin J Morley, and Peter G Davis. Neonatal nasal intermittent positive pressure ventilation: what do we know in 2007? *Arch Dis Child Fetal Neonatal Ed*. Sep 2007; 92(5): F414–F418.
3. Royal College of Obstetricians and Gynaecologists. Antenatal corticosteroids to reduce neonatal morbidity and mortality. Greentop guideline No. 7, October 2010.

**NEONATAL SEPSIS
AND
ANTIBIOTIC THERAPY IN
NEWBORNS**



Chapter 9

NEONATAL SEPSIS AND ANTIBIOTIC THERAPY IN NEWBORNS

9.1 Introduction

Both worldwide and in Sri Lanka, neonatal sepsis is a significant cause of neonatal deaths. World Health Organization estimates that 1 million deaths per year are due to neonatal sepsis and in Sri Lanka 20% of neonatal mortality is due to sepsis¹.

If diagnosed early and treated with good supportive care and antibiotics, it is possible to save most babies with neonatal sepsis. Decreasing invasive interventions, promoting breastfeeding and maintaining proper hand hygiene are the best preventive strategies to reduce the occurrence of neonatal sepsis.

Antibiotic use should be rationalized and standardized in order to reduce inappropriate usage and emergence of multi resistant organisms.

9.2 Definitions

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

Early onset sepsis (EOS)

Suspected sepsis within 72 hours of birth. The source of the pathogen is the maternal genital tract or the delivery area. Commonest pathogens are

- Streptococci (mainly Group B Streptococci;GBS)
- E.coli, coliform and other gram negatives
- *Listeria monocytogenes*

Respiratory distress due to congenital (intrauterine) pneumonia is the predominant manifestation of EOS.

Late onset sepsis (LOS)

Appearance of signs and symptoms suggestive of sepsis >72 hours after birth. The pathogens are acquired from community or hospital (nosocomial). Commonest organisms are,

- Gram-negative bacilli - *Klebsiella*, *Escherichia coli*, other coliforms
- *Serratia*
- *Pseudomonas*
- Coagulase negative staphylococcus (CONS)
- *Staphylococcus aureus*

LOS commonly presents as septicaemia, pneumonia or meningitis.

9.3 Risk factors for sepsis

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

- Maternal pyrexia >38°C or other evidence of infection
- Prolonged rupture of membranes (ROM >18hrs)
- Foul smelling liquor
- Spontaneous preterm delivery (<37 weeks)
- Very low birth weight (<1500g)
- Prolonged or difficult delivery with instrumentation or ≥ 3 vaginal examinations in 24 hours or presence / removal of cervical suture
- Maternal UTI in the third trimester

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

- Very low birth weight, prematurity
- Lack of breastfeeding
- Delayed enteral feeding
- Frequent handling/extensive resuscitation with or without invasive procedures
- Disruption of skin integrity with needle pricks and use of intravenous fluids
- Poor hygiene
- Poor maintenance of asepsis in the neonatal unit, including improper hand washing techniques
- Superficial infections (eg; skin and umbilical sepsis)
- Previous or prolonged hospitalization

9.4 Clinical features

Clinical presentation of sepsis in neonates is highly variable. In the early stages, signs may be subtle and, although difficult to define, a mother or nurse may report that a baby is simply ‘not right’.

Frequent early signs

- Isolated tachypnoea (respiratory rate sustained above 60 breaths/min with minimal recessions) and
- feeding difficulties (not feeding or poor suck) are the most frequent early signs of infection.

Other signs

- Hypo or hyperthermia following exclusion of environmental causes and dehydration axillary temperature above 37.5°C or below 36.0°C
- Irritability – may indicate the presence of meningitis.
- Skin – Petechiae, septic foci, paronychia or omphalitis.
- Poor cutaneous circulation - mottling and delayed capillary filling (>3 seconds).
- Jaundice - Unexplained jaundice; in the absence of other explanations, jaundice may indicate a urinary tract infection.
- Cardiovascular – heart rate ≥ 160 beats/min; low pulse volume, hypotension or shock
- Gastrointestinal – vomiting, diarrhoea, abdominal distension
- Respiratory – Apnoea, cyanosis, grunting and dyspnoea. For ventilated babies, an increase in ventilation requirements often accompanies sepsis as well as pneumonia.
- Central nervous system - A high-pitched cry, neck retraction, bulging fontanelle and convulsions are late features of neonatal meningitis.
- Haemorrhagic diathesis - petechiae and bleeding from puncture sites due to DIC; thrombocytopaenia without DIC is commoner. Bleeding from the gut or the renal tract are late signs of sepsis.
- Sclerema - diffuse hardening of the subcutaneous tissue resulting in a tight smooth skin that feels bound to the underlying structures; often associated with gram-negative infection
- Tone – maybe hypotonic

Examination should include assessment of

- Hydration
- Murmurs or triple rhythm – congenital heart disease and endocarditis / myocarditis
- Abdomen – distension and rigidity, masses, bowel sounds, organomegaly
- Spinal column for defects
- Limbs for signs of osteomyelitis and septic arthritis

9.5 Meningitis

About 25-30% of septicemic neonates may have meningitis which is often silent without signs of meningeal irritation.

Diagnosis

Full sepsis screen :

Blood culture*
Full blood count*
CRP/micro ESR*
Urine Culture
CSF examination
CXR

**Partial sepsis screen*

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

Collection of sample for blood culture: Inoculation of 1-2 mL of blood (at least 1 mL) is recommended for adequate and appropriate growth in a paediatric blood culture bottle. The ideal ratio of blood to culture medium should be 1:10. The physician should ensure proper aseptic technique during collection of blood to avoid contamination. After inoculation of blood in the culture bottle, it should be kept outside at room temperature, till it is dispatched to the laboratory for facilitation of growth of microorganisms. Dispatch at the earliest (unless facilities are available to incubate at 37°C).

Indirect method of diagnosis:

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

- **Total leukocyte count (TLC):** A total leucocyte count below 5000/cu mm.
- An **absolute neutrophil count (ANC)** of < 1800 per cu mm is an indicator of infection. Neutropenia is more predictive of neonatal sepsis than neutrophilia.
- **Immature neutrophils** (Band cells + myelocytes + metamyelocytes) **to total neutrophils ratio (ITR)** > 0.20 means that immature neutrophils are over 20 percent of the total neutrophils. This happens because bone marrow pushes even the immature cells into circulation, to fight infection.
- **C-reactive protein (CRP):**
 - **A single negative CRP does not exclude sepsis. CRP has a lag phase to respond especially in pre-term neonates (upto 48 hours to achieve highest levels in extremely low birth weight infants). Therefore serial CRPs are more useful.**

- CRP is helpful in excluding infection if 2 values more than 24 hours apart with first sample being taken more than 12-24 hours after onset of symptoms are normal
- The CRP can also be positive in other conditions like prolonged rupture of membranes, maternal fever during labour, fetal distress, perinatal asphyxia, shock, intraventricular haemorrhage, pneumothorax, and meconium aspiration pneumonia.

A negative sepsis screen helps to rule out sepsis; a positive screen may not be confirmatory when blood culture is negative. Therefore a practical positive “sepsis screen” takes into account two or more positive tests out of the five given below in blood culture negative babies:

1. Leukopenia (TLC <5000/cumm)
 2. Neutropenia (ANC <1800/cumm)
 3. Immature neutrophil to total neutrophil (I/T) ratio (> 0.2)
 4. Micro ESR (> 15 mm 1st hour)
 5. CRP +ve (>10mg/L)
- Perform sepsis screen if,
 - Sepsis is suspected clinically or
 - there are $\geq$ two risk factors in an asymptomatic baby

Table 9.1: Normal cerebrospinal fluid values in neonates

Type of infant	White cell count (count/mm ³)	Protein (g/l)	Glucose (mmol/l)
Preterm	9 (0-30)	1 (0.5-2.5)	3 (1.5-5.5)
Term	6 (0-21)	0.6 (0.3-2.0)	3 (1.5-5.5)

Courtesy: Robertson Textbook of Neonatology 5th Edition; 2013.

The CSF glucose level is sometimes given as a percentage of the serum glucose done at least 30 minutes prior to the lumbar puncture: normal 0.6 (60%).

- For CSF results that are not clear-cut use clinical judgment for diagnosing meningitis.
- Lumbar puncture (LP) must be performed in all neonates with late-onset sepsis. In EOS, CSF examination may be deferred in a neonate with RDS without any risk factors for sepsis. In all cases it must be done preferably before starting antibiotics.
- In a neonate with meningitis not showing clinical recovery after institution of antibiotics, LP should be repeated after 48 hours.
- Ideally, the CSF WBC count & CSF sugar must be performed within 30 minutes of drawing the sample. It must be noted that CSF WBC and glucose rapidly fall with time, giving spurious results.
- Neonatal meningitis frequently occurs in the absence of bacteremia and in the presence of normal CSF parameters. No single CSF value can reliably exclude the presence of meningitis in neonates. The CSF culture is critical to establishing the diagnosis of neonatal meningitis²

Management

- Supportive care and antibiotics are two equally important components of the management.
- The supportive care includes:
 - Maintaining temperature, airway, breathing and circulation. May require ventilation, fluid boluses, inotropes
 - Ensure optimum oxygenation (maintain SpO₂ 90 - 94%). Aim for higher saturation for babies at high risk of PPHN (meconium aspiration syndrome)

- Maintain normoglycemia
- Inj Vit K 1mg IV if there is active bleeding from any site; may need platelets, FFP if in DIC.
- Avoid enteral feed if haemodynamically compromised, give maintenance IV fluids but start orogastric feeds as soon as hemodynamically stable.

9.6 Antibiotic therapy

- Empirical antibiotic therapy should cover the common causative bacteria. If any of the cultures prove to be positive and a sensitivity pattern is available antibiotics may be revised.

9.6.1 Indications for antibiotics

a) Prophylaxis/empirical therapy for “at risk babies”

Prophylactic antibiotics should be considered in following circumstances which are risk factors for early onset sepsis

1. Foul smelling liquor or malodorous baby
2. When ≥ 2 of following risk factors are present
 - Maternal pyrexia $>38^{\circ}\text{C}$ or other evidence of infection
 - Prolonged rupture of membranes (ROM $>18\text{hrs}$)
 - Fetal distress (tachycardia, bradycardia, abnormal CTG), passage of meconium in-utero with no other explanation)
 - Spontaneous preterm delivery (<37 weeks)
 - Low Apgar <7 at 5 min
 - Prolonged or difficult delivery with instrumentation or ≥ 3 vaginal examinations or presence / removal of cervical suture

- Maternal UTI in the third trimester
3. Unclean delivery and cord separation
 4. Previous baby affected with GBS and mother's recent GBS status unknown or not treated adequately

b) Suspected sepsis

If sepsis is clinically suspected, antibiotics should be commenced as early as possible after obtaining relevant cultures.

9.6.2 Choice of antibiotics

Early onset sepsis

First line

- Benzyl Penicillin (or Ampicillin) and Gentamicin
- add Cefotaxime or replace Gentamicin with Cefotaxime if meningitis is suspected

Second line (Remember to choose antibiotic combination to cover Staph. and gram negatives)

- Should also consider the prevalent organism in the unit and its antibiotic sensitivity at that particular time period
- Flucloxacillin/cloxacillin with Amikacin/ Cefotaxime.
- Include Cefotaxime with any of the combinations in suspected meningitis

Third line

Meropenem; +/- Vancomycin (consider including Vancomycin if staph/MRSA is suspected specially if central lines are used).

Initial choice of antibiotics is judged by the clinical scenario and is therefore the responsibility of the medical team. Subsequently the

antibiotic therapy should be adjusted according to blood culture reports and/or clinical response.

9.6.3 Duration of antibiotic therapy

- Prophylaxis (asymptomatic baby) – if remains well and sepsis screening is negative, including blood culture report after 48 hours, stop antibiotics.
- If blood culture is positive and CSF is normal, treat for 10 days.
- Initially symptomatic baby, screening negative and clinically well in 48 hrs, - repeat FBC and CRP – if negative stop antibiotic.
- Symptomatic baby, responded to treatment within 48 hrs and FBC and/ or CRP positive but blood culture negative, treat for 7-10 days. (exclude meningitis if clinically indicated).
- In above situations if the initial CRP was high, it is best to treat until it comes back to normal.
- Beware of CRP which may be persistently high due to local infection such as cannula site infection or abscess.

9.6.4 Choice of antibiotics in special circumstances

Proven meningitis (Positive CSF)

- Empirical therapy for early onset disease- Penicillin/ ampicillin and cefotaxime
- Empirical therapy for the late onset disease- cefotaxime
- Definitive therapy
GBS : Benzyl penicillin for 14 days
Gram negative meningitis: cefotaxime (or according to the culture report) for 21 days

CSF positive but no organism isolated- penicillin 14 days and cefotaxime 21 days.

Pneumonia

- Early onset pneumonia (usually within 48hrs)
 - Penicillin or ampicillin with gentamicin (alternative option is penicillin and cefotaxime)
 - Duration: 10 days (if the organism is *Staphylococcus aureus*, anti-staph therapy for 21 days)
- Late onset pneumonia (after 48 hrs especially in ventilated babies)
 - If the baby is already on antibiotics, broaden spectrum to cover CONS, pseudomonas (or antibiotics covering the prevalent/colonised bacteria)
 - Cefotaxime and vancomycin provide a good coverage
 - Duration : 7-10 days
 - Un-resolving, non responsive neonatal pneumonia may be caused by *Ureaplasma urealyticum* or Mycoplasma. Erythromycin/clarithromycin is the antibiotic of choice for both these pathogens.

Bone and joint infections

- Cefotaxime and flucloxacillin/cloxacillin are the first line antibiotics until the culture report is available
- IV antibiotics should be continued for 4-6 weeks.
- Vancomycin can be considered as second line therapy

Superficial infections

- Umbilical cord infection

Purulent discharge without periumbilical erythema: only local antibiotic

- Umbilical granuloma does not need antibiotic therapy; only requires cauterization
- Umbilical sepsis with early periumbilical erythema may be treated with oral flucloxacillin / cloxacillin and local therapy.
- If there is significant periumbilical erythema or signs of sepsis is/are present, start IV flucloxacillin / cloxacillin and gentamicin or flucloxacillin / cloxacillin and cefotaxime
- If the baby is systemically very unwell MRSA cover with vancomycin and cefotaxime is a better option.

Skin infection

- Staph. skin sepsis should be differentiated from normal neonatal skin conditions.
- If in doubt, start oral therapy with flucloxacillin/cloxacillin.
- If systemically unwell, commence IV flucloxacillin/cloxacillin with gentamicin or cefotaxime.
- Alternatively for a very sick baby, combination of vancomycin and cefotaxime provide a satisfactory coverage.

Varicella infection

- If the mother develops varicella during the 3 weeks prior to delivery, there is a 25% chance of her baby developing the illness.
- Prophylaxis:
Babies born to mothers who develop varicella between 7 days antenatally and 7 days postnatally, should receive a dose of zoster immunoglobulin (ZIG), 250mg soon after

delivery or as soon as possible after the mother becomes symptomatic. But this is not feasible in Sri Lanka as ZIG is not freely available. In the absence of VZIG, normal immunoglobulin can be given. In the absence of both, antiviral treatment dose (IV aciclovir 20mg/kg/dose - 8hrly) can be given for 7 days.

Any preterm baby born <28weeks, exposed to varicella (from a source other than the mother) in the neonatal period should be managed as above despite maternal immune status.

- Babies born to mothers with perinatal varicella should be isolated from other babies from birth.
- If a neonate develops features of varicella even after receiving prophylaxis, IV acyclovir is the treatment of choice.

Use of blood product as adjuvant therapy in the management of neonatal sepsis.

- Routine, prophylactic treatment with FFP and intravenous immunoglobulin (IVIG) in term babies, is/are not recommended when managing neonatal sepsis.
- The routine administration of IVIG to prevent or treat sepsis in very low birth weight infants is not recommended and the available evidence is adequate to state that there is no longer a need for further trials on this subject either.

9.6.5 Prevention of neonatal sepsis

It is best to focus on practices that have been shown to reduce nosocomial infections (hand hygiene, nutrition, skin care and vascular access care) and improving a culture of intensive care that dedicates itself to this goal.

Prevention of infection in hospital

- Adhere to 6 steps of hand washing

- Strict asepsis during procedures and when using central IV lines
- Safe birthing practices
- Early & exclusive breastfeeding
- Early enteral feeds
- Maternal tetanus immunisation
- Early diagnosis and prompt treatment of all maternal infections
- No pre-lacteal feeds
- Cord should be kept clean and dry
- Avoid over-crowding
- Maintain hygiene
- Minimize invasive interventions such as needle pricks and IV alimentation
- Do not leave currently unnecessary IV cannulae, CVP lines, catheters, IC tubes etc insitu
- Nursery environment should be clean and dry
- Ensure round the clock water supply
- Adequate ventilation
- Maintain environmental temperature at $28 \pm 2^{\circ}\text{C}$

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

9.6.6 Drug doses

(Doses given below are according to the BNF for children-2014)

Ampicillin

<7days 30mg/kg 12hrly

7-21days 30mg/kg 8hrly

21-28days 30mg/kg 6hrly

If GBS is suspected

<7days 50mg/kg 12hrly

7-21days 50mg/kg 8hrly

21-28days 50mg/kg 6hrly

In meningitis increase the dose to 100mg/kg/8hrly

Amikacin

Loading dose 10mg/kg

Then 7.5mg/kg 12hrly

Less nephrotoxic than gentamicin

Benzyl penicillin

Neonates under 7 days 25mg/kg 12hrly

Neonates 7-28days 25mg/kg 8hrly

If GBS is suspected double the dose

In suspected or proven meningitis 75mg/kg/8hrly

Cefotaxime

<7days 25mg/kg 12hrly

7-21days 25mg/kg 8hrly

21-28days 25mg/kg 6-8hrly

Double the dose in severe infections and meningitis

Flucloxacillin / cloxacillin

<7days 25mg/kg 12hrly

7-21days 25mg/kg 8hrly

21-28days 25mg/kg 6hrly

Double the dose in severe infection

Gentamicin

Extended interval dose regimen

<32 weeks 4-5mg/kg 36 hourly

>32 weeks 4-5mg/kg 24 hourly

Multiple daily dose regimen

<29 weeks 2.5mg/kg 24hrly

29-35 weeks 2.5mg/kg 18hrly

>35weeks 2.5mg/kg 12hrly

(Extended interval dose regime is less nephrotoxic)

Netilmicin

Less toxic than gentamicin. Dose 5mg/kg 24hrly

Meropenem

<7 days 20mg/kg 12hrly

7-28days 20mg/kg 8hrly

Double the dose in severe infection

Vancomycin

<29weeks 15mg/kg 24hrly

29-35 weeks 15mg/kg 12hrly

>35weeks 15mg/kg 8hrly

Summary

- Neonatal sepsis is a major contributor to neonatal mortality
- Signs of neonatal sepsis may be subtle.

- Early detection and treatment can save lives
- Neonatal meningitis may not have specific CNS clinical features
- Rational use of antibiotics is essential to prevent emergence of multi-resistant organisms

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