Introduction
Neonatal mortality in resource-limited countries runs at an unacceptably high level. The World Health Organization (WHO) estimates that worldwide there are 9000 neonatal deaths per day. Of these, approximately one-third are a result of neonatal infections, one-third are due to fetal hypoxia and a further one-third are due to prematurity and low birth weight.

If death and long-term or permanent disability are to be avoided, the management of neonatal emergencies must be both coordinated and effective. The care delivered in the first few minutes and hours of life is a major determinant of the outcome. Since in resource-limited countries almost half of the deliveries do not occur in hospitals, it is important that community-based skilled birth attendants (SBAs), traditional birth attendants (TBAs) and community health workers (CHWs) are encouraged to develop skills to recognise the vulnerable baby prior to delivery and provide effective intervention as required after birth.

Basic aspects of newborn care that apply to both community and hospital deliveries
In order to minimise the number of infants dying from birth-related problems (including perinatal asphyxia) or arriving at hospital with major complications which cannot be corrected, it is important for the hospital to work closely with the community.

The following approach has been shown to be helpful:

- All community-based healthcare professionals, including SBAs, TBAs and CHWs, should be able to undertake basic resuscitation of the newborn. Skills-based training involving manikins and the provision of a self-inflatable bag and mask to all these healthcare workers is essential, as delaying newborn resuscitation until the infant reaches the hospital will usually be too late, resulting in death or severe brain damage.

- Clean delivery kits should be available to all such healthcare workers.
- There should be regular clinical audits and educational meetings with participation from all community-based healthcare workers.
- Community-based SBAs, TBAs and CHWs should ensure that mothers with pregnancy-related complications (e.g. preterm birth, breech presentation, twins) are identified and referred to the local hospital where there are good facilities for obstetric and newborn care.
- The local hospital must provide comprehensive emergency obstetric and neonatal care. Good management of labour and delivery is the key to intact neonatal survival.

Mothers who require referral to hospital for delivery include those with:
- peripartum bleeding
- malpresentation (breech, face, shoulder)
- preterm labour (< 35 weeks)
- twins
- abnormal fetal heart rate in labour.

The baby at risk of developing problems at birth
Preterm birth
Maturity matters more than birth weight. Prematurity is defined as gestation of less than 37 weeks (or less than 259 days from the first day of the mother’s last menstrual period). In the absence of special facilities, mortality increases substantially in cases of gestation less than 32 weeks, and survival at less than 28 weeks is unlikely in resource-limited settings. When a preterm delivery is anticipated, realistic expectations should be discussed with the parents, and any limitations on resuscitative efforts should be agreed upon.

Preventative strategies
These may include minimising the risk of surfactant deficiency and stopping premature uterine contractions.

Minimising the risk of surfactant deficiency: this can be halved if the mother is given a short course of high-dose steroid treatment before delivery:
- dexamethasone, 12 mg IM, two doses 12 hours apart
- or dexamethasone, 6 mg IM, four doses 12 hours apart.

Stopping premature uterine contractions:
- Give 20 mg nifedipine orally. Up to three further doses can be given at 30-minute intervals if uterine contractions persist.
- If this stops labour, give 20 mg nifedipine orally three times a day for the next 3 days.

Other problems associated with preterm birth include the following:
- Even very small babies can survive preterm birth
successfully once the early problems associated with surfactant deficiency have been overcome, and as long as they are nursed in a clean environment and not allowed to get cold.

- Preterm babies are at increased risk of infection and hypothermia.

The main challenge is to give these babies enough nutrition for them to start growing again as soon as possible (see Section 3.3).

- Here, too, maturity is more important than weight. Babies born before 36 weeks’ gestation nearly always need some help with feeding.
- Breast milk is ideal, and everything possible should be done to help the mother sustain her lactation until the baby is ready to feed reliably from the breast. A limited ability to suck and swallow usually appears from 32 weeks’ gestation, but it remains unpredictable, unreliable and uncoordinated until 36 weeks’ gestation.
- In the event that breastfeeding cannot be initiated immediately after birth, mothers should be encouraged to start expressing breast milk, to be given by nasogastric tube or cup and spoon.
- Partial breastfeeding can also help the mother to sustain her lactation, but in any event the mother should regularly express milk. Some mothers might find expressing breast milk difficult and may require help with this.

**Infection**

It is important to identify babies at risk of infection prior to delivery. If identified, the mother should be given antibiotics appropriately. Many of the babies who become infected during delivery develop respiratory signs very soon after birth, but in a few, the features are those of neonatal sepsis. In addition, there are a proportion of babies who are initially asymptomatic, and therefore prophylactic antibiotics should be commenced in the infant if there are risk factors for infection.

**When to consider antibiotics for the mother and newborn**

- Symptomatic ascending infection in utero needs urgent treatment. If this is overlooked, both the mother’s and the baby’s life will be in danger.
- Asymptomatic infection is, however, a much commoner problem. This occasionally progresses so rapidly once labour starts that, unless treatment is started at once, the baby will die even if the most appropriate antibiotic is given immediately after birth. Because such infection by definition is silent, it is important that treatment be considered in any mother going into active spontaneous labour before 35 weeks’ gestation.
- Membrane rupture can be both a sign of, and a risk factor for, ascending bacterial infection. What most people mean by premature rupture of membranes (PPROM) is really preterm pre-labour rupture of membranes (PPROM), where the membranes rupture before there is any overt sign of uterine activity or any detectable uterine contractions. When this happens in the preterm baby, it is often a sign of the start of some sort of ascending infectious process. This process has already weakened the amniotic membranes and may stimulate the onset of preterm labour. Antibiotics must be given to the mother.

- Treatment with antibiotics should also be considered at any gestation if the mother’s membranes rupture more than 18 hours before delivery. If premature rupture of membranes occurs before the onset of premature labour contractions then infection is more likely.
- Maternal fever (> 38°C) in labour is a strong indication for initiating antibiotics for the mother. Similarly, foul-smelling or purulent liquor requires IV antibiotic treatment of the newborn from birth without waiting for any signs of infection.

**Antibiotic management of perinatal infection**

Where facilities allow, a blood count, C-reactive proteins and blood cultures should be taken before starting antibiotics. Because a range of bacteria can be involved, treatment of the baby needs to protect against group B streptococcal, coliform and *Listeria* infection, making a combination of ampicillin and gentamicin the best strategy:

- Give ampicillin 50–100 mg/kg IV 12-hourly and gentamicin 5 mg/kg every 24 hours IV if more than 32 weeks’ gestation, and 3 mg/kg if less than 32 weeks.

The WHO recommends that a neonate with risk factors for infection (i.e. membranes ruptured > 18 hours before delivery, maternal fever > 38°C before delivery or during labour, or foul-smelling or purulent amniotic discharge) should be treated with prophylactic antibiotics (IM or IV ampicillin and gentamicin) for at least 2 days. After this the neonate should be reassessed and treatment continued only if there are signs of sepsis (or a positive blood culture).

**Hypothermia (see Section 3.3)**

Hypothermia seriously increases the risk of surfactant deficiency and hypoglycaemia, and must be avoided.

**Preparation for birth in the home and in hospital**

For the majority of deliveries, only a minimum amount of resuscitation equipment is needed.

**Equipment for basic resuscitation of the infant at home**

The following equipment is needed:

- 2 clean dry towels
- a firm working surface (padded)
- a bulb suction device
- a well-fitting mask (size 0/1)
Management at delivery of a baby not needing resuscitation

Summary of management of the healthy baby at birth

- Deliver the baby on to the mother's abdomen or a warm surface, dry and cover.
- Clamp cord when pulsation stopped, usually between 2 and 3 minutes after birth and keep the baby between the mother's thighs level or below the placenta.
- Prevent hypothermia by nursing skin to skin with the mother.
- Initiate early breastfeeding.
- Minimise infection by hand washing, cord care and using clean materials.
- Give an injection of vitamin K.

Most babies do not need any resuscitation at birth but only require basic care to prevent infection and hypothermia. Extensive mouth suction, face mask oxygen, and vigorous stimulation in order to provoke a first gasp or cry are unnecessary rituals without clinical justification. As long as the baby becomes pink, and starts to breathe without distress, most babies should stay with their mothers and have a first feed at the breast within minutes of birth.

A simple approach would be to keep newborns without complications in skin-to-skin contact with their mothers during the first hour after birth to prevent hypothermia and promote breastfeeding. Colostrum, the initial milk with a clear, yellowish and thick appearance, is an extremely nutritious and concentrated feed rich in immunoglobulins (it is only present during the first 3 to 4 days). Mothers should be informed of its benefits and that it is ideal for their baby to feed on this as soon after birth as possible and as frequently as possible.

Preventing heat loss after birth

- Once any necessary resuscitation process has finished and as soon as the baby becomes pink, and starts to breathe without distress, they can be given to the mother for skin-to-skin contact and their first feed at the breast.
- This practice, among other benefits, not only prevents hypothermia but also helps in better uterine contraction following delivery.
- The practice of using water or oil to clean the skin within a few hours of birth before the body temperature has stabilised can make the baby dangerously hypothermic. A simple drying of the skin with a warm towel or sheet is all that is required.
- There is no more effective source of warmth than the mother's own body, so long as the baby is first well dried to minimise evaporative heat loss. A larger sheet or blanket can then be used to protect both mother and baby from the convective heat loss caused by draughts.
- Babies have relatively large heads. Covering the head with a shawl, blanket or woollen cap can significantly reduce heat loss.
- Heat and water loss through the skin can be a particular problem in babies born before 32 weeks' gestation.

This can be limited initially by wrapping all but the face in a clean plastic wrapping such as cling film or a food-grade plastic bag with a hole cut in the end of the bag for the baby's head to protrude, for a few hours after birth. Remember that plastic over the face can cause death from suffocation. If plastic bags or cling film are not available, the preterm baby must be wrapped well in a clean towel or blanket. However, plastic bags are very good for preventing heat loss, but only in conjunction with an overhead heat source or heated mattress. If the fluid in the bag gets cold it will cool the baby quicker than drying and wrapping.

- Heat supplementation can be provided by locally built and maintained incubators, overhead heating systems, and skin-to-skin (kangaroo) care.
- Ideally, the first bath should be delayed for at least 24 hours.

Managing the placenta, cord and umbilical stump

Babies often become relatively anaemic 4 to 6 months after birth because red cell production does not keep pace with body growth. This problem can be minimised by ensuring that blood intended for the baby is not left in the placenta at birth.

If the baby is held higher than the placenta (i.e. on the mother's abdomen) while the cord is still pulsating, blood will drain out of the baby and into the placenta, so hold the (covered) baby just below the placenta for 2 minutes if the cord is still pulsating. If the cord is clamped before it stops pulsating, this will also reduce the normal 'placental transfusion' at birth, especially if the uterus has not yet contracted.

If, however, blood is artificially 'milked' from the placenta into the baby, it is possible to leave the baby with so many red cells that the blood becomes thick and polycythaemic. Neonatal polycythaemia has many complications, including putting the circulation under strain, making the capillary circulation very sluggish, and increasing the risk of jaundice (see below).

It is recommended after a vaginal delivery to wait for 2 minutes before cutting the cord if it is still pulsating, to maximise the baby's haemoglobin, unless there is a need to start resuscitating the baby.

The cord must be cut cleanly, and the cut stump secured in a manner that minimises the risk of late haemorrhage. Remember that prevention rather than treatment is the key. A supply of fresh disposable razor blades is one widely adopted strategy in some communities where home birth is the norm.

The umbilical stump will shrink as it dries out. Plastic clamps that shut down further as the cord starts to shrink are very effective. They are relatively inexpensive, and they do make it possible to cut the stump about 2–4 cm from the skin. An elastic band, if carefully applied, is a cheap and well-tested alternative. A stump that is left too long provides a reservoir where bacteria can breed and multiply with great speed, and therefore should not be permitted. A length of 2–4 cm is ideal.

A short stump does not need to be covered except to keep it from snagging on clothes and blankets. Recent studies in resource-limited countries have shown that the application of 4% chlorhexidine solution immediately after birth can prevent omphalitis. Other possible antiseptics include surgical spirit or iodine.
Often the cord manifests a little ‘stickiness’, which may be of no concern. However, a local antiseptic should be applied if a red skin flare suggests early spreading staphylococcal cellulitis. Such babies must also be given an oral anti-staphylococcal antibiotic (cloxacillin or flucloxacillin). If the skin around the stump becomes oedematous with increasing redness, IV cloxacillin or oral flucloxacillin (25 mg/kg three times a day for 7 days) is usually the most logical choice. Babies who are systemically unwell always need urgent broad-spectrum antibiotic treatment, IV or IM, for sepsis.

The risk of neonatal tetanus can be eliminated by ensuring that all mothers are immunised against tetanus with at least two injections of tetanus toxoid 1 month apart during pregnancy.

The risk of cross-infection during or after birth
Puerperal infection (‘child-bed fever’) is an illness that killed thousands of recently delivered women for more than two centuries. The fact that this could be eliminated if birth attendants washed their hands thoroughly every time they moved from one woman to the next was shown many years before it was ever realised that this lethal illness was caused by group A streptococcal infection. The arrival of antibiotic treatment has reduced the risk of death, but it has not lessened the need for meticulous hand washing before vaginal examination or delivery. Failure to observe this simple but important precaution also puts the baby at risk of cross-infection, especially if the baby is being cared for in a hospital setting.

The WHO estimates that infection is responsible for one-third of all neonatal deaths (over 3000 deaths a day). Kangaroo care has significantly reduced the number of neonatal deaths from infection by colonising babies with the mother’s bacteria rather than those of the hospital.

Neonatal examination before discharge of a baby from the hospital
Before discharging the baby it is important that some basic checks are made. These include ensuring that the baby is feeding well, has passed meconium and urine and does not have any gross congenital abnormalities. Always check for jaundice. If there are qualified personnel available, a more detailed check could be undertaken. All examinations should be documented, including abnormalities, even if there is no other action which can be taken. It is also important to check local guidelines, if any.

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<thead>
<tr>
<th>Pre-Discharge Newborn Checklist</th>
<th>Common problems to look for</th>
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<tr>
<td>Name</td>
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<td>Date of birth</td>
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<td>Mode of delivery</td>
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<td>Birth weight</td>
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<td>Type of feed</td>
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<tr>
<td>Tick if normal/Describe if abnormal</td>
<td>Anencephaly, occipital encephalocele, microcephaly, large fontanelle, abnormal shape of head</td>
</tr>
<tr>
<td>Face</td>
<td>Abnormal looking facies</td>
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<tr>
<td>Ears</td>
<td>Low set ears, absent ears, ear tags</td>
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<tr>
<td>Eyes</td>
<td>White-coloured pupil, white cornea</td>
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<tr>
<td>Nose</td>
<td>Blocked nostrils with breathing difficulty</td>
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<tr>
<td>Lips</td>
<td>Cleft lip</td>
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<tr>
<td>Palate</td>
<td>Missing palate</td>
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<tr>
<td>Neck</td>
<td>Swelling on the neck, holding neck to one side</td>
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<tr>
<td>Clavicles</td>
<td>Lumps or bumps on the clavicle</td>
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<tr>
<td>Chest</td>
<td>Shape of chest</td>
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<tr>
<td>Abdomen</td>
<td>Scaphoid (empty) abdomen</td>
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<tr>
<td>Umbilicus</td>
<td>Omphalocele, gastrochisis, hernia</td>
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<tr>
<td>Genitalia</td>
<td>Abnormal genitilia, undescended testis, hypospadias</td>
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<tr>
<td>Anus</td>
<td>Absent anus, abnormally placed anus</td>
</tr>
<tr>
<td>Spine</td>
<td>Spina bifida, meningocele</td>
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<td>Upper limbs</td>
<td>Absent limbs, contractures of limbs, not moving arm</td>
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<td>Lower limbs</td>
<td>Not moving limbs, unequal limbs</td>
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<tr>
<td>Hands</td>
<td>Missing or extra digits</td>
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<tr>
<td>Feet</td>
<td>Abnormally shaped feet (talipes), missing or extra digits</td>
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<tr>
<td>Hips</td>
<td>Hip dysplasia (Barlow and Ortolani manoeuvres)</td>
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<tr>
<td>Jaundice</td>
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<tr>
<td>Chest</td>
<td>Air entry (right and left)</td>
</tr>
<tr>
<td>CVS</td>
<td>Murmur, femoral pulse, cyanosis</td>
</tr>
<tr>
<td>Abdomen</td>
<td>Spleen, liver, kidney, palpable mass</td>
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<tr>
<td>Birth marks</td>
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</tbody>
</table>
The following data should be recorded in the notes of every newborn baby.

**Baby’s name (if given at the time)**
- Name, address, date of birth, and any identifying number
- Parity and previous obstetric history
- Blood group
- First day of last menstrual period
- Results of any antenatal serology (e.g. rubella, syphilis, rhesus titres, HIV status)
  - Illness during the pregnancy
  - Drugs taken during the pregnancy
  - Family history of any illnesses

**Father’s data**
- Full name, address and date of birth
- Family history of any illnesses

**Labour and delivery data**
- Time of onset: whether induction of labour or spontaneous
- Time membranes ruptured and any other known risk factors for infection (see below)
- Duration of first and second stage of labour
- Drugs given to the mother in labour
- Presentation and mode of delivery
- Full details of any resuscitation for baby or mother
- Time, dose, route of administration and full generic name of any drugs given to the mother

**Baby data**
- Temperature shortly after delivery, to document adequate thermoregulation
- Birth weight
- Head circumference (best measured after 24 hours when moulding has subsided)
- Length (ideally)
- Full physical examination, noting any abnormalities or evidence of birth trauma detected
- Details of dose, preparation and route of administration of any drugs given at delivery (e.g. vitamin K)
- If not already given, ensure that vitamin K 1 mg IM is administered

**Follow-up home visits**

Trials in South Asia have shown that three home visits in the first week of life (starting on the day of birth) by trained healthcare workers can reduce neonatal mortality by 30–60%. During their visits, the healthcare workers promote essential newborn care, examine babies for danger signs, and treat or refer when appropriate, counsel the families in how to recognise danger signs and emphasise the importance of prompt referral when they are identified.

The WHO and UNICEF recommend that skilled healthcare workers (nurses or midwives) should undertake these visits, but in many settings this is not possible. Volunteers have also been trained to do this, and recently the effectiveness of this has been shown in Ghana, where a fall in neonatal mortality followed two home visits during pregnancy and three visits in the first week of life.

**Further reading**

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### 3.2 Resuscitation of the newly born

#### Introduction

**Respiratory changes at birth in a healthy term infant**
- During life in utero, the infant’s lungs are full of lung tissue fluid. The fluid is removed during labour and at birth by the following mechanisms:
  - at the onset of labour, lung fluid production stops
  - as labour progresses, re-absorption of lung fluid occurs
  - about 35 mL of fluid are expelled from the lungs as a result of thoracic compression during vaginal delivery
  - the first breaths generate relatively high pressures to inflate the lungs, which has the effect of pushing this fluid into the circulation. These first breaths establish the infant’s functional residual capacity.
- Surfactant is produced in the alveoli to prevent them collapsing completely during expiration.
  - Production starts slowly at 20 weeks’ gestation, and increases rapidly from 30–34 weeks and thereafter.
- Surfactant production is reduced by hypothermia, hypoxia and acidosis.

Caesarean section is associated with delayed clearance of pulmonary fluid, and reduces the initial functional residual capacity

Most infants breathe well and do not need active ‘resuscitation’ at birth. Simply drying the infant with a warm dry sheet/towel will in most cases stimulate a cry from the infant thus expanding the lungs (see Section 3.1). Attempts to clear the airway, to stimulate breathing, or to give facial oxygen are unnecessary. Therefore routine airway suctioning is not needed. Most infants make all the circulatory adjustments required at birth without external intervention as the lungs expand. All that the birth attendant has to do