

## Newborn resuscitation, assisted transition and on-going care in low resource settings

J O'Donohoe, J Thomson\* and C Robinson

\*Correspondence email: [julia.thomson1@nhs.net](mailto:julia.thomson1@nhs.net)

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### Summary

Deaths of babies in the first 28 days of life in resource-limited countries can be significantly reduced with a small number of low-tech interventions. This article summarises the core equipment and skills needed for the resuscitation of newborns where equipment is limited and skilled paediatric support is not available. It draws on the WHO Newborn Care Guidelines, updated in November 2017, to illustrate recent changes in resuscitation practices and to emphasise the importance of keeping babies warm, and breastfeeding early. Anaesthetic practitioners are well placed to promote good practice in all these aspects of newborn management.

**Key words:** neonate, neonatal mortality, cardio-pulmonary resuscitation, birth, stillbirth

### INTRODUCTION

Worldwide in 2016, 46% of deaths of children under five occurred in the newborn period.<sup>1</sup> The global average neonatal mortality rate (deaths in the first 28 days of life) is 18.6 per 1000 live births. However there is a vast difference between rates in Europe which average 5 per 1000 and in the Eastern Mediterranean region and Africa which average 27.7 and 27.2 per 1000 respectively. The authors represent a group of health professionals from the UK who teach newborn care in Cameroon, West Africa, and train local instructors. Reduction of the infant mortality rate in Cameroon is our goal. Much can be gained by raising the standard of newborn resuscitation at birth. Unfortunately, many babies are beyond our help by the time they are born, and it may be that the most gain is to be had from learning, teaching and carrying out appropriate care of the surviving newborns in the first 28 days of their lives. The World Health Organisation (WHO) updated its Newborn Care Guidelines in 2017 and invites us to concentrate on keeping babies warm, supporting breastfeeding, recognising and treating infection. Medical and non-medical anaesthetic practitioners in low resource areas of the world are likely to be involved in neonatal resuscitation particularly in the context of Caesarean deliveries. As well as providing a skilled service to an individual baby at the time of resuscitation, it is likely anaesthesiologists will be looked to for examples of good practice in the immediate aftermath, particularly in the absence of skilled paediatric staff.

*Imagine a situation where you are managing a primigravida woman with obstructed labour who is now having an emergency Caesarean delivery (under spinal or general anaesthesia). The baby is delivered, the cord is cut and the midwife has taken the baby to the resuscitation table. The baby is pale, floppy and not breathing. The mother is stable, the obstetrician is closing up and you offer to help the midwife with the baby.*

*Let's use this scenario to look at a few issues surrounding stabilisation of the newborn infant.*

*Cutting the cord:* Timing of this has changed recently to facilitate passive blood transfusion from placenta to baby. WHO now advises not cutting the cord for 1 to 3 minutes after delivery of the baby "unless the neonate is asphyxiated and needs immediate resuscitation".<sup>2</sup>

*Neonatal versus adult resuscitation:* The change from intra-uterine to extra-uterine life involves extensive physiological changes. Some newborn babies require assistance with this adaptation rather than a need for resuscitation in the way an older child or adult might. Simple manoeuvres carried out promptly are likely to yield a rewarding response. In newborns, unlike adults, hypoxia is the primary problem and the Airway and Breathing must be prioritised. Cardiac compressions will not be effective unless there is oxygen in the blood supply.

#### J O'Donohoe

MB, MRCP, FRCPC, MSC  
Retired Paediatrician  
NORTHERN IRELAND

#### J Thomson

BM, MSC, FRCPC, MACADMED  
Consultant Paediatrician  
Homerton University  
Hospital NHS  
Foundation Trust  
London  
UNITED KINGDOM

#### C Robinson

NREMT (USA), EMT (Illinois)  
PG Dip Resuscitation  
Practice  
Acting Lead  
Resuscitation Officer  
Western Health and  
Social Care Board  
NORTHERN IRELAND

### **Ethics: Resuscitation versus no or limited resuscitation**

It is not always appropriate to start or continue resuscitation attempts. Consider the following situations:

1. *Preterm infants:* babies of 1kg or more can breathe for themselves and have a good chance of survival if kept warm and any infections treated. If the estimated date of delivery is known, 1kg usually correlates with 28 weeks' gestation or more. Weighing newborns (particularly if small) increases the risk of hypothermia and should not precede resuscitation. The midwife may be able to estimate weight by looking at the baby; use the whole team's expertise. Smaller babies with shiny skin and fused eyes are likely to be too young to sustain their own lives after resuscitation without the help of ventilators in the neonatal unit. You will need to assess the appropriateness of trying to help these very small infants if you do not have advanced neonatal facilities.

2. *When there is no response to resuscitative attempts:* WHO suggests that if there is no heart beat after 10 minutes of adequate resuscitation there is unlikely to be any response to further efforts. If the heart beat is present but still less than 60 beats per minute at 20 minutes, there is also unlikely to be a positive outcome and resuscitation efforts should be stopped. It is important to teach this to healthcare providers so they do not try to resuscitate for too long and do not feel to blame if they cannot resuscitate the baby.

3. *Congenital abnormalities:* It would not be appropriate to resuscitate a child with obvious anencephaly (no brain development). One of our newly trained Cameroonian instructors used the immediacy of WhatsApp to contact one of us recently to check that she was correct not to resuscitate a baby with sirenomelia (fused, undeveloped lower part of the body leading to a mermaid-like appearance) she had just delivered. Other than these two examples, there are not many congenital abnormalities which can be so clearly recognised as to justify not attempting resuscitation.

*Your role:* An episode of resuscitation is one element of care that has the potential to reduce neonatal mortality. An anaesthetic practitioner aware of the broader context may be able to encourage good practice in a range of situations beyond resuscitation. The most readily available effective interventions besides resuscitation are temperature control, prevention of infection, kangaroo (skin to skin) mother care and breastfeeding. Ensure that the operating theatre is not too cold – turn off air-conditioning prior to delivery so that the temperature is not less than 25°C. Successful resuscitation may produce a “teachable moment” where advice about skin to skin care and breast feeding may be more readily accepted by relieved and grateful parents, and well modelled to other healthcare staff.

*Maintenance of Temperature:* Hypothermia is common in newborns in all parts of the world. Prevention of hypothermia is probably the single most useful intervention in the neonatal period. Hypothermia reduces the production of surfactant, lowers blood glucose and exacerbates acidosis. Mortality in the immediate post-partum hours is proportional to the degree of hypothermia. Ensure that two dry, warmed towels are available at a delivery - one to dry the baby and the other to cover it. The head should be covered with a hat. Once stabilised, put the baby skin to skin with its mother or another family member if the mother is not yet available. This allows the baby to

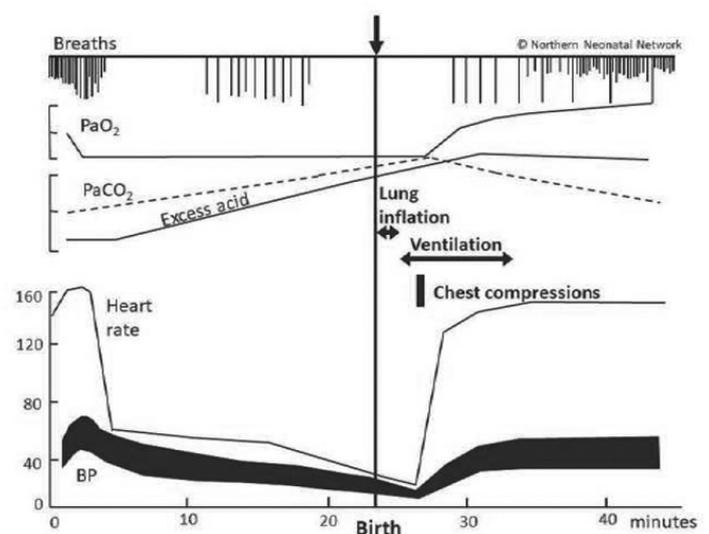
maintain its temperature, commence breastfeeding (if with mother) and start to be colonised by the family's bacteria which will protect it from hospital acquired infections.

*Apgar Score and Resuscitation:* The Apgar score allows the midwife at a normal delivery to assess the baby's condition at 1 and 5 minutes of age. Since a newborn baby should be helped to produce its first breath by 1 minute of age, the Apgar score is irrelevant to decision making and plays no part in any of the available resuscitation algorithms.

*How to Judge the Need for Resuscitation:* If a baby is not active and crying immediately after birth,<sup>4</sup> things need to be assessed: colour, tone, breathing and heart rate. Peripheral cyanosis is a normal phenomenon in the newborn. However a pale, mottled, greyish colour suggests a serious problem. Reduced tone suggests that there is not enough oxygen going to the muscles or brain; a floppy baby is usually unconscious. If respiration is absent or the baby is gasping (about 12 deep, shuddering breaths per minute), bag-valve mask (BVM) ventilation should be started promptly.

*How to Assess the Response to Intervention:* A slow heart rate is one of the hallmarks of a need for ongoing respiratory support. Heart rate changes quickly in response to changes during resuscitation in newborns. Colour change, increase in tone and eventually spontaneous breathing will follow. Once the baby is crying, wrap him/her up and put skin to skin with the mother to establish breastfeeding. This is not the time for weighing, bathing, dressing or giving Vitamin K. These tasks can be completed after the first feed while the mother is being cleaned up. Anaesthetic practitioners are in a position to influence these early actions for the benefit of both baby and mother. Breastfeeding leads to the release of oxytocin and therefore the contraction of the uterus and a reduction in the risk of postpartum haemorrhage.

*Physiology:* If you have not seen this physiological diagram (Figure 1) from the Resuscitation Council (UK) Newborn Life Support course



**Figure 1:** Diagram showing the effects of sudden onset of hypoxia (time 0) and the response to resuscitation at birth indicated by the arrow at the top of the diagram. Reproduced with the kind agreement of the Northern Neonatal Network. All rights reserved.<sup>3</sup>

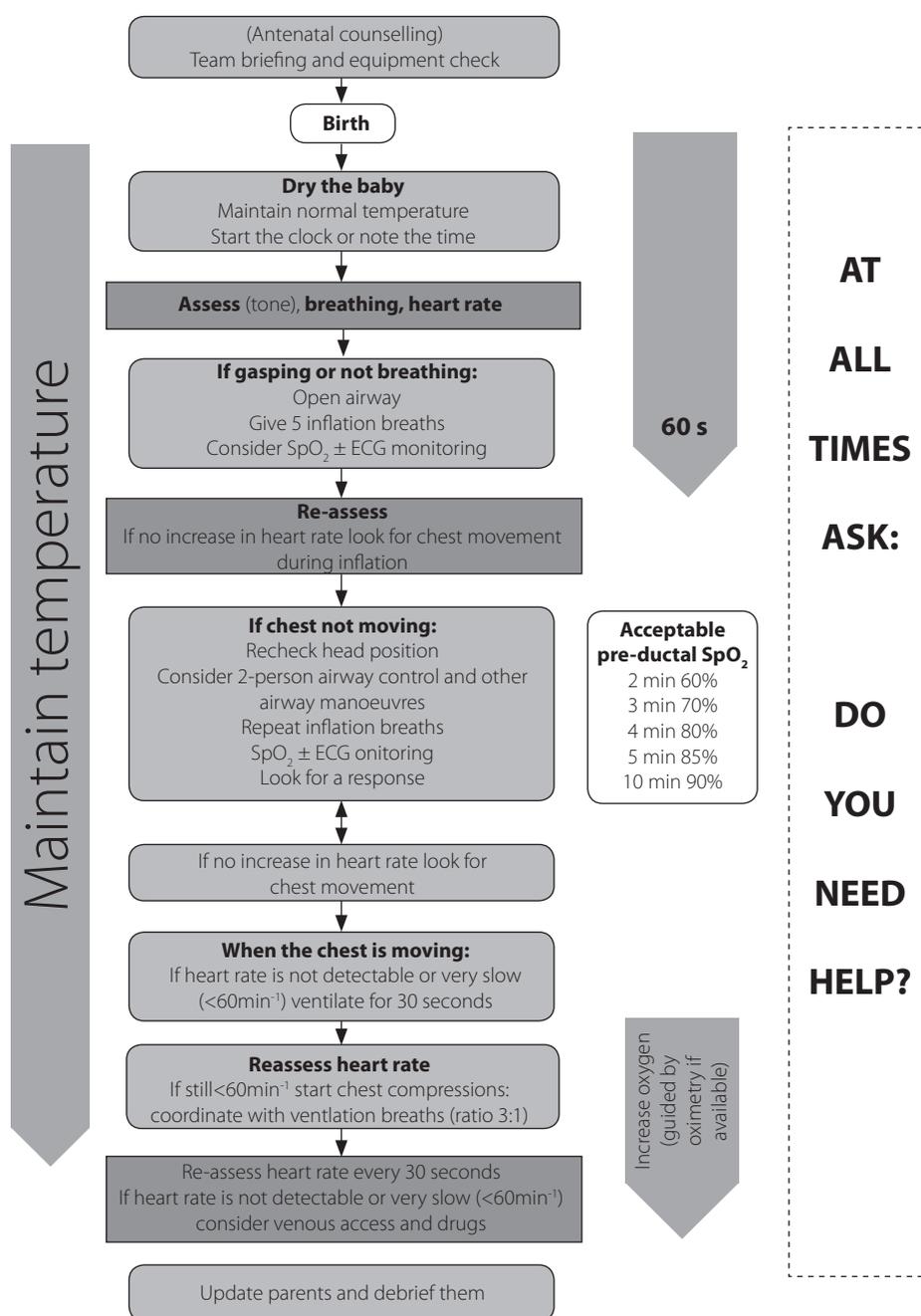
manual, it is worth taking a few minutes to try and understand it because it explains why some infants seem to resuscitate themselves, whilst others take a lot of effort to save and some resuscitation attempts – however expertly delivered - are unsuccessful. The data has been obtained from animal studies and represents what happens to various physiological parameters within the fetus when the oxygen supply is cut off in utero at time 0.

The most relevant features of Figure 1 from a clinical perspective are the top line (where each vertical line represents a breath) and the line in the lower third of the diagram representing heart rate. Lines representing PaO<sub>2</sub> and pH (labelled Excess acid) are easily

understood from normal physiology but are often not measurable in resource-poor areas of the world.

The sudden hypoxia triggers breathing movements even in the womb. If these breathing movements are not followed by an increase in PaO<sub>2</sub>, they will stop. This is referred to as primary apnoea. After a further period of hypoxia, there will be irregular gasping breathing efforts and if these are not followed by an improvement in PaO<sub>2</sub> these will also stop and a period called terminal apnoea occurs.

The difficulty clinically is when there is no breathing and a slow heart rate in a baby after birth, it is impossible to know whether this is



**Figure 2:** Newborn Life Support algorithm. Reproduced with the kind permission of the Resuscitation Council (UK). All rights reserved.<sup>4</sup>

primary or terminal apnoea, and if terminal apnoea, how long it has been going on for. The only way to differentiate is by response to resuscitation. If there is a response, it is almost certainly either primary apnoea or early terminal apnoea. If there is no response, it probably means it is long standing terminal apnoea and sufficient damage has been done in utero to prevent successful resuscitation. These are the cases where prolonged resuscitation is futile.

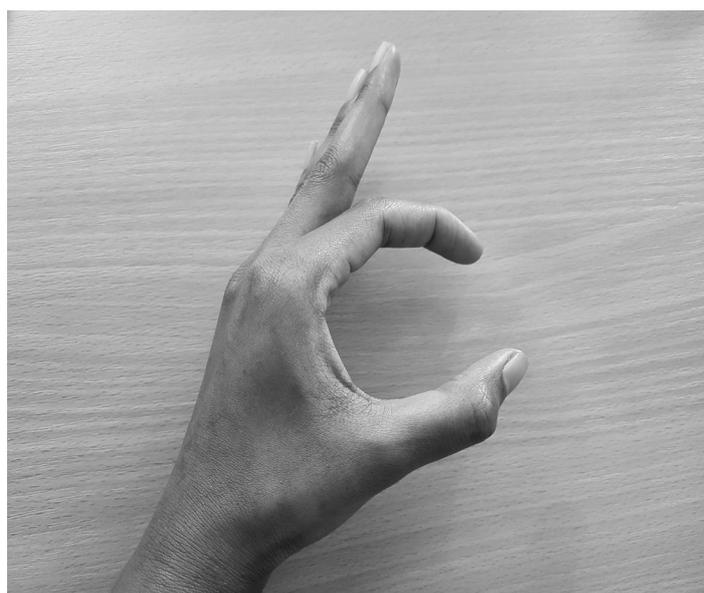
*So, to get back to our clinical scenario: you approach the resuscitation table and start to work through whichever resuscitation algorithm your health facility uses. The below example Figure 2 is from the Resuscitation Council (UK). Yours may differ. However, the principles and evidence behind each version are similar and the important thing is that all members of the same team use the same algorithm. All the world's principal resuscitation organisations base their resuscitation algorithms on the recommendations of the International Liaison Committee on Resuscitation (ILCOR) Consensus on Science and Treatment Recommendations (CoSTR).*

We have already discussed drying and assessing the baby. This and the successful opening of the airway is the most that the majority of babies who are a bit floppy at birth require. Note there is no role for intubation, drugs and cardiac compressions until the last few boxes of the algorithm. Feedback from our Cameroonian paediatric, nursing and midwifery colleagues suggest that anaesthetic practitioners who have not been appropriately trained in newborn resuscitation tend to start at the bottom of the algorithm to the detriment of the baby. Consider displaying a cognitive aid such as a newborn resuscitation algorithm on your delivery room wall. These are available from the Resuscitation Council in the UK (<https://www.resus.org.uk/resuscitation-guidelines>), the European Resuscitation Council (<https://cprguidelines.eu/>), the American Academy of Paediatrics ([http://pediatrics.aappublications.org/content/136/Supplement\\_2/S196](http://pediatrics.aappublications.org/content/136/Supplement_2/S196)) or the Helping Babies Breathe programme ([https://www.aap.org/en-us/ImagesGen/hbs\\_2nded\\_actionplan.jpg](https://www.aap.org/en-us/ImagesGen/hbs_2nded_actionplan.jpg)).

**Suction:** Suction is nowadays generally regarded as being unnecessary and potentially harmful because of the vagal response provoked. In most newborns, the frothy secretions seen are a small fraction of the fluid left in the lungs from intra-uterine life. This fluid is cleared by a baby's first breaths, or by effective bag-valve-mask (BVM) ventilation if the baby is not breathing spontaneously. Suction is still advocated for infants born through thick meconium who do not breathe at birth



**Figure 3:** Putting the baby's head into the "neutral position" i.e. parallel to the surface on which the baby is lying



**Figure 4:** "C" position of thumb and index finger



**Figure 5:** "E" position of middle, ring and small finger



**Figure 6:** "C" grip with thumb and index finger pressing the mask onto the face and the "E" grip on the mandible pulling it up into the mask



**Figure 7:** Single person BVM ventilation

but even in these cases, the evidence for its efficacy as an intervention is weak. The meconium will have been inhaled deep into the baby's lungs before birth during the process of gasping. There is no role for suction on the perineum on delivery of the head.

*Oxygen in Neonatal Resuscitation:* Current guidelines are for babies to be resuscitated using air rather than oxygen. A self-inflating BVM (500ml size) is therefore your most useful piece of resuscitation equipment.

*Neutral position:* The term neutral position refers to the plane of the face being parallel to the underlying table (Figure 3). Because infants have a large occiput, putting them in the adult-orientated "head-tilt/chin-lift" or "sniffing the morning air" position is unnecessary and may overextend and thus obstruct their airway.

### **Bag Valve Ventilation- Techniques**

**Grip:** The grip can be described as a combination of a C grip and an E grip, sometimes also referred to as the C3. As shown in Figures 4, 6 and 7, the C part is the index finger and thumb encircling the face mask and exerting pressure on the shoulder of the mask. The E (Figures 5, 6 and 7) grip is formed of the remaining three fingers which are applied to the mandible to draw the jaw up into the mask. We have found in Cameroon and the UK that this description serves as an effective aide memoire and helps our learners to get a good seal.

### **Two-handed technique:**

If you have assistance, the illustrated two-handed technique (Figure 8) will reduce the leak around the mask and you will achieve better lung inflation. Ask the midwife for help.

If there are persisting difficulties, a technique such as that in Figure 9 may help with jaw thrust to open the airway.

Bag Valve Mask (BVM) Ventilation – inflation breaths and ventilation breaths. In the European approach to neonatal resuscitation, the first 5 breaths given are referred to as inflation breaths. They are longer than subsequent breaths and are given over 3 seconds each. An adequate breath is one that causes the chest to rise; overly vigorous inflation can cause a pneumothorax. We found getting our Cameroonian



**Figure 8:** Single person, two-handed technique, used when it is difficult to prevent air leak. Bag Valve Mask is not shown for the sake of clarity



**Figure 9:** A two-handed technique with jaw thrust. The mask is being held in place by pressure from the two thumbs

colleagues to say "one long breath" as they ventilated and making the ventilation last until they said it, ensured an adequate length of time for each inflation breath. Subsequent breaths are given at a rate of 30 per minute.

### **Cardiac Massage Techniques:**

Cardiac massage should only be started when the infant's chest has been moving adequately with BVM ventilation for 30 seconds and the heart rate is still less than 60 beats per minute (see Figure 2). The most effective method is the encircling technique with fingers behind the baby's back and two thumbs on the lower third of the sternum (Figure 10). Depress the chest one third of the anterior/posterior depth at a rate of 3 compressions for each breath. An alternative position for single-handed rescuers is to press down on the middle of the baby's sternum with the first and second fingers of one of your hands, keeping your other hand free for airway manoeuvres (Figure 11). <http://www.medicalaidfilms.org/film/how-to-resuscitate-a-newborn-baby/> is essential viewing material for all anaesthetic practitioners prior to starting work in the obstetric field. Cardiac massage can be stopped when the heart rate is above 60 beats per minute or in the unfortunate situation where there is still no heart beat after 10 minutes of active and adequate resuscitation or



**Figure 10:** Cardiac compressions hand position. In the newborn cardiac massage is seldom of value if BVM ventilation is not being carried out well



**Figure 11:** single rescuer cardiac massage

the heart beat remains under 60 beats per minute after 20 minutes of active and adequate resuscitation.

**Vascular Access:** Umbilical Venous Cannula and Intra Osseous Access: Volume replacement in resuscitation is rarely needed. Inserting a small nasogastric tube 5cms into an umbilical vein is probably the quickest method of establishing venous access at birth. It should be done as cleanly as possible, and fluid or medications given as needed. An intra-osseous needle, inserted into the bone marrow cavity of the baby's proximal tibia can also be used. If you are not familiar with the use of an intraosseous needle, you may find the 25 minute video from OPENPediatrics ([www.openpediatrics.org](http://www.openpediatrics.org)) helpful, available at <https://www.youtube.com/watch?v=RTxbWkHKH-M>. Needles specifically for this job may not be available in your setting but a sturdy hypodermic needle of 18g with a syringe attached will usually be an effective alternative.

**Medications in Neonatal Resuscitation:** Adrenaline, sodium bicarbonate and sometimes 10% dextrose are used in high resource countries but the evidence for their efficacy is poor and the outcome

for the baby is probably not improved greatly. In areas where there are no high level neonatal facilities, the role of medications in newborn resuscitation is unproven and probably best avoided.

You dry the baby, wrap him in a dry towel and put on his hat. You put his head in the neutral position, note that he is not breathing and his heart rate is slow. You apply a well-fitting face mask and, using a C and E type grip, you administer 5 slow inflation breaths. The chest rises satisfactorily and the midwife tells you that the baby's heart rate has come up. The baby cries and you give him to his mother for skin to skin care and he goes to the breast immediately. A life saved, well done!

#### **Training resources:**

**Videos:** basic neonatal life support in the community using mouth-to-mouth resuscitation techniques instead of bag and valve mask is well taught and explained at <http://www.medicalaidfilms.org/film/what-to-do-when-a-newborn-baby-is-not-breathing/>. A more detailed video from the same group, 20 minutes long and covering all aspects of newborn resuscitation is well worth watching at <http://www.medicalaidfilms.org/film/how-to-resuscitate-a-newborn-baby/>. All aspects of newborn delivery and care in resource poor areas are beautifully illustrated in the Global Health Media videos which we recommend to you highly (<https://globalhealthmedia.org/videos/>).

**Training Courses:** Probably the most widely available course in resource poor areas is Helping Babies Breathe (<https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/helping-babies-survive/Pages/default.aspx>). The training project we have been most directly involved in is the Newborn Care Course (<http://www.nicheinternational.org.uk/newborn-care-course/>), originally developed by Maternal and Child Advocacy International (<http://www.mcai.org.uk/>) and the Advanced Life Support Group ([www.alsg.org](http://www.alsg.org)), both based in the UK. The Newborn Care Course uses the UK Resuscitation Council guidelines for the life support teaching component (<https://www.resus.org.uk/information-on-courses/newborn-life-support/>).

**Written material:** The World Health Organisation published its updated guidelines on Management of the Newborn in 2017 ([http://www.who.int/maternal\\_child\\_adolescent/documents/newborn-health-recommendations/en/](http://www.who.int/maternal_child_adolescent/documents/newborn-health-recommendations/en/)).

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