



525 Twenty-third St. N.W.,  
Washington, D.C. 20037

Tel: 202.974.3000  
Fax: 202.974.3724  
E-mail: [chaparrc@paho.org](mailto:chaparrc@paho.org)  
E-mail: [lutterch@paho.org](mailto:lutterch@paho.org)

[www.paho.org](http://www.paho.org)



## Beyond survival:

Integrated delivery care practices  
for long-term maternal and infant nutrition,  
health and development



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Integrated delivery care practices  
for long-term maternal and infant nutrition,  
health and development



**Pan American  
Health  
Organization**



*Regional Office of the  
World Health Organization*

For more information, please contact:  
Unit on Child and Adolescent Health  
Pan American Health Organization  
525 23rd Street, NW, Washington D.C. 20037  
Website: <http://www.paho.org>  
Telephone: (202) 974-3519

Pan American Health Organization

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## I. Title

1. INFANT, NEWBORN
2. INFANT CARE
3. INFANT NUTRITION, PHYSIOLOGY
4. CHILD DEVELOPMENT
5. DELIVERY, OBSTETRIC

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Child and Adolescent Health Unit  
Family and Community Health  
Pan American Health Organization  
525 Twenty-third Street, N.W.  
Washington, DC 20037-2895  
[www.paho.org](http://www.paho.org)

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# Table of Contents

Acknowledgments .....	1
Introduction.....	2
1. Optimal timing of umbilical cord clamping .....	5
Recommendation for practice .....	5
1.1 History of the timing of umbilical cord clamping and current cord clamping practices .....	6
1.2 Physiological effects of the timing of cord clamping and determinants of the “placental transfusion” .....	6
1.3 Immediate benefits of delayed cord clamping.....	8
1.4 Long-term benefits of delayed cord clamping: Infant iron status .....	10
1.5 Infant iron status and development: An emphasis on prevention.....	13
2. Mother and newborn skin-to-skin contact .....	16
Recommendation for practice .....	16
2.1 Immediate benefits of skin-to-skin contact.....	16
2.2 Long-term benefits of early skin-to-skin contact.....	18
3. Early initiation of exclusive breastfeeding .....	19
Recommendation for practice .....	19
3.1 Immediate benefits of early and exclusive breastfeeding.....	21
3.2 Long-term benefits of breastfeeding .....	22
4. Integration of delivery care practices within the context of health facility and domiciliary deliveries.....	23
4.1 Contextual considerations: Current health facility and domiciliary delivery care practices.....	24
4.2 Steps for achieving universal implementation of an integrated set of delivery care practices.....	27
4.2.1 Increasing access to scientific information supporting evidence-based practices.....	27
4.2.2 Addressing the skills needed to implement the recommended practices .....	27
4.2.3 Establishment and communication of regional, national and local policies and guidelines for implementation of the recommended practices .....	28
4.2.4 Advocacy and synchronization with other maternal and neonatal care efforts .....	29
4.2.5 Organization of delivery care services.....	30
4.2.6 Monitoring and evaluation .....	30

5. Conclusions .....	32
Appendix 1: Research questions regarding the implementation and integration of these practices.....	33
Appendix 2: Are there exceptions to the recommended practices?.....	36
References .....	39
Additional Resources and Websites.....	47
Box 1: Active management of the third stage of labor .....	3
Figure 1: Stepwise nature of the placental transfusion .....	7
Figure 2: Importance of gravity and placement of the infant for the speed of placental transfusion .....	8
Table 1: Summary of immediate and long-term benefits of delayed umbilical cord clamping for infants (term, pre-term/low birth weight) and mothers.....	9
Box 2: Amount of iron provided in the “placental transfusion” allowed by delayed clamping .....	11
Table 2: Worldwide prevalence of anemia in children between 6 and 35 months of age from available Demographic and Health Surveys .....	12
Figure 3: How long should birth iron stores last? An analysis by birth weight and cord clamping time.....	13
Figure 4: Cognitive composite scores over time by iron status and socioeconomic level, from a longitudinal study of Costa Rican infants followed through adolescence.....	15
Table 3: Summary of immediate and long-term benefits of early mother to newborn skin-to-skin contact .....	17
Table 4: Under-5 deaths that could be prevented in the 42 countries with 90% of worldwide child deaths in 2000 through achievement of universal coverage with individual interventions .....	20
Table 5: Summary of Immediate and long-term benefits of breastfeeding for mother and infant .....	21
Figure 5: Integration of essential steps for maternal, neonatal and infant survival, health and nutrition.....	25
Box 3: Actions needed to ensure implementation of the essential delivery care practices.....	30

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# Introduction

*The combination of practices recommended in this document is unique in that it crosses the divide between “maternal” and “neonatal” care, thus truly contributing to the goal of a “continuum of care” for mothers and infants.*

It is now well recognized that delivery and the immediate postpartum period is a vulnerable time for both the mother and infant. During the first 24 hours after delivery it is estimated that 25 to 45% of neonatal deaths and 45% of maternal deaths occur.<sup>1,2</sup> Thus delivery and postpartum care practices that attend to the most serious and immediate risks for the mother (e.g. postpartum hemorrhage

and postpartum infections) and neonate (e.g. asphyxia, low birth weight/prematurity, and severe infections) are the most commonly addressed by public health interventions. Only recently has the fate of the newborn been directly focused upon, since previous delivery care initiatives mainly addressed the health and safety of the mother at childbirth<sup>2</sup> while

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The recent quantification of the immense contribution of neonatal mortality to overall under-five child mortality provided the opportunity to highlight several simple, inexpensive and evidence-based practices that can improve survival of the “forgotten newborn”.

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child survival programs tended to concentrate on conditions affecting survival after the neonatal period (i.e. after the first 28 days of life).<sup>1</sup>

The recent quantification of the immense contribution of neonatal mortality to overall under-five child mortality (roughly 1/3 of all under-five deaths),<sup>1</sup> provided the opportunity to highlight several simple, inexpensive and evidence-based delivery care practices that can improve survival of the “forgotten newborn” during the delivery/postpartum period.<sup>3,4</sup> However, while attention is now

being paid more equally to improving survival of both components of the mother-infant dyad during delivery and the post-partum period, a crucial opportunity to implement simple practices that can affect long-term nutrition, health and development outcomes may be being overlooked. Delayed umbilical cord clamping, immediate mother to newborn skin-to-skin contact and initiation of exclusive breastfeeding, are three simple practices that, in addition to providing immediate benefit, can have long-term impact on the nutrition and health of both mother and child and possibly affect the development of the child far beyond the immediate neonatal and postpartum period. Therefore, an integrated package of care that includes these three practices, together with maternal care practices already being promoted to prevent maternal morbidity and mortality, such as active management of the third stage of labor, will optimize both short- and long-term infant and maternal outcomes.

## Objectives

The objective of the present document is twofold. First, the current knowledge of the immediate and long-term nutritional and health benefits of three practices will be reviewed. These include:

1. Delayed umbilical cord clamping
2. Immediate and continued skin-to-skin contact between mother and infant
3. Immediate initiation of exclusive breastfeeding

While there are clearly many essential delivery care practices, the three practices that we review

have either not received adequate attention, or deserve renewed emphasis, and have positive effects on nutritional status, which is generally not an outcome encompassed in the discussion of delivery care practices.

Secondly, we aim to illustrate that these three practices can be feasibly and safely implemented together for the benefit of both mother and infant. Previous recommendations have implied that several maternal and infant care practices may not be

compatible with one another: for example, early cord clamping was until recently recommended as a part of active management of the third stage of labor<sup>5</sup> (*Box 1*) and one of the reasons suggested for practicing immediate cord clamping was to place the infant in contact with the mother as soon as possible after delivery.<sup>6</sup> Delivery practices have generally been described without simultaneously mentioning both components of the mother-infant dyad (e.g. active management guidelines gen-

### **Box 1: Active management of the third stage of labor for the prevention of postpartum hemorrhage**

Postpartum hemorrhage is the leading cause of maternal mortality worldwide, contributing to 25% of all maternal deaths,<sup>85</sup> and uterine atony is its most common cause. Fourteen million cases of postpartum hemorrhage are estimated to occur annually on a global level.<sup>85</sup> Active management of the third stage of labor (as it was previously recommended<sup>110</sup>) significantly reduced the incidence of postpartum hemorrhage from uterine atony by 60%,<sup>5</sup> the incidence of postpartum blood loss of 1 liter or more and the need for costly and risky blood transfusions,<sup>94</sup> and prevented complications related to postpartum hemorrhage. Recently, the World Health Organization revised its recommendations for active management to include delayed umbilical cord clamping rather than early cord clamping.<sup>94</sup> Since cord clamping time has never been shown to have an effect on maternal bleeding, and to the contrary, there is evidence that a less distended placenta is more easily delivered, it is not expected that this change will affect the efficacy of active management for the prevention of postpartum hemorrhage. However the efficacy of the revised protocol should be formally assessed.

As it is currently recommended, active management includes three steps to be performed by a skilled provider:<sup>94,111</sup>

1. Administration of an uterotonic drug (e.g. 10 IU of oxytocin intramuscularly) soon after delivery of the infant to avoid uterine atony.
2. Delayed clamping and cutting of the umbilical cord followed by delivery of the placenta by controlled cord traction: After clamping and cutting the cord, keep slight tension on the cord and await a strong uterine contraction. Very gently pull downwards on the cord while stabilizing the uterus by applying counter traction with the other hand placed just above the mother's pubic bone.
3. Uterine massage immediately following delivery of the placenta, and every 15 minutes for the first two hours.

erally do not include mention of the infant). We provide an integrated framework of steps, based on current evidence, which should be readily adaptable to a variety of delivery settings.

## Target audience

Our target audience for this document includes health practitioners attending deliveries in health facilities as well as public health decision makers who are responsible for establishing health policy for maternal and newborn care. The intended target audience for this document is intentionally broad in order to increase knowledge regarding the recommended practices among a wide range of in-

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Delayed umbilical cord clamping, immediate mother to newborn skin-to-skin contact and initiation of exclusive breastfeeding, are three simple practices that, in addition to providing immediate benefit, can have long-term impact on the nutrition and health of both mother and child and possibly affect the development of the child far beyond the immediate neonatal and postpartum period.

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dividuals who will all be essential in effecting change. While we acknowledge that different individuals involved in maternal and newborn care will need varying levels of knowledge in order to promote and implement the recommended practices, the scientific evidence and practical recommendations included in this document will be useful to the entire audience. For example, practicing obstetricians, pediatricians and midwives may want more practical

information on “how” to implement the practices, as well as strong scientific evidence in order to justify changes in their clinical practice. Public health decision makers may be more interested in the overall health benefits of the practices presented through the scientific evidence, but will also need to understand the basic skills in order to assess how

existing systems and programs can be adapted to accommodate the recommended practices. Thus for all groups, the “why” and “how” behind the recommended practices are essential knowledge, and therefore this document will be valuable to both practicing clinicians and public health decision makers.

## Organization of document

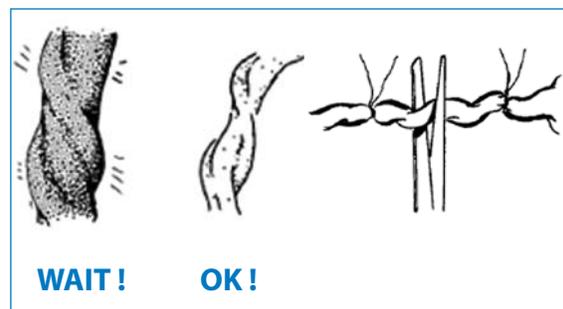
The first three sections of the document address each of the three practices in the following format: a recommendation for practice is presented first followed by a discussion of the evidence indicating short- and long-term benefit for both mother and infant. The final section of the document presents an integration of the separate steps into a feasible sequence and addresses what is known regarding current delivery care practices. We conclude with a discussion of what steps may need to be taken to overcome barriers to the adoption and sustained implementation and integration of the essential delivery care practices discussed.

# 1. Optimal timing of umbilical cord clamping

## Recommendation for practice

After the infant is delivered and dried with a clean dry cloth, a fully reactive infant\* may be placed prone on the maternal abdomen where s/he can be covered with a warm dry blanket. The optimal time to clamp the umbilical cord for all infants regardless of gestational age or fetal weight is when the circulation in the cord has ceased, and the cord is flat and pulseless (approximately 3 minutes or more after birth).<sup>7</sup> After cord pulsations have ceased (approximately 3 minutes after delivery), clamp and cut the cord following strict hygienic techniques.

*\*If the infant is pale, limp, or not breathing, it is best to keep the infant at the level of the perineum to allow optimal blood flow and oxygenation while resuscitative measures are performed. It is important to note that most infants (more than 90%) respond to the initial steps of resuscitation, including drying and stimulation. A smaller percentage, less than 10%, require active resuscitative interventions to establish regular respirations, and approximately half of those infants will respond without further active resuscitative efforts.<sup>8</sup> Thus in the majority of cases, resuscitation can be performed simultaneously with delayed cord clamping.*



## 1.1 History of the timing of umbilical cord clamping and current cord clamping practices

Debate as to the “correct” time to clamp the umbilical cord after delivery has been documented since at least the early 1900s, when obstetric practices began to shift from the “present prevalent practice” of delayed umbilical cord clamping (i.e. 2-3 minutes after delivery or at the end of cord pulsations) in 1935,<sup>9</sup> towards early umbilical cord clamping (i.e. 10 to 15 seconds after delivery) which appears to be the current and prevalent practice in many settings. It is not clear why practices changed, but it has been suggested

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Regardless of the particular reasons behind the change in practice from delayed clamping to early clamping, it is clear that there was no scientific evidence supporting early clamping as the more beneficial practice for the infant, or for the mother.

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that many different factors played a role, including an overall movement in obstetrics towards more “interventionist” techniques which included the movement of more births from the home into the hospital setting where “ligation of the cord makes it possible to get babies and mothers out of the delivery room more rapidly”<sup>10</sup> and where

women usually labor in dorsal positions rather than more upright positions and receive more analgesics and intravenous fluids, and where the umbilical cord and placenta are managed more actively. Other reasons that have been suggested for the institution of early clamping include: the fear of increasing hyperbilirubinemia and/or polycythemia in the late clamped infant, the presence of a neonatologist or pediatrician in the delivery room anxious to attend to the infant, the rush to measure cord blood pH and gases, and to place

the infant in skin-to-skin contact with the mother as soon as possible.<sup>6</sup> Regardless of the particular reasons behind the change in practice from delayed clamping to early clamping, it is clear that there was little to no scientific evidence supporting early clamping as the more beneficial practice for the infant, or for the mother.

## 1.2 Physiological effects of the timing of cord clamping and determinants of the “placental transfusion”

For a period of time after birth there is still circulation between the infant and placenta through the umbilical vein and arteries, and thus the timing of cord clamping will have profound effects on infant blood volume at delivery. By measuring placental residual blood volume after clamping the umbilical vein and/or arteries at various time points, it was shown that blood flows through the umbilical arteries (from the infant to the placenta) during the first 20 to 25 seconds after birth but is negligible by about 40-45 seconds.<sup>11</sup> In contrast, in the umbilical vein, blood flow continues from the placenta to the infant up to 3 minutes after delivery, after which blood flow is insignificant. From studies that have attempted to measure infant blood volume in full-term infants after different cord clamping times,<sup>12-18</sup> the approximate midpoint of the estimated values from these studies was 40 ml per kg of placental blood transferred to the infant after a delay in clamping of at least 3 minutes.<sup>19</sup> This represents an increase of about 50% in total blood volume of the newborn. For preterm infants, placental transfusion after delivery also occurs, although the amount of transfer is relatively smaller. A delay of 30-45 seconds permits an increase in blood volume of approximately 8 to 24% with slightly greater transfusion occurring after vaginal birth (between 2-16

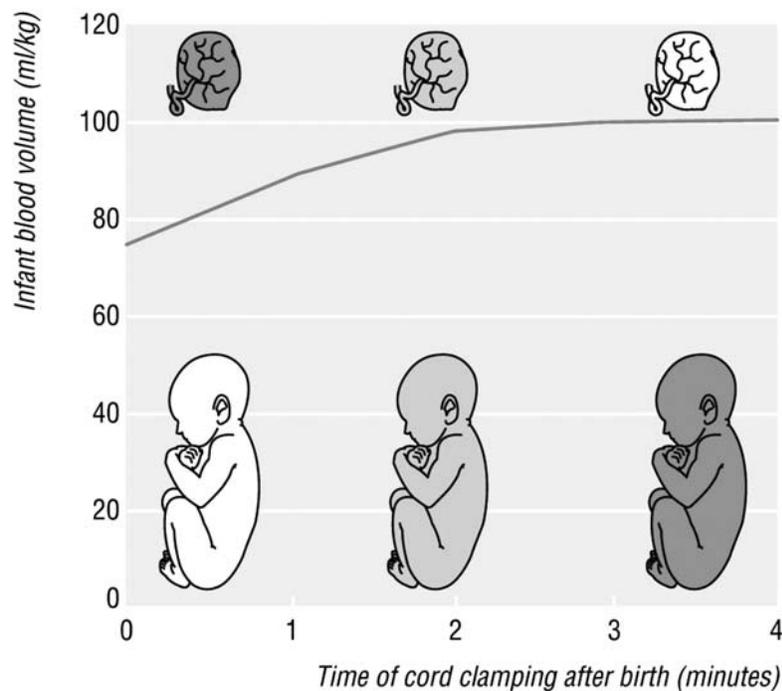
ml/kg after cesarean delivery, and 10-28 ml/kg after vaginal delivery).<sup>20,21</sup>

The rate of placental transfusion is rapid at first and then slows in a stepwise fashion, with approximately 25% of the transfer occurring in the first 15 to 30 seconds after the uterine contraction of birth, 50-78% of the transfer by 60 seconds and the remaining transfer by three minutes.<sup>17</sup> (Figure 1) The rate and amount of transfer can be affected by several factors. Uterine contraction is one factor that can accelerate the rate of transfer. The uterine contraction that naturally occurs between 1 and 3 minutes after the birth contraction is thought to be responsible for

the last “step” of the placental transfer.<sup>22</sup> When methylergovanine (an oxytocic drug) was given immediately after birth, placental blood transfer occurred in one minute, after a uterine contraction occurred at approximately 45 seconds.<sup>22</sup> Gravity can also play a role in the rate and amount of transfer (Figure 2). If the infant is held significantly below the level of the uterus, gravity

The insufficient circulating blood volume caused by immediate cord clamping can have immediate negative effects which may be more readily evident in pre-term and low-birth weight infants because of their initially smaller fetal-placental blood volume and slower cardio-respiratory adaptation.

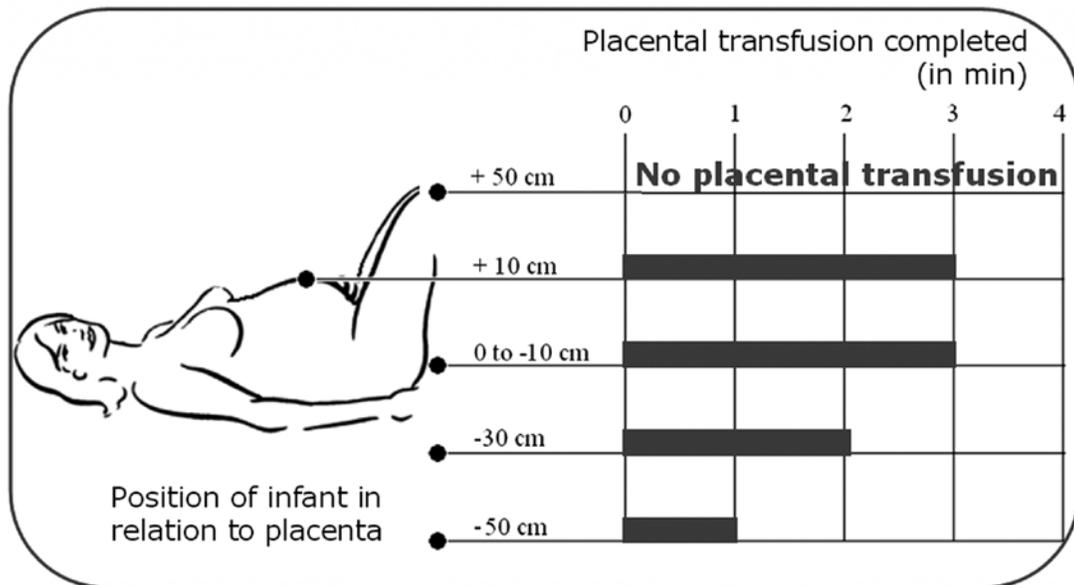
**Figure 1: Stepwise nature of the placental transfusion**



Distribution of blood between infant and placenta depending on time of cord clamping after birth (adapted from Linderkamp<sup>23</sup> and Yao<sup>17</sup>). The term infants are at the level of the introitus, about 10 cm below the placenta

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**Figure 2: Importance of gravity and placement of the infant for the speed of placental transfusion**



The figure shows how placement can affect the time to completion of placental transfusion. Within approximately 10 cm above or below the level of the placenta, the placental transfusion is estimated to occur within approximately 3 minutes. Significantly below the level of the placenta increases the rate, but not the total amount of transfer. Significantly above the level of the placenta impedes the placental transfusion entirely.

*Figure reproduced with permission from Patrick van Rbeenen.*

seems to speed the rate of transfer, but does not change the total amount of blood transferred.<sup>23</sup> If the infant is held sufficiently high enough above the mother's uterus (50 to 60 cm in one study), placental transfusion can be prevented by stopping blood flow through the umbilical vein.<sup>11</sup> Between 10 cm above or below the level of the mother's uterus, the amount and rate of transfer is thought to be approximately similar.

### 1.3 Immediate benefits of delayed cord clamping (Table 1)

The insufficient circulating blood volume caused by immediate cord clamping can have immediate negative effects which may be more readily evident

in pre-term and low-birth weight infants because of their initially smaller fetal-placental blood volume and slower cardio-respiratory adaptation. A recent randomized controlled trial of the effect of a 30 to 45 second delay in clamping as compared to immediate (5-10 seconds) umbilical cord clamping in newborns less than 32 weeks gestation found a significantly lower incidence of intraventricular hemorrhage and late-onset sepsis (i.e. sepsis that occurs after the first week of life) in the delayed clamped infants.<sup>24</sup> A lower incidence of intraventricular hemorrhage with delayed clamping was also demonstrated in two meta-analyses of studies in pre-term and low birth weight infants.<sup>25,26</sup> Pre-

**Table 1: Summary of immediate and long-term benefits of delayed umbilical cord clamping for infants (term, pre-term/low birth weight) and mothers**

Immediate benefits			Long-term benefits	
Pre-term/low-birth weight infants	Full-term infants	Mothers	Pre-term/Low-birth weight	Full-term
<p><b>Decreases risk of:</b></p> <ul style="list-style-type: none"> <li>- Intra-ventricular hemorrhage</li> <li>- Late-onset sepsis</li> </ul> <p><b>Decreases need for:</b></p> <ul style="list-style-type: none"> <li>- Blood transfusions for anemia or low blood pressure</li> <li>- Surfactant</li> <li>- Mechanical ventilation</li> </ul> <p><b>Increases:</b></p> <ul style="list-style-type: none"> <li>- Hematocrit</li> <li>- Hemoglobin</li> <li>- Blood pressure</li> <li>- Cerebral oxygenation</li> <li>- Red blood cell flow</li> </ul>	<p>Provides adequate blood volume and birth iron stores</p>	<p>Indication from “cord drainage” trials that a less blood filled placenta shortens the third stage of labor and decreases incidence of retained placenta</p>	<p>Increases hemoglobin at 10 weeks of age</p>	<p>Improves hematological status (hemoglobin and hematocrit) (2 to 4 months of age)</p> <p>Improves iron status through 6 months of age</p>

term infants are more susceptible to intraventricular hemorrhage than full-term infants, and immediate clamping may increase the risk of intracranial bleeding by causing hypotension, which has been shown to be a risk factor for intraventricular hemorrhage.<sup>27</sup> Although not yet investigated, the authors of the recent randomized controlled trial<sup>24</sup> proposed that the increased incidence of late-onset sepsis seen in the immediate clamping group (8/33 in the immediate-clamped group versus 1/36 in the delayed-clamped group  $p = 0.03$ ) was due to a loss of protective primitive hematopoietic progenitor cells (in which cord blood is very rich) resulting in a compromised immune response. Further research is needed to better investigate the relationship between clamping time and sepsis which is estimated to contribute to approximately one quarter (23%) of neonatal deaths.<sup>28</sup>

Individual studies have shown other immediate benefits of delayed clamping for low birth weight or very low birth weight infants including higher hematocrit levels,<sup>29</sup> blood pressure,<sup>29</sup> and hemoglobin levels,<sup>30</sup> greater oxygen transport (including cerebral oxygenation)<sup>31</sup> and higher red blood cell flow.<sup>32</sup> Delayed cord clamping may be particularly important in low resource settings that have little access to expensive technology, as delayed clamping in pre-term/low-birth weight infants has also been associated with fewer days on oxygen,<sup>33</sup> fewer days on or a decreased need for mechanical ventilation,<sup>29,33</sup> a decreased need for surfactant<sup>29</sup> and a decreased need for transfusions for low blood pressure or anemia.<sup>25</sup>

In full-term infants, a recent meta-analysis showed that delayed clamping did not impose an increased risk of negative neonatal outcomes, the

two most commonly studied being neonatal polycythemia and jaundice.<sup>34</sup> Although delayed-clamped infants did have significantly higher hematocrit at 7 hours (2 trials, 236 infants) and between 24 and 48 hours of life (7 trials, 403 infants), no clinical signs

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Delayed cord clamping may be particularly important in low resource settings that have little access to expensive technology, as delayed clamping in pre-term/low-birth weight infants has also been associated with fewer days on oxygen,<sup>33</sup> fewer days on or a decreased need for mechanical ventilation,<sup>29,33</sup> a decreased need for surfactant<sup>29</sup> and a decreased need for transfusions for low blood pressure or anemia.<sup>25</sup>

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of polycythemia were reported in the studies reviewed. Treatment for asymptomatic polycythemia may only be warranted when the venous hematocrit exceeds 70%,<sup>35,36</sup> as not all infants with elevated hematocrit will have hyperviscosity,<sup>37,38</sup> generally thought to be the cause of clinical symptoms. However, a recent systematic review of the most common treatment for polycythemia, partial exchange transfusion, showed no long-term benefit to neurodevelopmental outcomes from the practice, and an in-

creased risk of necrotizing enterocolitis.<sup>39</sup>

In addition, the same meta-analysis<sup>34</sup> showed that delayed cord clamping did not significantly increase mean serum bilirubin within the first 24 hours of life (2 trials, 163 infants) or at 72 hours of age (2 trials, 91 infants), or the incidence of clinical jaundice at 24 to 48 hours of age (8 trials, 1009 infants) or the number of infants requiring phototherapy (3 trials, 699 infants).

Few studies on the timing of cord clamping have included maternal outcomes, but three recent studies did measure maternal bleeding using both quantitative<sup>40,41</sup> and qualitative methods.<sup>41,42</sup> None of the studies found a significant difference in the measured<sup>40</sup> or estimated<sup>41,42</sup> amount

of maternal blood loss by clamping time, nor a significant difference in pre- or postnatal maternal hemoglobin levels.<sup>41</sup> It has been speculated that a less blood-filled and distended placenta may be actually easier to deliver,<sup>43,44</sup> perhaps contributing to fewer complications during the third stage of labor. A less blood-filled placenta could result from delayed cord clamping or the practice of placental cord drainage, which involves immediately clamping and cutting the umbilical cord, but then immediately unclamping only the maternal side in order to allow the remaining placental blood to drain freely. A Cochrane review of two studies on the effect of placental drainage on maternal outcomes showed that it significantly reduced the length of the third stage of labor and the incidence of retained placenta at 30 minutes after birth.<sup>44</sup> A more recent study not included in the review also found a significantly reduced time to placental delivery with placental drainage.<sup>45</sup>

## 1.4 Long-term benefits of delayed cord clamping: Infant iron status (Table 1)

Delayed cord clamping increases the newborn's blood volume and thus iron stores at birth (*Box 2*), which has been shown to be very important for preventing iron deficiency and anemia during infancy. Up to 50% of infants in developing countries are estimated to become anemic by 1 year of age,<sup>46</sup> although the estimates in some countries well exceed that number (*Table 2*). While iron deficiency is but one cause of anemia, it is estimated to be the principal cause of anemia in this age group, contributing to roughly 50% of anemia cases. As the peak prevalence of anemia (between 6 and 24 months of age) corresponds to an important and iron-sensitive period of mental and motor devel-

## Box 2: Amount of iron provided in the “placental transfusion” allowed by delayed clamping

Assuming a hemoglobin concentration of 170 g/L at birth, and 3.47 mg of iron (Fe) per gram of hemoglobin (Hb), for a 3.2 kg infant, a placental transfusion of 40 ml/kg<sup>19</sup> would provide:

$$3.2\text{kg} \times 40 \text{ ml/kg} = 128 \text{ ml blood}$$

$$128 \text{ ml blood} \times \frac{170 \text{ g Hb}}{1000 \text{ ml blood}} \times \frac{3.47 \text{ mg Fe}}{\text{g Hb}} = 75.5 \text{ mg Fe}$$

This amount of iron is roughly equivalent to **3.5 months** of infant iron requirements for a 6-11 month-old infant (0.7 mg/day).<sup>112</sup>

opment, anemia during infancy is a serious public health problem with long-term health, socioeconomic and social implications. Mechanisms and evidence for the negative and perhaps irreversible effects of iron deficiency on development will be discussed in section 1.5.

The problem of anemia begins well before the end of the first year of life in almost all world regions as evident in Table 1. Birth iron stores are a strong predictor of iron status and anemia later in infancy<sup>47,48</sup> and the high prevalence of anemia already evident at 6 to 9 months of age indicates that birth iron stores are not adequate in many populations. For full-term normal birth weight infants born to mothers with adequate iron status and who receive delayed cord clamping, birth iron stores are estimated to be adequate (i.e. maintain hemoglobin levels and provide sufficient iron for growth) for roughly 6-8 months of age.<sup>19</sup> (Figure 3) However, pregnant women in developing countries frequently are anemic, and pre-term and low-birth-weight births are common. Thus delayed clamping has a significant role to play in reducing

the high levels of anemia during these early ages.

Eight studies have examined the effect of the timing of cord clamping on hematological and iron status outcomes in full-term infants beyond the first weeks of life,<sup>41,42,49-54</sup> several of which were included in a recent systematic review.<sup>34</sup> The authors of this review concluded that a delay in clamping of the umbilical cord for a minimum of 2 minutes was beneficial for long-term infant iron status (2-6 months of age). The most recent study included in the recent meta-analysis which also had the longest follow-up and largest sample size, was a randomized controlled trial of 476 infants born in Mexico City and followed to 6 months of age.<sup>42</sup> Infants who received delayed umbilical cord clamping (at approximately 1 1/2 minutes after delivery) had significantly higher mean corpuscular volume, ferritin concentration, and total body iron at 6 months than infants whose umbilical cords were clamped

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Delayed clamping has a significant role to play in reducing the high levels of anemia during infancy.

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**Table 2: Worldwide prevalence of anemia in children between 6 and 35 months of age from available Demographic and Health Surveys\***

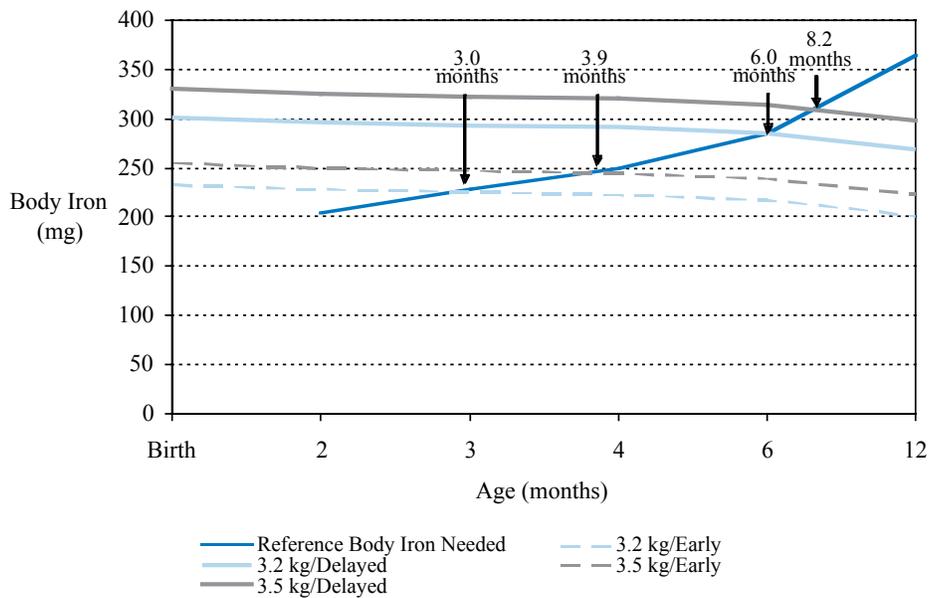
	Prevalence of Hemoglobin < 11 g/dL (%) by infant age groups			
	6 to 9 months	10 to 11 months	12 to 23 months	24 to 35 months
<b>Sub-Saharan Africa</b>				
Benin 2001	90	86	89	83
Benin 2001	90	86	89	83
Burkina Faso 2003	93	99	96	95
Cameroon 2004	84	81	81	67
Congo (Brazzaville) 2005	72	74	69	67
Ethiopia 2005	76	73	69	51
Ghana 2003	74	86	84	76
Guinea 2005	82	80	87	82
Lesotho 2004	65	64	58	52
Madagascar 2003/2004	86	90	78	66
Malawi 2004	91	88	84	74
Mali 2001	79	91	86	86
Rwanda 2005	77	68	64	55
Senegal 2005	81	88	92	85
Tanzania 2004	83	88	83	75
Uganda 2000/01	83	84	76	64
<b>North Africa/West Africa/Europe</b>				
Armenia 2005	75	66	45	32
Egypt 2005	60	67	57	49
Jordan 2002	47	65	51	31
Moldova Republic 2005	45	59	44	33
<b>Central Asia</b>				
Kazakhstan 1999	23	42	67	48
Kyrgyz Republic 1997	53	40	61	45
Turkmenistan 2000	38	45	55	38
Uzbekistan 1996	59	64	62	59
<b>South and Southeast Asia</b>				
Cambodia 2000	85	90	79	60
India 1998/99	70	75	78	72
<b>Latin America and the Caribbean</b>				
Bolivia 2003	71	89	75	51
Haiti 2000	81	86	80	64
Honduras 2005	63	67	53	37
Peru 2000	59	72	71	50

\*Source: ORC Macro, 2007. MEASURE DHS STATcompiler, <http://www.measuredhs.com>, September 19 2007.

immediately (approximately 17 seconds after delivery). The difference in body storage iron between clamping groups was equivalent to more than 1 month of iron requirements. The effect of delayed

cord clamping was even greater in infants who were born with birth weight below 3000 grams, born to mothers with iron deficiency, or who did not receive iron-fortified formulas or milks.

**Figure 3: How long should birth iron stores last?  
An analysis by birth weight and cord clamping time**



The dark blue line indicates the estimated body iron needed to maintain adequate hemoglobin levels and provide for growth (i.e. the “reference” body iron needed). The light blue and gray lines indicate the levels of body iron available for the first 12 months of life (including the birth iron stores and iron provided through breast milk) for 4 different scenarios of birth weight and cord clamping time.<sup>19</sup> The intersection of each light blue/gray line with the dark blue line indicates the point at which body iron becomes insufficient to support growth and haemoglobin concentrations.

There are few studies that have examined long-term outcomes in pre-term/low birth weight infants, although these infants would likely receive significant long-term benefit from delayed clamping because of their increased risk of developing iron deficiency and anemia. Iron reserves at birth are positively related to infant birth size and gestational age, so smaller, premature infants will have smaller iron reserves to begin with. In addition, they may deplete their smaller iron stores more quickly because of their more rapid rate of growth, for which iron is a necessary component. One study of 37 premature infants (gestational

age between 34 and 36 weeks) randomly assigned to receive delayed clamping (at 3 minutes after delivery) or early clamping (mean of 13.4 seconds), showed significantly higher hemoglobin concentrations at both 1 hour and 10 weeks of age in the delayed clamped group.<sup>30</sup>

### 1.5 Infant iron status and development: An emphasis on prevention

The negative effects of iron deficiency on development have been the subject of investigation for the past several decades in both animal models and humans. Animal models have been developed to more

closely mimic the development of iron deficiency in humans, and to model the effects of iron deficiency occurring at different time points in development (e.g. fetal life through weaning), while controlling for environmental factors that frequently complicate the interpretation of results in humans.<sup>55</sup> There are several different mechanisms that have been elucidated with animal models through which iron deficiency during infancy is hypothesized to negatively affect development including myelination, dendritogenesis, synaptogenesis, and neurotransmission. The poorer development of iron deficient infants may also be explained by a phenomenon known as “functional isolation”, which refers to a collection of

behaviors displayed by iron deficient and anemic infants (e.g. being more fearful, wary, hesitant, unhappy, and tense, exhibiting less pleasure and tending to be more “attached” to their mothers during play<sup>56</sup>) which may

contribute to their poorer development.

The interaction between nutritional and environmental factors can make the interpretation of results in human studies difficult, as infants more commonly affected by iron deficiency and anemia generally are from lower socioeconomic classes which have characteristics that also may contribute to poor development: lack of stimulation in the home, low maternal education and IQ, maternal depression, absent fathers, low birth weight, early weaning, parasitic infections, elevated blood lead levels and general under-nutrition.<sup>56</sup> However, even after controlling for these differences, it has been generally found that iron deficiency anemia during infancy (between 6 to 24 months of age) is associated with poorer cognitive, mo-

tor, and/or social/emotional outcomes.<sup>55</sup> Of even more concern are the results of studies which show persistent developmental deficiencies in anemic or chronically iron deficient infants who received treatment to correct the deficiency and/or anemia. In some studies, effects remain even more than 10 years after treatment.<sup>57</sup> A recent follow-up study of a cohort of Costa Rican adolescents who had been tested for iron deficiency anemia as infants and children, showed that at 19 years of age, middle-socioeconomic status participants who had chronic iron deficiency as infants and received treatment scored on average 9 points lower on cognitive testing than their peers of similar socioeconomic status who had not suffered from iron deficiency anemia.<sup>58</sup> (Figure 4) For low socioeconomic status young adults, the difference in cognitive test scores associated with iron deficiency anemia during infancy was nearly tripled to 25 points, indicating the compounded negative effect of lower-socioeconomic status and iron deficiency on development. The lasting effect of iron deficiency anemia during infancy was such that young adults of middle socioeconomic status with low iron status in infancy had test scores that were not different from the test scores of young adults of low socioeconomic status who had adequate iron status. Thus, preventing iron deficiency anemia during infancy may ensure that all children are able to optimize the education that they are provided.

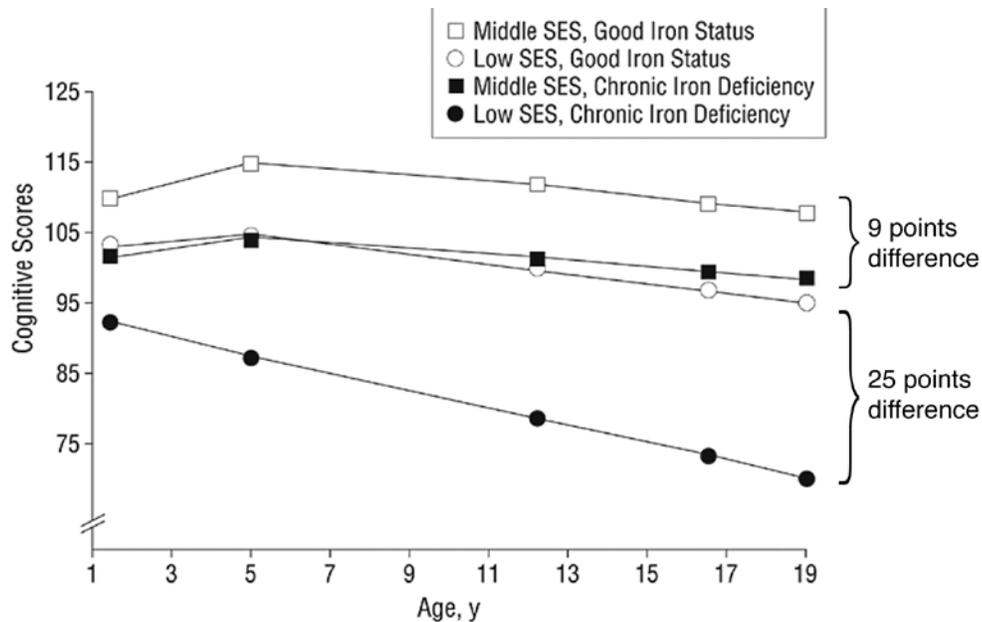
Similarly, one study of 6-month old infants showed slower conduction times for auditory brainstem responses in infants with iron deficiency anemia, as compared to normal controls, suggesting that myelination may have been altered in the infants suffering from iron deficiency anemia.<sup>59</sup> Of particular concern was that during the year of

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Preventing iron deficiency anemia during infancy may ensure that all children are able to optimize the education that they are provided.

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**Figure 4: Cognitive composite scores over time by iron status and socioeconomic level, from a longitudinal study of Costa Rican infants followed through adolescence**



Iron status group and SES level each affected initial scores ( $P = .01$  for chronic-iron deficiency difference within middle-SES families and  $P = .003$  for chronic-iron deficiency difference within low-SES families). Change over time differed only for the chronic-iron deficiency group in low-SES families ( $P = .02$  for change from infancy to age 5 years and  $P = .04$  for change from age 5 to 19 years). Each participant is represented once: good iron status ( $n = 67$ ) compared with chronic iron deficiency ( $n = 20$ ) in middle-SES families and good iron status ( $n = 65$ ) compared with chronic iron deficiency ( $n = 33$ ) in low-SES families. Symbols are placed at the average age for each assessment.

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follow-up in the original study, and even 4 years later,<sup>60</sup> the originally anemic infants did not catch up to the control infants even after treatment to correct the anemia.

From these studies it appears that treatment for an already established deficiency of iron may not be sufficient to prevent the negative and long-term effects of iron deficiency anemia on development, thus emphasizing the need for interventions

aimed at *preventing* the development of iron deficiency. In addition, in light of recent reports of potential negative effects of iron supplementation on morbidity and growth in particular subgroups of children (e.g. infants with adequate iron status<sup>61</sup>), interventions such as delayed cord clamping that help to maintain adequate iron status, are of particular importance.

## 2. Mother and newborn skin-to-skin contact

### Recommendation for practice

After delivery, place the reactive newborn directly on the mother's chest, prone, with the newborn's skin touching the mother's skin. While the mother's skin will help regulate the infant's temperature, cover the infant's back and the mother's chest with a warm, dry cloth and cover the infant's head with a cap or cloth to prevent heat-loss. As much as possible, keep mother and infant in this position for at least the first hour of life, delaying any routine procedures, and providing frequent supervision to detect any complications. Skin-to-skin contact does not have to be limited to the delivery room but should be practiced as frequently as possible during the first days of life in order to maintain infant temperature, promote frequent breastfeeding and enhance maternal-infant bonding.



Early skin-to-skin contact between the mother and her infant after delivery (i.e. placing the naked infant, prone, on the mother's bare chest or abdomen, and covering both with a warm blanket) assists in the adaptation of the newborn to life outside of the womb. The practice promotes immediate breastfeeding as it takes advantage of an infant's early alertness and innate behaviors to latch on to the breast within the first hour of life often without particular assistance.<sup>62,63</sup> Because of the importance of early exclusive breastfeeding for neonatal survival and later breastfeeding outcomes (which will be discussed in section 3), environments and practices that allow early exclusive breastfeeding to occur are essential. Early skin-to-

skin contact also provides additional short- and long-term benefits independent of the establishment of breastfeeding, including temperature control and mother-infant bonding.

### 2.1 Immediate benefits of skin-to-skin contact (Table 3)

Routine newborn care practices such as bathing and measuring the newborn may negatively affect early contact between mother and infant<sup>64</sup> and initiation of breastfeeding,<sup>65</sup> as continuous uninterrupted skin-to-skin contact has been shown to improve the success of the first breastfeed.<sup>62</sup> Skin-to-skin contact during the first hour after birth elicits organized "prefeeding behavior"

**Table 3: Summary of immediate and long-term benefits of early mother to newborn skin-to-skin contact**

Immediate benefits		Long-term benefits	
Infant	Mother	Infant	Mother
Improves effectiveness of first breastfeed and reduces time to effective suckling	Improves maternal affectionate and attachment behaviors	Positively associated with breastfeeding status at 1 to 4 months postpartum and a longer breastfeeding duration	Improves maternal affectionate and attachment behaviors
Regulates/maintains infant temperature	Decreases maternal breast engorgement pain		
Improves cardio-respiratory stability*			

\*Pre-term infants

in which the infant first begins spontaneous suckling and rooting movements and then localizes the breast, attaches to the nipple and begins to suckle.<sup>66,67</sup> The website [www.breastcrawl.org](http://www.breastcrawl.org) provides a striking video of how a newborn infant finds his mother's breast and initiates breastfeeding soon after birth. A recent randomized controlled study found that infants who were placed in early skin-to-skin contact with their mother starting in the first minute post-birth and remaining in contact for on average one and a half hours, had significantly more successful breastfeeding scores for the first latch ( $p = 0.02$ ) and a shorter time to begin effective breastfeeding ( $p = 0.04$ ) than infants who had been swaddled in blankets and held by their mother following standard hospital care procedures.<sup>68</sup> Since breastmilk production is determined by how frequently the infant suckles and empties the breast, early, frequent and effective nursing is important for both establishing milk production and preventing excess neonatal weight loss.<sup>69</sup> As "insufficient milk" and newborn weight loss are

very common reasons for abandoning breastfeeding or supplementing breastmilk with formula or other liquids, the effect of skin-to-skin contact on establishing early effective breastfeeding has obvious implications for short- and long-term breastfeeding outcomes. Early supplementation with formula or other liquids reduces the frequency of suckling and thus sets up a potentially vicious cycle where supplementation is continually increased because of decreased breast milk production.

Early skin-to-skin contact also provides benefits to both the mother and infant independent of its role in establishing breastfeeding. Thermal control is an essential component of preventing neonatal morbidity,<sup>3</sup> particularly in low birth weight infants, and skin-to-skin contact provides an inex-

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Because of the importance of early exclusive breastfeeding for neonatal survival and later breastfeeding outcomes, environments and practices that allow early exclusive breastfeeding are essential.

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pensive, safe and effective method for maintaining newborn temperature. Skin-to-skin contact has been shown to be as effective as incubator care for re-warming of hypothermic infants<sup>70</sup> and infants placed in skin-to-skin contact with their mother were significantly warmer than infants placed in cots<sup>71</sup> likely because of the thermal response of maternal skin temperature (mediated by oxytocin)<sup>63</sup> in reaction to skin-to-skin contact with her infant.<sup>72</sup>

A recently updated Cochrane review on the effects of skin-to-skin contact also showed improved maternal affectionate and attachment behaviors with skin-to-skin contact, both in the short- (e.g. 36 to 48 hours after delivery) and long-term (e.g. at 1 year of age) although the effect of skin-to-skin contact on these outcomes is likely attenuated with time.<sup>63</sup> Mothers with skin-to-skin contact also reported decreased breast engorgement pain at 3 days postpartum in one trial.<sup>73</sup> Other benefits of skin-to-skin contact include better cardio-respiratory stability in late preterm infants<sup>74</sup> and a shorter length of time crying as compared to infants not in skin-to-skin contact with their mothers.<sup>75</sup> Although particularly promoted for temperature regulation of low-birth-weight infants (e.g. “Kangaroo mother care”<sup>76</sup>), skin-to-skin contact is likely beneficial for all infants because of these positive effects on breastfeeding, infant temperature regulation, and maternal-infant bonding, all essential components of neonatal survival.

## 2.2 Long-term benefits of early skin-to-skin contact (Table 3)

The positive effects of skin-to-skin contact on early breastfeeding behaviors in the immediate postpartum period may extend into later infancy. A recently updated Cochrane review on skin-to-skin contact also showed long-term benefits to breastfeeding from early skin-to-skin contact including breastfeeding status at 1 to 4 months postpartum and total duration of breastfeeding.<sup>63</sup>

### 3. Early initiation of exclusive breastfeeding

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#### Recommendation for practice

After delivery, routine newborn care procedures that separate mother and baby should be delayed for at least the first hour to allow mother and newborn to be in uninterrupted skin-to-skin contact to encourage and promote initiation of breastfeeding within the first hour.<sup>77</sup> Trained assistance should be offered to mothers for the first and subse-



quent breastfeeds if necessary to ensure that the infant is adequately latched to the breast and suckling effectively. Assistance should be provided in a supportive and appropriate manner, being sensitive to the mother's desire for modesty and privacy. Mothers should be encouraged to breastfeed frequently and should be allowed unrestricted access to their infant through rooming-in in maternity wards. Practices shown to be detrimental to breastfeeding should be avoided (e.g. separation of mother and newborn, use of pre-lacteal feeds or other non breastmilk liquids, and use of bottles or pacifiers).

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The importance of breastfeeding for infant nutrition and the prevention of infant morbidity and mortality as well as the prevention of long-term chronic diseases is well established, and thus breastfeeding is an essential component of infant and child survival and health programs. The impact of breastfeeding on neonatal and child survival was recently quantified in an analysis of mortality data from 42 countries which contributed 90% of worldwide child deaths in 2000.<sup>78</sup> Of the interventions studied it was estimated that exclusive breastfeeding for the first 6 months followed with continued breastfeeding from 6-11 months of age was the single most effective intervention

for preventing child mortality, estimated to prevent 13% of all under-five deaths. (Table 4) Therefore, establishing breastfeeding immediately after delivery (i.e. within the first hour after birth) is crucial for immediate survival. Early breastfeeding is also related to long-term breastfeeding behaviors and breastfeeding has been associated with many additional positive long-term nutrition and health outcomes for both mother and infant.<sup>79</sup>

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The importance of breastfeeding for infant nutrition and the prevention of infant morbidity and mortality as well as the prevention of long-term chronic diseases is well established.

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**Table 4: Under-5 deaths that could be prevented in the 42 countries with 90% of worldwide child deaths in 2000 through achievement of universal coverage with individual interventions**

	Estimated under-5 deaths prevented	
	Number of deaths (x10 <sup>3</sup> )	Proportion of all deaths
<b>Preventive interventions</b>		
Breastfeeding	1301	13%
Insecticide-treated materials	691	7%
Complementary feeding	587	6%
Zinc	459 (351)*	5% (4%)*
Clean delivery	411	4%
Hib vaccine	403	4%
Water, sanitation, hygiene	326	3%
Antenatal steroids	264	3%
Newborn temperature management	227 (0)*	2% (0%)*
Vitamin A	225 (176)*	2% (2%)*
Tetanus toxoid	161	2%
Nevirapine and replacement feeding	150	2%
Antibiotics for premature rupture of membranes	133 (0)*	1% (0%)*
Measles vaccine	103	1%
Antimalarial intermittent preventive treatment in pregnancy	22	<1%
<b>Treatment interventions</b>		
Oral rehydration therapy	1477	15%
Antibiotics for sepsis	583	6%
Antibiotics for pneumonia	577	6%
Antimalarials	467	5%
Zinc	394	4%
Newborn resuscitation	359 (0)*	4% (0%)
Antibiotics for dysentery	310	3%
Vitamin A	8	<1%

\* Numbers represent effect if both levels 1 (sufficient) and 2 (limited) evidence are included, value number in brackets shows effect if only level-1 evidence is accepted. Interventions for which only one value is cited are all classified as level 1.

*Reprinted with permission from Elsevier (Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS, Bellagio Child Survival Study Group. How many child deaths can we prevent this year? The Lancet 2003;362:65- 71.)*

### 3.1 Immediate benefits of early and exclusive breastfeeding (Table 5)

Early initiation and exclusivity are two important and related parts of establishing the protective effect of breastfeeding against neonatal morbidity and mortality. Beginning breastfeeding immediately ensures that the newborn receives colostrum, often referred to as the infant's "first immunization", because of its rich content of important immune factors (both secretory and cell-mediated), anti-microbial and anti-inflammatory agents, and Vitamin A, all important for immediate and long-term protection from infections. Human milk as the exclusive and sterile food for the newborn also prevents the introduction of disease-causing pathogens through contaminated liquids (including the water used to make formula as well as the pow-

dered formula itself) or foods. Feeding other liquids or solids not only provides a potential route of entry for pathogens, but causes gastrointestinal damage, making their entry into the infant's body easier. Contamination of powdered infant formula with *Enterobacter sakazakii* and other bacteria has been associated with reports of neonatal death (due to systemic invasive infections), and is a particular concern for pre-term and low birth weight infants who are more susceptible to the infections caused by these organisms (e.g. necrotizing enterocolitis, septicemia, and meningitis).<sup>80</sup> As an example of the impressive impact that exclusive and early breastfeeding can have on neonatal mortality and morbidity, a recent study in Ghana estimated that early initiation of breastfeeding could reduce all-cause neonatal mortality by 22% and newborns fed breast

**Table 5: Summary of immediate and long-term benefits of breastfeeding for mother and infant**

Immediate benefits *		Long-term benefits	
Infant	Mother	Infant	Mother
Prevents neonatal and infant morbidity and mortality	Stimulates oxytocin release causing uterine contractions	Decreases risk of: <ul style="list-style-type: none"> <li>- Acute otitis media</li> <li>- Non-specific gastroenteritis</li> </ul>	Lactational amenorrhea helps to delay future pregnancies and protects maternal iron status
Early breastfeeding associated with longer breastfeeding duration during infancy	Possibly protective of maternal mood	<ul style="list-style-type: none"> <li>- Hospitalization for severe lower respiratory-tract infections</li> <li>- Atopic dermatitis</li> <li>- Obesity</li> <li>- Type 1 and 2 diabetes</li> <li>- Childhood Leukemia</li> <li>- Sudden Infant Death Syndrome</li> <li>- Necrotizing enterocolitis</li> </ul>	Decreases risk of: <ul style="list-style-type: none"> <li>- Type 2 diabetes,</li> <li>- Ovarian cancer</li> <li>- Breast cancer</li> </ul>
Early exclusive breastfeeding associated with exclusive breastfeeding later in infancy		Improved motor development	More rapid weight loss

*\*Immediate benefits from early initiation of exclusive breastfeeding*

milk exclusively were four times less likely to die.<sup>81</sup> In another study from a rural area of The Gambia, use of pre-lacteal feeds was associated with a 3.4 higher odds of neonatal death.<sup>82</sup> Finally, exclusive breastfeeding also prevents clinical and sub-clinical gastrointestinal blood loss, caused by mixed feeding (particularly the use of cow's milk) which can negatively impact infant nutritional status, especially iron status. As iron is generally not lost from the body except through bleeding,

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A longer lifetime duration of breastfeeding has also been associated with long-term maternal health outcomes, including a decreased risk for type 2 diabetes, ovarian and breast cancer.<sup>86</sup>

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damage to the intestine from mixed feeding causing blood loss can contribute to poorer nutritional status.

Immediate breastfeeding is also beneficial for the mother, as early suckling stimulates endogenous oxytocin release,<sup>83</sup> inducing uterine contraction,<sup>84</sup>

which may reduce maternal bleeding. Uterine atony is the primary cause of postpartum hemorrhage, and postpartum hemorrhage is the main cause of maternal mortality worldwide, contributing to 25% of maternal deaths.<sup>85</sup>

Not breastfeeding, or stopping breastfeeding early also appears to be associated with postpartum depression,<sup>86</sup> although further research is needed to better establish the temporal nature of this relationship. There is some evidence that breastfeeding may be protective of maternal mood, through its effects on reducing maternal stress and attenuating the inflammatory response, which is hypothesized to be involved in the pathogenesis of depression.<sup>87</sup> Although mental health issues have received relatively little attention as public health priorities, particularly in developing countries the relationship between breastfeeding and postpartum depression should not be overlooked as some studies have shown that postpartum depression may have nega-

tive effects on infant growth, nutrition and development.<sup>88</sup> Additional research is needed.

### 3.2 Long-term benefits of breastfeeding (Table 5)

Early breastfeeding behaviors also help to establish longer-term breastfeeding patterns. Early exclusive breastfeeding has been associated with exclusive breastfeeding later in infancy<sup>89</sup> and the time of the first breastfeed has been shown to positively relate to the overall duration of breastfeeding.<sup>90-92</sup> Maintaining exclusive breastfeeding for 6 months followed by continued breastfeeding until the child is two-years-old or beyond as recommended by WHO,<sup>93</sup> has obvious health and nutritional benefits for the infant for continued prevention of disease, and provision of adequate nutrition. A history of being breastfed has been associated with decreased risk of acute otitis media, non-specific gastroenteritis, hospitalization for severe lower respiratory tract infections, atopic dermatitis, asthma in young children, obesity, type 1 and 2 diabetes, childhood leukemia, sudden infant death syndrome, and necrotizing enterocolitis.<sup>86</sup>

For the mother, establishment of breastfeeding and continued frequent on-demand nursing of the infant helps to delay future pregnancies through lactational amenorrhea. Lactational amenorrhea can have benefits for the mother's nutritional status, particularly with regard to iron, as it prevents iron loss through menstrual bleeding. A longer lifetime duration of breastfeeding has also been associated with long-term maternal health outcomes, including a decreased risk for type 2 diabetes, ovarian and breast cancer.<sup>86</sup> Exclusive breastfeeding also accelerates pregnancy weight loss, which with increasing rates of overweight and obesity among women of reproductive age in the developing world, could be a considerable benefit.

## 4. Integration of essential delivery care practices within the context of maternal and newborn health services

Because care during pregnancy, delivery and the postpartum period involves two individuals whose health and nutrition are tightly linked, in making recommendations for delivery care practices, the relative benefit of each practice to both short- and long-term outcomes of both mother and infant should be assessed. Most importantly, these recommendations should be based on the best level of scientific evidence available. Practices that have become routine or were implemented out of convenience but are not supported by scientific evidence, such as immediate cord clamping, should be identified and discouraged, and replaced with evidence-based practices. As an example, in response to the accumulating evidence as to the benefit of delayed cord clamping for infant outcomes, revisions were made to the protocol for active management of the third stage of labor, the main strategy to prevent postpartum hemorrhage. Active management, through a sequence of steps that reduces the incidence of uterine atony (the main cause of postpartum hemorrhage), has been shown to decrease the incidence of severe blood loss and the need for costly and risky blood transfusions.<sup>5,94,95</sup> Earlier protocols for active management included 1) injection of an oxytocic drug soon after delivery of the infant, 2) early cord clamping and 3) delivery of the placenta by controlled cord traction.<sup>5</sup> However, a specific contribution of early cord clamping to uterine atony—that is, apart from the effect of the oxytocin injection and controlled

cord traction—was never established, nor does there appear to be a physiological mechanism that would support its inclusion in recommendations to prevent postpartum hemorrhage. Thus, because early cord clamping was of dubious benefit to the mother and of obvious detriment to the infant, it was removed from guidelines for active management of the third stage of labor, which currently include 1) injection of an oxytocic drug soon after delivery of the infant, 2) delayed cord clamping followed by delivery of the placenta by controlled cord traction and 3) uterine massage.<sup>94</sup>

It is also essential to ensure that delivery care practices are integrated with one another, not only because they will affect both mother and infant, but so that they can be feasibly implemented. The individual importance of each component, however, cannot be overlooked. For example, some authors have suggested that placement of the infant on the mother's abdomen immediately after delivery (in order to facilitate immediate skin-to-skin contact) was one of several factors that increased the use of immediate cord clamping in the last century.<sup>6</sup> This likely occurred because little emphasis was placed on the importance of the timing of cord clamping, rather than an incompatibility between the two practices, as placement of the infant in immediate skin-to-skin contact with the mother can begin without immediately clamping the cord. However, with the integration of care practices that before had not been seen in an inte-

grated manner, additional research questions arise that will help to refine the implementation of these practices (*Appendix 1*).

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Of the practices previously recommended as part of active management of the third stage of labor, early cord clamping has been the most readily adopted, despite being the component of previous active management protocols with the least evidence supporting its implementation, leading to its abandonment in recently revised active management guidelines.

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*Figure 5* presents a proposed sequence of steps that integrates active management of the third stage of labor (including delayed cord clamping), maternal-newborn skin-to-skin contact and immediate initiation of exclusive breastfeeding that should be considered for all vaginally-delivered infants (*Appendix 2*). This is a proposed framework of the basic order and integration of steps but adaptations may

need to be made according to differences in delivery setting (e.g. position of the mother during delivery, number of personnel assisting with the delivery) and prevalent cultural practices.

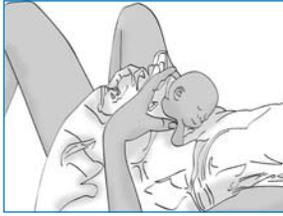
#### **4.1 Contextual considerations: Current health facility and domiciliary delivery care practices**

While deliveries occurring in health facilities have the obvious benefit to both the mother and infant of immediate access to skilled care, unfortunately not all current hospital practices are evidence-based, nor of benefit to the mother or infant. As health facility deliveries continue to increase—in 1996, they accounted for 42% of deliveries in Africa, 53% in Asia and 75% in Latin America<sup>96</sup>—it will be imperative to address the particular practices that may be detrimental to maternal and newborn health and institute practices that are evidence-based. For example, many

hospital practices have been documented as interfering with the establishment of breastfeeding, in particular the hospital practice of giving glucose water or infant formula in a bottle. Separation of the mother and her newborn has also been shown to be detrimental to the establishment of breastfeeding for first time mothers.<sup>97</sup> In addition, health care providers are frequently not sufficiently trained to support and assist with the establishment of breastfeeding. While the Baby-Friendly Hospital Initiative (BFHI) implemented by WHO and UNICEF in the early 1990s addressed hospital practices detrimental to breastfeeding and helped improve training of health workers in breastfeeding support, there has unfortunately been no monitoring of BFHI certification, nor a renewed public health investment in this area.

Similarly, a recent survey of practices employed in third stage management in Europe found that between 65% and 74% of labor units in Austria, Denmark, Finland, Hungary and Norway had policies of waiting until the cord stopped pulsating before clamping, while 68% to 90% of delivery units in Belgium, France, Ireland, Italy, the Netherlands, Portugal, Spain, Switzerland and the UK had policies of immediate cord clamping.<sup>98</sup> An earlier study of 15 university-based obstetrical care centers in 10 countries (from North and South America, Africa, Asia, and Europe) found similar variability in practices between and within countries, however on average early cord clamping was practiced 79% of the time.<sup>99</sup> Of the practices previously recommended as part of active management of the third stage of labor, early cord clamping has been the most readily adopted, despite being the component of previous active management protocols with the least evidence supporting its implementation.

## Figure 5: Integration of essential steps for maternal, neonatal and infant survival, health and nutrition



**1.** After delivery, immediately dry the infant. Then place the reactive infant, prone, on the mother's abdomen.\* Keep the infant covered

with a dry cloth or towel to prevent heat loss.

*\*If the infant is pale, limp, or not breathing, it is best to keep the infant at the level of the perineum to allow optimal blood flow and oxygenation while resuscitative measures are performed. Early cord clamping may be necessary if immediate attention cannot be provided without clamping and cutting the cord.*

**2.** Give oxytocin (10 IU, intramuscularly) soon after delivery.



**3.** After cord pulsations have ceased (approximately 3 minutes after delivery), clamp and cut the cord following strict hygienic techniques.



**4.** Place the infant directly on the mother's chest, prone, with the newborn's skin touching the mother's skin. While the moth-

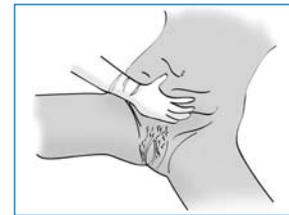
er's skin will help regulate the infant's temperature, cover both the mother and infant with a dry, warm cloth or towel to prevent heat loss.

Cover the baby's head with a cap or cloth.



**5.** Deliver the placenta by controlled cord traction on the umbilical cord and counter-pressure to the uterus.

**6.** Massage the uterus through the abdomen after delivery of the placenta.



**7.** During recovery, palpate the uterus through the abdomen every 15 minutes for two hours to make sure it is firm and monitor the amount of vaginal bleeding.



**8.** Aim to delay routine procedures (e.g. weighing, bathing) for at least the first hour so that mother and baby can be together

in uninterrupted skin-to-skin contact and begin breastfeeding. If necessary, offer to assist the mother with the first breastfeed, being sensitive to her need for modesty.

While knowledge of evidence-based practices is necessary, it is not always sufficient to ensure translation into appropriate interventions. As an example, a survey of thermal control practices by health professionals across 7 different countries showed that even though two-thirds to three-quarters of the health professionals surveyed possessed adequate knowledge about thermal regulation, care practices employed were consistently inadequate.<sup>100</sup> Understanding the reasons and barriers behind this resistance to change will be essential

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Practices that have been shown to be detrimental or of no benefit to maternal or infant health should be eliminated, and appropriate, integrated and evidence-based care practices such as the ones described in this document need to be the standard of care.

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in developing effective and sustainable implementation strategies. A qualitative study that investigated the reasons that practicing physicians did not always adopt evidence-based perinatal care practices included lack of access to scientific information or an inability to understand the scientific literature, lack of time or physical resources, attitudes by health practitioners that

resist change as well as conflicting clinical guidelines and policies.<sup>101</sup> Although this study addressed health care practitioners practicing in hospitals in Latin America, it is likely that similar barriers exist in other regions. Strategies to overcome these barriers will be discussed in section 4.2.

Domiciliary births can also include infant care practices that place at risk both the establishment of early and exclusive breastfeeding as well as temperature control of the newborn. Although customs vary by region, detrimental care practices commonly observed in home delivery settings include: the use of prelacteal feeds<sup>102-105</sup>; delaying

the initiation of breastfeeding for hours or days<sup>106</sup>; early bathing of the baby (< 6 h after birth)<sup>105,107</sup> which decreases newborn temperature<sup>108</sup> and may remove the vernix, (a cream-like white substance present on the skin of the infant at birth shown to have antimicrobial properties)<sup>109</sup>; not feeding or discarding colostrum; or placement of the baby on the ground rather than in contact with the mother (often without drying) until the placenta is delivered.<sup>106</sup> Several studies have shown that mothers delivering at home were more likely to use prelacteal feeds for their infants<sup>102-104</sup> and less likely to exclusively breastfeed later in infancy<sup>102</sup> than mothers delivering in health facilities. There are little data with regard to umbilical cord clamping practice in domiciliary births, and while delayed clamping is thought to be practiced more frequently in this setting, this assumption is primarily based on anecdotal reports.

Strategies proposed to decrease maternal and neonatal mortality include increasing the number of deliveries attended to in primary-level health centers by skilled providers, and in cases in which delivery in a health facility is not possible, at least providing skilled attendance. However, based on the above description of care practices in both health facilities and homes, simply increasing the number of deliveries in hospitals or providing skilled attendants at domiciliary deliveries may ensure greater coverage of deliveries with skilled care, but may not ensure better quality of care nor improved health and nutrition outcomes. Appropriate, integrated and evidence-based care practices such as the ones described in this document need to be the standard of care, and practices that have been shown to be detrimental or of no benefit to maternal or infant health should be eliminated.

## 4.2 Steps for achieving universal implementation of an integrated set of delivery care practices

Widespread changes in clinical practice are needed to ensure that newborns and their mothers benefit from the integrated set of delivery care practices being advocated. However, the process of translating evidence-based recommendations into practice is challenging. Translating the integrated set of delivery care practices advocated in this document to the standard practice of care can benefit from an assessment and analysis of national and local situations with respect to current practices as well as current barriers to change. Such an assessment should include the review of protocols and guidelines, the observation of actual practices, and qualitative work to identify the most important barriers to change among different delivery care providers. Most countries implement some actions related to active management of third stage labor and breastfeeding promotion. Little information, however, is available on timing of cord clamping though anecdotal reports and limited data suggest it is more likely to be immediate rather than delayed. Also, even when national protocols and/or guidelines for delayed cord clamping exist, information on the extent to which they are followed is not available. Information on the practice of immediate and continued skin-to-skin contact is also scarce. Although many hospitals practice rooming-in, this usually begins later than the critical first hour after birth, after the newborn has been bathed by nursing staff and examined by medical staff. Also, the infant is often dressed and wrapped when finally placed in contact with the mother, thus preventing skin-to-skin contact. Documentation of current practices and barriers together with an analysis outlining the benefits of adopting

the new integrated set of care practices is important for the development of a plan to implement the necessary changes in clinical practice and to organize delivery care services to facilitate their application. An implementation plan could benefit from the incorporation of several strategies which address significant barriers to adopting evidence-based care practices.

### 4.2.1 Increasing access to scientific information supporting evidence-based practices

Knowledge of the evidence-base for these practices, as provided in this document, is necessary and should underlie all clinical practice, medical/nursing school curricula and public health policy. While access to freely-available online resources for maternal and infant care practices (such as the sources listed in the final section of this document) may always be out of reach to a portion of the population because of financial, language, and other barriers, internet access is becoming increasingly available in many settings. Thus less traditional methods of increasing access to scientific evidence should be explored, for example, e-learning methods which can incorporate more interactive and visual components.

### 4.2.2 Addressing the skills needed to implement the recommended practices

A significant barrier to changes in practice that has been documented in other settings is the lack of adequate skills to employ the new practices or techniques. Fortunately, for the practices recommended in this document, the skills required are not “new” (except perhaps for skin-to-skin contact) nor highly technical. However, tightly associated with the process of acquiring new skills, which contributes to resistance to change, is the fear of

the unfamiliar, in terms of both performing the new technique and its potential “unknown” outcome. Lacking any previous personal experience with which to guide them, practitioners may fear

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Appropriate training materials, which address *how* to deliver each practice, *why* each practice is important, and answer related concerns and questions are essential.

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employing the technique itself, as well as any potential negative outcomes they could see as resulting from the new practice. Thus appropriate training materials, which address *how* to deliver each practice, *why* each practice is important, and answer concerns and

questions related to implementation (e.g. risk of neonatal polycythemia with delayed cord clamping) are essential.

#### *4.2.3. Establishment and communication of regional, national and local policies and guidelines for implementation of the recommended practices*

Establishing the “why” and “how” behind the recommended practices will be an essential step for their implementation, but to ensure that this knowledge is translated into appropriate interventions, it needs to be implemented into national, regional and local policies for delivery care. These policies, in turn, need to be widely and consistently disseminated and communicated. While national or regional policies and guidelines will not be sufficient alone to ensure implementation at the individual level, they are important for changing both current and future practices. They provide a basis for the teaching of evidence-based practices in medical curricula, and also may reduce some of the fear associated with implementation of new techniques felt by

practicing physicians. This is particularly important in light of the fact that recent revisions in the WHO Recommendations for the Prevention of Postpartum Hemorrhage call for delayed cord clamping<sup>94</sup> in contrast to previously established and widely disseminated guidelines calling for early clamping. Changes in established clinical practice resulting from the translation of the revised WHO recommendation to delay clamping require translation into revised international and national professional guidelines and policies, academic textbooks and training materials, and the standard of practice for clinical care. As conflicting or unclear clinical policies and norms can be a significant barrier to implementation of change, it is important that revised norms at the regional, national and local level take into account the integrated nature of delivery care practices, so that one practice is not implemented for benefit of the mother at the loss of a beneficial practice for the infant, or vice versa. As evidenced in this document, because of the linked nature of maternal and neonatal health, perinatal care practices frequently affect both parts of the mother-infant dyad. To improve public health indicators of maternal and infant well being, such change needs to occur on a widespread level. In the absence of a well-orchestrated concerted effort at regional, national, and local levels, this can take years, even decades, to occur. At the local or hospital level, it will be important to identify particular individuals who can motivate and remind current practitioners to continue implementing the recommended practices, and also effectively and consistently communicate hospital policy to any new additions to the maternity service. This will be particularly important in teaching hospital settings, where there is frequent rotation of stu-

dents, interns and residents, who are learning by observing the practices of practicing physicians and nurses.

#### 4.2.4 Advocacy and synchronization with other maternal and neonatal care efforts

Advocacy, based on the scientific evidence, to raise awareness and knowledge among important stakeholders is an essential part of the process for implementing change. Continuous advocacy is necessary to engage stakeholders and decision-makers at many levels to initiate and maintain the process of implementation. For the practices outlined in this document, critical initial stakeholders include international, regional, and national professional associations of obstetrics and gynecology, pediatrics, neonatology, midwifery and nursing and leading academic scholars in these fields. Obtaining the support and enthusiasm of these associations and scholars is necessary to initiate the implementation process and to give visibility to the integrated care practices being advocated. These associations and scholars are usually responsible for initiating new and revised protocols and guidelines for clinical practice, the content of medical journals, updating medical texts, teaching new professionals, and providing in-service training (*Box 3*). Depending on the country, the Ministry of Health also has a key role to play.

Advocacy among pregnant women is also essential. In many settings, pregnant women may have little to no input as to the delivery care practices which are employed in their care, even if those practices are overly aggressive medically, or of no benefit (or even of potential harm) to their own or their infant's health. Increasing women's knowledge of the importance of appropriate care

practices for their own health and that of their newborn will help to form a critical mass of beneficiaries that lobby for the institutionalization of these practices during delivery. In addition, providing them with the knowledge of the importance of the correct care practices, ideally beginning in prenatal care, will help to ensure not only a smoother implementation of the new practices (as they will have a better idea of what to expect during delivery) but also create a demand for their implementation.

Ideally, to increase the impact and coverage of the recommended practices and avoid duplication of efforts, the implementation and advocacy of the practices outlined in this document should be harmonized and coordinated with the efforts of already established global initiatives for improving maternal and neonatal health (e.g. Saving Newborn Lives, Prevention of Postpartum Hemorrhage Initiative, Partnership for Maternal, Newborn and Child Health). As evident by the names of these initiatives, the extent to which each initiative addresses both maternal and neonatal care practices and health outcomes varies. The combination of practices recommended in this document is unique in that it crosses the divide between "maternal" and "neonatal" care, thus truly contributing to the goal of a "continuum of care" for mothers and infants. In addition, the evidence of short- and long-term impact of each of these practices for *both* mother and infant reinforces the importance of analyzing care practices in the context of the mother-infant dyad, rather than the mother and newborn separately. The combined practices outlined in this document should be integrated among other prenatal, perinatal and postnatal care practices currently being advocated by these initiatives (e.g. prenatal

### Box 3: Actions needed to ensure implementation of the essential delivery care practices

- Develop advocacy materials. These materials could include information on the recommended practices and their evidence base, the prevalence of anemia in infants and young children, the relationship between anemia and cognitive development, current norms, guidelines, and protocols with respect to timing of cord clamping and proposed changes.
- Revise and update national and professional protocols.
- Revise and update information in medical, nursing, and midwifery textbooks.
- Conduct in-service training on recommended practices.
- Include sessions on the recommended practices in professional conferences of obstetrics, pediatrics, neonatology, midwifery, and nursing.
- Publish lay articles on the importance of the recommended practices in newspapers and women's magazines.
- Expand implementation of the Baby-friendly Hospital Initiative and reassessment of certified hospitals.

immunizations, prevention of neonatal asphyxia and sepsis and postpartum hemorrhage).

#### 4.2.5 Organization of delivery care services

Implementation of the essential delivery care practices can be greatly facilitated by the physical organization of delivery care services, particularly in settings with a high volume of births where delivery rooms need to be turned over quickly and space tends to be scarce. Ideally, a mother would stay in the delivery room in skin-to-skin contact with her newborn infant for at least the first hour after giving birth. This room likely provides the most privacy as well as avoids any disruption during the critical period when the newborn is alert and awake and most likely to initiate breastfeeding with little or no assistance. If this is not possible, skin-to-skin contact should be initiated in the delivery room and the mother and infant covered

with a sheet or blanket while they are moved to a recovery room or the general maternity ward. Care should be taken to make this transition as easy as possible for the mother and infant and that, when moved, a bed is immediately available. Revitalizing and expanding the Baby-friendly Hospital Initiative and including the care practices advocated in this document can serve as a catalyst for their implementation as well as the organization of services to facilitate their achievement.

#### 4.2.6 Monitoring and evaluation

The implementation of the recommended practices needs to be monitored and rigorously evaluated in order to determine whether the implementation of practices succeeds and is continued for the long-term. Both process and impact outcomes should be monitored (ideally included in monitoring systems already in place) and the

results communicated at the hospital, national and regional level to the appropriate stakeholders. Obviously, the ability of the hospital or country to monitor and evaluate the implementation process will depend greatly on the information systems already established. Communicating results at the national or regional level will be important for determining where changes or modifications need to be made in the implementation process, and which practices are more challenging to implement. Individual practitioners will want to know whether the effort that they have made in changing their practices is having an effect and thus communication of local and national results will be important.

## 5. Conclusions

As infant mortality declines in the developing world, it becomes increasingly concentrated in the neonatal period. Within the neonatal period, the first 24 hours after delivery can account for up to 45% of all infant and maternal deaths. The essential delivery care practices for maternal and newborn health and nutrition advocated in this document are preventive of neonatal mortality and may also be protective of mothers. However,

the evidence-base for their benefits goes well beyond survival and demonstrates long-term effects on maternal health and on infant health, nutrition and cognitive development. Unlike many life saving and changing interventions, their implementation implies no recurring costs. Once established as the standard practice of care, millions of mothers and newborns will reap their benefits.

## Appendix 1: Research questions regarding the implementation and integration of these practices

While all three practices have been proven beneficial and safe when analyzed separately, a few remaining questions arise—of both clinical/physiological and operational aspects—when the practices are integrated.

### *Clinical/physiological research questions*

#### *Small-for-gestational age infants and delayed umbilical cord clamping*

While the safety and benefits of delayed cord clamping in adequate-for-gestation age infants (both term<sup>34,113</sup> and preterm<sup>25,26</sup>) are relatively well established, the short and long-term effects of delayed clamping in small-for-gestational age infants have not been specifically investigated. Small-for-gestational age infants account for approximately 24% of births in developing countries.<sup>114</sup> There is good evidence that in small-for-gestational-age infants iron status is compromised<sup>115</sup> and they have an increased risk of developing anaemia compared to infants born appropriate-for-gestational-age because of their more rapid growth rate. In view of this, delayed cord clamping could be of particular relevance to this group. In addition, in developing countries the baseline risk for polycythaemia-hyperviscosity syndrome is likely to be lower than in industrialised countries.<sup>116</sup>

#### *Efficacy of revised active management guidelines for prevention of postpartum hemorrhage*

The efficacy and effectiveness of the recently revised guidelines for active management of the third stage of labor (which now include delayed cord clamping) in preventing postpartum hemorrhage have not been assessed. There is no physiological reason to expect that the inclusion of delayed cord clamping in the active management protocol would decrease the effectiveness of active management. To the contrary there is evidence that a less blood-filled placenta may be beneficial to third stage management. However, the efficacy and effectiveness of the revised protocol should be evaluated.

#### *Timing of cord clamping relative to oxytocin administration*

Because previous active management guidelines did not allow for delayed cord clamping, oxytocin was administered upon delivery or immediately following delivery of the infant and the cord clamped fairly immediately afterwards. While no negative effects are anticipated, it has not been investigated whether waiting to clamp the cord following administration of oxytocin immediately after the infant's delivery would have effects on

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the infant. While oxytocin is routinely given to mothers in many delivery settings for augmentation of labor, and oxytocin (both exogenous and endogenous) has been shown to be transferred to the infant via the placenta,<sup>117</sup> little research has been done regarding potential negative effects of oxytocin administration on the infant.

#### *Delayed cord clamping and cesarean delivery*

Fewer studies have analyzed the effect of delayed cord clamping in cesarean delivery as compared to vaginal deliveries. In Latin America, cesarean delivery accounts for as much or more than half of births in some settings. Delayed cord clamping can be practiced in cesarean delivery: a study that showed that placental transfusion did occur with delayed clamping in cesarean deliveries (evident by the increased hemoglobin and hematocrit in the hours after birth as compared to immediate clamping), placed the infants on their mother's laps and clamped the cord at 3 minutes after delivery.<sup>40</sup> No studies have investigated long-term effects of delayed clamping on iron or hematological status in infants born by cesarean delivery.

#### *Skin-to-skin contact after cesarean delivery*

The feasibility of implementing skin-to-skin contact (or equally beneficial alternatives) and early breastfeeding as soon as it is safe and possible after cesarean delivery has not been investigated. As a possible alternative, one study has investigated the benefits of father-to-newborn skin-to-skin contact after cesarean delivery, showing both decreased crying time, and improved pre-feeding behaviors.<sup>118</sup> The acceptability of this option in different settings should be evaluated.

### *Operational research questions*

#### *Current delivery care practices and norms*

There are little data as to the frequency of use of the care practices discussed in this document, particularly with regard to cord clamping time and skin-to-skin contact. A review of both clinical guidelines and norms, as well as an assessment of current practices observed in different delivery settings (both facility and domiciliary) and by different care providers are necessary in order to assess how implementation can most effectively occur.

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#### *Barriers to adoption of the recommended practices*

Additional data on the barriers preventing the adoption of evidence based perinatal care practices in specific regions are necessary in order to develop implementation materials and target advocacy efforts appropriately.

#### *Coordination with other evidence-based care practices*

There are obviously many more essential delivery care practices than those addressed in this document (e.g. clean cord care, neonatal resuscitation, immunizations). Assessing and documenting how best to integrate the combination of practices discussed here with other pre-natal and postnatal care practices for both mother and infant will be essential.

#### *Special considerations for implementation into domiciliary deliveries*

The limited data available on delivery care practices in domiciliary deliveries, and the special considerations for implementation of the recommended practices in this setting (e.g. training of birth attendants, adaptation of traditional or cultural practices, limited resources) makes this an important area of research.

## Appendix 2: Are there exceptions to the recommended practices? Frequently asked questions

There are very few exceptions in which delayed umbilical cord clamping, early skin-to-skin contact and initiation of exclusive breastfeeding should not be practiced. A few common situations in which the application of one or more of the recommended practices may be questioned are discussed below.

### *Delayed umbilical cord clamping and...*

#### *...the depressed or asphyxiated infant.*

If the infant is pale, limp, or not breathing, it is best to keep the infant at the level of the perineum to allow optimal blood flow and oxygenation while resuscitative measures are performed. Adequate blood volume is necessary for the establishment of respiration, as the pulmonary circulation requires an increase from 8-12% of the fetal cardiac output to 40-50% of the newborn cardiac output.<sup>119</sup> Immediately clamping the cord of depressed neonates deprives the infant of his/her only blood and oxygen source, with potential short-term and long-term repercussions. It is important to note most infants (more than 90%) respond to the initial steps of resuscitation, including drying and stimulation. A smaller percentage, less than 10%, require active resuscitative interventions to establish regular respirations, and approximately half of those infants will respond without further active resuscitative efforts.<sup>8</sup> It is possible to conduct positive pressure ventilation with mask and bag, or even a full resuscitation with intubation without severing the infant's umbilical cord.<sup>7</sup> However, in cases of severe asphyxia where the cord is flat or pulseless upon delivery (indicating a lack of placental-fetal circulation), immediate cord clamping may be indicated so that immediate resuscitative measures can be taken.

#### *...nuchal cord.*

The appropriate timing of umbilical cord clamping when the cord is wrapped around the newborn's neck (i.e. nuchal cord) is still controversial. However, increasing evidence indicates that clamping the cord before the infant is delivered may be harmful, increasing the risk of hypovolemia, anemia, cerebral palsy and possibly death.<sup>120</sup> Nuchal cord combined with the compression of the cord during uterine contractions will compromise fetal blood volume. Cord clamping before delivery may lead to fetal hypovolemia, by preventing the equilibration of placental-fetal circulation after delivery. It is recommended that the integrity of the nuchal cord be maintained as much as possible, by

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slipping the cord over the infant's head or shoulders (when allowed by the tightness of the cord) or employing the "somersault maneuver."<sup>121</sup>

...*diabetic mothers.*

Infants of diabetic mothers may be at increased risk of developing polycythemia because of compromised oxygen delivery during gestation resulting in a higher hematocrit at birth. However, the beneficial effects of delayed clamping for birth iron stores (which have been shown to be frequently compromised in newborns of diabetic mothers<sup>122</sup>) and thus long-term iron status<sup>123</sup> may outweigh any potential negative effects of an increased neonatal hematocrit.

... *Rhesus-sensitization of the mother.*

While fetomaternal transfusion may occur during labor and delivery, there is also evidence that microchimerism (both maternal and fetal) occurs during gestation (as early as the first trimester).<sup>124-126</sup> It is unlikely that the timing of cord clamping would affect the transfer of fetal cells to the mother or maternal cells to the infant. It has been suggested that delayed cord clamping, by decreasing the volume of placental blood "trapped" in the placenta may actually decrease the possibility of fetomaternal transfusion. A study that compared the effect of different methods for managing delivery of the placenta on fetomaternal transfusion showed that clamping at the end of the cord pulsations followed by placental drainage, caused the lowest degree of fetomaternal transfusion in comparison to early clamping or early clamping followed by placental drainage.<sup>127</sup>

...*mother-to-child transmission of HIV.*

Whether the practice of delayed umbilical cord clamping increases the risk of mother to child HIV transmission is not known. However, there is no biological evidence that allowing an equilibration of placental blood (i.e. blood that has been in circulation between the placenta and fetus during gestation) between the placenta and the infant by waiting to clamp the umbilical cord would increase the transfer of a blood-borne virus (either HIV or other viruses) to the newborn. When the placenta separates, the integrity of the syncytiotrophoblast and the fetal endothelium may become compromised allowing transfer of the virus; however, placental separation would not likely occur *before* the recommended time of cord clamping (approximately 3 minutes after delivery). However, to reduce the possibility of HIV transmission at delivery, it is essential that contact between maternal blood (e.g. blood from maternal tearing or lacerations) and the newborn be avoided.

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### *Breastfeeding and...*

#### *...the HIV-positive mother.*

Exclusive breastfeeding is recommended for HIV-infected women for the first 6 months of life unless replacement feeding is acceptable, feasible, affordable, sustainable and safe before that time. When replacement feeding is acceptable, feasible, affordable, sustainable and safe, avoidance of all breastfeeding by HIV-infected women is recommended.<sup>128</sup>

### *Skin-to-skin contact and...*

#### *... the HIV-positive mother.*

If a HIV-positive mother has decided not to breastfeed, skin-to-skin contact should still be encouraged for its beneficial effects apart from helping to establish early breastfeeding.

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## Additional Resources and Websites

In addition to the references listed above, the following websites may provide additional information on the topics discussed in this document. All websites are current as of October 2007.

### **Maternal and neonatal survival**

#### **Saving Newborn Lives, Save the Children**

<http://www.savethechildren.org/programs/health/saving-newborn-lives/>

#### **Partnership for Maternal, Newborn and Child Health**

<http://www.pmnch.org>

#### **Prevention of Postpartum Hemorrhage Initiative, (POPPHI)**

<http://www.pphprevention.org/index.php>

POPPHI is a USAID-funded three-year project focusing on the reduction of postpartum hemorrhage. Website contents include policy documents, technical briefs, posters and a toolkit for the steps of Active Management of the Third Stage of Labor which includes an animated demonstration. Resources available in English, Spanish and French.

#### **International Federation of Gynecology and Obstetrics (FIGO)/ International Confederation of Midwives (ICM) joint statement on prevention and treatment of postpartum haemorrhage**

[http://www.figo.org/initiatives\\_prevent.asp](http://www.figo.org/initiatives_prevent.asp)

#### **Access Program**

<http://www.accesstohealth.org/>

The ACCESS Program is a 5-year global program, sponsored by the U.S. Agency for International Development (USAID), that aims to improve the health and survival of mothers and their newborns.

## Iron deficiency and anemia and other micronutrient deficiencies

### Iron Deficiency Project Advisory Service (IDPAS)

<http://www.idpas.org/>

“IDPAS Iron World” includes an outline of webpages with a diverse set of documentation related to micronutrient nutrition with emphasis on preventing and controlling iron deficiency anemia.

### WHO Global Database on Anemia

<http://www.who.int/vmnis/anaemia/en/>

The database includes data by country on prevalence of anemia and mean hemoglobin concentrations.

### WHO Publications on Iron Deficiency/Anemia

[http://www.who.int/nutrition/publications/anaemia\\_iron\\_pub/en/index.html](http://www.who.int/nutrition/publications/anaemia_iron_pub/en/index.html)

### Micronutrient Initiative

<http://www.micronutrient.org/home.asp>

### A2Z Project, The USAID Micronutrient and Child Blindness Project

<http://www.a2zproject.org/>

## Importance of nutrition for health and development and achievement of the Millennium Development Goals

“Repositioning Nutrition as Central to Development: A strategy for large-scale action”, The World Bank, 2006

Download text: <http://siteresources.worldbank.org/NUTRITION/Resources/281846-1131636806329/NutritionStrategy.pdf>

Video presentation and powerpoint: <http://www1.worldbank.org/hdnetwork/external/hel/mshekar.htm>

Text excerpt: *“Malnutrition remains the world’s most serious health problem and the single biggest contributor to child mortality. Nearly one-third of children in the developing world are either underweight or stunted, and more than 30 percent of the developing world’s population suffers from micronutrient deficiencies... It has long been known that malnutrition undermines economic growth and perpetuates poverty. Yet the international community and most governments in developing countries have failed to tackle*

*malnutrition over the past decades, even though well-tested approaches for doing so exist. The consequences of this failure to act are now evident in the world's inadequate progress toward the Millennium Development Goals (MDGs) and toward poverty reduction more generally. Persistent malnutrition is contributing not only to widespread failure to meet the first MDG—to halve poverty and hunger—but to meet other goals in maternal and child health, HIV/AIDS, education, and gender equity... ”*

### **Pan American Health Organization's Regional Strategy and Plan of Action on Nutrition in Health and Development**

<http://www.paho.org/english/gov/cd/CD47-18-e.pdf>

### **Breastfeeding resources**

#### **The Baby-Friendly Hospital Initiative, (BFHI)**

<http://www.who.int/nutrition/topics/bfhi/en/>

[http://www.unicef.org/nutrition/index\\_24806.html](http://www.unicef.org/nutrition/index_24806.html)

#### **WHO publications on infant and young child feeding**

<http://www.who.int/nutrition/publications/infantfeeding/en/index.html>

Includes updated materials (January 2006) for Baby-Friendly Hospital Initiative implementation (training of health workers and policy-makers, with additional sections for settings with high HIV prevalence); the International Code of Marketing of Breast Milk Substitutes; and publications on breastfeeding and complementary feeding.

#### **LINKAGES**

<http://www.linkagesproject.org/>

USAID funded the 10-year LINKAGES Project (1996–2006) to provide technical information, assistance, and training to organizations on breastfeeding, related complementary feeding and maternal dietary practices, and the lactational amenorrhea method. Website includes assessment, training, counseling and monitoring and evaluation tools for infant and young child feeding.

#### **Breastfeeding and mother-to-child HIV transmission**

[http://www.who.int/nutrition/topics/feeding\\_difficulty/en/index.html](http://www.who.int/nutrition/topics/feeding_difficulty/en/index.html)

#### **Breastcrawl (UNICEF India)**

<http://www.breastcrawl.org>

Provides a video as well as resources for promotion of “breastcrawl” as a method of immediately initiating breastfeeding after delivery.

