

# Thermal Care of Newborns

July 2016

## Purpose

This brief and its companion on early and exclusive breastfeeding address key elements of “essential newborn care,” important routine care practices regardless of place of birth. While these two aspects of care are particularly potent determinants of newborn survival, they have received disproportionately little program attention. These documents serve primarily to present an epidemiologic argument for increased prioritization.

## Introduction

Hypothermia means lower than normal body temperature. In a newborn, hypothermia or chilling can be a sign of potentially serious infection or a marker of other risk factors not necessarily related to thermal care. But it is also a consequence of care practices, and it is an important risk condition for newborns. The reason for special concern about newborns and hypothermia is that newborns have limited ability to regulate their body temperature, particularly in the first 12 hours or so of life (McCall 2010); this is especially so for those born preterm. Hypothermia is also extraordinarily common, regardless of where the birth takes place: 32% to 85% of infants born in hospitals have been found to develop hypothermia at some point, and 11% to 92% among babies born at home (Lunze 2013). As Bissinger (2010) notes, thermal stress can be critically important especially during the “golden hour” after birth, and especially for very low birthweight newborns. The key point to recognize is the two very important linked phenomena of

1. the extra risk of thermal stress for all newborns due to wet skin and a cooler environment immediately after delivery and in the first hours of life; and the extra evaporative heat loss for very small babies (having a high surface-area-to-body-mass ratio)
2. the relative inability of newborns to generate and conserve heat (especially if they're preterm)

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*Increased risk of heat loss at the very time when one is least able to generate and conserve heat.*

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This risky combination means that the thermal care components of essential newborn care are critically important to prevent hypothermia and lower mortality and morbidity risks. But for all the evidence available to us of how important thermal care is for newborn survival, it gets surprisingly little program attention.



Zainabu practices kangaroo mother care with her 7-day-old son, Yasini, at a hospital in Tanzania. Photo: Colin Crowley/Save the Children

## Evidence

What impact are interventions aiming to prevent hypothermia having on mortality risk? Direct evidence for effectiveness of interventions is relatively sparse, so this review also considers evidence from descriptive studies that attempt to determine the contribution of hypothermia to subsequent development of serious illness. However, as mentioned, hypothermia can be both a symptom and a contributing cause of life-threatening infection in the newborn. That can pose a challenge in interpreting findings from descriptive studies showing an association between hypothermia and mortality risk.

### Hypothermia – frequency and contributing preventable factors (thermal care)

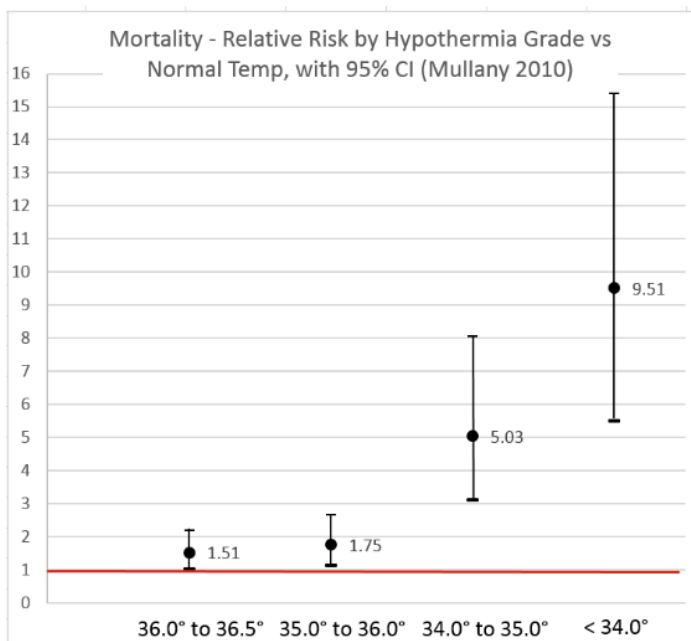
- In Uganda, a randomized controlled trial (RCT) in a hospital setting (Bergstrom 2005), N=239, found that bathing within one hour of birth was associated with increased hypothermia (<math>36.5^{\circ}\text{C}</math> rectal temperature) at 70 and 90 minutes postpartum compared with no bathing (OR = 2.90, 95% CI: 1.69–5.04; and OR = 3.88, 95% CI: 2.18–6.91, respectively).

- In a large community-based study in Nepal (N=23,240) with repeated measures of temperature over the first 28 days of life (Mullany 2010), approximately half of newborns were found to have at least one temperature measure of moderate to severe hypothermia (<36.0°C axillary), with the highest likelihood over the first 24–72 hours of life. Risk of hypothermia varied by season but even in the hottest season one in five newborns were found to be hypothermic.

### Mortality risk

- Sodemann (2008), in a study in Guinea-Bissau found that those with temperatures <34.5°C were at five times higher mortality risk over the first week of life, with elevated risk persisting to 2 months of age.
- In the large population-based study in Nepal referred to above (Mullany 2010), most births occurred at home. Regular axillary temperature assessments were done (median time to first temperature measurement was 19 hours after birth; 88% were within 72 hours of birth), as well as ambient temperature readings. Analysis was done in a way to reduce the contribution of reverse causality (hypothermia as a sign of potentially severe infection). Using newly established temperature cutoffs for grading hypothermia (which better correlated with risk), risk of death for first measured temperature was found to be elevated, compared with normothermic newborns, as follows:

In this analysis, effect size was adjusted for age, ambient temperature, sex, early breastfeeding initiation, ethnic group, birth-weight, hand-washing practices of mother and birth attendant, place of delivery, and signs of illness on the day of measurement.



## Interventions

### Reviews

- A Cochrane review by Moore et al. (2012) of early skin-to-skin care for healthy full-term newborns found greater physiologic stability and better breastfeeding outcomes.
- McCall's Cochrane review (2010) on interventions immediately at birth beyond "routine" thermal care for preterm or low birthweight newborns found plastic wraps/caps to be effective for those of gestational age <29 weeks in reducing hypothermia risk; but stockinette caps were not.
- The Cochrane review of Kangaroo Mother Care (KMC) by Conde-Agudelo (2014) addressed evidence from RCTs of intermittent or continuous skin-to-skin care for low birthweight newborns in hospital, generally in comparison to care in an incubator or under a radiant warmer and found lower mortality risk (RR=0.60, 95% CI: 0.39–0.92, 8 trials).
- With the exception of one small US-based trial (Rojas 2003) (N=60), all of the studies of KMC in Conde-Agudelo's Cochrane review that had mortality as an outcome were conducted in low- and middle-income countries. Although thermal care was a central component of the intervention package tested, there were other elements, notably support for feeding. Findings from these reviews do, however, provide evidence for the effectiveness of extended skin-to-skin care on thermal stability and consequent survival.

### Important individual papers

- In a hospital-based, before-and-after study conducted in Nepal (Johanson 1992), at baseline the usual practice was not to immediately dry and wrap newborns. At two hours after birth 85% had rectal temperatures <36°C (N=495) and at 24 hours after birth, 50% had temperatures that low (N=405), and 14% had temperatures <35°C. After introducing the new practice of immediate drying and wrapping, at two hours after birth 38% had rectal temperatures <36°C (N=298) and at 24 hours, the proportion with temperatures that low was 18% (N=231); none had temperatures <35°C.
- In a study of late preterm newborns by Bergman (2004), in comparison to newborns receiving incubator care, those kept skin-to-skin showed greater cardio-respiratory stability, and blood glucose levels 75 to 90 minutes following the birth were significantly higher.
- In a RCT in a tertiary care setting in Gujarat that included term and late preterm newborns (Nimbalkar 2014), skin-to-skin care was started within 30–60 minutes of delivery and continued for 24 hours. Newborns in the

skin-to-skin care group achieved more rapid thermal control compared to the comparison group and significantly lower incidence of hypothermia over the first 48 hours. In this study those in the control group had eight times higher risk of developing hypothermia than those randomized to skin-to-skin care (RR=8.0, 95% CI: 1.9–33.0).

- In a community-level cluster RCT in Bangladesh (Sloan 2008), household-level antenatal counseling for all pregnant women encouraged continuous 24-hour per day skin-to-skin care, particularly over the first two days of life, regardless of birthweight. The trial showed effects on maternal care practices including earlier initiation of breastfeeding (although even in the intervention arm this was generally quite delayed, at an average of five hours after birth), much reduced bathing within the first day of life, and at least some practice of skin-to-skin care (with 24% of those in the intervention arm reporting more than seven hours a day of such care). However, no mortality effect was demonstrated. Since overall mortality across both intervention and control arms was considerably lower than assumed for the study power calculations, and the sample size was determined to detect a reduction in neonatal mortality of 27.5% or more, the study may have been underpowered to show a mortality effect. Furthermore, while such thermal care practices can be beneficial for normal birthweight babies, it is particularly among low birthweight babies that one would expect a significant mortality effect.
- The same investigators did further analysis of data from their original study (Ahmed 2011) and found a dose-response relationship with the lowest mortality for those held skin-to-skin at least seven hours per day over the first two days of life; neonatal mortality in this group was just one-fourth of the national rural average. Newborns kept skin-to-skin for less than seven hours per day did not have better health or survival than those receiving no skin-to-skin care. Although this is suggestive of benefit, an important contribution from uncontrolled confounding cannot be ruled out.
- In a somewhat similar community-based cluster RCT in Uttar Pradesh, Kumar (2008) showed significantly lower mortality in their intervention clusters than in the - comparison arm (RR=0.46, 95% CI: 0.35–0.60). This study was conducted in a rural area where most births take place at home and had very high baseline neonatal mortality and very suboptimal thermal care practices. The intervention focused primarily on prevention of hypothermia (including skin-to-skin care) but also addressed birth preparedness, clean delivery and cord care, breastfeeding, and care-seeking from suitable providers. Home visitation by community health workers

during pregnancy and postnatally was an important element. Unlike the Bangladesh study (Sloan 2008), the approach also entailed fairly intensive community mobilization. Although the emphasis was on thermal care, the actual package delivered was considerably broader, so it is not possible to isolate its contribution to the observed reduction in mortality risk. Nevertheless, these findings give some indication of the maximum expected mortality benefit of intensive efforts to improve thermal care practices at the community level in a high-mortality setting.



Abayanesu, 22, with her newborn daughter in Black Lion Hospital, Addis Ababa, Ethiopia.  
Photo: Caroline Trutmann/Save the Children

## Discussion

Thermal care practices can be seen as part of a broader behavioral cluster also including early-initiation and exclusive breastfeeding and immediate stimulation at birth. Optimal practice of this suite of behaviors is important for all babies, especially during the first day of life, but especially important for very small babies, and extending over the first days and weeks of life. In settings where many births happen at home, it is particularly during pregnancy that there are frequently opportunities (for example, through antenatal care contacts) to influence such practices at birth and over the first hours afterwards. From data published in Mullany (2010), we have evidence that hypothermia is very common and is a potent risk factor for newborn mortality. The causal pathway we have been considering can be understood as follows:

**thermal care practices → hypothermia → serious infection or other pathology → death**

We do not have definitive evidence available to confidently tease apart such causal flow from other potentially related factors. In the analysis in Mullany (2010), various moves

were made to control out “reverse causality” – cases in which hypothermia was in fact a sign accompanying sepsis leading to death – as well as a number of known potential confounders, including place of birth, gestational age, timing of breastfeeding initiation, and handwashing practices of the mother. With such adjustments made in the analysis, large effect sizes remained. For all of those in the sample found to be hypothermic at first temperature measurement, if their risk of death were reduced to that of those who were normothermic (with the analysis controlled for these various potential confounders), overall mortality in the sample would have been reduced by 45%.

Clearly, there is more going on in this population than what is outlined in the causal pathway above. The association seen between hypothermia and mortality risk may be confounded by other unmeasured factors (for example, in this analysis it was not possible to control for gestational age at birth). Furthermore, thermal care practices are certainly not the only important driver of hypothermia prevalence. So the actual mortality effect of significantly improving thermal care practices would certainly be less than 45%, but these data suggest the effect would nevertheless be quite large, consistent with the large effects seen in the Kumar study (2008), which focused mainly on improving such practices.

There are simple measures that can be taken over the first minutes and hours of life that can meaningfully reduce thermal stress. For the magnitude of reduction in risk of death that can plausibly be inferred from available evidence, the minimal programmatic attention given to improving such practices is hard to justify.

## Actions to be taken

As we have seen from published evidence, both for home and facility births, thermal care in many settings is poor and this very significantly increases risk of newborn death. In both settings, we need to aim for the following:

- At birth: immediate drying, promptly placing the baby skin-to-skin on the mother’s chest, covering and putting the baby to the breast. Any time it is necessary that the baby be exposed, e.g., for weighing, this should be under a radiant heat lamp, maintaining the “warm chain.”
- Over the first day of life: maximize time spent skin-to-skin, delay bathing, minimize time spent exposed.
- For very small newborns: continue maximizing time spent skin-to-skin, with careful attention to avoid chilling, through the first week of life and beyond.

Although in home settings the mother and other household caregivers have plenty of scope to improve care practices, in a health facility setting this is largely determined by health workers and standard procedures in that setting, with less of a decision-making role for mothers. So strategies need to be developed specifically addressing each of these settings, focusing on the key actors.

To ensure these care practices following home births, it is important to reach mothers and others who influence such care (e.g., trained birth attendants, mothers-in-law, other household members) before the birth to ensure that they are knowledgeable and motivated to provide such care. Antenatal care may be a suitable platform. Similarly, in settings where community health workers have contact with women during pregnancy (e.g., during pregnant women’s group meetings or home visits), they may be well placed to effectively influence such practices.

For facility births, it is important to change norms and procedures and ensure that health workers observe these care principles. Quality improvement approaches may be appropriate. In some settings special effort focusing on thermal care could be incorporated into initiatives like Baby-Friendly Hospitals certification.

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*Most of the content of this brief is an extract from Hodgins S, Tielsch J, Rankin K, Robinson A, Kearns A, Caglia J. A New Look at Care in Pregnancy: Simple, Effective Interventions for Neglected Populations. PLoS One (in press).*



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