INTRAPARTUM-RELATED DEATHS: EVIDENCE FOR ACTION 1

Two million intrapartum-related stillbirths and neonatal deaths: Where, why, and what can be done?

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A R T I C L E   I N F O

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A B S T R A C T

Background: Intrapartum-related neonatal deaths (‘birth asphyxia’) are a leading cause of child mortality globally, outnumbering deaths from malaria. Reduction is crucial to meeting the fourth Millennium Development Goal (MDG), and is intimately linked to intrapartum stillbirths as well as maternal health and MDG 5, yet there is a lack of consensus on what works, especially in weak health systems. Objective: To clarify terminology for intrapartum-related outcomes; to describe the intrapartum-related global burden; to present current coverage and trends for care at birth; and to outline aims and methods for this comprehensive 7-paper supplement reviewing strategies to reduce intrapartum-related deaths. Results: Birth is a critical time for the mother and fetus with an estimated 1.02 million intrapartum stillbirths, 904,000 intrapartum-related neonatal deaths, and around 42% of the 535,900 maternal deaths each year. Most of the burden (99%) occurs in low- and middle-income countries. Intrapartum-related neonatal mortality rates are 25-fold higher in the lowest income countries and intrapartum stillbirth rates are up to 50-fold higher. Maternal risk factors and delays in accessing care are critical contributors. The rural poor are at particular risk, and also have the lowest coverage of skilled care at birth. Almost 30,000 abstracts were searched and the evidence is evaluated and reported in the 6 subsequent papers. Conclusion: Each year the deaths of 2 million babies are linked to complications during birth and the burden is inequitably carried by the poor. Evidence-based strategies are urgently needed to reduce the burden of intrapartum-related deaths particularly in low- and middle-income settings where 60 million women give birth at home.

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1. Introduction

The fourth Millennium Development Goal (MDG) target for child survival is to reduce under-5 child mortality by two-thirds by 2015, with a global target of 32 per 1000 live births [1]. Given that the global neonatal mortality rate (deaths in the first 28 days of life) is 30 per 1000, the burden of deaths in the neonatal period alone approximates the entire MDG 4 target. While postneonatal mortality is being reduced [2], there has been limited progress in reducing the neonatal mortality rate. Hence, neonatal deaths account for an increasing proportion of under-5 mortality—now 42% of under-5 deaths compared with 37% of under-5 deaths in 2000 [1]. In low-income countries over the last decade there has been no measurable reduction in early neonatal mortality (deaths in the first week of life), yet high-income countries continue to make progress, and the gap between the rich and the poor continues to widen (Fig. 1). Therefore, reducing the global total of 3.82 million neonatal deaths [2], and particularly the 3 million who die in the first week of life (the early neonatal period), is crucial to meeting MDG 4. The solutions to reduce neonatal deaths, and especially early neonatal deaths, are intimately linked to maternal health and to provision of effective maternal and neonatal health services. Thus, addressing current global gaps for care at birth is critical to achieving both MDG 4 and MDG 5, for maternal mortality reduction.

Each year, an estimated 904,000 intrapartum-related neonatal deaths (previously termed ‘birth asphyxia’) occur, accounting for approximately one-third of the early neonatal deaths [3,4]. Closely linked are an estimated 1.02 million intrapartum or ‘fresh’ stillbirths; however, stillbirths are not currently recorded in MDG or Global Burden of Disease metrics [5]. While intrapartum-related neonatal deaths account for 9% of all under-5 child mortality, a proportion comparable to malaria, they are

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not addressed in global health policy and programming. Despite availability of some data, this invisibility is mostly related to a lack of clarity in what we currently know works and vision for what could work in different health systems settings. Information is needed to guide programs, particularly in low-income countries where the majority of deaths due to intrapartum-related injury occur [6]. While there are accepted solutions feasible for scaling-up interventions within weak health systems and at community level for neonatal deaths, these majorities of deaths due to intrapartum-related injury occur [6]. While there have been recent systematic reviews, most notably an extensive series related to the evidence for reducing stillbirths [11], there is a dearth of literature on what works for intrapartum-related deaths and especially what works at scale in low-resource settings.

1.1. Objectives

This paper is the first in a series entitled “Intrapartum-related deaths: Evidence for action.” The goal of this series is to call the Maternal, Newborn, and Child Health (MNCH) communities to collective action, laying out the evidence and actions required to strengthen healthcare delivery systems and increase community mobilization to reduce the largely preventable and inexcusable 2 million deaths each year that are related to lack of care at birth.

The objectives of the series are as follows:

1. To summarize data regarding intrapartum-related outcomes for mother and fetus/neonate including:
   - Neonatal mortality outcomes notably intrapartum-related neonatal deaths, early neonatal mortality rate (ENMR), and neonatal mortality rate (NMR).
   - Impairment following intrapartum-related injury such as neonatal encephalopathy.
   - Linked outcomes, including the stillbirth rate (SBR) particularly intrapartum stillbirths, the perinatal mortality rate (PMR), and maternal mortality ratio (MMR).
2. To undertake new analyses to define the variation in terms of burden, coverage gaps/trends, and health system capacity in order to set data-based priorities to more systematically address the global burden of intrapartum-related deaths in varying health system settings.
3. To systematically review the evidence regarding interventions and strategies that avert intrapartum-related adverse outcomes, including:
   - Care at the time of childbirth, and ways to increase care provision, for example through task shifting (Paper 2) [12].
   - Neonatal resuscitation and post-resuscitation management (Paper 3) [10].
   - Improving linkages between community and facility (Paper 4) [13].
   - Community-based interventions (Paper 5) [14].
   - Perinatal audit (Paper 6) [15].
4. To synthesize policy implications for maternal, neonatal, and child health programs and to consider available evidence and experience with regard to various delivery strategies. We underscore differing priorities by varying health system capacity, and provide case studies with a focus on reducing delays, reaching under-served populations, and experience with large-scale programs [16].

In this first paper of the series, we summarize the global epidemiology of intrapartum-related stillbirths and neonatal deaths, including issues surrounding confusion of terminology, to guide programmatic action. We undertake a new analysis to define the variation of burden and identify trends and coverage gaps according to 5 categories of neonatal mortality, which are markers of health system performance for care at birth. In subsequent papers, we build on this analysis to set data-based priorities to more systematically prioritize actions to address the global burden of intrapartum-related deaths based on these 5 NMR categories.

2. The burden of intrapartum-related outcomes

2.1. Challenges to estimation

2.1.1. Lack of consistent definitions and terminology

The terms and definitions used to describe a baby in poor condition at birth have evolved over time, driven both by a greater understanding of pathophysiology and clinical manifestations, but also by increasing litigation in high-income countries. The word “asphyxia” is based on a Greek word meaning “pulseless” and is applied to a syndrome that combines hypoxia (low levels of oxygen) and metabolic acidosis [17]. “Birth asphyxia” is an imprecise term, that was broadly defined by the World Health Organization (WHO) in 1997 as the clinical description of a newborn who “fails to initiate or maintain regular breathing at birth” [18]; this term applies to an important clinical condition—the need for resuscitation—but is not predictive of outcome nor does it imply a particular causation (e.g. intrapartum hypoxia) since the baby may be not breathing for other reasons, for example prematurity. While many clinical markers have been used to indicate possible intrapartum injury, such as Apgar scores, fetal acidosis or fetal distress, these lack specificity and have low positive predictive value for long-term outcomes [19].

Over the last decades, there has been a paradigm shift in the terminology used to describe what has previously been called “birth asphyxia” or “perinatal asphyxia” [3,20–22]. Epidemiologic measurement of intrapartum injury has transitioned from process-based (e.g. obstructed labor, breech presentation) or symptom-based (fetal distress, Apgar scores) indicators to outcome-based measures of mortality and acute morbidity, usually defined through multi-indicator approaches. For example, intrapartum stillbirths weighing over 1000 g, or neonatal encephalopathy, is a syndromic diagnosis of a baby with impaired consciousness and other neurobehavioral symptoms (Table 1). These outcomes have improved correlation with etiology and with long-term prognosis [3].

Three consensus statements addressing the terminology and diagnosis of “birth asphyxia” have been released since 1996 [19,20,22]. All 3 statements have recommended that terms such as “birth asphyxia,” “perinatal asphyxia,” “fetal distress,” “hypoxic-ischemic encephalopathy,” or “post-asphyxial encephalopathy” should not be used unless
Table 1

Terms and definitions: Shifting from “birth asphyxia” to intrapartum stillbirths and intrapartum-related neonatal deaths.

MORTALITY OUTCOMES

- Early neonatal death: Death in the first 7 days of life.
- Fetal death: A baby born with no signs of life after 22 weeks of gestation (equivalent to 500 g). Late fetal death is a baby born dead after 28 weeks of gestation (equivalent to 1000 g) [96].
- Stillbirth: This can be taken as equivalent to late fetal death, that is a baby who is born with no signs of life after 28 weeks of gestation (equivalent to 1000 g) [11].
- Intrapartum-related stillbirth: A stillborn baby (shows no signs of life at delivery and weighs more than 500 g or is greater than 22 weeks of gestation) with intact skin and no signs of disintegration in utero. The death is assumed to have occurred in the 12 hours before delivery and was most likely due to an intrapartum hypoxic event. Babies with severe congenital abnormalities are not included (based on Wigglesworth’s classification) [3].
- Intrapartum-related neonatal deaths (previously called “birth asphyxia” deaths): Neonatal deaths of term babies with neonatal encephalopathy (see below) or who cannot be resuscitated (or for whom resuscitation is not available). Where possible, other causes should be excluded such as lethal congenital malformations and preterm birth complications (less than 34 completed weeks of gestation or birth weight <2000 g). Also includes a smaller group of babies who die from birth injury without hypoxic brain injury; for example, organ rupture [3,23].

MORBIDITY OUTCOMES

- Neonatal encephalopathy (NE): “A disturbance of neurological function in the earliest days of life in the term infant manifested by difficulty initiating and maintaining respiration, depression of tone and reflexes, abnormal level of consciousness and often by seizures” [95,96], which may follow an intrapartum hypoxic insult or be due to another cause. Neonatal encephalopathy is usually separated into 3 grades (mild, moderate, severe) by clinical findings during the first week of life. Virtually all babies with mild NE who are normal at the end of the first week of life will be free of long-term neurological damage. The majority of infants with severe NE will die or manifest severe neurological impairment.
- Hypoxic ischemic encephalopathy (HIE): A syndrome of abnormal neurological behavior in the neonate, which is frequently associated with multi-system dysfunction and follows severe injury before or during delivery. There are several systems for categorizing HIE (most commonly into mild, moderate, severe). Most authorities now prefer the term Neonatal Encephalopathy and then specifying if the encephalopathy is associated with intrapartum injury.
- Disability: Any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being (International Classification of Functioning, Disability and Health).
- Cerebral palsy: A non-progressive disorder of motor function, which may originate during pregnancy, delivery or in the postnatal period.

NEED FOR RESUSCITATION

- “Non-breathing baby:” Infant with perinatal respiratory depression after birth that may be due to any of a multitude of causes, including but not restricted to intrapartum hypoxia, respiratory distress syndrome-preterm birth, infection, general anesthesia during labor, and meconium aspiration. Neonatal deaths that occur in the first hours after birth or in small babies are less likely than other neonatal deaths to be reported [37–39]. Furthermore, the liveborn baby who does not breathe at birth may be misclassified as a stillbirth for several reasons. In the home setting, when the infant is not examined by a professional health worker, the presence of a heart beat may not be assessed to determine whether the non-crying, non-breathing, non-moving infant was liveborn. Interestingly, in a before-and-after comparison of implementation of essential newborn care and neonatal resuscitation training in Zambia, stillbirth rates declined from 23 to 16 stillbirths per 1000 live births (RR 0.63; 95% CI, 0.44–0.88). The authors speculated that the apparent decrease in stillbirths may have resulted from effective resuscitation of liveborn babies who would have been previously misclassified as stillborn [40]. Additionally, recording an infant as stillborn may avoid a sense of blame for the family or birth attendant, or circumvent the need to fill out a death certificate [1].

2.1. Lack of comparable cause-specific data

Data regarding intrapartum-related hypoxic events (including intrapartum-related neonatal deaths and intrapartum stillbirths) are lacking in the regions where the burden is the greatest [32,27]. Reliable coverage with vital registration systems is available for less than 3% of all neonatal deaths and is not generalizable to typical low- and middle-income country settings [1]. Verbal autopsy methods (questionnaires used with family members after the death) are the only option for cause-of-death data for the majority of neonatal deaths and stillbirths [28]. There have been advances in case definitions and algorithms for use in verbal autopsy, but full consensus and consistent use is still lacking, particularly for hierarchical attribution if the baby died with signs suggestive of several possible causes-of-death [29–36].

2.1.3. Lack of reliable data on numbers and rates of neonatal deaths

Neonatal deaths that occur in the first hours after birth or in small babies are less likely than other neonatal deaths to be reported [37–39]. Furthermore, the liveborn baby who does not breathe at birth may be misclassified as a stillbirth for several reasons. In the home setting, when the infant is not examined by a professional health worker, the presence of a heart beat may not be assessed to determine whether the non-crying, non-breathing, non-moving infant was liveborn. Interestingly, in a before-and-after comparison of implementation of essential newborn care and neonatal resuscitation training in Zambia, stillbirth rates declined from 23 to 16 stillbirths per 1000 live births (RR 0.63; 95% CI, 0.44–0.88). The authors speculated that the apparent decrease in stillbirths may have resulted from effective resuscitation of liveborn babies who would have been previously misclassified as stillborn [40]. Additionally, recording an infant as stillborn may avoid a sense of blame for the family or birth attendant, or circumvent the need to fill out a death certificate [1].

2.2. The size of the problem

2.2.1. Intrapartum-related neonatal deaths

During the 1990s, estimates of the burden of “birth asphyxia” varied considerably from 400 000 to 1.6 million per year due in large part to the lack of data from low-income countries and varying case definitions and methods of estimation [41–43]. In 2005, the first set of systematic estimates were published for 194 countries using vital registration data, where available, and for countries without national data, using single-cause logistic regression modeling based on study datasets mainly from verbal autopsy data. This exercise resulted in a global estimate of 904 000 intrapartum-related neonatal deaths (range, 0.65–1.17 million) for the year 2000 [3]. In a subsequent exercise with the Child Health Epidemiology Reference Group, the proportionate distribution for 7 cause-of-death in the neonatal period was estimated for 193 countries, using new analysis of vital registration data for the 45 countries with available data. A multi-
cause regression model based on 56 input datasets was applied to estimate numbers for cause-of-death for those countries without representative data [4]. This multi-cause method is now the standard approach for estimation of neonatal cause-of-death used for United Nations estimates [44] as well as for the Global Burden of Disease [45]. Although these methods for estimating the national burden of intrapartum-related neonatal deaths differed, notably as single and multi-cause approaches, the global results from both methods were very similar: 904 000 (range, 650 000–1.17 million) [3] and 910 000 (range, 600 000–1.08 million) [4].

Although there is wide uncertainty around this data, it is clear that the number of deaths is huge. Intrapartum-related deaths are 1 of the top 5 causes of child deaths and account for more deaths each year than malaria or conditions prevented by immunizations, yet receive much less attention and funding [46].

The variation in cause-specific mortality rate according to category of NMR is shown in Fig. 2. In the lowest category (Categories 1), rates of intrapartum-related neonatal deaths are less than 0.5 per 1000 live births, whereas in the highest category (NMR>45), rates of intrapartum-related neonatal deaths are nearly 24-fold higher, at 11.8 per 1000 live births (Fig. 2).

2.2.2. Intrapartum-related impairment

The WHO World Health Report 2005 estimated that as many as an annual 1 million survivors of “birth asphyxia” may develop cerebral palsy, learning difficulties or other disabilities [44], although the methods to generate these estimates are not detailed. The Global Burden of Disease assessment concluded that “birth asphyxia” was responsible for 42 million disability-adjusted life years (DALYs), which is double that due to diabetes and almost three-quarters of the burden responsible for 42 million disability-adjusted life years (DALYs), which was double that due to diabetes and almost three-quarters of the burden due to HIV/AIDS (58 million DALYs) [47].

However, these estimates are uncertain as there is a paucity of data from low- and middle-income countries and a complete lack of data on intrapartum-related impairment from community-based settings, where the majority of the burden occurs. Data on the global burden of intrapartum-related impairment are scarce and further limited by inconsistent definitional categories for impairment [48].

A systematic review and estimation exercise is being conducted by the Child Health Epidemiology Reference Group for the Global Burden of Disease Project to estimate the global incidence of neonatal encephalopathy. In brief, PubMed, Popline, Cochrane, EMRO, EMBASE, LILACS, and AIM databases were searched, all titles were reviewed, and articles were pulled that had potential data on incidence, case fatality or chronic disability. The searches and modeling are described elsewhere [49]. Here we report the preliminary findings of the reported neonatal encephalopathy incidence, neonatal case fatality, and disability by median and range for each NMR category.

Of the infants who survive the first few hours, the development of neonatal encephalopathy is strongly predictive of long-term neurodevelopmental disability [50–52], with the highest rates of death or disability associated with severe stage 3 neonatal encephalopathy (near 100%) and lower rates of adverse outcomes in mild stage 1 neonatal encephalopathy (32%) [52]. Table 2 shows the median incidence of neonatal encephalopathy by NMR category. In very low mortality settings (NMR<5), the median incidence of neonatal encephalopathy is 1.9 per 1000 live births (range, 0.7–6.0) compared with 26.5 per 1000 live births in the highest mortality settings (based on single study), a 14-fold disparity. The median neonatal case fatality for neonatal encephalopathy in very low mortality settings is 21% (range, 17%–37%) versus 31% (range, 20%–33%) in the high mortality settings (NMR=31–45), although there is a complete lack of data from very high mortality settings (>45%) and no data from community settings, where the majority of intrapartum-related events are concentrated. Across all NMR categories, approximately 25%–29% of neonatal encephalopathy survivors may have a long-term moderate or severe impairment. Systematic estimates for neonatal encephalopathy and related impairment will be completed and published in 2010.

<table>
<thead>
<tr>
<th>CATEGORY 1</th>
<th>CATEGORY 2</th>
<th>CATEGORY 3</th>
<th>CATEGORY 4</th>
<th>CATEGORY 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY LOW MORTALITY NMR ≤5</td>
<td>LOW MORTALITY 6 – 15</td>
<td>MODERATE MORTALITY 16 – 30</td>
<td>HIGH MORTALITY 31 – 45</td>
<td>VERY HIGH MORTALITY &gt;45</td>
</tr>
<tr>
<td>Skilled attendance 100%</td>
<td>Skilled attendance 99%</td>
<td>Skilled attendance 88%</td>
<td>Skilled attendance 52%</td>
<td>Skilled attendance 46%</td>
</tr>
</tbody>
</table>

Fig. 2. Variation of cause-specific mortality across 193 countries organized according to five categories of neonatal mortality, as a marker of health system capacity. Sources: New analysis of 193 countries grouped by level of NMR into 5 categories adapted from Lancet Neonatal Series [1] 2005 and updated for 2009 using neonatal mortality [2] and revised neonatal cause-specific estimates for Countdown [72] 2008 based on methods from Lawn et al. [4] 2006. The skilled birth attendance is based on median, and the range is reported in Table 2.
2.3. Where?

2.3.1. Which countries?

As with early neonatal deaths, almost all intrapartum stillbirths (>99%) and intrapartum-related neonatal deaths occur in low- and middle-income countries. In high-income countries the rates and numbers of neonatal deaths are much lower, and the proportion attributed to be intrapartum-related is around 12% (Fig. 2). Hence, fewer than 50 000 intrapartum-related neonatal deaths occur in high-income countries. South Asia and Africa—with large numbers of births and deaths, and higher cause-specific intrapartum-related rates—together account for 73% of all intrapartum-related neonatal deaths worldwide (Fig. 3). These world maps, created by Worldmapper (Fig. 3) [53], adjust the scale of each country in proportion to the measure indicated, dramatically portraying the heavy burden in these regions. The 10 countries with the highest numbers of intrapartum-related neonatal deaths (Fig. 3a) and intrapartum stillbirths (Fig. 3b) are mainly those with the largest numbers of births (India, China, Democratic Republic of Congo, Pakistan, Nigeria, Bangladesh, Ethiopia, Indonesia, Afghanistan, and Tanzania). These 10 countries alone account for more than 65% of all intrapartum-related neonatal deaths.

![Worldmapper maps](http://www.worldmapper.org/display.php?selected=215)

![Worldmapper maps](http://www.worldmapper.org/display.php?selected=219)

![Worldmapper maps](http://www.worldmapper.org/display.php?selected=260)

The countries with the highest rates of intrapartum stillbirth are primarily in West Africa, for example Cote d’Ivoire (14 per 1000) and Nigeria (11 per 1000), and South Asian countries with challenging geographical barriers and low access to skilled health care, such as Nepal (14 per 1000) and Pakistan (14 per 1000); however, these rates may underestimate the magnitude of the problem because of under-reporting, as discussed earlier.

2.3.2. Variation within countries: Inequities and gender
Disparities in intrapartum-related mortality rates are also evident within countries because the highest burden occurs among those with inequitable access to obstetric and immediate postnatal care. Neonatal mortality is much higher for the poorest of the poor. For example, in Nigeria the NMR is 23 per 1000 births for the highest income quintile, but 59 for newborns in the poorest quintile families. If all the babies in Nigeria had the same risk of neonatal mortality as the richest, then there would be 127 000 fewer newborn deaths in Nigeria each year [54]. The rural poor have the greatest geographic and financial challenges in accessing care, particularly emergency obstetric care (EmOC). Cesarean delivery rates in rural Sub-Saharan Africa are less than 1% [12].

Controlling for other factors, baby girls have a lower mortality rate than baby boys [55]. In societies where care is equal for boys and girls, the ratio of neonatal mortality for boys to girls is usually at least 1.2 or higher [1]. Analysis of Demographic Health Survey (DHS) data for African countries does not show a loss of this advantage for female babies, although DHS may not be sensitive enough to detect this difference. A number of studies from South Asia have reported reduced care seeking for girls, and even female infanticide [56].

2.4. When? Timing of stillbirths, maternal, and neonatal deaths

2.4.1. Timing of intrapartum-related neonatal outcomes
The vast majority of intrapartum-related neonatal deaths occur early: 78–90% in the first 48 hours and almost all within the first week of life (97–98%) [32,33,35,38]. Fig. 4 shows the timing of these deaths in a community setting in rural Nepal. Neonatal encephalopathy symptoms such as reduced consciousness and convulsions typically will manifest within the first 24 hours of life [57]; babies who die from neonatal encephalopathy do so primarily in the neonatal period, and mainly in the first days of life, even in countries with neonatal intensive care [51].

2.4.2. Linked outcomes of intrapartum stillbirths and maternal deaths
Whilst around 23% of neonatal deaths globally are estimated to be intrapartum-related, the proportion of stillbirths and maternal deaths that are intrapartum-related is even higher: 32% and 42%, respectively (Fig. 5).

The first systematic estimates for intrapartum stillbirths were reported for 2000. National estimates for 192 countries based on 73 population-based study datasets from 56 countries yielded approximately 1.02 million annual intrapartum stillbirths (95% CI, 0.66–1.48). The disparity in intrapartum stillbirth rates is approximately 10-fold from the poorest to richest regions (Table 2); at country-level the disparity increases to over 50-fold, with rates of intrapartum stillbirth ranging from 0.3 to 15.5 per 1000 births [3].

There were an estimated 535 900 maternal deaths worldwide in 2005 [58]. The maternal mortality ratio (MMR) is high in the same countries where NMR, intrapartum-related neonatal deaths, and intrapartum stillbirth rates are high. For example, in the countries in Category 5 (NMR >45 per 1000), the MMR is 8-fold higher than for the countries with the lowest mortality (920 vs 12 per 100 000 births) (Table 2). Multiple regression analysis of global estimate data also reported a very close correlation between SBR and MMR [59].

 Globally, an estimated 42% of maternal deaths are intrapartum-related, defined as during birth or the first day after birth (Fig. 5) [60]. Most of the direct obstetric causes of maternal deaths are intrapartum related including obstetric hemorrhage, puerperal sepsis, some hypertension complications, and anesthetic-related. In South Africa, 39% of direct maternal deaths and 42% of perinatal deaths are directly intrapartum related—the largest causal group for either maternal deaths or perinatal deaths (Personal communication RC Pattinson, data from Saving Mothers Confidential Enquiries into maternal deaths in South Africa and Saving Babies 2006–2007: Sixth Perinatal Care survey of South Africa).

For mothers who die of an intrapartum cause, it is rare for the baby to survive. Maternal morbidity and “near miss” maternal deaths are also closely linked to adverse fetal and neonatal outcomes. Among women with obstetric fistula, a high proportion has experienced an intrapartum stillbirth or an intrapartum-related neonatal death, although systematic reporting for the perinatal outcomes is often lacking [11]. Likewise women with near miss often do not have a surviving baby, although few report on this outcome [61]. In South Africa, for 1002 maternal deaths and “near miss” maternal deaths (1997–2006), 325 babies were undelivered at the time of the mother’s death. Among the 677 remaining pregnancies, the SBR was 182 per 1000 total births which is 10-fold higher than the SBR for uncomplicated pregnancies (Personal communication RC Pattinson). There is a need to improve classification systems that better crosslink maternal and perinatal outcomes.

Therefore, the time of greatest risk of mortality and morbidity for both the mother and baby is at birth. Analysis of the average daily mortality rate for mothers and babies demonstrates a substantial rise in mortality for the mother at the initiation of labor and delivery, peaking at 0.8 per 1000 births at the time of birth, a 10-fold higher risk than for the rest of the postnatal period. The concurrent risk for intrapartum stillbirths is around 10 per 1000 births and for neonatal death on the first day of life it is around 11 per 1000 births. The convergence of increased mortality risk lasts into the first 2 postnatal weeks of life, although for both the neonate and the mother [60], it is most acute at birth and in the first 48 hours of postnatal life [62]. This underscores the urgent need to coordinate childbirth and early postnatal interventions for both the mother and baby [63].
2.5. Why?

2.5.1. Which cause, where, and why?

The successful transition of the newborn baby from life in utero to life at birth is based on a complex balance between the health of the mother, the course of the pregnancy, and the process of delivery and immediate postnatal care. During normal labor, the fetus will experience hypoxia but is able to tolerate this remarkably well. Problems occur if there is severe or sustained lack of oxygen to the fetus, which may occur before, during or after labor. Studies in industrialized settings give varying estimates for the proportion of neonatal encephalopathy in term infants that occurs during the intrapartum period, ranging from very low in some studies (~30%) [64,65] to much higher (~80%) in other more recent studies using magnetic resonance imaging [66]. For example, one large study in the UK found that 197 of 245 term babies with neonatal encephalopathy had evidence on cerebral magnetic resonance imaging that was diagnostic of an acute intrapartum insult [66]. Prenatal conditions may contribute to anywhere from 5-70% of cases of neonatal encephalopathy [64-66], and postnatal injury accounts for an estimated 10% of cases [67,68]. However, even in high-income countries, many questions remain unanswered.

The use of causal web analysis to take into account coexisting prenatal and intrapartum factors has been an important advance in understanding [26,69]. Studies assessing the timing of insult are not available from low-income country settings, but it is likely that intrapartum causes account for a larger proportion, given the higher incidence of serious complications in labor and reduced availability of skilled care during birth [70].

2.5.2. Maternal risk factors and complications

The inextricable connection between the health of the mother and fetus is demonstrated by the strong associations between maternal risk factors and morbidity and perinatal death (Table 3). While certain prepregnancy factors (such as maternal stunting or poor obstetric history) are consistently associated with elevated risk of perinatal mortality (risk range 1–5), prenatal conditions such as anemia or hypertensive disease, appear to be stronger risk factors (risk range 2–14). However, by far the most predictive factors for perinatal mortality are intrapartum complications (risk range 2–85), such as malpresentation or obstructed labor, that may increase the risk for perinatal death by a factor of 85. Identifying and intervening for these maternal conditions may have a significant impact on the health of the fetus and newborn, as well as the mother. The role of prenatal risk factor and complication screening in averting intrapartum-related deaths is discussed further in the fourth paper in this series [13].

Table 3

<table>
<thead>
<tr>
<th>Time period</th>
<th>Risk factor</th>
<th>Adjusted odds ratio*</th>
<th>Approximate range</th>
</tr>
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<tbody>
<tr>
<td>Before pregnancy</td>
<td>Maternal age&lt;br&gt;&lt; 18 years&lt;br&gt;&gt;35 years</td>
<td>1.1–2</td>
<td>Approximate range 1 to 5</td>
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<tr>
<td></td>
<td>Maternal size&lt;br&gt;Height &lt; 150 cm&lt;br&gt;Pre-pregnancy wt &lt; 47 kg</td>
<td>1.3–5</td>
<td>(NS in 2 studies)</td>
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<td></td>
<td>Parity&lt;br&gt;Primigravida&lt;br&gt;Parity &gt; 6&lt;br&gt;Poor obstetric history</td>
<td>1.3–2.2</td>
<td>1.4–1.5</td>
</tr>
<tr>
<td></td>
<td>(Previous perinatal death or instrumental delivery)</td>
<td>1.6–4</td>
<td></td>
</tr>
<tr>
<td>During pregnancy (antenatal)</td>
<td>Multiple pregnancy&lt;br&gt;Maternal anemia&lt;br&gt;(PCV &lt; 0.34&lt;br&gt;(PCV &lt; 0.21)</td>
<td>2.0–7</td>
<td>Approximate range 2 to 14</td>
</tr>
<tr>
<td></td>
<td>Maternal jaundice/cholestasis&lt;br&gt;Hypertensive disorders&lt;br&gt;Pre-eclampsia&lt;br&gt;Eclampsia&lt;br&gt;Diabetes&lt;br&gt;Syphilis (perinatal death)&lt;br&gt;Maternal malaria (blood test positive)&lt;br&gt;HIV&lt;br&gt;HIV and malaria</td>
<td>NS in 4 studies 2–4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Post-term (&gt; 42 weeks gestation)&lt;br&gt;Preterm birth (&lt; 37 weeks gestation)</td>
<td>1.5</td>
<td>2–4</td>
</tr>
<tr>
<td>During labor and childbirth (intrapartum)</td>
<td>Obstructed labor/dystocia&lt;br&gt;Prolonged second stage&lt;br&gt;Meconium staining of liquor&lt;br&gt;Malpresentation&lt;br&gt;Breech&lt;br&gt;Other&lt;br&gt;Bleeding per vagina after 8th month&lt;br&gt;Maternal fever during labor&lt;br&gt;(&gt; 38 °C)&lt;br&gt;Rupture of membranes &gt; 24 h</td>
<td>7–85</td>
<td>Approximate range 2 to 85</td>
</tr>
<tr>
<td></td>
<td>3–5&lt;br&gt;12&lt;br&gt;12&lt;br&gt;6–15&lt;br&gt;8–34&lt;br&gt;3–6&lt;br&gt;10–11&lt;br&gt;1.8–7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: PCV, packed cell volume; NS, not significant.
* Odds ratios included are statistically significant and from population-based studies adjusting for major confounders (parity and socioeconomic status) and significantly associated with intrapartum stillbirth and/or neonatal death or perinatal death. Table adapted from Lawn et al. 2005 [1]. Figures rounded to the nearest whole number unless less than 2. References [97-110].
management of intrapartum-related complications is addressed in the second paper in the series [12].

2.5.3. The cultural curtain cloaking pregnancy and birth

For the 60 million women giving birth at home each year, physical distance is often a barrier. In many cases, there are also cultural norms that keep pregnancy hidden and preclude care seeking outside the home at the time of birth or in the postnatal period [11]. Should complications occur, which may be understood as having a non-biomedical cause, traditional remedies are often used, such as heated copper coins on the baby’s back (Panel 1). While there are many gaps in service supply, understanding and addressing the socio-cultural context as well are critical to accelerating coverage of effective care.

2.6. Why? Health system gaps in coverage of care

2.6.1. The inverse care law

Table 2 demonstrates the inverse relationship between access to skilled care at birth and intrapartum-related neonatal mortality and intrapartum stillbirth rates across different mortality levels. In the lowest NMR categories, which have nearly universal skilled birth attendance, the rate of intrapartum-related NMR is as low at 0.45 per 1000 live births and the intrapartum stillbirth rate is 1.22 per 1000 births. Whereas in the highest NMR categories (Group 5), the median percentage of skilled birth attendance is less than 50%, and the rate of intrapartum-related NMR is 11.8 per 1000 and the intrapartum stillbirth rate is 11.4 per 1000. This is an ecologic association and cannot be taken as causal; however, skilled birth attendance and facility birth may be good markers of health system access and capacity [71]. Recent analysis, also ecologic, suggests that MMR and SBR are inversely related to access to cesarean delivery [59]. The countries with NMR over 30 per 1000 together account for 77% of the intrapartum-related mortality and yet the majority of births and deaths are at home. The data as well as care are lacking, and the health system and health information solutions must be based on this reality [16]. The inverse care law is vividly illustrated in Fig. 3, with global maps depicting the gross inequities in care coverage and intrapartum deaths.

The Worldmapper [53] figures show clearly that the highest density of intrapartum-related neonatal deaths and intrapartum stillbirths are concentrated in Sub-Saharan Africa and South Asia. Yet these are also the areas suffering from the most desperate shortage of physician workforce, with near absence of physicians (Figure 3c) and a dearth of midwives (Figure 3d). There is also inequitable distribution of health professionals within the countries. For instance, the doctor population ratio in urban areas in India is 1.3 per 1000 population, whereas it is just 0.33 in rural areas.

2.6.2. The global gap for care at childbirth: Are we making progress?

Gaps in healthcare coverage during the prenatal, intrapartum, and postnatal periods contribute markedly to the inequities in health outcomes. Although some regions have made progress in increasing the coverage of skilled care at birth, the highest mortality regions have seen little progress in the last decade. The coverage gap of skilled birth attendance is widest in certain regions, namely Sub-Saharan Africa and South Asia, where baseline coverage is lowest globally and progress to reaching universal skilled attendance is slow (Fig. 6). The rates of increase for skilled birth attendance in these regions is less than 0.5% per year and at current rates, by 2015, a skilled birth attendant will only reach 1 out of every 2 women in Sub-Saharan Africa and South Asia. This is a priority gap requiring substantial work to define potentially scalable approaches to reaching universal skilled birth attendance in varying contexts [4]. Postnatal care is also a critical, yet neglected, gap in low- and middle-income countries, and coverage is even lower than skilled birth attendance and much lower than prenatal care [2,44]. In the 68 priority countdown countries, a median of only 21% of mothers received postnatal care within 48 hours of birth [72].

Equity gaps in prenatal care and skilled birth attendance are present among the marginalized populations within countries—between rich and poor, between urban and rural. The inequities in access to prenatal care and skilled birth attendance are most pronounced between rich and poor in South Asia and Sub-Saharan Africa, where coverage rates may differ by up to 4-fold (Fig. 7).
mothers in the lowest wealth quintile in South Asia, skilled birth attendance is less than 10% and prenatal care coverage is 80%. Similarly, rural mothers have lower access to skilled birth attendance and cesarean delivery than mothers in urban areas [12]. In South Asia, only 33% of rural deliveries are attended by a skilled birth attendant compared with 68% in urban settings [12].

As well as coverage gaps and equity gaps, another critical gap in coverage is the quality gap. For women or neonates who do interact with the health system, the effective interventions may not be provided; for example, at prenatal care there may be a gap between those who come and those whose condition (malpresentation, pre-eclampsia, diabetes) is identified and correctly managed. This missed opportunity in health systems is discussed in the final paper of this series.

3. Solutions to reduce intrapartum-related deaths

3.1. Prevention strategies for intrapartum-related deaths

Interventions to reduce the burden of intrapartum-related complications can act by 3 main mechanisms:

- **Primary prevention of the insult**: Improved maternal health including nutritional status, prenatal recognition of at-risk pregnancies, skilled attendance at birth, and particularly early recognition and timely management for obstetric complications.

- **Secondary prevention after the event**: Resuscitation of the “non-breathing” neonate.

- **Tertiary prevention for the baby with acute complications**: Management of the baby with acute complications of “perinatal asphyxia” such as neonatal encephalopathy, which is complex to address even in well-resourced health systems, and late sequelae such as cerebral palsy.

Of the 3 possible approaches, primary prevention of the insult is likely to have the greatest impact on intrapartum-related mortality [3,73]. Prepregnancy risk factors, such as short inter-pregnancy spacing, low maternal nutritional status, and young age only predict some of the population-attributable risk, and intrapartum complications may occur to mothers without these risk factors (Table 3). In low-resource settings, intrapartum stillbirths may comprise the majority of intrapartum-related deaths [70] and these deaths can only be averted with adequate intrapartum care and timely emergency obstetric care, which must be available for all births [74]. For intrapartum-related neonatal deaths, early recognition and management of women with childbirth complications is expected to have higher efficacy than resuscitation or attempts to manage neonatal encephalopathy after neurological injury has occurred [13,73]. The evidence for facility-based intrapartum care is reviewed in the second paper [12] in this series; risk screening and referral are reviewed in the fourth paper; and the options for community-based recognition and care are covered in the fifth [14].

Secondary prevention of intrapartum-related hypoxic injury through neonatal resuscitation is reviewed in the third paper [10].

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Fig. 8. Reducing delays to emergency obstetric and neonatal care. Abbreviations: BEmOC, Basic Emergency Obstetric Care; CEmOC, Comprehensive Emergency Obstetric Care. For contents of the papers please refer to Table 4. Image of home birth reprinted with permission granted by the American College of Nurse-Midwives.
The potential impact of tertiary prevention is likely to be lower than primary and secondary prevention. Interventions may have marginal effects on disability-free survival even in high-income settings; and in low- and middle-income settings, neonatal intensive care is infrequently available [75]. The management of neonatal encephalopathy in district and referral hospitals is discussed in the third paper.

3.2. Addressing deadly delays: The need for linkages

Delays in receiving appropriate care can be important for many conditions, but delays of even a few hours in addressing an obstetric emergency around the time of birth can be significant. Delays of minutes in resuscitating a non-breathing baby can result in death or major impairment. The “classic” 3 delays were first described in relation to delay for women with obstetric emergencies. The delays include[76,77]: (1) delay in recognition of the problem and the decision to seek care; (2) delay to reach a health facility; and (3) delay in receiving quality care at the facility.

Strategies to reducing these 3 delays are crucial to effectively link mothers and babies to skilled obstetric and newborn care, and are depicted in Fig. 8 and discussed in the fourth paper in the context of improving maternal outcomes and pregnancy outcomes [13]. The continuum from the home, to first-level health clinic, to referral hospital ensures effective linkages from all potential places of care giving. Functional linkages to EmOC are especially crucial for the 60 million women who deliver at home each year [13].

The continuum of care approach is a conceptual framework for integrated maternal, neonatal, and child health that has been defined by the dimensions of time through the lifecycle and levels of care within the health system [2,78,79]. Programs to reduce intrapartum-related injury must address risk factors across the entire continuum of the life cycle from adolescence through pregnancy and childbirth. For example, ensuring adequate child nutrition may reduce rates of maternal stunting, and delayed age of first birth may decrease the risk of obstructed labor [80]. Interventions for the primary prevention of intrapartum-related injury are required during the time of pregnancy and childbirth, while secondary and tertiary prevention measures are needed in the immediate postnatal and neonatal periods.

3.3. Contextualizing local culture and traditions when designing solutions

Communities may have diverse beliefs and customs for the baby who does not breathe at birth [81]. Elucidating local explanatory models for abnormal childbirth and the non-breathing baby are essential to understand behavioral responses and to develop interventions to effectively influence behavior change during pregnancy and childbirth. Panel 1 highlights qualitative data on knowledge, attitudes, and practices from two different South Asian settings with a predominance of home births. In Bangladesh, the mother catching a cold and evil spirits were commonly believed to cause a baby not to breathe, and common responses included stimulating the baby, mouth-to-mouth breaths, or stirring and/or warming the placenta in a bowl of water. In Shivgarh, India, a spiritual healing process was invoked for the non-breathing baby that involved chanting mantras and placing a bowl of water. In Shivgarh, India, a spiritual healing process was invoked for the non-breathing baby that involved chanting mantras and placing a bowl of water. In Shivgarh, India, a spiritual healing process was invoked for the non-breathing baby that involved chanting mantras and placing a bowl of water.

While some traditional practices may stimulate the infant and trigger breathing, others may increase delays to receiving effective care.

4. Methods and overview for this series on intrapartum-related deaths

4.1. Searches and methods

For this series we systematically reviewed the evidence for impact of the interventions and strategies detailed in Table 4. The searches were first conducted in 2002, for a background report for an Expert Meeting in Cape Town [83], and have now been updated to 2009. Searches of medical literature databases were conducted, including PubMed, Popline, EMBASE, LILACS, IMEM, African Index Medicus, the Cochrane library, and WHO documents. Additionally, “snowball searching” was performed, whereby literature referenced in bibliographies of key papers was identified. Attempts were made to identify other relevant literature and non-published data through a survey of experts and program managers [6], directly contacting experts and agencies working in newborn care, and reviewing abstracts published in recent maternal and child health conferences.

Search strategies included various combinations of keywords and MeSH headings relevant for specific interventions. The search terms used are shown in web appendix 1 (available in the online version). Articles were limited to those published after 1960 and involving human subjects. All languages were included and if an article was deemed relevant by title and abstract screening, the full article was translated. All titles were screened for initial inclusion; for those of potential relevance
the abstract was reviewed to determine whether to review the full article. There were a total of 29,358 hits, with around 5,000 abstracts reviewed, and more than 530 articles reviewed. The majority (over 95%) were peer-reviewed papers. The balance was composed of relevant reports and monographs, mainly program reports (Fig. 9).

Identified reports and studies were included in the following categories:

1. Trials, studies with inclusion criteria as follows: a study design using a controlled trial methodology (randomized controlled trial (RCT) design, quasi-experimental design with non-random control, or before-and-after comparison); definition of the intervention; population-based study (either in the community, or in an institution where the majority of the population give birth); and reported perinatal, neonatal, stillbirth, early neonatal, and ideally intrapartum-related mortality rates with a consistent case definition.
2. Systematic reviews of mortality or relevant intermediary outcomes.
3. Reports of effect on important intermediate or process indicators, such as care seeking, facility delivery, and utilization of EmOC, morbidity.
4. Publications detailing relevant program experiences, particularly at scale that may be of relevance for case studies.

Data abstracted included study setting, baseline mortality and skilled birth attendance coverage, postnatal care coverage, study design, intervention description, intermediate outcomes (including changes in knowledge, attitudes, behaviors, and care seeking), and impact outcomes (SBR, ENMR, PMR, NMR, and MMR, as well as intrapartum stillbirth rate and intrapartum-related neonatal mortality rate).

4.2. Grading of evidence and meta-analysis

The level of evidence was assessed using the GRADE system criteria [84], to evaluate the quality of the evidence (strong, moderate, low or very low) based on standard criteria (Table 5). We used an adaptation of GRADE developed by the Child Health Epidemiology Reference Group (CHERG) specifically for low- and middle-income settings [85] and focused on the evidence for effect on cause-specific mortality. As our specific interest is for intrapartum-related ("birth asphyxia") outcomes, this is a particular constraint as cause-specific data are limited [3,4]. Once the level of evidence was assigned, based on group consensus a recommendation for programmatic application was allocated, which may be for or against, and may be strong, weak, or conditional. For many of the interventions that are considered standard practice in obstetric care, there is no high-quality evidence and indeed, often only limited moderate- or low-quality evidence. In some cases, this is because the intervention became standard practice before the RCT was invented; for example, it would now be considered unethical to undertake a RCT of cesarean delivery versus placebo. The advantage of the GRADE system is that for conditions that pass the so-called "parachute test" (it is obvious that a parachute saves lives and an RCT is impossible) [86], it can be stated that evidence grade is low, but the recommendation is strong.

Higher quality studies were included and considered for pooling risk estimates if the study design was an RCT or quasi-experimental study. In the absence of high-quality studies, observational studies of lower quality were considered for meta-analysis if the intervention, study design, and the outcomes of interest were comparable. However, historical or ecologic data were excluded. All analyses were conducted using STATA 10 statistical software (StataCorp, College Station, TX, USA).

4.3. Organization of strategies reviewed in Supplement

Interventions were specifically selected for their potential effectiveness, relevance, and applications in low- and middle-income countries, and are listed in Table 4. The series of papers in this Supplement are structured according to different strategies to avert intrapartum-related injury along the continuum of care (Fig. 8). In the second paper we review improving intrapartum obstetric interventions in health facilities, focusing on the content and impact of individual intrapartum interventions and innovative solutions to provide care in settings with extreme resource constraints [12]. In the third paper we review the evidence and program implications of neonatal resuscitation and post-resuscitation management, in both facility and community settings [10]. In the fourth paper we focus on creative strategies to link families to...
and quality improvement. The improve health delivery systems and quality of care via perinatal audit skilled birth attendants[14]. In the sixth paper we highlight strategies to bring care closer to the community, including use of trained traditional care through community mobilization or use of improving birth preparedness, increasing demand for skilled obstetric facility-based skilled obstetric care and to reduce the 3 delays, by

Table 5
The GRADE criteria for review of the quality of evidence.

<table>
<thead>
<tr>
<th>Quality of evidence</th>
<th>Study design</th>
<th>Lower the quality when*</th>
<th>Higher the quality when*</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Randomized trial</td>
<td>Study limitations:</td>
<td>Strong association:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– 1 Serious limitations</td>
<td>+ 1 Strong, no plausible confounders, consistent and direct evidence***</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td>– 2 Very serious limitations</td>
<td>+ 2 Very strong, no major threats to validity and direct evidence**</td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td>– 1 Important inconsistency</td>
<td>+ 1 Evidence of a Dose response gradient</td>
</tr>
<tr>
<td>Very low</td>
<td></td>
<td>Directness:</td>
<td>+ 1 All plausible confounders would have reduced the effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– 1 Some uncertainty</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>– 2 Major uncertainty</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>– 1 Imprecise data</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>– 1 High probability of Reporting bias</td>
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5. Conclusion

This first paper of the Supplement on “Intrapartum-related deaths: Evidence for action” has brought together data on the size of the global burden related to this silent killer that is responsible for more deaths than childhood malaria, and yet is absent from the global health policy and program agenda. Each year an estimated 904 000 babies die soon after birth due to intrapartum-related injury, particularly childbirth complications, primarily in low- and middle-income countries[1]. These deaths are closely linked to at least 1.02 million stillbirths occurring during labor—a total of nearly 2 million deaths [3]. In addition, an unknown number of babies survive the insult, only to suffer long-term impairment, and are thus unable to reach their full potential [48]. Consensus on definitions surrounding “birth asphyxia” and their wide dissemination across stakeholders is urgently required to build an effective movement to address this huge, yet neglected, problem.

During this same time period, approximately half of the world’s half a million maternal deaths occur, as well as many more near-miss maternal deaths and significant maternal morbidity [87]. The time of birth and the immediate postnatal period are crucial as the times of greatest risk for pregnant women and babies (Fig. 5). However, more than 60 million women give birth annually without skilled care at birth, mostly at home, and the majority does not receive early postnatal care. In rich countries, women enter pregnancy in a better nourished condition, and other prepregnancy factors are less common; however, in the last century the advent of modern obstetrics and neonatal intensive care has resulted in dramatic reductions in perinatal and intrapartum-related mortality through primary prevention of the insult and early management with neonatal resuscitation. A recent multicountry analysis suggests that prenatal care is poorly correlated with MMR and SBR, but a rise in coverage of cesarean delivery from 0% to 10% was significantly associated with reductions in MMR and SBR [59]. Furthermore, high-technology innovations have been developed to manage and improve the outcomes for the minority of neonatal encephalopathy cases born in high-income settings. However, these strategies do not reach low- and middle-income countries, especially the poor, who primarily bear the burden of morbidity and mortality from intrapartum-related childbirth complications.

Maternal mortality ratio (MMR) is proposed as a marker of the accessibility and quality of the health system that is required to address maternal deaths due to obstetric causes, including a functioning continuum of care. Given that the MMR globally is 4 per 1000 and the neonatal mortality rate (NMR) is 28 per 1000, NMR may be more readily measurable yet still closely correlated with MMR and also intimately linked to health system performance. Indeed, the United Nations Population Fund (UNFPA) has recently proposed an indicator to track the quality of obstetric care combining intrapartum stillbirth rate with neonatal deaths on the first day [88]. This is currently being tested in a more refined version of the indicator by combining intrapartum stillbirths and predischarge neonatal deaths weighing over 2000 g as a surrogate of intrapartum-related neonatal deaths (Personal communication, R Pattinson). The opportunities for prevention and management of intrapartum-related neonatal deaths or “birth asphyxia” sit primarily in maternal health programs, yet these programs have not received priority among international agencies or in low-resource country programs; within maternal health programs there has been limited attention to these important outcomes, which could increase the imperative for action.

The goal of this series is to call the Maternal Newborn and Child Health communities to collective action, laying out the evidence and actions required to strengthen healthcare delivery systems, and increase community mobilization to reduce the largely preventable and inexcusable 2 million deaths each year that are related to lack of care at birth.

6. Conflict of interest

The authors have no conflicts of interest to declare.

7. Funding

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Appendix A. Supplementary data


References


Panel 1. Traditional community knowledge, attitudes, and practices in South Asia for the baby who does not breathe at birth

Qualitative research from India and Bangladesh illustrates some traditional beliefs and practices regarding the baby who does not breathe at birth. In Shivgarh, rural India, household interviews were conducted with pregnant women, fathers, mothers-in-law, female relatives and neighbors, community leaders (e.g. teachers, pundits), and other newborn care stakeholders (e.g. traditional newborn care providers, TBAs, health system workers) regarding common household perceptions and practices [82]. In Bangladesh, a multisite study is ongoing in rural Matlab, urban slums of Dhaka, and rural Dinajpur (Sibley et al. personal communication, June 15, 2009). Cultural domain analysis with case illness narrative and time-event analysis were conducted of laywomen, TBAs, and professional health workers [112].

Cultural explanatory models of a baby who does not breathe at birth

In Shivgarh, India, this condition was not considered a disease, and has no specific name or cause. Approximately 15% of newborns encountered breathing problems at birth, and symptoms commonly recognized by community members included “not crying” immediately after birth and “bluish discoloration of the newborn face.” Community members also frequently mentioned observing slow breathing, unconsciousness of the baby, and not sucking on the mother’s breast as important signs. Women named various reasons as to what led to a baby not breathing, e.g. bursting of the waters prior to delivery causing the newborn aspirates dirty water, breech delivery, tying of umbilical cord around the neck of the newborn resulting in breathlessness, side effects of medicines consumed by the mother during pregnancy, or a forced delivery using hand, instrument.

In the Bangladesh study, there was an overall high level of agreement and ability to discriminate between a normal baby and one who has difficulty breathing at birth. Signs mentioned by at least 80% of respondents were absent or weak cry, absent or gasping breathing, and skin pallor or cyanosis. Causes of a non-breathing baby mentioned by at least 80% of respondents included prolonged labor, injury to the baby during birth, and a malnourished mother. There were subgroup differences, however. For example, laywomen, TBAs, and village doctors believe that a mother getting cold during pregnancy is a cause of this problem while TBAs and laywomen agree that evil spirits or alga batas is a cause.

Traditional practices for the non-breathing baby

In Shivgarh, the majority of community members attempted to address breathing problems with home-remedies before seeking professional care. The most common practices were sprinkling cold water on the baby’s face (37%) and patting the baby on the back and soles in the upside down position (34%). Other remedies included wiping the baby’s face with a cloth; rubbing the umbilical cord; removing the umbilical cord from around the neck; and massaging of the fontanel, soles, and hands with a mixture of warm water with mustard oil and carom seed. If the newborn still could not recover, then the baby underwent a spiritual healing process, which consisted of heating copper coins and placing them on the baby’s back after chanting a mantra, or placing dried egg-yolk in a folded cloth on the baby’s epigastrium. If the newborn still did not recover then the community sought unqualified medical practitioners to give the baby oxygen before seeking formal health care.

In Bangladesh, the majority (60%–80%) of respondents agreed that wiping or cleaning the nose and mouth, covering, warming, giving mouth-to-mouth breaths, and stimulating the baby were treatments for a non-breathing baby. Also mentioned were massaging the baby and soaking and stirring the placenta in a bowl of water (the placenta being thought to contain the baby’s life force). Respondents generally agreed that care should be sought from an allopathic doctor, followed by a village doctor, TBA, and spiritual healer in that order. Similar findings have been observed by others [113–118]. The beliefs varied by type of respondent, showing the importance in targeting different messages to these different audiences who influence the decision to seek care.

Photograph: A typical shed specially made for delivery in Bangladesh. The mother is 15 years old, it is her first child. Photo reprinted with permission granted by Save the Children.