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Newborn survival in Bangladesh: a decade of change and future implications

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Remarkable progress over the last decade has put Bangladesh on track for Millennium Development Goal (MDG) 4 for child survival and achieved a 40% decline in maternal mortality. However, since neonatal deaths make up 57% of under-five mortality in the country, increased scale up and equity in programmes for neonatal survival are critical to sustain progress. We examined change for newborn survival from 2000 to 2010 considering mortality, coverage and funding indicators, as well as contextual factors. The national neonatal mortality rate has undergone an annual decline of 4.0% since 2000, reflecting greater progress than both the regional and global averages, but the mortality reduction for children 1–59 months was double this rate, at 8.6%. Examining policy and programme change, and national and donor funding for health, we identified various factors which contributed to an environment favourable to newborn survival. Locally-generated evidence combined with re-packaged global evidence, notably *The Lancet* Neonatal Series, has played a role, although pathways between research and policies and programme change are often complex. Several high-profile champions have had major influence. Attention for community initiatives and considerable donor funding also appear to have contributed. There have been some increases in coverage of key interventions, such as skilled attendance at birth and postnatal care, however these are low and reach less than one-third of families. Major reductions in total fertility, some change in gross national income and other contextual factors are likely to also have had an influence in mortality reduction. However, other factors such as socio-economic and geographic inequalities, frequent changes in government and pluralistic implementation structures have provided challenges. As coverage of health services increases, a notable gap remains in quality of facility-based care. Future gains for newborn survival in Bangladesh rest upon increased implementation at scale and greater consistency in content and quality of programmes and services.

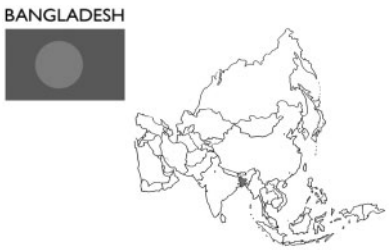
Keywords Bangladesh, newborn, neonatal mortality, maternal, neonatal and child health, newborn survival, Millennium Development Goals, epidemiology, health systems research, implementation

KEY MESSAGES

- Bangladesh is on track for Millennium Development Goal 4, and has made more progress in reducing neonatal deaths than most low-income countries. The neonatal mortality decline in the last decade (4.0% per year) is higher than the regional and global averages (2.0% and 2.1% per year, respectively); however, the decline for children 1–59 months was double this rate (8.6% per year).
- Over the last decade extensive changes have occurred in health policy related to newborn care, including a National Newborn Health Strategy. Civil society and academics have played key roles, alongside the government. Local and global data and evidence have been influential, but pathways between research and action are complex due to a pluralistic health system and a diversity of policies and programmes.
- The initial focus for newborn care was primarily through community-based initiatives. Eighty per cent of pregnant women live in rural areas, but models to service the growing urban poor population are urgently needed as well.
- Priorities to further accelerate progress for newborn survival include greater consistency between the many implementing partners at community level, and more systematic focus on quality of care in facilities, especially for the vulnerable. Full coverage of care would save an estimated 70 000 newborns and 48 000 stillbirths in 2015.

Box 1 Bangladesh at a glance

Total population (2011)	150 500 000
Mothers, babies and children	
Annual births (2010)	3 038 000
Maternal mortality ratio per 100 000 live births (2010)	240
Annual number of maternal deaths	7 200
Stillbirth rate per 1000 total births (2009)	36
Annual number of stillbirths	129 000
Neonatal mortality rate per 1000 live births (2010)	27
Annual number of newborn deaths	83 000
Mortality rate per 1000 live births for children 1–59 months (2010)	19
Annual number of child deaths 1–59 months	57 000
Under-five mortality rate per 1000 live births (2010)	48
Annual number of under-five deaths	140 000
Health system	
Health worker density per 10 000 population (2005)	5.8
Percentage of births that take place in a facility (2011)	29%
Context	
High percentage of rural population, low literacy rate and high poverty	
Lack of skilled health workers	
Frequent changes in government leadership	



Data sources: Population estimates (UNFPA 2011); maternal mortality estimates (WHO *et al.* 2012; NIPORT and MEASURE Evaluation 2011); annual live births, neonatal and under-five mortality (UNICEF *et al*. 2011) with new analysis of mortality trends by age of death; stillbirth estimates (Cousens *et al*. 2011); health worker density (WHO 2011a); facility births (NIPORT *et al*. 2012). Note that mortality rates and numbers are for most recent year.

Introduction

Bangladesh has made remarkable progress towards child health in the past decade and is currently on target to meet Millennium Development Goal (MDG) 4 for child survival (Chowdhury *et al*. 2011). This is particularly impressive given only 19 of the 75 Countdown to 2015 priority countries are on track for MDG 4. From 2000 to 2010, under-five mortality declined by 5.8% annually, which reflects greater progress than both the global and regional annual averages of 2.5% and 2.9%, respectively (Hill *et al*. 2012). Maternal mortality in the country decreased by 40% from 2000 to 2010 (Chowdhury *et al*. 2011; NIPORT and MEASURE Evaluation 2011). Maintaining this impressive progress will depend on the continued reduction of newborn mortality (deaths in the first 4 weeks of life), as these deaths now account for 57% of under-five mortality (Oestergaard *et al*. 2011; UNICEF *et al*. 2011).

Of the 50 countries with the highest rates of reduction for neonatal mortality, Bangladesh is one of only two low-income countries on this list (Oestergaard *et al*. 2011). The rapid decline in neonatal mortality has occurred despite widespread poverty, low levels of female literacy, a multi-pronged health care system and more than two-thirds of births taking place at home without skilled assistance (Box 1). Thus, it is important to understand the factors contributing to change in newborn survival in order to successfully scale up effective interventions through existing programme platforms. In the complex Bangladesh health system, where a wide range of implementers work, what are the major facilitators and barriers on the pathway from evidence

to policy change to programme scale up? Bangladesh has been the site of newborn health research which has influenced global technical guidelines and recommendations (Sines *et al*. 2006; Sines *et al*. 2007; WHO *et al*. 2009). What has been the local influence of this research and are there other factors that may moderate the influence of research on policy either for uptake or indeed non-uptake of findings?

This paper is the third in a seven-paper supplement to evaluate change for newborn survival, focusing on the years 2000–10. In this paper, we examine newborn survival in Bangladesh, applying a common results framework and standardized analyses and tools in order to better understand what has or has not progressed and why, in terms of mortality rates and coverage of care, funding, and policies and programmes. By examining these data and the linked narrative, we seek to identify accelerators and constraints for progress, in order to inform a future agenda for further neonatal mortality reduction in Bangladesh.

Methods

Evaluation framework and overview

This evaluation is structured according to a standard results and evaluation framework beginning with the goal level (reduction in neonatal mortality), moving to strategic objective level (increase in healthy behaviours and coverage of high impact interventions), while also considering changes in context and other important social determinants of health. The intermediate results level involved an examination of policy and programme change at scale in health systems; the methodology and framework of which can be found in the first two papers of this supplement (Lawn *et al*. 2012; Moran *et al*. 2012).

Data collection methods

We conducted a thorough review of relevant policy documentation, national reports and guidelines, and peer-reviewed literature. Standard methods and tools (Lawn *et al*. 2012) were developed, employed and quality-checked for this multi-country analysis. More information on the methods used to search and identify data sources are detailed in the first and second paper in this supplement (Lawn *et al*. 2012; Moran *et al*. 2012).

The Bangladesh Newborn Change and Future Analysis Group, a national team of 40 experts representing government, professional organizations, non-governmental organizations and academics convened by the Ministry of Health and Family Welfare (MoHFW) and Save the Children, undertook these analyses and reviewed the findings (group members are listed in the 'Acknowledgements' section). The team met in January 2011 and then subsequently in smaller meetings to further refine information, clarify pivotal events and issues, and interpret changes for newborn survival in their country. The deliberate inclusion in analysis discussions of group members from diverse backgrounds with different roles in newborn survival was intended to prevent information bias.

Data analysis methods

To analyse changes in national neonatal mortality rate (NMR), causes of neonatal death and coverage of newborn-related behaviours and services between 2000 and 2010, we created a comprehensive database using data extracted from national surveys, United Nations (UN) estimates, Institute for Health Metrics and Evaluation (IHME) estimates and Child Health Epidemiology Reference Group (CHERG) neonatal causes of death estimates (NIPORT and ORC Macro 2001; NIPORT and ORC Macro 2003; NIPORT and ORC Macro 2005; Rahman *et al*. 2005; NIPORT and Macro International 2009; NIPORT *et al*. 2012; Lozano *et al*. 2011; NIPORT and MEASURE Evaluation 2011; UNICEF *et al*. 2011; Liu *et al*. 2012). To assess change over time, the average annual rate of reduction for NMR is compared with regional and global rates as well as with under-five mortality rate, the mortality rate for children aged 1–59 months, and maternal mortality ratio (WHO *et al.* 2012; UNICEF *et al*. 2011; Hill *et al*. 2012). Survey details and other issues relating to data quality and estimates are given in Supplementary Data Web Annex A.

To evaluate factors contributing to mortality, we examined the associations between inter-sectoral indicators, such as total fertility rates, female literacy and gross national income (GNI) per capita, and changes in NMR (Oestergaard *et al*. 2011; World Bank 2011; Lawn *et al*. 2012). The Lives Saved Tool (LiST) was then used to evaluate associations of coverage changes with neonatal mortality change in Bangladesh (Johns Hopkins Bloomberg School of Public Health 2010). Details of these analyses are available in Supplementary Data Web Annexes B and C, respectively.

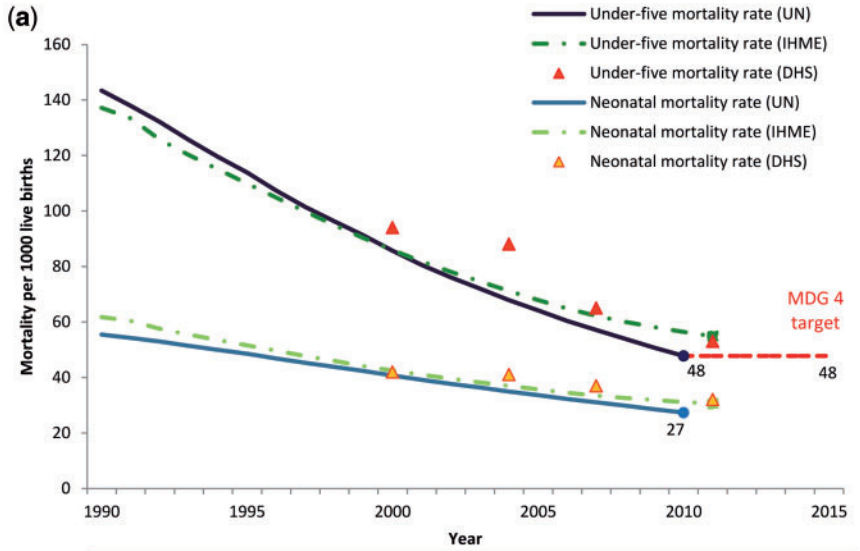
We applied two standard tools to assess changes in national newborn policy and programmes (Lawn *et al*. 2012; Moran *et al*. 2012). First, a Policy and Programme Timeline identified critical events and actions that could have had an impact on newborn health programmes (Supplementary Data Web Annex D) (Lawn *et al*. 2012). Second, 27 selected Scale-up Readiness Benchmarks determined whether each benchmark was in place (achieved), not in place (not achieved), or partially achieved or in progress (partially achieved) for three time points (2000, 2005, 2010) (Supplementary Data Web Annex E) (Moran *et al*. 2012). Both tools were completed by the national expert team and supporting documents were collected and verified independently by out-of-country reviewers.

Availability and access to newborn health services, quality of these services and demand for newborn care were assessed using a review of the relevant published peer reviewed literature. Standard measurements such as the World Health Organization (WHO) recommendation for health worker human resource density and geographic tracking of implementation were employed across country case studies (WHO 2011a; Lawn *et al*. 2012). National financing and official development assistance (ODA) for health overall, as well as specifically for maternal, newborn and child health (MNCH), were analysed to assess changes in financial resources (Pitt *et al*. 2010; WHO 2011b). All government and donor funding values are in constant 2008 United States Dollars.

Results and discussion

Neonatal mortality reduction (goal level)

Neonatal mortality has consistently fallen since 1990 according to available data sources for Bangladesh (Figure 1a and Figure 1b). Between 1990 and 2010, UN estimates show decreasing NMR of 55 to 27 per 1000 live births, an average



Average annual rate of reduction	1990-2010	2000-2010
Under-five mortality rate	5.50%	5.80%
Children 1-59 months mortality rate	7.60%	8.60%
Neonatal mortality rate	3.50%	4.00%

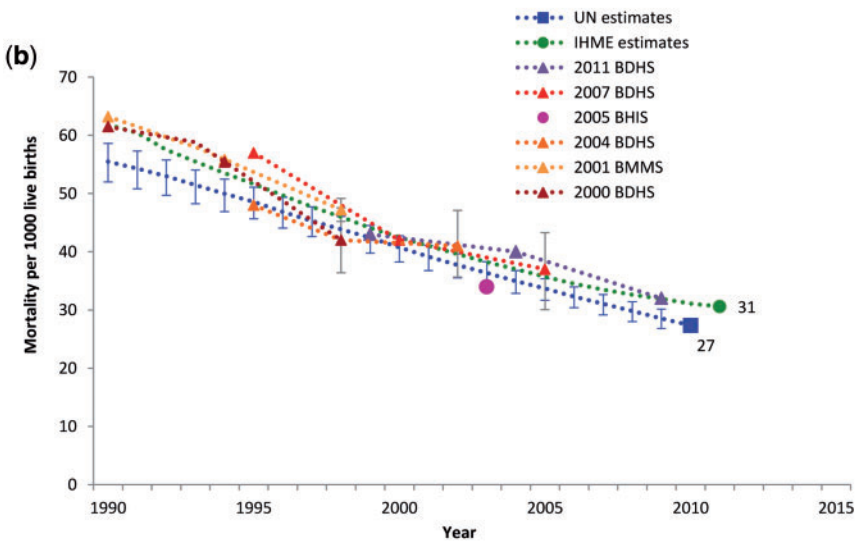


Figure 1 **(a)** National progress towards Millennium Development Goal 4 for newborn and child survival from 1990 *Data sources:* Bangladesh Demographic and Health Surveys (BDHS) (NIPORT and ORC Macro 2001; NIPORT and ORC Macro 2005; NIPORT and Macro International 2009; NIPORT *et al*. 2012). UN estimates of neonatal and under-five mortality (UNICEF *et al*. 2011) with new analysis of mortality trends by age of death. IHME estimates (Lozano *et al*. 2011). Note: Survey point estimates from household surveys are centred two years prior to survey date. MDG 4 target from Countdown to 2015 decade report reflecting a 2/3 reduction from 1990 U5MR. **(b)** Neonatal mortality trends from 1990 *Data sources:* Bangladesh Demographic and Health Surveys (BDHS)(NIPORT and ORC Macro 2001; NIPORT and ORC Macro 2005; NIPORT and Macro International 2009; NIPORT *et al*. 2012). Bangladesh Health and Injury Survey (BHIS) (Rahman *et al*. 2005). Bangladesh Maternal Mortality Survey (BMMS) (NIPORT and ORC Macro 2003). UN estimates (UNICEF *et al*. 2011). IHME estimates (Lozano *et al*. 2011). *Notes*: Survey point estimates from household surveys are centred two years prior to survey date. Uncertainty bounds are provided for UN estimates and 95% confidence intervals for data from national household surveys, where available.

annual decline of 3.5% (UNICEF *et al*. 2011). This downward trend is reflected in national surveys (NIPORT and ORC Macro 2001; NIPORT and ORC Macro 2005; NIPORT and Macro International 2009; NIPORT *et al*. 2012). Since 2000, the annual rate of neonatal mortality decline increased to 4.0%, but this is slower than annual reductions seen in under-five mortality (5.8%) and maternal mortality (5.0%), and especially mortality reduction for children aged 1–59 months (8.6%) (UNICEF *et al*. 2011; WHO *et al*. 2012). The national annual decline of NMR for this time period is greater than both the global and Southern Asia regional averages (2.1% and 2.0%, respectively) (Hill *et al*. 2012).

Over 88% of neonatal deaths are from three highly preventable causes: severe infection, intrapartum-related (asphyxia) and

complications of preterm birth (Figure 2) (Liu *et al*. 2012). From 2000 to 2010, there has been moderate change to the proportionate contribution of these causes with deaths from preterm birth complications appearing to have increased and infections decreased (Liu *et al*. 2012). Bangladesh acheived maternal and neonatal tetanus elimination in May 2008 (WHO 2008). Birth registration climbed from 10% to 54% from 2006 to 2009 and may reflect increasing linkages with the formal health sector and decreasing attitudes of fatalism towards newborn deaths (UNICEF and Statistics 2007; UNICEF and Statistics 2010).

Healthy behaviours and equitable use of effective health services (strategic objective level)

From 2000 to 2010, national household surveys (NIPORT and ORC Macro 2001; NIPORT and ORC Macro 2003; NIPORT and Macro International 2009; NIPORT and MEASURE Evaluation 2011; NIPORT *et al*. 2012) indicated increases in coverage of certain interventions relevant to newborn survival (Figure 3), with the most noticeable improvements in births in facility (8% to 29%), skilled birth attendance (12% to 28%), one antenatal care visit (33% to 52%) and deliveries by caesarean section (2% to 17%). Coverage of breastfeeding within 1 hour of birth increased from 17% to 43% and coverage of exclusive breastfeeding for children less than 1 month increased from 64% to 85%.

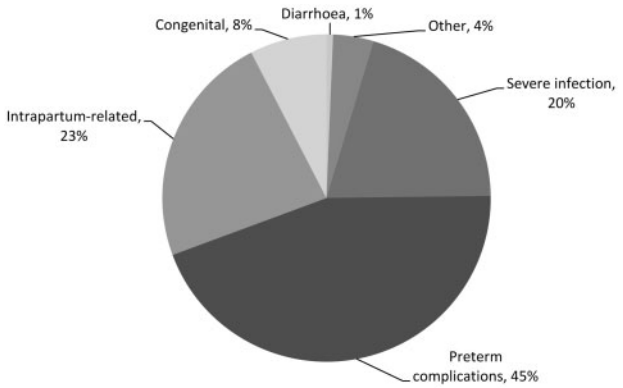


Figure 2 Estimated causes of mortality around the year 2010 for 102,000 neonatal deaths *Data source:* Bangladesh-specific mortality estimates (Liu *et al*. 2012). *Notes*: Severe infection includes sepsis, meningitis, pneumonia and tetanus. Percentages have been rounded.

Service use was generally higher for outreach care, such as contraceptive prevalence (48%) and at least two doses of tetanus toxoid immunization (60%). Over half of pregnant women reported attending at least one antenatal care visit (52%), whereas just under a quarter attended at least four (24%). Just over one-quarter (27%) of women received postnatal care from a skilled provider within 2 days of their delivery (NIPORT *et al*. 2012). Although postnatal care coverage has improved slightly over the decade, there is still a lack of early postnatal home visits in programmes. A descriptive analysis from the Projahnmo study in rural Bangladesh found 67% lower neonatal mortality amongst newborns who received a postnatal care visit within 48 hours of birth compared with those who received no visit (Baqui *et al*. 2009).

A study on inequities in maternal care revealed improvements for antenatal care but little progress for care at the time of birth, with large gaps in access to caesarean sections in particular (Collin *et al*. 2007). According to the 2010 Bangladesh Maternal Mortality Survey (BMMS) (NIPORT and MEASURE Evaluation 2011), wide disparities continue to exist for care at the time of birth, with 8% of women in the poorest wealth quintile having given birth in a facility, compared with 53% of women in the richest quintile. Coverage of postnatal care within 2 days of birth is 51% for the richest families compared with only 7% for the poorest families (NIPORT and

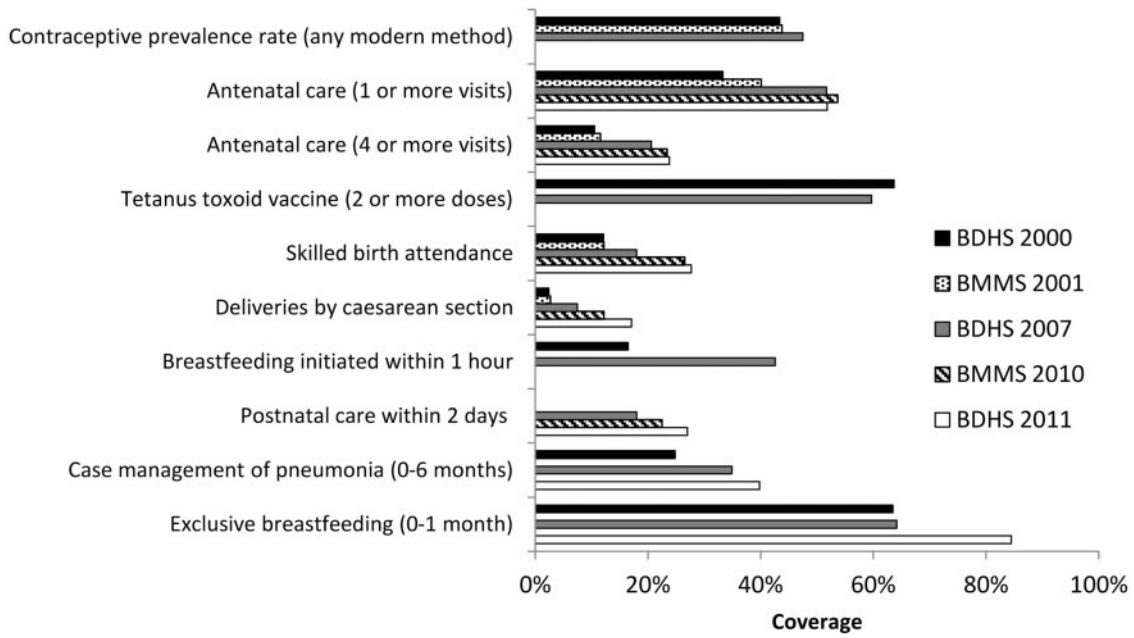


Figure 3 Trends in coverage data for newborn-related interventions and packages (2000–2010) *Data sources:* Bangladesh Demographic and Health Surveys (BDHS) (NIPORT and ORC Macro 2001; NIPORT and Macro International 2009; NIPORT *et al*. 2012), and Bangladesh Maternal Mortality Survey (BMMS) (NIPORT and ORC Macro 2003; NIPORT and MEASURE Evaluation 2011).

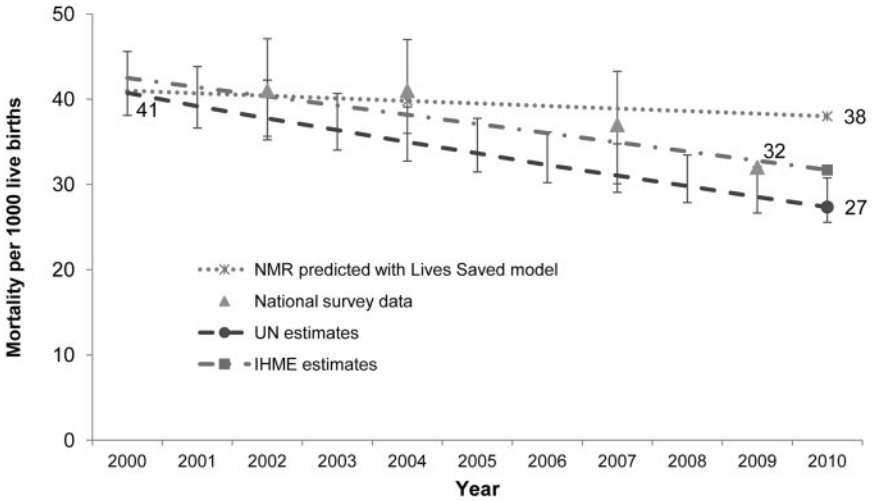


Figure 4 Results of predicted neonatal mortality reduction through changes in coverage (2000–2010) *Data sources:* Bangladesh Demographic and Health Surveys (BDHS) (NIPORT and ORC Macro 2001; NIPORT and Macro International 2009; NIPORT *et al*. 2012), and Bangladesh Maternal Mortality Survey (BMMS) (NIPORT and ORC Macro 2003; NIPORT and MEASURE Evaluation 2011). UN estimates (UNICEF *et al*. 2011). IHME estimates (Lozano *et al*. 2011) and LiST analysis. *Notes*: Survey point estimates from national household surveys are centred two years prior to survey date. Uncertainty bounds are provided for UN estimates and 95% confidence intervals for national household surveys, where available. See Web Annex C for details on the LiST analysis and inputs.

MEASURE Evaluation 2011). These inequities are likely associated with the divide between urban and rural families, with availability of care favouring the non-poor populations (Ahmed *et al*. 2009; Khan *et al*. 2011).

The growing segment of urban poor is often overlooked and may have poorer health outcomes than their rural counterparts (Moran *et al*. 2009). The Demand Side Financing programme, aimed primarily at poor women, encourages use of maternal health services using vouchers. Two recent evaluations of the voucher scheme have shown improvements in coverage for ANC, delivery and PNC in 53 districts where vouchers were available, results that were observed across the socio-economic spectrum but most marked in the increase of demand for services amongst the poor (Ahmed and Khan 2011; Nguyen *et al*. 2012). A study of mortality reductions in poor urban settings found that high coverage of newborn-related interventions reduces neonatal deaths and can be accomplished using community volunteers and low-level health workers (Afsana and Rohde 2010).

Evaluation of associations with neonatal mortality change

A retrospective LiST analysis was undertaken to consider if changes in intervention coverage could account for neonatal mortality reduction. LiST predicted much less of an NMR reduction in 2010 (to 38 per 1000 live births) than what is reported by UN or IHME estimates (27 per 1000 live births) suggesting that little of the change in NMR over the decade was predicted by coverage changes in LiST (Figure 4 and Supplementary Data Web Annex C). There are several possible explanations. First, a number of neonatal-specific interventions lack coverage data and cannot be accurately estimated (Lawn *et al*. 2012), such as neonatal resuscitation and infection management. Second, it is plausible that the major decrease in fertility rates accounts for some of the NMR reduction, as identified in an analysis for 144 countries in the first paper of this series which showed fertility change as a predictor explaining change in neonatal mortality (Lawn *et al*. 2012). The LiST model does take into account fewer deaths due to fewer births but does not include differing risk for lower fertility. Third, it is likely that other contextual changes, female literacy changes and increasing GNI, had an impact on mortality rates. National changes in some socio-economic factors between 2000 and 2010 were significant. From 2000 to 2010, GNI per capita increased from US$380 to US$700, and the adult female literacy rate increased from 40% to 50% (World Bank 2011). Lowered fertility rates and increased facility use influenced gains in maternal survival in Bangladesh (Chowdhury *et al*. 2009; NIPORT and MEASURE Evaluation 2011). Unfortunately, the limited number of data points and the lack of coverage data for many neonatal-specific interventions meant that a country-specific multivariate analysis would not be able to quantify further the possible contribution of contextual and coverage factors to the observed change in NMR (Supplementary Data Web Annex B).

Programme change at scale in health systems (intermediate results level)

Policy and programme change at scale in health systems

Significant progress for newborn policies and programmes was achieved between 2000 and 2010, based on the Policy and Programme Timeline as well as the Scale-up Readiness Benchmarks (Supplementary Data Web Annexes D and E). As reducing neonatal mortality became an important issue on the national agenda, stakeholders reached consensus around evidence-based interventions and integrated these interventions into the national health sector plan, resulting in implementation, particularly in the north (Figure 5). The Scale-up Readiness Benchmarks confirm this trajectory over time. From 2000 to 2005, 14 benchmarks were implemented and achieved,

Box 2 Pathways between data and evidence generation to programmatic scale up in Bangladesh

Rationale

In 2001, a national situation analysis of newborn health in Bangladesh provided a repackaging of the existing data, including results from household surveys, to describe when, where and why newborns were dying and to highlight opportunities for reducing newborn mortality. The process of developing the report served as a consensus-building mechanism and later that year sparked the creation of a Newborn Working Group comprised of senior government managers, international agencies, local non-governmental organizations (NGOs) and professional bodies. To further advance the local evidence-base, new studies were designed and launched in partnership with various agencies and the Ministry of Health and Family Welfare (MoHFW). With little understanding about to how to reach mothers and babies at the community level—where most deaths occur—these studies aimed to fill critical knowledge gaps related to household practices and community-based interventions.

Process

Both global and national evidence have influenced the process of design and scale up of newborn care in Bangladesh over the last decade, but as in many countries, this process has not always been linear (Figure 8). The Bangladesh newborn situation analysis was critical in increasing attention. Formative research catalysed more focus on home practices and also led to national materials for practice change. The Society for Education Action and Research in Community Health (SEARCH) project, a community-based newborn care study from India, influenced Projahmno, a large cluster randomized control trial. Projahmno, while using specially recruited, single purpose community health workers, adapted the intensive home visit package used by SEARCH to contain fewer visits and examined alternative models to home-based injections of antibiotics for neonatal sepsis. The results were influential globally (Baqui *et al*. 2008) and helped shape the UN joint statement on home visits for newborn care. The influence of this study locally was enhanced by site visits from policy makers even before publication. At national level, the influence on policy of Projahnmo or other study-related site visits as opposed to learning from other non-research programme implementation is hard to disentangle.

Testing and indeed scale up of integrated community-based newborn care preceded the development and testing of single interventions to address the main causes of newborn deaths. Studies which show negative results are as important to guide policy as those which show positive effects. For example, a trial of traditional birth attendants trained in neonatal resuscitation using bag-and-mask showed no significant effect on mortality rates and led to the decision not to pursue this at scale, especially while resuscitation is not yet available for the majority of facility births (Ellis *et al*. 2011; Lee *et al*. 2011). Investigation of the negative result observed in the Bangladesh women's group intervention (Azad *et al*. 2010) helped researchers refine the study conditions (such as coverage) and another trial is now underway (Houweling *et al*. 2011). However, equivocal trials may contribute to some policy confusion. For example, the only global trial of community-based Kangaroo Mother Care (KMC) to date was in Bangladesh (Sloan *et al*. 2008), and the non-significant effect may have reduced local momentum for facility-based KMC despite high quality evidence of mortality effect for facility-based services.

Results

Evidence generated contributed to a higher profile for newborn survival, helped build consensus on technical solutions, influenced policies and programmes and increased funding. Global and local evidence were available and used to develop a *National Neonatal Health Strategy* to guide newborn health programming. Following the integration of newborn health into policy, the professional bodies in Bangladesh worked collaboratively to develop and pilot technical modules that were then endorsed by the government and used to train thousands of service providers throughout the country. Evidence has influenced a series of 13 large-scale newborn programmes—now rolling out in districts with a total population of over 30 million people (Figure 5). The current health sector plan includes plans to hire and train at least 13 500 community health workers to provide newborn care services (GPRB 2011).

Informed advocacy from a diverse group of stakeholders seems to have been an effective mechanism for advancing maternal and newborn care, particularly at the community level. However, consistency and quality across programmes remain a challenge and too little is known about the pathway of effective implementation at scale. In addition, the linkages to facilities and improving quality of care in facilities remains a key gap in local, as well as global evidence for improving neonatal and also maternal health.

whereas by 2010, one additional benchmark had been achieved with seven partially achieved (Figure 6) (Moran *et al*. 2012).

Before 2000, the importance of addressing newborn survival to ensure attainment of MDG4 had limited national awareness. In 2001, Save the Children's Saving Newborn Lives programme began and facilitated the completion of a national newborn situational analysis (Saving Newborn Lives 2001), which brought national attention to the issue and catalysed the creation of a Newborn Working Group mandated to focus on newborn health issues (Box 2).

Additional activities promoted newborn survival at the national level. The second global meeting of the Healthy Newborn Partnership was held in Bangladesh in 2003, and this led to the signing of the Dhaka Resolution for Newborn Health, which marked commitment by the Government of Bangladesh to emphasize newborn survival in policy (Healthy

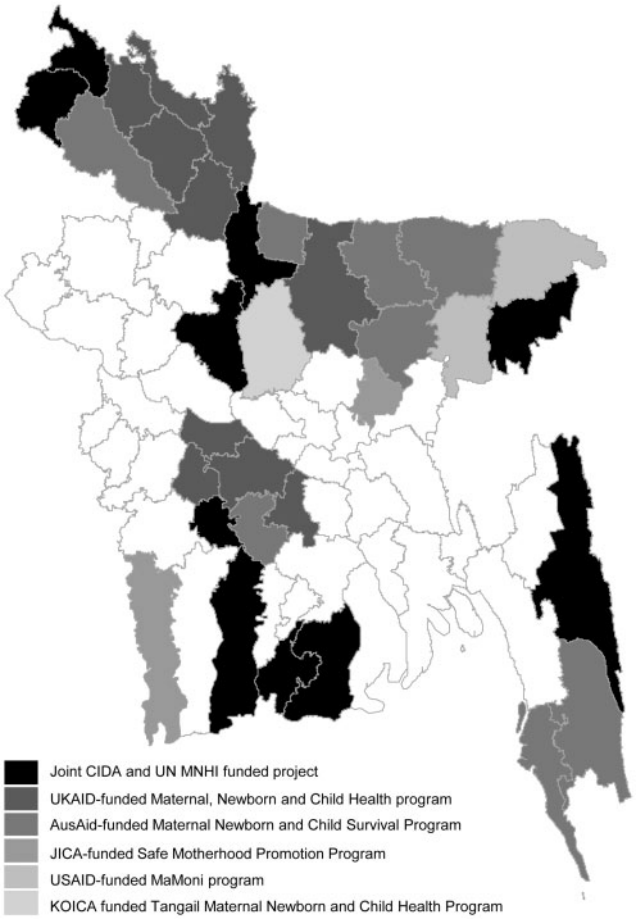


Figure 5 National scale up for Newborn Care in Bangladesh *Data source:* Analysis of Save the Children.

Newborn Partnership 2003). When the national health sector strategic plan was reviewed in 2004, newborn advocates capitalized on the opportunity to incorporate newborn health components and target indicators, and influenced integration into several training programmes. A Deputy Programme Manager position was created within the child health section of the Director General of Health Services to serve as the focal person for newborn health. A lack of resources and frequent shifts in the MoHFW personnel contributed to less emphasis on newborn health in the 2006–11 health sector plan (GPRB 2008).

Policy for newborn health regained momentum from a number of events and influencers: visits to share best practice, a WHO regional meeting in 2005 and, importantly, research results from a cluster randomized trial undertaken at ICCDRB showing impact of community-based packages on newborn survival (Baqui *et al*. 2008). A national stakeholder meeting in January 2006 was held to discuss gaps in care for priority newborn health interventions and led to the design of research to investigate implementing these interventions. The MoHFW established a National Core Committee that was mandated in 2007 to develop a *National Neonatal Health Strategy* (NNHS) and Guideline (Box 2). Following NNHS approval in 2009, an action-planning process began to identify key steps towards implementation. This process in part led to the reincorporation of newborn health strategies into the 2011–16 Health, Population and Nutrition Sector Development Program (GPRB 2011).

South-to-south exchanges by policy makers with India, Nepal and South Africa inspired uptake of innovations for newborn care in Bangladesh's programmes and policies. Interestingly, these visits seem to generate more uptake than written communications alone, even when publications are designed for policy makers. High-level policy makers invested in these programmes in a personal way. A visit in 2002 to the home-based neonatal care programme SEARCH in Gadchiroli, India, helped policy makers to work with researchers to design a community-based package for newborn services relevant to the local context, and also influenced the Projahmno study, which was intended to adapt the approach to be more scaleable in Bangladesh (Bang *et al*. 1999; Bang *et al*. 2005; Baqui *et al*. 2008). Another visit in 2007 to the Morang Innovative Neonatal Intervention (MINI) project in Nepal (Khanal *et al*. 2011; Pradhan *et al*. 2012) influenced the decision to have community health workers manage sick newborns and the initiation of operational research to gather sufficient evidence for implementation at scale. Uptake of mortality audit was also prompted by south-to-south learning and exchanges with

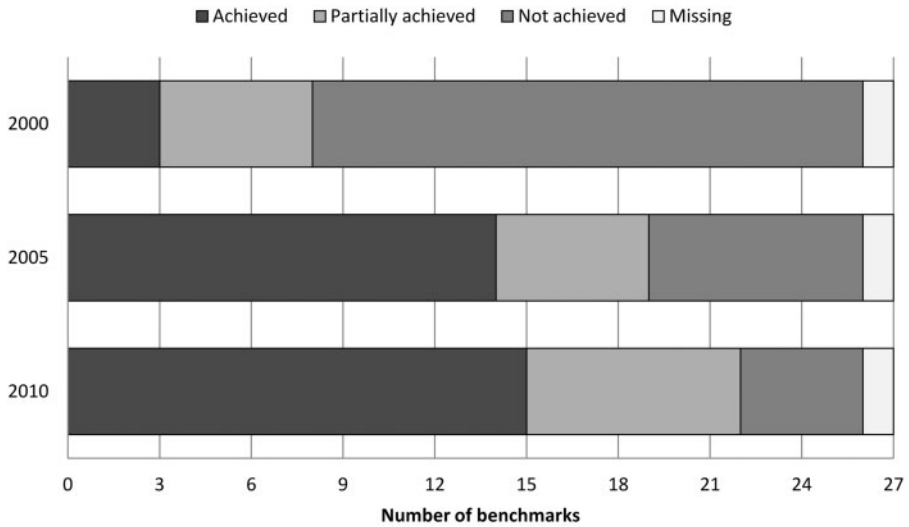


Figure 6 Progress towards Scale-up Readiness Benchmarks for newborn care *Notes*: Details on this analysis can be found in the second paper of this supplement (Moran *et al*. 2012). Full results and documents reviewed can be found in Supplementary Data Web Annex E. The missing benchmark relates to financial commitments and does not have data.

South Africa (Pattinson *et al*. 2009); this was catalysed at the time of the Healthy Newborn Partnership meeting, and has moved into national policy since.

Global and regional events, such as the launch of *The Lancet* Neonatal Series in 2005 and the UN Joint Statement on Home Visits for Newborn Care in 2009 (Lawn *et al*. 2005; *The Lancet* 2005; WHO and UNICEF 2009) (see Supplementary Data Web Annex D), the Healthy Newborn Partnership meeting in Dhaka in 2003, USAID Asia and Near East meetings in 2007 and 2010 and MotherNewbornNet bulletins, played a synergistic role by communicating the latest evidence and tools to advance newborn health, and linking rapid global change in attention and action to country level (Shiffman 2010).

Availability and access to newborn care services

Health services in Bangladesh are delivered by the MoHFW, through two separate directorates (Health Services and Family Planning), and a combination of donor-funded NGO networks and the informal private sector. The pluralistic nature of health service delivery produces a fragmented referral system, therefore much of the population uses the informal sector to access health services (Parkhurst and Rahman 2007; Bangladesh Health Watch 2008; Ahmed *et al*. 2009). Over the past decade, critical scarcity of health human resources and unequal distribution of providers and health services for urban and rural populations has persisted (Bangladesh Health Watch 2008). The 2005 density of doctors and nurses was 5.8 per 10 000 people, much lower than the WHO benchmark of 23 (Bryce and Requejo 2010; WHO 2011a).

Variation in coverage across the continuum of care reflects issues of both access and utilization. With 80% of pregnancies in rural areas (Rahman *et al*. 2005), distance to health services is one of the reasons given for not accessing maternal and newborn care (NIPORT and Macro International 2009). Attempting to address this, at least 13 different newborn care programmes have been rolled out since 2006, with the potential to cover approximately one-third of the population (Figure 5 and Supplementary Data Web Annex F). The new national health plan is dedicated to ensuring the scale up of essential newborn care and other newborn health initiatives by 2016. The selection of districts for scale up is driven both by the status of certain indicators (NMR, MMR, IMR) and availability of donor funding (see Box 2 for further discussion of scale up strategies).

Quality of newborn care services

There are limited national data on quality of care for newborn services and a gap exists for agreed upon metrics. The 1999–2000 Service Provision Assessment (SPA) reported that more than 80% of district-level facilities and half of primary-level facilities provided delivery and postpartum care; however, it asked few questions specific to newborn survival (Saha 2002). Sub-national research studies have demonstrated increased met need for emergency obstetric care (EmOC), which includes neonatal resuscitation, from 11% to 27% over 4 years (1998–2002), with the number of EmOC facilities at the district level still low (Islam *et al*. 2005). Other studies have documented improved quality of obstetric care in peri-urban vs rural districts (Anwar *et al*. 2009) and increased coverage of antenatal care and postnatal care (Darmstadt *et al*. 2010). The lack of specific data on quality of care for newborn services is an important element to consider when scaling up newborn interventions.

Although data are lacking, there is political commitment to improve the quality of maternal and newborn care, using perinatal mortality audits. The NNHS and National Health Strategies include directives for perinatal mortality audit and the Director General has called for notification of all maternal and perinatal deaths. A pilot project in LAMB hospital in northwest Bangladesh and learning from audit in South Africa were instrumental in the government's decision to make audit part of the national strategy, and the system has

now been taken up by more than 20 health facilities (Pattinson *et al*. 2009).

Demand for newborn care

Skilled birth attendance and careseeking for newborn illness both increased over the decade (NIPORT and MEASURE Evaluation 2011; NIPORT *et al*. 2012). Increased education and GNI, improved communication and also national campaigns were linked with improved health service use, specifically EmOC services (NIPORT and MEASURE Evaluation 2011). Community mobilization initiatives, such as an integrated safe motherhood and newborn care programme called MaMoni, demonstrated the feasibility of using community networks to disseminate essential newborn care messages, conducting surveillance to identify pregnancies and births, and supporting households to seek care for sick newborns (Jahan 2010). Community mobilization, as well as peer-counselling, was also associated with greater utilization of EmOC services and over 60% increased rates of exclusive breastfeeding (Islam *et al*. 2005; Faruque *et al*. 2008). In a sub-national study, Islam *et al*. (2005) found the proportion of facility births rose from 5% to 12% after initiatives to increase awareness of mortality had been implemented in the Khulna district of Bangladesh (Islam *et al*. 2005).

Lack of services and distance meant that women delay accessing care, resulting in increased maternal and neonatal mortality (Ronsmans *et al*. 2010). Neonatal mortality is many times more common for women with complications in childbirth, requiring access to timely, appropriate care (Koblinsky *et al*. 2011). The low levels of skilled birth attendance are associated with higher proportions of intrapartum-related neonatal deaths (Chowdhury *et al*. 2010). A sub-national qualitative study found that most families considered careseeking during the newborn period fatalistic, preferring care delivered at home by homeopaths (Winch *et al*. 2005). Potentially harmful practices, such as using mustard seed oil on the baby's skin and umbilical cord, were also prevalent (NIPORT and Save the Children 2003; Winch *et al*. 2005).

Financial resources for health

Funding for health in general and MNCH specifically increased over the past decade as efforts to reach the MDGs intensified. Across a range of 13 initiatives and research projects, a total of approximately $300 million (USD) was granted to advance MNCH in Bangladesh (Supplementary Data Web Annex F). The total health expenditure nearly tripled from $1.3 billion in 2000 to $3.1 billion in 2009 with the majority of spending coming from out-of-pocket (Figure 7a) (WHO 2011b). While the Commission on Macroeconomics and Health recommends that $35 per person per year be spent on health ($53 at constant 2008 USD), the total health expenditure per capita was only $19 in 2009 (WHO 2001; WHO 2011b).

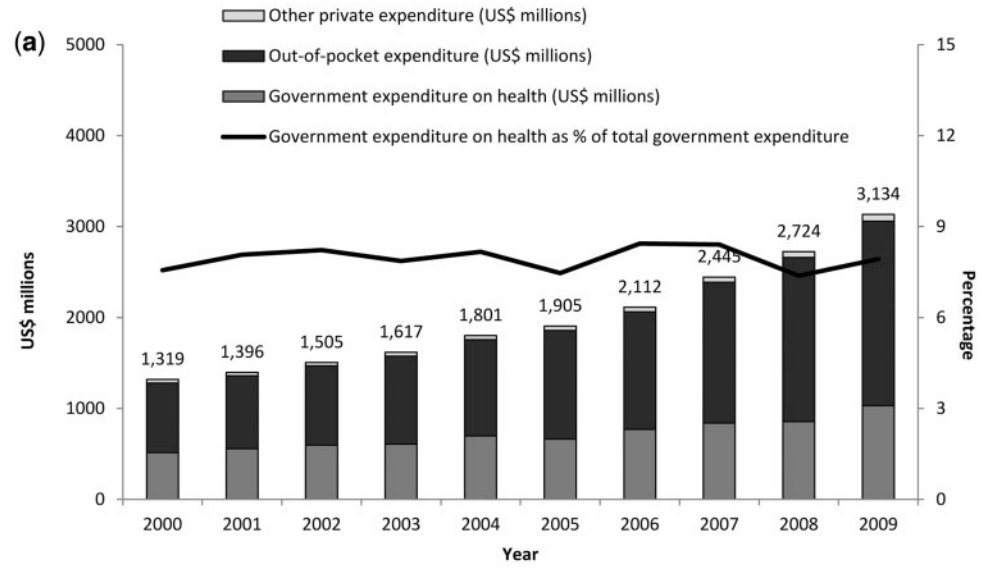
The percentage increase in ODA for maternal, newborn and child health ($79 million to $135 million) was greater than the increase in overall ODA for health between 2003 and 2008 ($175 million to $252 million) (Pitt *et al*. 2010). While ODA per child doubled and maternal and newborn health ODA increased by a third, these were both still lower than the average for Countdown to 2015 countries; however, this is a common phenomenon for countries with large populations (Figure 7b) (Pitt *et al*. 2010). Bangladesh received more donor contributions for projects actually mentioning newborns compared with other countries and this also started earlier in the decade (Lawn *et al*. 2012). The proportion of ODA for MNCH mentioning newborn care was relatively low (14%) considering that neonatal deaths make up 57% of under-five deaths. Additionally, there was little ODA in the category of exclusive benefit to newborns over this time period.

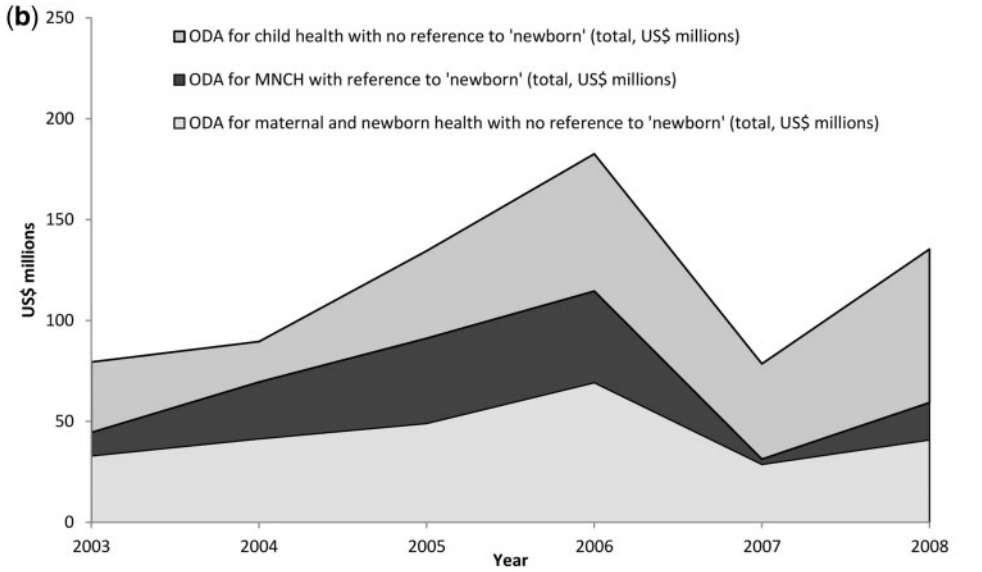
Implications

Our multi-country and multi-faceted analysis of change for newborn survival shows a substantial and sustained decline in neonatal mortality, and demonstrates the complexity of translating research into implementation of policy and programmes in a unique context. While the national neonatal mortality rate has declined at 4.0% on average per year since 2000, reflecting greater progress than the global and Southern Asia regional averages, this is less than half the rate of decline for children 1–59 months and slower than national reductions in under-five and maternal mortality (Hill *et al*. 2012) (Figure 1). This is noteworthy since it indicates that much of the progress towards MDG4 has been for children after the first month of life. While there have been some increases in coverage of key interventions such as skilled attendance and postnatal care in this time period, these still remain low, reaching less than one-third of families. Major reductions in total fertility, some change in GNI and other contextual factors are likely to also have had an influence on mortality reduction. We identified various factors which contributed to an environment favourable to newborn survival, including the role of research and evidence, the influence of key partnerships and champions, as well as the interaction of global publications and meetings with local change. Considerable donor funding also appears to have contributed.

Pathways from research to policy to implementation

This analysis underlines the importance of interpreting data and research findings for policy makers and actively engaging them in uptake (Box 2). However, as for many other examples of the influence of research on programmes, the pathways are not always as simple and linear as may be expected at the start (Figure 8). Some overarching themes emerge, including the importance of local ownership and involvement, and broad representation of all stakeholders in formulating national-level technical oversight of research and associated policies. After the dissemination of Bangladesh's newborn health situation analysis, stakeholders expressed the need for locally-generated evidence with national ownership by both the MoHFW and relevant stakeholders, for improving newborn survival and addressing the special needs of sick newborns. These individuals engaged in site visits and policy creation, such as obtaining permission for community health workers to inject antibiotics and governmental participation in the Projahnmo Technical Advisory Group. In 2009, the Projahnmo trial team published evidence of the importance of early postnatal home visits, winning *The Lancet* paper of the year (Baqui *et al*. 2008) (Box 2). In addition, operations research from community-based care





Comparison with Countdown to 2015 (68 countries)	Bangladesh		Countdown country averages	
Comparison of MNCH donor funding	***2003***	***2008***	***2003***	***2008***
ODA for health per capita	$1.19	$1.60	$4.30	$9.50
ODA for child health per child	$2.30	$4.90	$5.80	$15.90
ODA for maternal and newborn health per live birth	$10.38	$15.20	$14.00	$31.00
Comparison of donor funding for newborn health	***2003***	***2008***	***2003***	***2008***
Value of ODA for MNCH which mentions 'newborn' (US$ millions)	$11.65	$18.53	$0.38	$3.51
Value of ODA for MNCH that specifically benefits newborns (US$ millions)	$0.00	$0.08	$0.00	$0.07

Figure 7 Health funding changes **(a)** Total health expenditure by government, out-of-pocket, and other private expenditure, and percentage of government expenditure on health compared with total government expenditure (2000–2009) *Data source:* Analysis of World Health Organization National Health Accounts (WHO 2011b). *Note:* all values in constant 2008 USD. **(b)** Changes in official development assistance for MNCH in Bangladesh (2003–2008), showing the proportion mentioning 'newborns' and comparing with averages (unweighted) for Countdown to 2015 priority countries. *Data source:* (Pitt *et al*. 2010) with special analysis done by C. Pitt. *Notes*: All values are in constant 2008 USD. MNCH donor projects with reference to newborn health include MNCH donor disbursements that mention the word newborn or relevant search terms in titles or project descriptions. The OECD database does not systematically capture funding from emerging donor states, foundations, non-governmental organizations or faith-based groups.

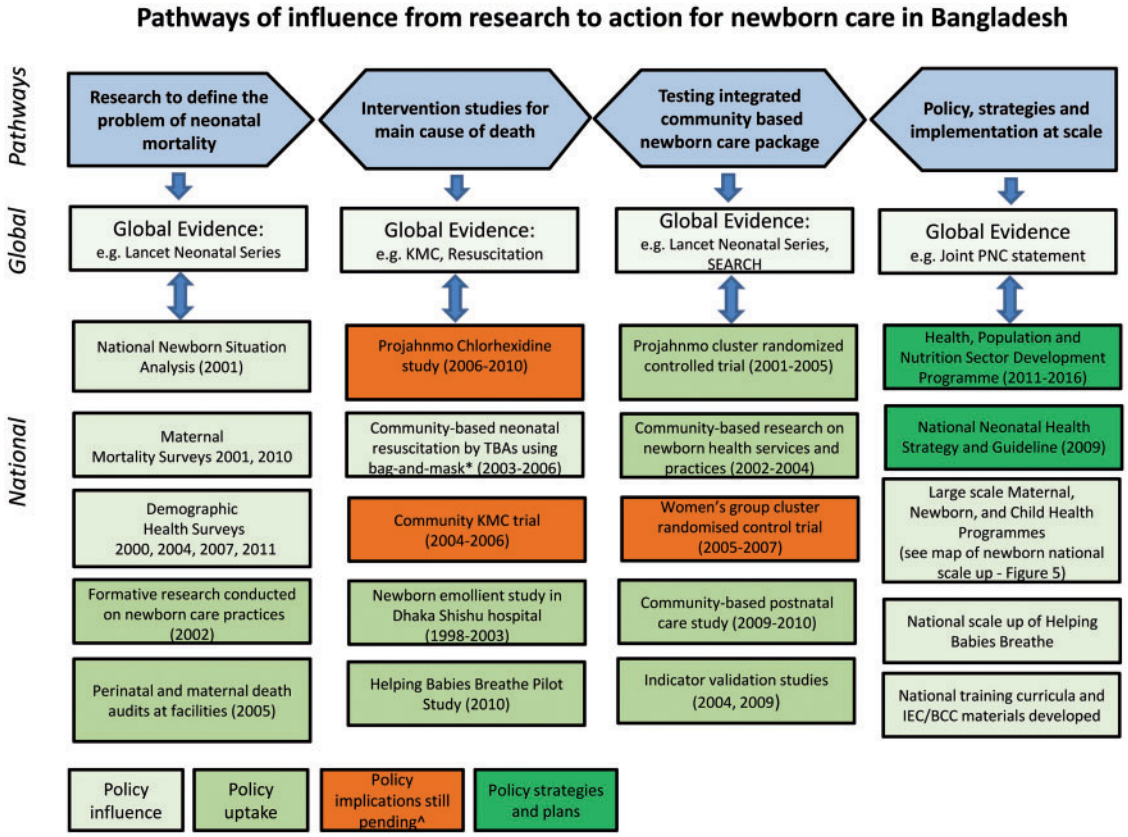


Figure 8 Pathways of influence from research to action for newborn care in Bangladesh *Data sources:* Research to define the problem of neonatal mortality Lawn *et al*. 2005; NIPORT and ORC Macro 2001; NIPORT and ORC Macro 2003; NIPORT and Save the Children 2003; NIPORT and ORC Macro 2005; NIPORT and Macro International 2009; Bang *et al*. 2005; Baqui *et al*. 2008; Khanal *et al*. 2011; Pattinson *et al*. 2009. Intervention studies for main causes of death Sloan *et al*. 2008; Ellis *et al*. 2011; Lee *et al*. 2011; Baqui *et al*. 2008; Baqui *et al*. 2009; Darmstadt *et al*. 2006; Syed *et al*. 2006; Darmstadt *et al*. 2008. Testing integrated community based package Lawn *et al*. 2005; Bang *et al*. 2005; Baqui *et al*. 2008; Barnett *et al*. 2006; Azad *et al*. 2010; Shah *et al*. 2010. Implementation at scale with operations research WHO and UNICEF 2009; Jahan 2010; GPBR 2008; GPBR 2011. *Note*: This figure is not inclusive of all studies in country but is rather illustrative of the studies that have influenced the pathway to change for newborn survival. For a more complete list of studies, please see Supplementary Web Annex G.
*indicates study that had a negative finding
^refers to more evidence being needed and/or operational issues under review.

was piloted within existing government and NGO service delivery settings and demonstrated the feasibility of using community health workers to scale up home visits for postnatal care (NIPORT and Save the Children 2003; Darmstadt *et al*. 2006; Syed *et al*. 2006). Site visits by policy makers in-country and to other countries have been highly influential for the uptake of policy and programme innovations for newborn care in Bangladesh.

Several trials on the effect of participatory women's groups, notably in Nepal and India (Manandhar *et al*. 2004; Tripathy *et al*. 2010), found reductions in neonatal mortality. However, a similar model tested in Bangladesh showed no significant effect and the analysis concluded that 'detailed attention to programme design and contextual factors, enhanced population coverage and increased enrolment of newly pregnant women might be needed' (Azad *et al*. 2010). Therefore, an additional trial will be testing an intensive women's group intervention with high population coverage in Bangladesh (Houweling *et al*. 2011).

Effective advocacy within Bangladesh resulted in the 2004 and 2007 Demographic and Health Surveys including key indicators on postnatal care and newborn behaviours and practices that are not in the core questionnaire and were not collected in most other countries (NIPORT and ORC Macro 2005; NIPORT and Macro International 2009).

Advocacy, partnerships and convening mechanisms

Despite several changes of government between 2000 and 2010 and their different health system structuring priorities, various partners continually brought newborn health back onto the national agenda, maintaining commitment from government officials. Partnerships, both formal and informal, were crucial in getting newborn health on the agenda and in affecting policy and programmatic changes (Simmons and Shiffman 2007; Yamey 2011). The NNHS is an excellent demonstration of a formal partnership with broad participation to advance national consensus. Building on a long history of collaboration, the MoHFW led the process with support from development partners, academics and research organizations. Professional bodies were critical in this process as they had established history and connections and brought academic credibility and technical inputs to the process. Members of these professional

associations remain influential champions. Harnessing the previously untapped advocacy potential of professional bodies is a significant achievement and lesson learned from the Bangladesh experience. Bangladesh has a wide range of high profile champions for newborn survival from many of these constituencies, who have worked together to advance newborn survival, including close collaboration between researchers and government officials. This finding resonates with Shiffman's conclusions regarding a small informal network being key to increasing international priority for this cause (Shiffman 2010).

Key events at both global and national levels and the establishment of international partnerships appeared to have inspired early focus on improving newborn health and influenced the implementation of context-adapted community-based programmes (Simmons and Shiffman 2007). Participation of individual champions in regional and international forums was also critical to linking country level work with the global newborn health community (Shiffman 2010). Several global partnerships of relevance to newborn survival met in Bangladesh and helped to link global innovation to catalyse change at country level. The interaction of these efforts has resulted in newborn health being a priority in the current health sector plan, with national support by government and a variety of donors and partners. Continued partnerships will be vital as programmes are scaled up in order to leverage momentum and funding.

Implementation realities in a pluralistic health system

Given the high rural population, accessing skilled care at birth remains a challenge and contributes to increased levels of neonatal mortality (Rahman *et al*. 2005). However, rapid expansion of the urban poor population has placed an added burden on the health system (Moran *et al*. 2009). As with rural families, neonatal survival and coverage of key interventions are lower among this group compared with wealthier urban populations (NIPORT 2008), but high coverage can be achieved to reduce mortality (Afsana and Rohde 2010). Socio-economic inequities should be prioritized when planning interventions and it is essential that standard newborn care interventions and tools are integrated into large-scale urban health programmes. One challenge is that urban health issues are managed through municipalities, which fall under the purview of separate Ministries. Socio-economic inequalities in Bangladesh have an important effect on mortality and must be taken into account when planning programmes for newborn health (Amouzou *et al*. 2010).

The private sector (both for-profit and not-for-profit providers) rapidly increased over the last decade, providing a challenge for harmonization and regulation of training. Families often access providers in these sectors for MNCH services; in fact, observed increases in facility deliveries can be attributed to increases in use of the private sector (Parkhurst and Rahman 2007; Ahmed *et al*. 2009; NIPORT and MEASURE Evaluation 2011). While the voucher scheme has been shown to increase equality in service access (Ahmed *et al*. 2009) and has elements which have some influence on newborn health, it could address newborn survival more directly if essential newborn care and early postnatal care components were strengthened.

Coverage of care at community level is vital to ensure improvements in mortality rates while access to facility-based care is still low. Accordingly, an emphasis has been placed on well-monitored community-based interventions as a way to achieve high coverage of neonatal interventions (Shah *et al*. 2010). The country's ability to implement, deliver and sustain proposed community-based service programmes at scale has been challenged due to the fragmented nature of the health system, a lack of health workers and also inconsistencies in training packages (Parkhurst and Rahman 2007; Ahmed *et al*. 2009). The recent endorsement of national training curricula and behaviour change materials for newborn care for community- and facility-based providers offers promise. More resources are needed to implement the training at scale, linked to the current health sector plan.

Another challenge to consistent scale up relates to the funding cycles for many implementing partners who are under pressure to achieve results in restricted time periods, and thus, frequently implement interventions without functional co-ordination with the government or other counterparts or without careful evaluation. Such projects do not always involve government health workers, making sustained capacity building within the formal health system a challenge (Bangladesh Health Watch 2010).

Health care services are delivered by various implementing organizations. Co-ordination of care at national level is difficult as newborn health packages must be endorsed by the two MoHFW Directorates prior to implementation. These two Directorates provide newborn care services at various levels through different cadres of community-health workers with parallel supervision and management structures, and their efforts are crucial to co-ordinate to ensure linkages from household to community clinics to first-level facilities.

Institutionalization of newborn survival and the future agenda

Bangladesh has been a pioneer for improving newborn survival. Over the last decade, newborn survival has evolved as a national health priority, and it is unlikely that the country would be on track to reach MDG 4 without the progress already made for newborn survival. However, this progress lags behind the national progress for maternal and child survival, and there is scope to accelerate change. Achieving universal coverage of the evidence-based interventions identified in the current health sector plan would mean the survival of 70 000 newborns and prevention of 48 000 stillbirths in 2015. Moderate increases (20%) in outreach interventions, such as postnatal care, could save up to 7000 newborn lives in 2015 (see Supplementary Data Web Annex C for details).

While newborn health is now prominent in national policies, strategies and plans, current data does not reflect wide-scale use of newborn care services and practices, and progress in achieving coverage at scale has been slow. Community-based programmes have mainly been implemented in the north but the new national health plan aims to scale up initiatives aimed at decreasing preterm and intra-partum deaths, based on the results of community-based research. In addition, process change is more obvious for community packages; a gap remains for improving coverage and quality of care within facilities, especially at the time of birth and for treatment of sick

newborns. Furthermore, while this analysis highlights many accomplishments in terms of research, policy and programme change, contextual change such as increased family incomes, lower fertility rates and higher levels of female education likely account for a significant share of the success to date.

The Government of Bangladesh's health sector plan through to 2016 includes newborn health as an essential component and has the potential to make a meaningful impact on the lives of newborns, but the focus must be on implementation at scale, monitoring results through data-driven reviews and greater consistency in programmes (GPRB 2011). The updated coverage data that has accompanied the release of the 2011 Demographic and Health Survey has confirmed coverage, equity and quality gaps and will help guide the roll-out of more targeted programmes.

Ongoing co-ordination between partners and more predictable funding will be crucial to accelerating implementation, especially to both rural populations and the increasing urban poor. Given a history of frequent changes in leadership, continued progress will depend on strong, sustained messaging both within and outside government, and institutionalizing ownership for newborn survival. Making high-impact interventions universally accessible across the country and maintaining a focus on newborn health issues will have a synergistic effect on the services for mothers and children, as well as promoting accountability (Chowdhury *et al*. 2005). Newborns are the most vulnerable citizens and priority must be given to reaching the poorest families in order to save more lives and maintain and accelerate the remarkable progress seen in Bangladesh over the last decade.

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Supplementary Data

Supplementary data are available at *Health Policy and Planning* Online.

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Conflict of interest

None declared.

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