Reducing neonatal mortality in a rural Bangladesh community

-the role of asphyxia prevention and management

Elin Hultsten

International Maternal and Child Health,
Department of Women's and Children's Health, Uppsala University
Medicine programme
Degree project, 30c
Supervisors: Lars-Åke Persson, Anisur Rahman
Examiner: Håkan Borg
Abstract

Introduction
Millennium development goal four aims at 2/3 reduction in mortality of children less than five years of age. Despite progress, neonatal mortality is still high in many parts of the developing world, including Bangladesh. Birth asphyxia is one of the major causes of these deaths. Hence, birth asphyxia need to be prevented and neonatal resuscitation need to be improved to save newborn lives. This study had two parts. One part focused to what extent the implementation of a package of known effective interventions for mothers and newborns was associated with the occurrence of birth asphyxia over time in the rural district Matlab, Bangladesh. The second part assesses the knowledge and the work situation of health care staff that manages birth asphyxia.

Aim
The aim of this study was to analyse the contribution of asphyxia to the current neonatal mortality rate in Matlab, Bangladesh, to evaluate the change in neonatal mortality rate and asphyxia deaths during the past few years of maternal and newborn interventions in the area and to assess the situation and challenges regarding asphyxia management from the perspective of health care staff within this area.

Methodology
A before-after study was conducted by using data from the Maternal, Newborn and Child Health programme (MNCH) that was running in the area of Matlab, Bangladesh. Also, a questionnaire was developed according to local conditions, with questions of knowledge, attitudes and practices in neonatal resuscitation. A total of 20 respondents, midwives and physicians, participated in the survey.

Result
The absolute and relative rate of birth asphyxia decreased significantly during MNCH programme. No difference was seen in birth asphyxia rate between different socio-economical groups, neither before nor during the intervention. The management of birth asphyxia was most likely improved, with a non-significant decrease in asphyxia mortality among asphyxiated babies. Also, the questionnaire revealed high confidence among midwives and physicians in most neonatal resuscitation tasks. Midwives were more confident than physicians, but their knowledge in resuscitation skills was lower. Most staff was educated in asphyxia management but few had got refresher training. Repeated training was considered important to improve birth asphyxia management by a majority of both midwives and physicians.

Discussion
This study suggests that a continuum of care for mothers and newborns consisting of a number of known effective interventions did result in decreased birth asphyxia mortality. Even though confidence in performing neonatal resuscitation was high among health care staff, a majority requested refresher training to improve resuscitation skills further. Continued education and training in asphyxia management skills may be important for the reduction of neonatal mortality in Matlab as well as in other developing country settings.
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Background

Neonatal mortality as the main matter in reaching Millennium Development Goal 4

The millennium development goals define eight different goals to reduce global poverty and ill health. The fourth goal aims at reducing mortality in children under five years of age with two-thirds from 1990 to 2015. Despite progress there are major challenges in meeting this goal. Reduction in mortality has mainly been attributed to a decreased mortality after the first month of life up to five years of age. This has been achieved through interventions such as good coverage of oral rehydration therapy to children with diarrhoea, satisfactory immunization coverage and availability to treatment of infectious diseases like bronchopneumonia and malaria. An increasing portion of deaths under five are now in the neonatal period (first 28 days of life) (Lawn, Cousens & Zupan, 2005). These neonatal deaths constitute more than three out of the nearly eight million under-five deaths occurring annually (Rajaratnam et al., 2010). Globally, the main direct causes are preterm birth (28%), severe infection (26%) and birth asphyxia (23%). Therefore, the handling of these conditions has to be improved to reach the Millennium development goals in time. Progress is needed in low- and middle-income countries, where 99% of these deaths take place (Lawn et al., 2005; Knippenberg et al., 2005). A child born in a developing country is over 13 times more likely to die within the first five years of life than a child born in an industrialized country (UN, 2008). The inequities continued to increase over the last decade with faster reductions in neonatal mortality rates in rich countries while no or small reduction was observed in low-income countries. The highest neonatal mortality rates are seen in Africa and the highest number of deaths in Southeast Asia. Together, they account for 73% of all intrapartum related deaths (Lawn et al., 2005; Lawn et al., 2009). Also, there are still disparities not only between countries but also within countries. Children from rural and poor families that lack basic education have higher mortality rates than those born in families with more resources (UN, 2008; Lawn et al., 2005). In many countries where the under five mortality has declined, disparities between rich and poor are still the same or increasing (UNICEF, 2010).

The same relationship between rich and poor countries, and also between different socio-economic groups, has been seen regarding birth asphyxia. The incidence of birth asphyxia is higher in developing countries compared to developed countries. This is probably related to a higher prevalence of risk factors in mothers in poor countries, like intrauterine growth retardation, a higher incidence of preterm babies and also a lack of antenatal care (Deorari, Paul, Singh & Vidyasagar, 2000). A study made by Lee et al. (2008) in Nepal showed that low socioeconomic status was highly associated with birth asphyxia. Increased education and literacy in both mothers and fathers decreased the risk of birth asphyxia.

How to overcome birth asphyxia as a main cause of neonatal mortality

Three-fourths of the neonatal deaths happen in the first week of life and the risk is highest the first day. Unique causes of death during this period are birth asphyxia and prematurity (Lawn et al., 2005). A study in a rural district of Bangladesh showed that birth asphyxia was the single largest category of death in the early neonatal period (first 7 days), accounting for almost 50% of the deaths in the first week. This reflects a lack of proper resuscitation and is also related to the high proportion of premature births in this region (Chowdhury et al., 2010b). Transition from intrauterine to extrauterine life is a complex physiological process that amazingly occurs normally in most babies. About 10% of all newborns need some kind of assistance to begin breathing and about 1% requires extensive resuscitation (Wiswell, 2003). Most of these 10% can be successfully resuscitated if treated immediately by simple methods like stimulating the baby by drying it, clearing the airways and giving ventilation. Use of a bag and mask or mouth-to-mask could save four out of every five babies who need resuscitation. Complex resuscitation with endotracheal intubation and oxygen is only required for a minority of asphyxiated children (Victoria, Rubens & the GAPPS Review Group, 2010).
A major problem is that many of deliveries in developing countries still happen at home without a skilled birth attendant (Chowdhury et al., 2010b). Each year about 60 of the 136 million deliveries in the world occur outside facilities. Only 56% of women deliver with a skilled attendant, and access is lowest for the poor (Darmstadt et al., 2009; Lee et al., 2009; Lawn et al., 2005). Also in facilities, access of quality care is not guaranteed. Health care staff doesn’t always have the knowledge and skills needed. Typically, only half or fewer of attendants in health facilities have resuscitation skills (Harvey et al., 2007). A study made in South Africa by Velaphi and Pattinson (2007) showed that avoidable factors for asphyxia deaths in rural hospitals were mostly health-worker related. Inadequate monitoring and poor partograph use was the most common causes. Shortage of physicians and midwives is also a contributing factor to absence of quality obstetric care in many parts of the developing world (Lawn et al., 2009; Carlo et al., 2008). Bream, Gennaro, Kajulafula, Mbwesa and Hehir (2005) looked at barriers and facilitators of newborn resuscitation in Malawi. Obstetric nurses participating in focus groups identified four themes that affected their practice: 1) confidence in their skills in assessing newborns and recognizing the need for resuscitation, 2) a lack of resources, 3) facilitators who would enable them to introduce resuscitation, and 4) solutions to the current problems.

The need for resuscitation of a newborn cannot always be predicted (20-76% of those that require resuscitation have no risk factors). Therefore there is a need for health care workers who attend deliveries to have sufficient skills in neonatal resuscitation and appropriate equipment available (Hofmeyr et al., 2009). To accomplish this institutional births need to increase, staff at all levels need training and seldom-used skills needs to be maintained by refresher training (Singhal & Bhutta, 2008). Several training programmes have shown good results in reducing neonatal deaths. In Malaysia, the Neonatal Resuscitation Programme (NRP) developed by the American Academy of Paediatrics (AAP) and American heart association was launched in 1996. After eight years an evaluation showed that perinatal mortality had declined from 9.1 to 6.8 per 1000 and neonatal mortality rate from 6.0 to 3.8 per 1000 live births (Boo, 2009). Another neonatal resuscitation programme was run in 20 provinces in China, starting in 2004. After four years Apgar scores less than 7 had decreased from 4.26% to 2.61%. Intrapartum related deaths in the delivery room decreased during three years from 33 to 22 per 1000 (Wall et al., 2009). In a third study, midwives in Indonesia got training in neonatal resuscitation. This resulted in an overall decrease in neonatal mortality rate from 15 to 9 per 1000 (PATH, 2006). Recently the program Helping Babies Breathe, HBB, was released. HBB is an initiative from AAP in collaboration with several partners aiming at developing a program for neonatal resuscitation in resource-limited areas. The training material, released in June 2010, is designed to create a system of ongoing training and includes a newborn simulator (HBB, 2010).

There are no clear guidelines for how many resuscitations needed per year to maintain skills and how an optimal refresher training should be done, but a 6-monthly process of supervision seems to be minimum. Knowledge and performance skills decrease significantly after this time. Anyhow it is clear that refresher training is essential for resuscitation to be carried out efficiently and effectively (Wall et al., 2009; Carlo et al., 2009).

**Barriers for women in low-income countries to access care**

Besides the barrier for receiving quality care described above, there are other known delays for women to get obstetric care in low-income countries: patient’s delay in seeking care and delay in reaching a health facility. Many social factors influence the decision to seek care, including lack of knowledge, cultural beliefs and lack of trust in the health system. Transportation is also a major problem in many countries where road conditions are poor and cost of transportation is high. The most common causes not to seek care are financial barriers, challenges with transportation and long travel distances. Anyhow, delays in getting quality care seem to contribute to the major part of the perinatal deaths. To minimize all these groups of obstacles it is important with a continuum of care from community to hospital, including early recognition and management of women with childbirth complications (Lee et al., 2009; Velaphi & Pattinson, 2007).

Community mobilization, including increased community awareness, participation and appropriate care seeking, has been shown to improve maternal, newborn and child health. This can been accomplished
through women’s groups, collective meetings and household visits from community health workers (Kumar et al., 2008; Lee et al., 2009; Manandhar et al., 2004). In a trial made in Sylhet, Bangladesh, women of reproductive age were randomised into one of three groups. One of the intervention groups got antenatal and postnatal home-visits to promote birth preparedness and to treat or refer sick neonates after birth. In the other intervention group birth and newborn-care preparedness and care seeking was promoted through community group sessions. After evaluation, the home-care group showed a decrease in neonatal mortality by 34% whilst group education meetings alone did not improve neonatal outcomes. Hence, home-based strategies to motivate women in countries with low health care use to preventable and curative neonatal care seems to reduce neonatal mortality. Community programs with low frequency of contacts and passive involvement do not seem to be effective (Baqui et al., 2008; Lee et al., 2009).

Distance and cost also influence the access of care. In rural Bangladesh, women living more than 1 km away from a sub-centre were less likely to have a skilled birth attendant than mothers living closer to a facility, according to a study made by ICDDR,B (2005). Effective transportation systems need to be present to overcome distances, but can be a major problem because of poor infrastructure, low access to public transportation and high cost. Also, the communication between community-based staff and hospital staff need to be enhanced to reduce referral time. With help to triage acute problems, emergency transportation to a specialist facility could be arranged quicker. Many obstetric complications such as haemorrhage, eclampsia and obstructed labour can be treated successfully if timely receiving medical care. Hopefully, new transportation vehicles and the growing access of mobile phones can be helpful in the future (Lee et al., 2009).

Some pregnancy complications are known to be associated with a higher risk of maternal death and birth asphyxia. Routine screening can discover prenatal risk factors such as anaemia, hypertension, multiple pregnancy, malpresentation and late vaginal bleeding. Anyhow, the most predictive risk factors are intrapartum complications, which can increase the risk of neonatal deaths up to 85 times (Lawn et al., 2009). A study made by Lee et al. (2008) to find risk factors for neonatal mortality due to birth asphyxia was made in southern Nepal. They showed that maternal fever, swelling of hands, feet and face and multiple births were all significantly associated with birth asphyxia mortality. Premature infants were also at higher risk. Meconium stained amniotic fluid did not increase the risk. Identifying and intervening against these risk factors in time may be important for the health of mothers, foetus and newborn.

There are many cost-effective evidence-based interventions available to reduce maternal and newborn health in low-resource settings. Probably, there could be a benefit in combining these interventions into packages. Darmstadt et al. (2005) made the estimation that if 16 evidence-based interventions were implemented at a coverage of 99% in the 75 countries that account for most of child mortality (WHO, 2005), 41-72% of neonatal deaths could be avoided. The interventions can be divided into three delivery modes: outreach, family-community, and facility-based clinical care. They include antenatal, intrapartum and postnatal care, delivery at facility with skilled birth attendant, prevention and management of infections and emergency obstetric care and more. Packages of care are also more cost-effective than single interventions (Darmstadt, Bhutta, Cousens, Adam, Walker & de Bernis, 2005).

**Definition of birth asphyxia and how it should be handled**

Birth asphyxia was defined by WHO in 1997 as a newborn who “fail to initiate or maintain regular breathing at birth”. The term is rather imprecise and the definition is very broad. Later years there have been suggestions to use other terms such as “intrapartum-related neonatal death” and “non-breathing baby” for a newborn baby in poor condition at birth (Lawn et al., 2009; Black et al., 2010). Since the term birth asphyxia is still widely used, also in Bangladesh, it is used in this report.

Birth asphyxia is a condition with severe lack of oxygen of the foetus and the newborn that can occur antepartum, intrapartum and postpartum. There are multiple causes of asphyxia, some of them are possible to predict, and others are not. Causes can be chronic, e.g. preeclampsia or heart or lung disease in the mother. Sometimes acute events cause birth asphyxia, for example ablatio placenta, cord compression and rupture of the uterus. Other reasons are preterm birth, infection or meconium aspiration. Noticeable symptoms of asphyxia that makes it possible to act early are changes in the foetus heart rate during labour,
umbilical cord acidosis and presence of meconium in the amniotic fluid. Such factors result in a low Apgar score after birth.

Hypoxic damage may affect most of the infant’s organs, including brain damage. An estimated annual of 1 million birth asphyxia survivors may develop cerebral palsy, learning difficulties or other disabilities (Lawn et al., 2009). That makes asphyxia an important cause of both neonatal morbidity and mortality. Some of these cases could have been avoided with proper resuscitation. According to WHO, resuscitation should be given to babies who are not crying, not breathing at all or gasping 30s after birth (Wall et al., 2009). Resuscitation shall include drying and stimulating the baby, clearing of airways, positioning and evaluation of breathing, heart rate and colour. If needed, ventilation is commonly given with 40-60 breaths per minute. CPR with chest compressions is indicated if heart rate is below 60 beats per minute after 30 seconds of ventilation. Compressions and ventilation shall then be coordinated and given with 3:1 ratio, 3 chest compressions followed by 1 ventilation, with 120 events per minute. These initial resuscitation steps could probably be taught and accomplished in most settings (Kattwinkel et al., 2010; Singhal & Bhutta, 2008; Wiswell, 2003).

**Appropriate equipment for resuscitation in low-resource settings**

Because neonatal resuscitation cannot always be predicted it is important with necessary equipment in fully operational condition present at all times. The basic equipment provided in health facilities should include items such as a firm and flat resuscitation place, suction device, a source of heat, and ventilation device (Wall et al., 2009). For successful handling of birth asphyxia, ventilation is one of the most important tasks. Effective ventilation device for low-resource settings has to be easy to use and obtainable for a reasonable price. Commonly used methods are mouth-to-mouth ventilation, mouth-to-mask ventilation, mouth-to-tube ventilation and bag-and-mask ventilation. Programme for Appropriate Technology in Health (PATH) in Indonesia showed that tube-and-mask is as effective as bag-and-mask when tested by midwives on mannequins. The midwives preferred the bag and mask because it was easy to use and felt safer with regard to transmission of infections (PATH, 2006). A study of management of birth asphyxia in India showed that bag-and-mask appeared to be superior to both tube-and-mask and mouth-to-mouth in reducing asphyxia-related deaths, partly because health care staff described it less tiring and more comfortable to use bag-and-mask. Mouth-to-mouth was least effective (Bang et al., 2005). Hence, bag-and-mask seems to be effective and preferred by health care staff. It is the standard of care and affordable versions are available for low-income countries (Wall et al., 2009). For appropriate fitting it is also important to have masks in size for both term and preterm babies available (Singhal & Bhutta, 2008).

Oxygen does not seem to be a critical factor for resuscitation. It is still unclear whether oxygen should be used or not when resuscitating newborns. The mortality rate may be lower when resuscitating with room air compared to 100% oxygen, but more studies has to be done (Singhal & Bhutta, 2008; Rabi, Rabi & Yee, 2007). So far, WHO recommends air for resuscitation of most children at community level and at facilities without routine availability of oxygen (Wall et al., 2009). Another controversial issue is regarding babies born through thick meconium. When meconium is present in a newborn baby that does not cry, suction is important for effective ventilation to be carried out. In these cases, WHO recommends suctioning with a mechanical suction device. However, routine suctioning in vigorous babies with meconium-stained fluids is not recommended at this time (Wall et al., 2009).

**Progress in reducing child mortality, what it takes to reach the MDGs in time**

In 2000, the UN Millennium Summit united 189 governments and at least 23 organisations to commit to the Millennium Development Goals (MDGs), defining targets of health and development to be achieved by 2015. Goal 4 is reduction of mortality in children under 5 years of age, and goal number 5 aims at reducing maternal mortality by three-quarters between 1990 and 2015.

Progress in receiving the MDG 4 remains mixed. Global under-five mortality fell by 28% from 1990 to 2008 (from 90/1000 to 65/1000). Some countries are on track and many others report accelerating progress
in the last decade, whereas progress in a few countries has declined. Anyhow, rate of improvement worldwide is insufficient. Neonatal mortality is still high with slow progress, now accounting for 41% of deaths. In Africa, almost no change has been recorded in neonatal mortality rate (Bhutta et al., 2010). Globally, early neonatal period has shown the least progress. No mortality reduction has been seen the last decade (Lawn et al., 2011). Bhutta et al. (2010) reviewed the progress in coverage of vital interventions between 1990 and 2000, in the 68 countries accounting for 95% of maternal and child deaths. Coverage of skilled attendants at birth was 54% and 50% got at least 4 antenatal care visits. Postnatal visits for mothers were a reality for 38% of mothers. Just as for neonatal mortality, maternal mortality remains high in most of the 68 countries. Among the interventions reviewed, disparities between rich and poor was greater for maternal and newborn intervention than for the ones delivered to older children.

Lawn et al. (2011) present results from a study, ranking the highest research priorities to reduce mortality from intrapartum-related neonatal deaths by 2015. Three quarters of the top ten priorities were dominated by implementation, how to deliver existing interventions. For instance the following proposed research questions: What strategies are effective in increasing demand for, and use of, skilled attendance?; Community participation package to improve recognition and acting for danger signs for mother in labour, including transport and communication. Also, high priority was given to research improving equity. Commitment to the MDG requires a change in health research investment from diseases prevalent in high-income countries to delivery and development research. Today, 10% of research is directed at 90% of the world’s burden of ill health, called the “10/90 gap”.

The case of Bangladesh

In year 2000 the Bangladesh government committed to the MDGs to reduce maternal and child mortality. Various policies and strategies have been made to achieve the current goals by 2015. The Health, Nutrition and Population Sector Programme (HNPSP) made a Midterm review in early 2008, which revealed that progress has been good. The interventions made to receive MDG 4, reducing under-five death with two thirds to 48 per 1000 live births, has been successful and Bangladesh is now on track for reaching this goal. Under-five deaths decreased from 133 per 1000 live births year 1993 to 88 per 1000 in 2004 and 54 per 1000 in 2008, reflecting excellent progress (NIPORT, 2009; HNPSP, 2009; UNICEF, 2010b). The decrease in child mortality is mostly seen among children older than one month due to a combination of interventions like vitamin A distribution, immunization coverage and diarrhoea management. Probably, the decrease is also related to development of non-health interventions such as primary education for girls, water and sanitation (HNPSP, 2009). Still, infant and neonatal mortality lags behind. Progress in maternal and newborn care is too slow. Neonatal mortality rate is 31 per 1000 live born, which represent 56% of all under-five deaths (Rajaratnam et al., 2010). One important factor causing the high neonatal mortality is that only 15% of deliveries in Bangladesh take place at facilities, currently only 17.8% of deliveries is attended by a doctor, nurse or midwife (NIPORT, 2009). The capacity to provide adequate care for both normal and complicated childbirths is limited. Bangladesh has one of the lowest nurses to population ratios in the world, below 0,14 per 1000 population, reflecting a critical shortage of skilled nurses and midwives. Availability of obstetric care is not evenly distributed. The gap between urban and rural areas in the use of antenatal care (ANC) and attended deliveries is big and seems to have widened. In 2007, the proportion of facility deliveries was 31% in urban areas compared to 11% in rural areas (WHO, 2007a; NIPORT, 2009). Differences are also seen between rich and poor. A child’s risk of dying is dependent on the economical status of the household. The risk of dying before five years of age in the top quintile is about half compared to the bottom quintile. Bangladesh does have a growing economy but still about 36% of the population lives on less than one dollar a day (UNICEF, 2007). It has also been seen that the mother’s level of education is inversely related to her child’s risk of dying. Bangladesh demographic and health survey for 2007 showed that only 8% of women aged 15-49 had completed primary school (grade 5), 12% completed secondary school (grade 10) and the median of education completed was 3.2 years (NIPORT, 2009). The total adult literacy rate is only 54% (UNICEF, 2010a).

Ensuring quality care before, during and after childbirth is, together with improved educational and economical conditions, critical to improve maternal and newborn health in Bangladesh as well as in other developing countries. Even though progress has been seen in many countries it is urgent to improve the
situation of the world's women and children in order to achieve the MDGs by 2015 (Lawn, Cousens & Zupan, 2005).

**MNCH programme - improving maternal and newborn health**

*Project title: Comprehensive maternal, neonatal and child health care to reduce mortality: a programmatic approach through a continuum of care in a rural community in Matlab, Bangladesh, with a package of known effective interventions*

From 2005 until 2010 a Maternal and Newborn Child Health (MNCH) project has been running in the district of Matlab, Bangladesh. The project is implemented within an area where a health and demographic surveillance system provides data on pregnancies, childbirths and the outcome for mothers and newborns. Interviews ascertaining causes of deaths are performed in the area through a systematic interview, a “verbal autopsy”, and details are also available regarding health care utilisation and health conditions of the newborn at birth. The hypothesis to be tested in the MNCH project was that an increased frequency of deliveries at facilities by skilled birth attendants and the availability of immediate community based post-partum care would lead to a reduction of perinatal, neonatal and maternal mortality. The goal was to improve maternal and newborn health while reducing the rich/poor gap in the use of services, which is a crucial factor for Bangladesh to achieve the MDGs. Some of the specific primary objectives were to reduce neonatal death to 20 per 1000 and the under-five mortality rate to 32 per 1000 live births. This will be achieved by a package of known effective interventions implemented in this rural area by a continuum of care from community to hospital. Other objectives of the project were to increase the proportion of infants being breastfed and to decrease the occurrence of birth-related asphyxia.

The programme design was based on a need assessment. At community level interventions were made to increase community awareness, participation and appropriate care seeking. Community support was increased with ante- and postnatal home-based care. Training of support persons on timely recognition and effective referral in case of obstetric complications was carried out, including home-based life-saving skills. At facility level, high-quality service by midwives and physicians are available 24h a day for mothers, newborns and children. Data collection was performed on all levels of services and baseline data was extracted from existing databases. The project also included some formative research to improve recognition of and response to prolonged labour and birth asphyxia.

**The rationale for doing this study**

In the work towards reaching the MDGs there is still much to be done regarding maternal and newborn health. Much research has been done on how neonatal mortality can be decreased and good results has been seen from neonatal resuscitation training and increased attendance of skilled personnel at deliveries. Still, birth asphyxia is one of the most common death causes in early neonatal period, even though it in most cases can be managed with simple methods. Possible obstacles for effective resuscitation to be carried out are lack of education and training for health-care staff, inadequate equipment and shortage in capacity such as manpower and space. Probably the health-care staff who has experience from these situations knows much about what the needs are and what can be done to improve neonatal resuscitation where they work. It could also be interesting to check which equipment that is actually present in labour rooms compared to what is recommended. The aim of developing a questionnaire and equipment checklist in this study was to describe the situation and challenge regarding asphyxia management from the perspective of health care staff in a rural Bangladesh area.

Several studies have proven the effect of interventions made to decrease maternal, newborn and child health in low-resource settings. Even though packages that combine these interventions are assumed to be successful in reducing neonatal mortality, it has not been introduced in many places. MNCH programme in Matlab, Bangladesh, implemented several interventions to create a continuum of care form community to hospital. The objective of my study was to investigate if the MNCH project resulted in a decreased asphyxia mortality rate. It was also interesting to see if there were increased activity and quality in asphyxia management and if socio-economical differences in asphyxia deaths changed during this period.
This study could identify to what extent asphyxia contributes to the current neonatal mortality problem, and describe the situation and challenge regarding asphyxia management from the perspective of the health care staff in the area. This may be useful for future steps towards the reduction of neonatal mortality.

Questions to be answered in this project

• What is the absolute and relative importance of asphyxia deaths over time – given the improved neonatal survival since the initiation of the MNCH project?

• Are the socio-economic differentials in asphyxia deaths remaining the same or decreasing over time?

• Is there an increased activity and quality in asphyxia management of the health care staff over time as reflected in the MNCH databases?

These three questions will be answered by analysing the available MNCH databases.

The following questions are based on data collection by questionnaires to health care staff:

• Is there preparedness among concerned health care staff and in their work environment for neonatal resuscitation at the Matlab sub-centres and hospital?

• Does the personnel in facilities have a sufficient knowledge on how to prevent and manage asphyxia? If not, what needs are identified by the staff?

Methodology

MNCH programme

Study area

Maternal, Neonatal and Child Health programme was implemented in the rural community of Matlab, situated in Chandpur district, Bangladesh. The population in the research area, consisting of about 220,000 people, was divided into two parts: one where the MNCH programme was implemented by ICDDR,B and one where service was given from the Bangladesh government, similar to the rest of the country. ICDDR,B service area was in turn divided into four blocks, A to D, with a population of approximately 27,000 in each. Every block had its own sub centre clinic where paramedical staff provided maternal and child care, including deliveries, 24 hours a day. Both sub-centres and field work was supported by the hospital in Matlab village. The government service area was divided into three blocks, F to H, with union level health structure facilities, comparable to the sub-centres, present. There was also a government hospital situated in Matlab. The targeted population of this programme were pregnant women and recently delivered mothers, newborns and children less than five years. The total study population included about 46,000 women of childbearing age, 13,000 children under five. About 5400 pregnancies occur each year in the area.

Since 1966, ICDDR,B has been running a Health and Demographic Surveillance System, HDSS, in Matlab. Data are collected by monthly household visits of community health workers. They record demographic events like pregnancies, marriages, childbirths, in and out migration, and the outcome for mothers and newborns. Interviews ascertaining causes of death are performed (verbal autopsy) and selected morbidity of children under-five and women of childbearing age are updated. Beside these, socioeconomic data, such as education and household assets, are collected by periodic census.

Study design

The MNCH programme included a package of evidence-based interventions at community and facility level implemented to create a continuum of care from community to hospital. Existing relevant components of the previous health care programme was strengthened and new service components added. The study was evaluated by using a quasi experimental/before-after design, also with evaluation of the individual
components of the programme. The programme design consisted of two types of research: needs assessment and formative research.

Existing staff in the community sub-centres and MNCH-clinic together with supervisors and managers were responsible for the implementation. Because the interventions required some new skills, existing personnel got intensive training to get the appropriate knowledge. Some personnel was also recruited to meet the new needs. Since one of the aims of the project was to involve the community and create a demand for the programme, the community health research workers (CHRW) played an important role. CHRWs were divided into surveillance CHRWs and service CHRWs. The former visited households to collect health and demographic data every two months. Service CHRWs got to include counselling visits concerning antenatal, delivery, and postpartum care in their work. Topics included training a support person for every pregnant mother in prevention, stabilization and referral if complicated home births. They were also trained to be Home Based Lifesaving Skills (HBLSS) guides. All pregnant women together with their support persons were getting knowledge and lifesaving skills reinforced by pictorial *Take Action Cards*.

After facility assessment some renovation of present facilities had to be done and an outside room was set up to house the Kangaroo Mother Care, KMC. Some instruments and equipment were also procured.

**Interventions**

The programme consisted of a package of interventions together with formative research on birth asphyxia and prolonged labour. The integrated package included new components as well as strengthening the existing programme.

**CHRW care**

At community level, CHRW implemented the programme. They provided counselling and home based services including preventive and limited curative care such as immunization, family planning methods and post-partum care. Family planning included prevention of early marriage, delay of first birth and to limit high parity. For every woman who got pregnant a birth-team was identified including the woman and her family, a female support person and a birth attendant. They were trained by the CHRW to be able to make decisions during labour and delivery in case of complications, including home-based life saving skills. One important part of the MNCH programme was to establish community awareness and a demand of facility use. Due to cultural factors, distance and cost, many women want to deliver at home and don’t seek facility health care. CHRW and programme field staff was the ones responsible for updating pregnant mothers, their families and the rest of the community about the new interventions.

**Facility care**

Sub-centre services include antenatal care, normal delivery and immediate newborn and maternal care. Counselling for mothers was given regarding breastfeeding, nutrition, postpartum care, family planning, newborn care and danger signs during pregnancy, delivery and post-partum period. Deliveries were monitored with a partograph. If complications arose, the mother was referred to hospital. The Matlab hospital provided the same care as the sub-centres and further treatment of pre-eclampsia and eclampsia with MgSO4, minor surgery and more. Women in need of caesarean section or with eclampsia were sent to the sub-district hospital in Chandpur.

**Services included for a pregnant mother**

Pregnancies were identified by surveillance CHRW by a spot urine test at the woman’s home. If positive the woman was visited by a service CHRW week 12-14 to get information and motivation to participate in the MNCH programme. If she approved, the family got counselling concerning pregnancy and delivery and a support person was be identified. As seen in figure 1, facility care included four antenatal visits at the sub-centre or at the hospital. In late pregnancy a new home visit was done where the CHRW again reminded about birth-preparedness, newborn care and complications readiness. She also set up a birth team.
After delivery the CHRW performed three to four postnatal home visits, to make sure the mother and newborn were doing well and also to collect data.

**Support person**

A support person was selected by the CHRW for every pregnant woman according to the criteria in figure 2. She was trained to recognise danger signs during pregnancy, delivery and postpartum period. If required, she would do mouth-to-mouth resuscitation of the newborn. A primary commission was to encourage the family to plan for a facility-delivery, saving money for and identifying transportation. The support person also counselled the mother about breastfeeding, nutrition and hygiene.

**Support person**

- A female from same or nearby household
- Willingness to help mother-newborn throughout labour, referral if necessary and into the early postpartum period
- Have a child and delivered at ICDDR,B health facility
- Have breast fed her child
- Will be present at birth-neonatal preparedness/complications preparedness meeting conducted by CHRW
- Should be available around EDD
- Will be able to learn mouth to mouth breathing, danger signs for mother and newborn
- Will counsel mother on breastfeeding, nutrition, and hygiene

**Figure 2. Criteria required for a support person to a pregnant woman.**
Prevention and resuscitation of asphyxiated babies

At facilities, physicians or midwives carried out resuscitation of newborn babies. Apgar score was used to decide how the situation would be managed. When needed, ventilation was given with bag-and-mask or mouth-to-mouth. At home deliveries, resuscitation were performed by the support person and ventilation given by mouth-to-mouth if needed. For all deliveries, the immediate care should include the following: prevention of heat loss, clearing of airways, suction if meconium stained fluid and lack of breathing.

Kangaroo mother care

Kangaroo mother care (KMC) was used for preterm babies in order to prevent hypothermia. The naked baby was places in a skin-to-skin position between the mother’s breasts. In this way the preterm was kept warm, breastfeeding was initiated more easily and the baby was continually stimulated, preventing apnoea.

Formative research

The formative research focused on birth asphyxia (BA) and prolonged labour (PL), because these two could partly be avoided by improved antenatal, intrapartum, and postnatal care. The objective was to improve recognition of and response to PL and BA. The study was performed on women of reproductive age, older women and traditional birth attendants (TBA) by using semi-structured interviews, structured interviews and group interviews. Questions concerning health beliefs, signs and management of BA and PL including personal experience of these was asked. Findings will contribute to implementation of a new MNCH programme.

Data collection, processing and evaluation

Data was collected from community, sub-centres and hospital through preset forms. Pre- and post-intervention data were collected from HDSS databases and also baseline survey. All data was self-reported, collected in interviews. Overall results of the programme was evaluated by a before and after and intervention vs. comparison area design. The findings were analyzed in terms of knowledge and practices.

Analysis of data from Matlab databases

This part of my study was made to find out to what extent the implementation of several known effective interventions in the MNCH programme had an impact on asphyxia management. It was also designed to investigate if the socio-economical differences in asphyxia deaths had been on the same level or decreased over time. To do this, the HDSS and MNCH general databases were used to extract data concerning neonatal mortality, birth asphyxia and socio-economical status in ICDDR,B service area. For data accessible since several years in the HDSS database, like number of births, causes of death, socio-economical assets, and other characteristics of the mothers, evaluation was made according to a before-after design. Year 2005 to 2006 was chosen as pre-intervention. To get as many births as possible for evaluation of the intervention-period, data from 2007 to 2010 were extracted to represent this period. Because collection of some variables was introduced with the programme, they had to be analysed as annual changes from 2007 to 2010. Data on Apgar score was one of these. Noticeably is that the programme started in full first in March 2007. Data were analysed in SPSS 15.0.

What is the absolute and relative importance of asphyxia deaths over time – given the improved neonatal survival since the initiation of MNCH project?

Data on neonatal deaths between 2005 and 2010 were extracted from the databases, including causes of death. These were compared on an annual basis with the number of babies born. Causes of death of infants deceased at home were ascertained through verbal autopsy interview data.

In developing countries, where most of deliveries are made at home, routine neonatal death registration is often non-existent or inadequate. A common way of generating epidemiological data on mortality in low-resource settings is therefore by verbal autopsy (VA). The method uses retrospective interviews of family members to ascertain the death cause of infants. In Matlab, a questionnaire is used, developed by a VA working group of INDEPTH (International Network of Field Sites with Continuous Demographic
Evaluation of Populations and their Health in developing countries. It is based on WHO’s VA-questionnaire (WHO, 2007b) and adapted to local customs and culture. The questionnaire includes both open-ended and closed questions on pregnancy, birth and illness, collecting information on symptoms, signs, care seeking and other events related to the deceased. An interviewer visits the affected family two to six weeks after the date of death. The mother is the primary respondent, but other family members may also supplement the interview. Three different physicians then review the records independently to assign a direct death cause, and if possible also an underlying cause of death. Death causes are registered as a three-digit code from the list of the tenth revision of International Statistical Classification of Disease, Injuries and Causes of Death (ICD-10). At least two of the physicians need to agree to assign a direct cause of death (Chowdhury et al., 2010a, 2010b). The death causes are then divided into five different categories according to a preset system used in MNCH programme: birth asphyxia, infection, malformation, preterm and others. For instance, deaths caused by cord around the neck or meconium aspiration are defined as birth asphyxia.

Are the socio-economic differentials in asphyxia deaths remaining the same or decreasing over time?

Data on socio-economical status set for each household by HDSS, is based on a number of parameters including the amount of land the household owns, what kind of materials used for the main dwelling and which assets the household has got. These variables are arranged according to a system commonly used in Bangladesh, resulting in a socio-economical asset score quintiles ranging from one to five. One is the poorest and five is the richest. All households in the study area in Matlab have got their assets evaluated in 2005 or later. Data regarding neonatal death cause was also extracted. When neonatal deaths occur at home, the death cause is set by verbal autopsy, as described above.

By cross-tabulating the number of asphyxia deaths with socio-economical status, the rate of birth asphyxia mortality in different groups was calculated. Comparison was made annually from 2005 and 2006 when the programme had not yet started, until the end of 2010.

Is there an increased activity and quality in asphyxia management of the health care staff over time as reflected in the MNCH databases?

To analyse the activity and quality in birth asphyxia management of health care staff over time, data concerning Apgar score in one minute was collected from all deliveries handled at facilities in ICDDR,B area (sub-centres and hospital) where health care staff is present 24 hours a day. Apgar scores are not set at deliveries made at home, even if skilled personnel are attending, and was therefore not possible to analyse. Birth asphyxia is in general defined as Apgar score less than seven in one minute. Score 0-3 is called severe birth asphyxia while 4-6 is mild to moderate asphyxia. Data on neonatal mortality cause, and among them birth asphyxia, was also extracted. The case fatality rate for asphyxia deaths was then compared on an annual basis. Comparison was made over time starting when the MNCH programme had been established in 2007, until December 2010.

Questionnaire

Development of questionnaire

This part of the study was carried out to find out if the health care staff handling birth asphyxia had enough knowledge and training. Another purpose was to describe the situation for health care workers, to be able to find possible undetected difficulties or challenges in birth asphyxia handling. This method, a questionnaire, was chosen to answer some of the study questions. According to this, the questionnaire was developed to include questions regarding knowledge, attitude and practice.

The first part was developed to have questions concerning education, experience and training in neonatal resuscitation and also on the respondents own confidence in doing different tasks common in resuscitation. Questions about attitudes were asked to find out about the perceived importance in managing asphyxia and also about relation to senior colleagues. This first part of the questionnaire consisted of 14 structured
multiple-choice questions and two semi-structured questions that the respondents answered in writing, either in Bengali or in English. Most of the questions were put as a statement with the answers: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree.

The second part was performed as an oral examination with questions regarding how health care staff practices their knowledge. Questions were asked and answers written down by the investigator. A small number of questions, only seven, was chosen to briefly show the level of the respondent’s knowledge in the most important parts of resuscitation. A more accurate assessment would have required a comprehensive test with several questions and preferably a practical examination. That would have been too extensive for the scope of this study.

The first question in second part was about the criterions evaluated to determine Apgar-score in a newborn. Apgar is a widely accepted system used to express the infant’s physical condition. It is usually determined one minute after birth and then again at five minutes. The score is the sum of 0-2 points gained on assessment of colour (Appearance), heart rate (Pulse), reflex irritability (Grimace), muscle tone (Activity), and Respiration (Gomella & Haist, 2007). Two points were given for each right answer, with a maximum of ten points. The question was included because Apgar-score is determined for all babies born in Matlab facilities. There is also a cut-off for resuscitation set to Apgar-score less than seven. Some of the questions originated from MNCH project’s “Checklist For Newborn Resuscitation”, which the health care staff were supposed to follow. In the question concerning neonatal resuscitation, respondents were supposed to mention eight steps of action performed when a newborn is not breathing at birth. Answers did not need to be given in the right order. Recommendations for inflation time when giving ventilation is differing from clinic to clinic and from country to country. American Heart Association recommends an inflation time of 40 to 60 breaths per minute (Kattwinkel et al., 2010). We set the limit for approval to 30-60 in this study. CPR is suppose to be given with a ratio of 3:1 of chest compressions and ventilation, which was required to be considered as the right answer.

All questions were in English. During development of the questionnaire the questions were discussed with physicians and a midwife working at Matlab hospital to adapt it to the local conditions. Final questionnaire was evaluated and revised according to opinions from the supervisors of this study. Defining what would be approved as right answers in terms of how to resuscitate was based on the MNCH checklist and guidelines from American Heart Association (Kattwinkel et al., 2010). See attachment 1.

Respondents of the questionnaire

Interviews using the questionnaire were performed among health care staffs that manage deliveries and care for the newborn children in the immediate postpartum period in sub-centres and at Matlab hospital. Staff working in the government’s service area was not included. There are four sub-centres in ICDDR,B service area in Matlab. Only three of them, B-D, were included in the study, because sub-centre A does not provide deliveries. These sub-centres take care of approximately 7-10 deliveries per month. Complicated deliveries are sent to the hospital in Matlab, if possible. There are two paramedical staff, also trained as midwives, working in each sub-centre, which makes six respondents. The hospital in Matlab village provide for 1100-1400 deliveries per year. At the time of the study there were six physicians and ten midwives in the hospital staff that regularly participated in deliveries. Everyone was requested to participate in the study, voluntarily. All, except one of the physicians and one midwife, responded to the questionnaire. The physician did not want to participate and the midwife was not present in the hospital during the weeks the study was carried out. This makes a total number of 20 respondents.

Data collection -questionnaire

The interviews took place during a period of two weeks in the beginning of December 2010. They were conducted with one respondent at the time while they were on duty. Before starting the interview, information was given about the purpose of the study and about how the different parts of it were suppose to be carried out. When needed, an interpreter was used to read and explain the questions in Bengali, which was the case at the sub-centres and with some of the midwives at the hospital. Interpretation was in most cases made by the same woman, working in another study for ICDDR,B. On some occasions, other people
present in the room would help. For example, physicians sometimes interpreted a few words for midwives. If possible the interviews were carried out in a quiet, separate room, but many of them had to be made with other people around. On average the interview was completed in 15-30 minutes.

**Data analysis - questionnaire**

The answers of the questionnaires was entered into and analyzed in SPSS 15.0, except question 19 concerning resuscitation, which was calculated by hand. The findings from the multiple-choice questions were analyzed in terms of percentage of different answers. Also, responses from physicians and midwives were compared to each other. The semi-structured questions, answered in writing, were divided into subject categories in order to determine the frequency of different views. An opinion that was only expressed by one person was not included. In some cases, answers from midwives working at sub-centres were compared with the ones from hospital staff members.

When evaluating the questionnaire one of the questions was considered to be too complicated. It was asked in a way that made it difficult to give that right answer even if the respondent had the knowledge. Another question was asked in an incorrect manner by the investigator. Both of these questions were therefore erased from the study.

**Neonatal resuscitation checklist**

**Development of checklist**

For a successful resuscitation to be carried out personnel capable of initiating resuscitation should attend every delivery. Also, the need of resuscitation cannot always be predicted. Therefore, it is important with complete resuscitation equipment in fully operational condition at all times. To investigate if there is preparedness for neonatal resuscitation at facilities in Matlab, a suitable equipment checklist was prepared. The list was based on knowledge of proper resuscitation methods and instruments in resource-limited areas. Information was taken from “Helping babies breathe” initiative, the checklist used for neonatal resuscitation in the MNCH-project and present research concerning neonatal resuscitation in low-resource settings (HBB, 2010; Singhal & Bhutta, 2008; Wall et al., 2009) (See attachment 2).

**Data collection - checklist**

Sub-centres and hospital was inspected concerning to which extent they fulfilled the checklist. At sub-centres, this was made at the same visit as the interviews. The inspection was not announced to the paramedical staff in advance. At the hospital, inspection was carried out in connection with one of the physician-interviews. In all facilities the student together with one of the staff members, a midwife or a physician, performed the inspection. Notes were made if something differing was observed. A total of four inspections was preformed, three in sub-centres (B-D) and one at the hospital in Matlab.

**Data analysis –checklist**

As the data sample was very small and the different checklists appeared to be similar, it was analyzed by hand. Regard was taken to observations made on how the items differed. Findings were presented in writing, since there was no need for further statistical analysis.

**Ethical issues**

This study was embedded into the ongoing MNCH project, which was approved by the RRC (Research Review Committee) and ERC (Ethical Review Committee) at ICDDR,B before this study was commenced. Before doing the interviews, the respondent was informed about the purpose of the study and how it would be carried out. Any respondent not willing to participate was excluded. Completed questionnaires were kept anonymous. No names or identification codes were noted, except working-place (sub-centre or hospital).
Results

**MNCH programme**

Research population

The number of deliveries in ICDDR,B research area in Matlab ranged between 2627 and 2751 per year, with a mean value of 2666, in year 2005 to 2010. The total number of deliveries was 15997. The number of neonatal deaths during the same period was 310, with a significant decrease in neonatal death rate in 2007-2010. Neonatal deaths in 2005 and 2006 before MNCH-programme started, reported as number per thousand births, which is a common way of expressing mortality rate, were 26/1000 and 23/1000 live births. In the following years, 2007 to 2010, the neonatal mortality decreased to 18/1000, 16/1000, 15/1000 and 18/1000 live births, respectively. The mean value of neonatal mortality during the MNCH project was 17/1000. See table 1.

<table>
<thead>
<tr>
<th>Year</th>
<th>Live births</th>
<th>Neonatal deaths</th>
</tr>
</thead>
</table>
| 2005 | 2681        | 69             | 26%
| 2006 | 2673        | 61             | 23%
| 2007 | 2627        | 48             | 18%
| 2008 | 2751        | 45             | 16%
| 2009 | 2627        | 40             | 15%
| 2010 | 2638        | 47             | 18%
| Total| 15997       | 310            |

Table 1. Number of live births and neonatal deaths in ICDDR,B research area from 2005 until 2010

Background characteristics of the women giving birth, including level of education, parity, and socio-economic status, may change over time and have impact on the rate of neonatal mortality. Table 2 shows how these variables varied annually during the current period. A significant change in parity with a trend towards fewer births was seen. Unfortunately some data regarding parity is missing from 2007. The level of education of the women giving birth also changed during the years. The number without any education at all decreased and the proportion of women starting secondary school increased. The distribution of rich and poor was about the same during these six years.
Table 2: Background characteristics of mothers: the rate of parity, education and asset score of women giving birth from 2005 to 2010

<table>
<thead>
<tr>
<th>Parity</th>
<th>2005</th>
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<th>2009</th>
<th>2010</th>
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<tbody>
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<td></td>
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<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>0</td>
<td>955</td>
<td>1044</td>
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<td>347</td>
<td>38.6</td>
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</tr>
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<td>1</td>
<td>799</td>
<td>754</td>
<td>29.8</td>
<td>804</td>
<td>28.2</td>
<td>276</td>
</tr>
<tr>
<td>2</td>
<td>497</td>
<td>474</td>
<td>18.5</td>
<td>513</td>
<td>17.7</td>
<td>160</td>
</tr>
<tr>
<td>3</td>
<td>262</td>
<td>232</td>
<td>9.8</td>
<td>213</td>
<td>7.9</td>
<td>71</td>
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<tr>
<td>4 or more</td>
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<td>169</td>
<td>6.2</td>
<td>122</td>
<td>4.5</td>
<td>109</td>
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<td>%</td>
<td>n</td>
<td>%</td>
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<td>%</td>
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<td>Non</td>
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<td>576</td>
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<td>Primary complete</td>
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<td>1018</td>
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<td>10.4</td>
<td>228</td>
<td>8.6</td>
<td>200</td>
<td>7.6</td>
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<tr>
<td>Higher education</td>
<td>160</td>
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<td>136</td>
<td>5.1</td>
<td>94</td>
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<table>
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<tr>
<th>Asset score quintile</th>
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<th>2006</th>
<th>2007</th>
<th>2008</th>
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<td>%</td>
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<td>%</td>
</tr>
<tr>
<td>1 Poorer</td>
<td>421</td>
<td>15.8</td>
<td>422</td>
<td>16.2</td>
<td>378</td>
<td>14.5</td>
</tr>
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<td>19.3</td>
<td>518</td>
<td>19.9</td>
<td>502</td>
<td>19.3</td>
</tr>
<tr>
<td>4</td>
<td>644</td>
<td>24.1</td>
<td>583</td>
<td>22.4</td>
<td>606</td>
<td>23.3</td>
</tr>
<tr>
<td>5 Richer</td>
<td>620</td>
<td>23.2</td>
<td>629</td>
<td>24.1</td>
<td>666</td>
<td>25.6</td>
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</table>

<table>
<thead>
<tr>
<th>p-value</th>
<th>p=0.042</th>
</tr>
</thead>
</table>

1. Number of deliveries the women made, current excluded
2. Primary complete is defined as completing grade 5
3. Secondary complete is defined as completing grade 10
4. Higher education is defined as 11 to 16 years
Of the 15997 births made during the years of this study, 7406 happened at facilities, in sub-centres or at the hospital, and 5500 of the deliveries happened at home. Remaining births was made at other facilities, outside ICDDR,B research area. The proportion of births at home decreased annually ranging from 48.7%, and 41.9% in 2005 and 2006, before the start of MNCH, to 41.8%; 32.3%, 22.8% and 18.6% from 2007 to 2010, respectively. Seven deliveries had no place of birth registered and are therefore missing in this data. While deliveries made at home decreased, and so did deliveries in sub-centres, while hospital deliveries increased from 25.2% before the programme to 41.4% in 2010. The decrease in home and sub-centre deliveries was also compensated by the fact that more deliveries were made at other facilities.

Asphyxia mortality

During the period of six years, birth asphyxia was the most common cause of neonatal mortality both at facilities and in other birthplaces. A total of 100 asphyxia deaths occurred accounting for 32.5% of neonatal deaths compared to preterm 23.7%; infection 16.9%; malformation 9.4% and others 17.5%. The percentage of neonatal deaths caused by birth asphyxia decreased from 2005 to 2010. The lowest rate was seen in 2007, as showed in table 3. Mean value of asphyxia deaths during MNCH period was 31.3% compared to 34.0% the two years before the programme started. In number per thousand live births it corresponds to 8/1000 before MNCH and 5/1000 during the programme. Noticeably is that the number of malformations increased to a rather high level and that the rate of infections got very low. Also, the proportion of preterm deaths was unusually low initially.

Table 3. Distribution of neonatal death causes during 2005 to 2010

<table>
<thead>
<tr>
<th>Neonatal death cause</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
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<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Birth asphyxia</td>
<td>25</td>
<td>19</td>
<td>14</td>
<td>15</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Infection</td>
<td>23</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Malformation</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Preterm</td>
<td>9</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Others</td>
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<td>13</td>
<td>12</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>68</td>
<td>61</td>
<td>48</td>
<td>45</td>
<td>40</td>
<td>46</td>
</tr>
</tbody>
</table>

P-value p=<0.01

Socio-economical differences

Divided into five categories, 15.5% of the study population was regarded as poorest and 25.0% as richest in the distribution. In-between there are three additional categories accounting for 17.4%; 19.6% and 22.5% ranging from poor to rich, respectively (see also table 2). There was no significant difference between the groups regarding the rate of asphyxia deaths. Birth asphyxia mortality-rates ranged between 0.2% and 1.0%, but decreased during the MNCH period, 2007-2010. Anyway, no obvious trends regarding asphyxia mortality could be seen between rich and poor.

Birth asphyxia management

During the MNCH programme a total of 188 (4.2%) babies born in facilities had birth asphyxia. The rate of asphyxiated babies decreased significantly during the four years, ending at 3.1% in 2010. Among them, 60 cases (1.4% of all babies) were more serious, with severe birth asphyxia. The frequency of severe asphyxia
was rather stable; no significant variation could be seen over time. Unfortunately, as much as 707 of the births made in facilities had no Apgar score noted and is therefore missing in this data.

Table 4. Number and percentage of babies born at a facility, during 2007 to 2010, who had birth asphyxia, severe birth asphyxia and the case fatality rate for asphyxia. Some data for 2007 are missing

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th></th>
<th>2008</th>
<th></th>
<th>2009</th>
<th></th>
<th>2010</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Birth in facilities</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Birth asphyxia</td>
<td>27</td>
<td>6,3</td>
<td>62</td>
<td>4,8</td>
<td>57</td>
<td>4,1</td>
<td>42</td>
<td>3,1</td>
</tr>
<tr>
<td>There of severe asphyxia</td>
<td>4</td>
<td>0,9</td>
<td>22</td>
<td>1,7</td>
<td>17</td>
<td>1,2</td>
<td>17</td>
<td>1,3</td>
</tr>
<tr>
<td>Asphyxia deaths</td>
<td>7</td>
<td>0,7</td>
<td>7</td>
<td>0,5</td>
<td>7</td>
<td>0,5</td>
<td>3</td>
<td>0,2</td>
</tr>
<tr>
<td>Case fatality rate asphyxia</td>
<td>26</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A total of 24 babies (0,5%) born in facilities died due to asphyxia during the MNCH programme period. The death rate varied annually between 0,2% and 0,7% as seen in table 4. Even if a decreased rate was seen in 2010, changes over time was not significant (p-value 0,56). To measure the quality in asphyxia management of health care staff over time, the number of asphyxiated babies who died, case fatality rate, was calculated. The rate decreased, but not significantly. P-value was 0,14.

**Neonatal resuscitation**

Twenty respondents answered the questionnaire, five of them were physicians and fifteen were midwives. Of the midwives, six were working at sub-centres, all other staff worked at the hospital in Matlab. All respondents were women.

**Knowledge of neonatal resuscitation**

The level of knowledge in the studied group seemed to be quite good from their own point of view. Level of education was relatively equal among respondents; accept that one of the physicians had no education in neonatal resuscitation at all. All of the others had theoretical education and at least one occasion of practical training, which was the case for 50% of respondents. Even though 65% had got their last training more than two years ago, frequency of training was not very high. Only 20% had been trained during the last six month, which is the recommended procedure. Despite this, 90% agreed or strongly agreed to believe they had enough knowledge in how to handle birth asphyxia. Also 90% agreed, 60% strongly, to believe they had enough practical training. The ones doubting in these two questions were physicians. Birth asphyxia does not occur very often, but all of the physicians had handled at least one case in the last six month, which also 67% of the midwives had done. Two of the midwives had never handled birth asphyxia or did it more than two years ago.

Confidence in neonatal resuscitation was generally good. All of the respondents agreed to feel confident in determining Apgar score and performing neonatal resuscitation, 70% vs. 65% strongly agreed. The question on confidence in doing bag-and-mask ventilation gave a more scattered answer, 40% strongly agreed while 15 % strongly disagreed. The four persons who disagreed were working at sub-centres where they did not give bag-and-mask ventilation. A similar answer was seen regarding chest compressions, with some of the sub-centre midwives feeling uncomfortable to do this. All of the physicians, on the other hand, agreed to feeling confident. Everyone agreed that more frequent training in neonatal resuscitation would make him or her feel more confident, 70% strongly agreed to this.
Attitude to neonatal resuscitation

All respondents agreed that managing birth asphyxia is one of the most important tasks in their job, 90% of them strongly agreed. All health workers seemed to have good contact with their superiors, because everyone felt comfortable to mention suggestions to their senior colleagues. Half of them strongly agreed, half agreed. Midwives felt more comfortable than physicians, 60% of midwives strongly agreed compared to 20% of the physicians.

Practicing neonatal resuscitation

Everyone seemed to be quite happy with the equipment prepared for resuscitation; 55% strongly agreed it was always enough equipment and 40% agreed. None of the physicians strongly agreed. Partograph was always used by 100% of the respondents, at least according to the answers. Knowledge about which criteria that is included in Apgar score was very good. All respondents had 8-10 points of 10 possible. Only three persons missed one of the criteria’s. The question about at what Apgar score resuscitation is supposed to be started gave a more diverse answer; 60% knew that it was less than seven and 40% gave the wrong answer. The answer had to be exact to be accepted as right. Distribution between physicians and midwives was identical in this question. Figure 3 shows what percentage of respondents could mention the different steps included in resuscitation. The knowledge appeared to be widely spread. There was a higher knowledge of initial steps like drying, stimulating and wrapping the baby to keep it warm. These are tasks made at all deliveries, also in healthy babies, and 60-100% of both physicians and midwives knew this. Positioning the newborn, evaluating colour and heart rate was the least mentioned steps in both professions. The knowledge was lower in midwives than physicians (20-27% of midwives compared to 40-80% of physicians). All of physicians mentioned ventilation and chest compressions as a part of resuscitation. The knowledge of these steps among midwives was lower, but also good, with 93% mentioning ventilation and 53% chest compressions, considering that physicians are the ones performing resuscitation if present. Knowledge in ventilation rate was high; a total of 74% gave the right answer, 60% of physicians and 79% of midwives (if 40 would have been the lowest accepted limit, another six persons would have given a wrong answer). One person did not answer this question because of language difficulties. CPR was also well known by most of the staff; 75% gave the right answer. All of the physicians knew that the ratio between chest compressions and ventilation was 3:1. The midwives working at sub-centres did not perform CPR, they refer these patients to Matlab hospital, and were overrepresented among the ones who did not know the answer to this question.

![Figure 3. How many of the 20 respondents who mentioned the different steps in neonatal resuscitation.](image)

Main problems and obstacles to manage and prevent birth asphyxia

In this semi-structured question, diverse answers were collected. Of the respondents, eight persons (40%) did not see any problems or obstacles at all in preventing and managing birth asphyxia and seven persons (35%) experienced lack of equipment of different kinds. Some of these thought that lack of caesarean section at the hospital was a problem, someone wanted CTG to better monitor deliveries and midwives
working at sub-centres experienced periods of electricity failure. They also experienced a need for an ambulance at all times when referring to hospital.

As many as four people mentioned staff-related difficulties; some thought there were not enough specialists and doctors and others considered inadequate manpower to be a problem. Another four of the respondents saw a problem in not enough trained staff, mostly assistants.

A third cluster of answers was regarding social factors making prevention and management of birth asphyxia difficult. At least three persons mentioned that kind of obstacles. They figured mothers were not willing to come to hospital when needed and that risk factor identification is sometimes delayed, partly because of lack of facilities for all mothers. Under nutrition and short stature was also mentioned.

**Suggestions to how neonatal resuscitation can be improved**

A majority of answers to this semi-structured question concerned the need of training for personnel, as much as 15 (75%) of respondents gave an answer associated to this. Refresher training was considered to be needed at all staff levels, preferably every six month to one year according to some of the staff. Also, four people suggested improved equipment, including access to caesarean section in Matlab hospital.

**Neonatal resuscitation checklist**

All of the four delivery rooms visited were well equipped according to the checklist. They all had eleven out of twelve possible items listed. The only thing missing compared to the list was a head covering. Even though all facilities had the same equipment, some of the items were of different kinds and there were some observations made.

All facilities visited had sterile surgical gloves, stethoscope, cloths and a flat and firm resuscitation place available. If the place for resuscitation was clean or not, was difficult to decide in certain cases. Observation was made that one of the resuscitation places consisted of a trolley on wheels, which might be inappropriate. One of the sub-centres had no sterile cloths the day of visit because there had been a delivery only a couple of hours before and the equipment were not yet sterilized in the autoclave. Every sub-centre used a light bulb as a resource of light and heat. The hospital had both a light bulb and a heater present. At all facilities sterile ties and scissors was used when cutting the umbilical cord. Mechanical suction device was present in all settings, some electrical and some foot-pumped. There were also oxygen available everywhere but it was only at the hospital they sometimes used it for the babies. In sub-centres the use of oxygen was only for mothers. All settings used a clock on the wall to keep track of time during resuscitation. All of them also had a self-inflating bag-and-mask available but none of the paramedical staff in sub-centres was using it. Instead they did mouth-to-mouth ventilation if any ventilation at all. There were also preterm-masks missing in all of the sub-centres. The bag-and-mask in the hospital had preterm mask present but was not complete because the bag accompanying the bag-and-mask was missing. None of the facilities visited used a head covering for the baby. Instead the cloth was wrapped in a way that it covered also the baby’s head.

**Discussion**

**MNCH programme**

The programmatic approach through a continuum of care made in Matlab, Bangladesh, was successful in means of neonatal mortality. Based on data from before and during the interventions, a significant reduction in neonatal mortality did come about. The mean value during the programme was 17/1000 live births, which is low compared to an average rate of 23/1000 worldwide and 31/1000 in Bangladesh in 2010 (Rajaratnam et al., 2010). The health of a baby is closely related to the health and living of it’s mother. This study showed that the socio-economical differences between mothers did not markedly change during the period. However, there was a trend towards lower parity and more educated mothers. The decrease in
parity, particularly in number of women giving birth to four or more children, could be caused by improved family planning in the area. The number of mothers with no education at all also decreased, and the rate attending secondary school increased. Studies have shown that education is one of the major socioeconomic factors that influence a person’s attitudes and behaviour, including increased knowledge of health and care seeking (NIPORT, 2007). The increase in education could probably not cause the major changes seen in the survival of newborns, but may have effected it. Large effect can possibly be attributed to the rate of homebirths, which decreased from 48.7% to 18.6% during the studied period. It is remarkable when compared to the average in Bangladesh, which is 85% homebirths (NIPORT, 2007). Skilled birth attendance has for long been considered a requirement to reduce intrapartum related deaths, which corresponds well with the results in this study (Lee et al., 2009; Lawn et al., 2011).

Among the neonatal deaths that did happen, both the absolute number and relative proportion of asphyxia decreased. Proportion of neonatal deaths caused by birth asphyxia was reduced from 34.0% before to 31.3% during the program. Still, it is higher than the global average of 23%, but account must be taken that determination of causes of death and categories might differ between studies (Lawn et al., 2005). Remaining neonatal death causes did not follow the most common distribution. The rate of infections was initially as high as expected, but then decreased to surprisingly low levels. By contrast, the level of malformations increased and so did preterm deaths.

In most low-income countries, disparities between rich and poor is seen in terms of higher maternal and neonatal mortality among the poor, partly because of low access to skilled care at birth (Darmstadt et al., 2009). Disparities in this and other interventions for mothers and newborns, has showed to be greater than for interventions delivered to older children. Bangladesh is one of the countries where equity gap narrowed lately, and Matlab seems to be a good example (Bhutta et al., 2010). When divided into five categories, 15-16% belonged to the poorest group and 23-28% to the richest. No obvious trends of changes could be seen during the six years of evaluation. What is even more interesting is that no significant disparities between asset score quintiles could be seen regarding asphyxia mortality rate. This might be partly explained by the fact that several research studies have been running in Matlab before this one. The population might be more conscious even before the MNCH-study was introduced, and the differences in knowledge not as great as in other communities. On the other hand, the trend towards more facility deliveries could be expected to contribute to an increased proportion of poor people getting skilled birth attendants, able to save more newborn lives.

Globally, about 10% of all babies born need some kind of assistance to begin breathing at birth (Wiswell, 2003). If the limit is set to Apgar score less than 7 for resuscitation to be started, calling it birth asphyxia, this was the case for 4.2% of babies born in Matlab. Data is only applied on babies born in facilities during the intervention years. The rate decreased significantly during the four years of 2007 to 2010, which probably reflects increased prevention skills of the health care staff. Also, a well functioning community-to-facility care can lead to early recognition of complicated pregnancies, which might need special care. Presumably, it could take some time for health staff and implementation of interventions to a continuum of care to work smoothly. Anyhow, no significant decrease could be seen in the rate of severe birth asphyxia, which was 1.4%. A study made by PATH in Indonesia, showed that after training of midwives, 85% of birth asphyxia cases were successfully managed and the babies survived. Also in this study, case fatality rate was calculated as a measure of the managing of birth asphyxia by health care staffs. The number of babies born with birth asphyxia that died decreased during the period. In 2010, 93% of asphyxiated babies survived. The reduction was not significant, p=0.14, but nevertheless indicate improved neonatal resuscitation skills.

### Neonatal resuscitation

This part of the study was aimed to assess knowledge and training, and to describe the situation for health care staff handling newborns in Matlab, Bangladesh. The result just gave a snap shot picture of the facts of knowledge that the respondents possessed. Based on these results we may conclude that both midwives and physicians felt satisfied with their education and training, being comfortable in performing most
resuscitation tasks. Despite that, practice skills left more to be desired and a majority of respondents requested more resuscitation training.

First part of the questionnaire presents the staff’s amount of training, knowledge, and comfort in neonatal resuscitation. In this study, 95% had at least one occasion of practical training in neonatal resuscitation and 90% agreed to have enough knowledge and practical training. Despite this, it is hard to draw any conclusions regarding their skills, because a majority of respondents did their last training more than two years ago. Studies in both high- and low-income countries show that resuscitation skills decline rapidly during months following education programs, six months seems to be minimum for refresher training (Carlo et al., 2009; Jukkala & Henly, 2009). Only 20% of respondents in this study had trained in the last six months. The fact that 65% of them got their latest training more than two years ago shows that more could be done to further decrease the neonatal mortality rate Matlab. In line with the above-mentioned study, 20% of respondents did request a frequency of training between six months to one year. This suggests that handling of asphyxia cases, which a majority of staffs had done in the last six months, cannot replace training.

Confidence in resuscitation was also good. Most of respondents who did not feel comfortable with the more complex skills as ventilation and CPR, was working at sub-centres and did not do these tasks. Teaching them that could probably improve the care in Matlab. If effective ventilation and CPR was given immediately after birth, instead of referring to Matlab hospital, survival may be improved further. Summarizing these results, there can be concluded that the midwives conception of their knowledge, comfortable and skills was generally higher than the physicians. Despite this, it did not correspond to their actual knowledge of resuscitation, which was not as high as the physicians.

The second part of the questionnaire showed that managing of birth asphyxia was considered as one of all of the respondent’s most important assignments. Everyone also felt comfortable with suggesting things to their senior colleagues, which can be seen as an expression of an open work environment.

Third part claimed to reflect the health care staff’s skills in resuscitation. All respondents agreed to have enough equipment, which corresponds well with the results from the checklists. Everyone also used a partograph, a paper form for monitoring labour progress, seen as a promising intervention to improve obstetric care in low resource settings (Hofmeyr et al., 2009). Even if this study cannot prove that the partograph was actually used and used the right way, it suggests that there is regular monitoring of most deliveries made in facilities. Knowledge of Apgar score was also good, but the limit for resuscitation was not as well known. Consideration must be taken that Apgar score is only a tool to determine the newborns condition. The precise limit for resuscitation is not always important for accomplishing resuscitation.

Knowledge in resuscitation according to MNCH check-list showed to be slightly higher among physicians than midwives. This was expected knowing that physicians are the ones doing resuscitation when present at the facility. Knowledge in both professions was lowest for evaluation and positioning of the baby, which might be harder to remember to mention, even if it is done in the reality. On the whole, resuscitation knowledge was good for both professions.

By letting respondents answer semi-structured questions on needs and improvements for resuscitation where they work, the purpose was to get a description of their situation and to find possible unexpected difficulties. The obstacles for managing and preventing birth asphyxia mentioned, were divided into three clusters of answers. Lack of equipment as CTG and access to Caesarean section was one of them. These we also mentioned as suggestions for improvement. The situation for midwives at sub-centres included periods of electricity failure, with no electrical light until the generator started, which could take some time. Of course, proper light is a requirement for proper resuscitation to be carried out. Another cluster concerned staff-related difficulties as lack of specialists and trained assistants as well as inadequate manpower. Third theme was social factors. Some mothers are not willing to get healthcare and if they do, access to care is not always sufficient. Delay in decision to seek care is a well-known barrier for women in rural areas of low-income countries to access care (Lee et al., 2009). It is also high-prioritised for research needed to decrease intrapartum-related neonatal deaths by 2015.
As much as 75% of respondents requested refresher training for all staff members in newborn resuscitation. Many of them got their last training when MNCH-programme started, which was about four years ago. Despite this, 90% agreed to have enough knowledge and training in handling of birth asphyxia. Several studies in developing countries showed good results from neonatal resuscitation programmes, with decreasing skills the months following training.

**Neonatal resuscitation checklist**

All four of the visited facilities had the same equipment, which is not very surprising because they all belong to the same unit. Even though all of the places visited were well equipped this does not mean that the equipment present is actually used and used in the proper way. That was not examined in this study. The fact that sub-centres had access to bag-and-mask, but they were never used, may mark that the level of equipment is not always well balanced with the midwives level of knowledge. Preterm-masks for the bag-and-mask was missing in the sub-centres. This should not be a problem very often even if the bag-and-mask were actually used, because complicated deliveries like preterm births are sent to the hospital if possible. Even if there were light bulbs at all places, paramedical staff at one of the sub-centres was telling that electricity is often missing in the evenings. Before the generator starts, which often takes several minutes, they use a hurricane as a source of light. The hurricane does not give sufficient light to provide proper resuscitation. This shows that even if the equipment is there and is used in the right way, there may be other circumstances affecting the possibility to give resuscitation. At one sub-centre there were no sterile cloths available because they recently had a delivery. Even if they were running the autoclave later that day, it shows that the equipment was not enough if several deliveries would occur during the same day. Lack of equipment could then be a limiting factor for providing safe deliveries. Noticeable was also that all of the equipment was not actually collected in the same place but often scattered in the room, for example the stethoscope. The equipment was not always totally prepared at all times in any of the facilities. For example the light bulb was not plugged everywhere. That kind of preparation had to be done when a woman was in labour.

**Strengths and weaknesses in this study**

The data from Matlab used for the analyses include all cases in the area. This implies that the results represent the situation in the area. HDSS has been collecting data since 1966, which was a good prerequisite for getting valid baseline information. Only a few cases were missing in the different variables, which is difficult to avoid when handling such large amounts of data. A weakness may be the use of verbal autopsy for determining causes of death. However, verbal autopsy is commonly used in low resource settings where many birth occur at home, outside formal health care settings, and where routine death registration often is missing. The VA form used in Matlab is based on WHO’s questionnaire and properly adapted to local customs and culture. A weakness with this system might be that different physicians are reviewing the records and assigning causes of death. Two physicians have to agree to assign a death cause, but assessments may vary when physicians are replaced. Even though VA questionnaire for neonates have been used by HDSS in Matlab since 2003 (Chowdhury et al., 2010a), this might be an explanation of the noticeable trends of some of the neonatal death causes. Cases initially defined as infection might have been assigned as preterm in later years, when awareness and criteria of diagnoses changed.

The questionnaire was also performed on a maximum of respondents, which gives a good coverage. Due to the limited scope of this part of the degree project there were only a few questions on practice. Therefore, it did not necessarily give an accurate picture of the practical knowledge. Focus was instead on the health care staff’s own experiences and opinions. Since as many respondents as possible were requested to take part in the study, the questionnaire could not be tested on several staff members before the survey. Otherwise, that would have been desirable.

Significance of the checklist was not very high because it was only carried out in facility settings within the ICDDR,B service area. Anyway it did illustrate a gap between the midwives knowledge and available equipment. All sub-centres were over-equipped. Teaching those midwives ventilation techniques could probably improve neonatal outcome further. Other weaknesses of the study were that proper sterilisation
was not checked and neither were the functioning of light bulbs and heater. Some of the information, for example about cord ties, was at some of the places only verbally. Even if the inspection was unannounced, it could be possible that information about it spread to not yet visited sub-centres. Anyway, there were no signs of such biases.

**Former and future research**

Awareness of neonatal mortality as a barrier in receiving MDG 4 in time has increased and led to enhanced research on neonatal survival in the last decades. Several interventions have been showed to be effective. Effective care at birth as well as empowering of communities is important to reduce neonatal mortality and could probably save hundreds of thousands of lives a year (Lee et al., 2009). To accomplish this, evidence-based strategies are urgently needed in low- and middle-income countries where most of the deaths occur (Lawn et al., 2009). Because birth asphyxia cause 9% of the worlds under-five deaths, 11% in Southeast Asia, it is one of the most important problems to fight (Black et al., 2010). To increase the effectiveness of interventions and make them more cost-effective, Darmstadt et al. (2005) suggested combining such interventions into packages for scaling up in the health systems. The potential effect was calculated to avert 41-72% of neonatal deaths depending on baseline neonatal mortality rate. The same idea of combining interventions in a programme with a continuum of care from community to hospital was accomplished in Matlab. It proved to be effective, with a decrease in neonatal deaths and increased facility deliveries. This shows that much can be done to save lives of mothers and children even without access to advanced care, when implementing continuous care. It is also important to increase the motivation and knowledge of people, to create a demand for care. Also, interventions have to be tailored to local conditions. Next step in improving the care for mothers and newborns in low-income countries may be monitoring for fetal distress and access to Caesarean section (Bhutta, Darmstadt, Haws, Yakoob & Lawn, 2009). More research is required on delivery and development to increase availability of interventions especially for the poorest. Some of the top research questions may be early detection of maternal complications, simpler and cheaper technology for neonatal resuscitation and strategies for increased demand for skilled attendance (Lawn et al., 2011).

In Matlab, the resuscitation skills, and therefore also neonatal mortality, may be decreased further by improved training. This study showed that refresher training was demanded by many of the health care staffs. Resuscitation training has showed to be effective in several studies, but more research has to be made on implementation. More feasible models of maintaining clinical competency need to be developed with guidelines for how often training should be given (Victoria et al., 2010; Lawn et al., 2011; Wall et al., 2009). There is also a need for development of simple and cheap technology (Lawn et al., 2011).

**Acknowledgements**

First of all, I want to thank my supervisors Lars-Åke Persson, Uppsala University, and Anisur Rahman, ICDDR,B, Bangladesh, for all the support during this study. I am also very thankful for all kindness, generosity and help I experienced in Matlab, Bangladesh. A special thanks to Aminur Rahman, Monjur Rahman and Harunor Rashid. I am also greatful to Erik Ahlin for support and help with layout. This study was partly financed by Sida (Swedish International Development Cooperation Agency) through the International Maternal and Child Health and by foundation of Uppsala University.
References


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Annex I

Questionnaire - neonatal resuscitation

Midwife/physician

Sub-centre/hospital

Date (dd/mm/yy)__________________

Mark your answers to each question with an X in one of the boxes.

1. What kind of education did you get in neonatal resuscitation?

   Non

   Only theoretical education

   Practical training on 1 occasion

   Practical training on 2-3 occasions

   Practical training on more than 3 occasions

2. When were the last time you got neonatal resuscitation training?

   Less than 6 months

   Between 6 months and 1 year

   Between 1-2 years

   More than 2 years

   Never did
3. I believe that I have enough knowledge in how to handle birth asphyxia.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</table>

4. I believe that I have enough practical training in how to handle birth asphyxia.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
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<td></td>
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</table>

5. When was the last time you handled birth asphyxia?

- Less than 3 month ago
- Between 3-6 months ago
- Between 6 months and 1 year ago
- Between 1-2 years ago
- More than 2 years ago or never did

6. I feel confident in determining Apgar score

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
7. I feel comfortable with performing neonatal resuscitation.

Strongly disagree  Disagree  Neither agree nor disagree  Agree  Strongly agree

8. I feel comfortable with doing bag-and-mask ventilation.

Strongly disagree  Disagree  Neither agree nor disagree  Agree  Strongly agree

9. I feel comfortable with doing chest compressions.

Strongly disagree  Disagree  Neither agree nor disagree  Agree  Strongly agree

10. I believe that more frequent training in neonatal resuscitation would make me more comfortable.

Strongly disagree  Disagree  Neither agree nor disagree  Agree  Strongly agree

11. Birth asphyxia managing is one of the most important tasks in my job.

Strongly disagree  Disagree  Neither agree nor disagree  Agree  Strongly agree
If strongly disagree, disagree or neither agree nor disagree: why?

__________________________________________________________________

12. I feel comfortable to mention suggestions for improvement of birth asphyxia handling to my senior colleagues.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
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13. There is always enough equipment prepared for resuscitation to be carried out.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
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14. How often do you use a partograph during labour?

<p>| | |</p>
<table>
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</thead>
<tbody>
<tr>
<td>Always</td>
<td></td>
</tr>
<tr>
<td>Most of the time</td>
<td></td>
</tr>
<tr>
<td>Sometimes I do, sometimes I don’t</td>
<td></td>
</tr>
<tr>
<td>Most of the time I don’t</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td></td>
</tr>
</tbody>
</table>

15. In your working place, what are the main problems and obstacles to prevent and manage birth asphyxia?
16. Do you have any suggestions to how neonatal resuscitation can be improved where you work?

The following questions are asked and completed by the investigator

17. Which 5 criterion are evaluated to determine Apgar-score in a newborn?

<table>
<thead>
<tr>
<th>Activity (muscle tone)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse (heart rate)</td>
<td></td>
</tr>
<tr>
<td>Grimace (reflex response)</td>
<td></td>
</tr>
<tr>
<td>Appearance (color)</td>
<td></td>
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<tr>
<td>Respiration</td>
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</tbody>
</table>

Others: ___________________________________________

18. At which Apgar-scores are neonatal resuscitation suppose to be started?

_________________________________________________

19. Which are the major steps in neonatal resuscitation of a baby who is not breathing?

- Dry and stimulate
- Keep warm
- Position
- Evaluate color and heart rate
- If heart rate >60: Ventilate
- If heart rate <60/min: give chest compressions, 3 chest
20. At which rate shall ventilation be done?

___________________________________________________

21. How many chest compressions and ventilations are done in a CPR-cycle?

___________________________________________________

22. At which rate shall chest compressions be done?

___________________________________________________

23. Which are the major 3 steps in after care following successful resuscitation?

- Monitoring for 6 hours
- Explain to the mother about what has been done and possible consequences
- Initiate breastfeed as soon as possible

(Question 22 and 23 was excluded in the results)
Annex II

**Neonatal resuscitation equipment**

Sub-centre/Hospital  
Date (dd/mm/yy)________________

<table>
<thead>
<tr>
<th>Equipment</th>
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<tbody>
<tr>
<td>Sterile, surgical gloves</td>
<td></td>
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<tr>
<td>Towels or cloths</td>
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<tr>
<td>Head covering</td>
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<tr>
<td>Clean, flat and firm resuscitation place</td>
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<tr>
<td>Heater or light bulb</td>
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<tr>
<td>Sterile scissors or blade</td>
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<tr>
<td>Cord ties or clamps</td>
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<tr>
<td>Suction device: bulb suction, mucus extractor or mechanical suction</td>
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<tr>
<td>Self-inflating bag-and-mask: 240-750ml, masks in sizes for term and preterm</td>
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<tr>
<td>Oxygen</td>
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</tr>
<tr>
<td>Stethoscope</td>
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<tr>
<td>Timer, clock or watch</td>
<td></td>
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</tbody>
</table>