Maternal and Neonatal Death Review System to Improve Maternal and Neonatal Health Care Services in Bangladesh
Whenever I ask Aadi “Who is the scientist, pappa?”, my son raises a finger towards him and always smiles. He is now somewhere in the universe, but I believe he is always with me. This doctoral thesis is dedicated to my scientist son, Abhradeep Biswas Aadi
ANIMESH BISWAS

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Abstract

Bangladesh has made encouraging progress in reducing maternal and neonatal mortality over the past two decades. However, deaths are much higher than in many other countries. The death reporting system to address maternal, neonatal deaths and stillbirths is still poor. Moreover, cause identification for each of the community and facility deaths is not functional. The overall objective of this thesis is to develop, implement and evaluate the Maternal and Neonatal Death Review (MNDR) system in Bangladesh. The study has been conducted in two districts of Bangladesh. A mixed method is used in studies I and II, whereas a qualitative method is used in studies III-V, and cost of MNDR is calculated in study VI. In-depth interviews, focus group discussions, group discussions, participant observations and document reviews are used as data collection techniques. Quantitative data are collected from the MNDR database. In study I, community death notification in the MNDR system was found to be achievable and acceptable at district level in the existing government health system. A simple death notification process is used to capture community-level maternal and neonatal deaths and stillbirths. It was useful for local-level planning by health managers. In study II, death-notification findings explored dense pocket areas in the district. The health system took local initiatives based on the findings. This resulted in visible and tangible changes in care-seeking and client satisfaction. Death numbers in 2012 were reduced in comparison with 2010 in the specific area. In study III, verbal autopsies at community level enabled the identification of medical and social causes of death, including community delays. Deceased family members cordially provided information on deaths to field-level government health workers. The health managers used the findings for a remedial action plan, which was implemented as per causal findings. In study IV, social autopsy highlights social errors in the community, and promotes discussion based on a maternal or neonatal death, or stillbirth. This was an effective means to deliver some important messages and to sensitize the community. Importantly, the community itself plans and decides on what should be done in future to avert such deaths. In study V, facility death review of maternal and neonatal deaths was found to be possible and useful in upazila and district facilities. The findings of facility death reviews were helpful to local health mangers and planners in order to develop appropriate action plans and improve quality of care at facility level. Finally, in study VI, the initial piloting costs required for MNDR implementation were estimated, including large capacity development and other developmental costs. However, in the following year, costs were reduced. Unit cost per activity was 3070 BDT in 2010, but, in the following years, 1887 BDT and 2207 BDT, in 2011 and 2012 respectively.

Keywords: Bangladesh, Facility Death Review, Maternal and Neonatal Health, Social Autopsy, Verbal Autopsy

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Definitions

**Community verbal autopsy:** A method of finding out the medical causes of death and ascertaining the personal, family or community factors that may have contributed to the deaths in women who died outside a medical facility (1). A community verbal autopsy identifies deaths that occur in the community and consists of interviewing family members of the deceased or neighbours who were present at the time of complications or consequences before death. It can also be used to identify contributing factors including first and second delays in the community.

**Facility death review:** A quantitative review of the causes of and circumstances surrounding maternal and neonatal deaths and stillbirths at health facilities. Deaths are initially identified at facility level but, where possible, reviews are also concerned with identifying factors at the facility that contribute to avoidable death.

**Maternal death:** The death of a woman while pregnant or within 42 days of the end of the pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes (1).

**Neonatal death:** The death of live-born infants on, or before 28 days post-partum (2).

**Social autopsy:** An innovative strategy wherein a skilled health personnel helps socially deficient people to improve their social skills by jointly analyzing the social errors they make and designing alternative strategies. It is a way of examining/scrutinizing a social barriers in an event/occurrence to determine why it occurred and how it could be prevented from re-occurring in the future.

**Stillbirth:** Any foetus born without a heartbeat, respiratory effort or movement, or any other sign of life at or after 28 weeks’ gestation (3).

**Upazila:** Each district in Bangladesh consists of a number of sub-districts called upazilas. Within each upazila, there are smaller units called unions; one upazila consists of a number of unions of different population sizes.
### List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI</td>
<td>Assistant Health Inspector</td>
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<td>ANC</td>
<td>Antenatal Care</td>
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<td>CC</td>
<td>Community Clinics</td>
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<td>CS</td>
<td>Civil Surgeon</td>
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<td>DDFP</td>
<td>Deputy Director Family Planning</td>
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<td>DGHS</td>
<td>Directorate General of Health Services</td>
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<td>DGFP</td>
<td>Directorate General of Family Planning</td>
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<td>FDR</td>
<td>Facility Death Review</td>
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<td>FPI</td>
<td>Family Planning Inspector</td>
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<td>FWA</td>
<td>Family Welfare Assistant</td>
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<td>GOB</td>
<td>Government of Bangladesh</td>
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<td>HA</td>
<td>Health Assistant</td>
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<td>HI</td>
<td>Health Inspector</td>
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<td>HPNSDP</td>
<td>Health, Population and Nutrition Sector Development Programme</td>
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<td>MCWC</td>
<td>Mother and Child Welfare Centre</td>
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<td>MDGs</td>
<td>Millennium Development Goals</td>
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<td>MDSR</td>
<td>Maternal Death Surveillance and Response</td>
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<td>MNDR</td>
<td>Maternal and Neonatal Death Review</td>
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<td>MNHI</td>
<td>Maternal and Neonatal Health Initiative</td>
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<td>MOHFW</td>
<td>Ministry of Health and Family Welfare</td>
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<td>MPDR</td>
<td>Maternal and Perinatal Death Review</td>
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<td>MMR</td>
<td>Maternal Mortality Ratio</td>
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<td>NGO</td>
<td>Non-Government Organization</td>
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<td>NMR</td>
<td>Neonatal Mortality Rate</td>
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<td>SA</td>
<td>Social Autopsy</td>
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<td>SDGs</td>
<td>Sustainable Development Goals</td>
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<td>ToT</td>
<td>Training of Trainers</td>
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<td>UFPO</td>
<td>Upazila Family Planning Officer</td>
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<td>UHC</td>
<td>Upazila Health Complex</td>
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<td>UH&amp;FPO</td>
<td>Upazila Health and Family Planning Officer</td>
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<td>UNICEF</td>
<td>United Nations Children Fund</td>
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<td>UNFPA</td>
<td>United Nations Population Fund</td>
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<tr>
<td>VA</td>
<td>Verbal Autopsy</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>15</td>
</tr>
<tr>
<td>2. BACKGROUND</td>
<td>18</td>
</tr>
<tr>
<td>2.1 Maternal and neonatal health in Bangladesh</td>
<td>18</td>
</tr>
<tr>
<td>2.2 Stillbirth in Bangladesh</td>
<td>20</td>
</tr>
<tr>
<td>2.3 Health Care and Services in Bangladesh</td>
<td>21</td>
</tr>
<tr>
<td>2.4 Maternal and Neonatal Death Review</td>
<td>24</td>
</tr>
<tr>
<td>2.4.1 From MPDR to MNDR: the pathway in Bangladesh</td>
<td>25</td>
</tr>
<tr>
<td>2.4.2 Audit or review</td>
<td>25</td>
</tr>
<tr>
<td>2.4.3 Community Death Review (Verbal Autopsy)</td>
<td>26</td>
</tr>
<tr>
<td>2.4.4 Facility Death Review</td>
<td>27</td>
</tr>
<tr>
<td>2.4.5 Social Autopsy</td>
<td>27</td>
</tr>
<tr>
<td>2.5 Rationale for the study</td>
<td>29</td>
</tr>
<tr>
<td>3. OBJECTIVES</td>
<td>31</td>
</tr>
<tr>
<td>3.1 Overall objective</td>
<td>31</td>
</tr>
<tr>
<td>3.2 Specific objectives</td>
<td>31</td>
</tr>
<tr>
<td>4. METHODS</td>
<td>32</td>
</tr>
<tr>
<td>4.1 Different data collection techniques</td>
<td>34</td>
</tr>
<tr>
<td>4.1.1 Focus group discussions (FGDs)</td>
<td>35</td>
</tr>
<tr>
<td>4.1.2 In-depth interviews (IDIs)</td>
<td>36</td>
</tr>
<tr>
<td>4.1.3 Participant observations</td>
<td>36</td>
</tr>
<tr>
<td>4.1.4 Document review</td>
<td>38</td>
</tr>
<tr>
<td>4.2 Data collection</td>
<td>40</td>
</tr>
<tr>
<td>4.3 Analysis</td>
<td>54</td>
</tr>
<tr>
<td>4.4 Ethical considerations</td>
<td>56</td>
</tr>
<tr>
<td>5. SUMMARY OF RESULTS</td>
<td>57</td>
</tr>
<tr>
<td>6. DISCUSSION</td>
<td>66</td>
</tr>
<tr>
<td>7. CONCLUSION</td>
<td>86</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>87</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>89</td>
</tr>
</tbody>
</table>
1. Introduction

Ninety-nine percent of maternal deaths due to pregnancy and its complications occur in developing counties (4). Similarly, a large number of neonatal deaths and stillbirths occur every year, a majority in low-income countries. Some 95% of total maternal and child deaths occur in 75 low- and middle-income countries (5), and countries in the Asia region are at high risk (6-7). It has been estimated that, for each stillbirth, there is one neonatal death (8). However, more than 70% of newborn deaths are preventable with evidence-based practices (7). Reducing maternal and neonatal deaths is an integral part of the global agenda to achieve millennium developmental goals (MDGs) 4 and 5 by 2015 (5).

Bangladesh has made encouraging progress in reducing maternal and neonatal mortality over the past two decades. Since 1990, maternal mortality has fallen by two-thirds (9), and neonatal mortality by more than 50 percent (4). The maternal mortality ratio (MMR) has fallen from 574 deaths per 100,000 live births in 1991 to 194 deaths in 2011. Recent data show that the MMR is 170/100,000 live births (10). Neonatal mortality declined between 1989 and 2014 from 52 to 28 deaths per 1000 live births (11). Nevertheless, challenges still remain to reduce MMR to 143 by 2015 to achieve MDG 5 by 2015. Moreover, the slow reduction in neonatal deaths which make up 60 percent of all under-five deaths is also considered to be a major challenge to achieving MDG 4 by 2015. There is already a serious need to set the post-MDG goals, called the sustainable development goals (SDGs), which are to be met by 2030. SDG 3.1 has the target of reducing the global maternal mortality ratio to less than 70 per 100,000 live births, while SDG 3.2 has been set to end preventable deaths among the newborn and children under five (12).

Bangladesh needs to put in a huge effort to achieve the SDGs. Here developments are promising, but challenges are still remain in a country in which a majority of maternal and newborn deaths occur at home, and where traditional birth attendants and relatives still perform 72.2% of normal deliveries in the community (13). Mothers in the family still lack the knowledge to ensure adequate birth planning and regular antenatal care. One study also shown that maternal and neonatal deaths including stillbirths are associated with low quality healthy environment, deficit in health care resources. Moreover, dissatisfaction of health care providers and recipient also responsible (14).

Further, as has already been mentioned, the majority of the maternal and neonatal deaths in developing countries are avoidable (9, 15). Whereas, many countries have deficit of data related to social, behavioural and
health system determinants of child and maternal deaths, In addition, civil registration system is so poor, that most of the deaths are under reported (16). Moreover, causes of death determination yet not take place in many of the low income countries (17).

A requirement for finding solutions and working on what really needs to be done to reduce such deaths is to establish a death review system. Such a system could reveal maternal and neonatal deaths and stillbirths separately, identify their unknown and unidentified causes, and highlight the primary factors to act upon for their future prevention.

Verbal autopsy is widely practiced in assignment of causes of deaths at community level, which helps the taking appropriate steps for the reduction of death (18-19). Also, facility death review of maternal and neonatal deaths is also utilized at medical facilities to improve the quality of services at facility level (20-21). Maternal death review has been identified as a key element in a strategy to improve the quality of maternal healthcare services by focusing on causes of deaths and on what could have been done to avert each one of them (22). Maternal death review is already used in many countries to identify the causes of community and facility deaths (23-28), whereas neonatal death and stillbirth review is also performed to explore causes of death more generally (6, 8, 18). In the South East Asian region, review of mother and newborn death is already performed in India, Nepal, Pakistan, Sri Lanka, and the Maldives (28-32). The World Health Organization [WHO] maternal death review model, “Beyond the Number” was developed in 2004 to review deaths both in community and at medical facilities (1). Later, in 2013, WHO published a new model, “Maternal Death Surveillance and Response”, which focuses more on how maternal death review findings serve to reduce maternal deaths at community and facility levels. The new model has an emphasis on counteractive responses to death findings (4). However, a comprehensive death review system for addressing maternal and neonatal deaths, and stillbirths, at both community and facility levels is lacking.

Bangladesh faces the challenge of reporting maternal, neonatal deaths and stillbirths in the community, and follow-up by death review at community level is absent. There are difficulties in obtaining information on deaths, including death review at facility level. At present, the country does not have any routine inbuilt ongoing surveillance system for identifying maternal and neonatal deaths or their causes. National-level maternal mortality surveys have been conducted twice in the last decade, in 2001 and 2010, to obtain details of causes of maternal deaths and compute the death ratio (13, 34). Given the country context and the demand, the Directorate General of Health Services (DGHS) of Bangladesh, in collabora-
tion with the Directorate General of Family Planning (DGFP) of the Government of Bangladesh, with technical assistance from UNICEF, Bangladesh, and the Centre for Injury Prevention and Research, Bangladesh (CIPRB), initiated the development and implementation of a comprehensive maternal and neonatal death review (MNDR) system to cover both community and facility deaths. The system also covers the notification and review of stillbirths, and is not restricted to the gathering of data; rather, the entire system is designed to work on responses to death for the reduction of deaths in the country. During 2010, this system was guided by WHO’s maternal death review model, “Beyond the Number” (1), under the joint GoB-UN Maternal and Neonatal Health Initiatives (MNHI). This study describes the development and implementation of the MNDR system, and evaluates its effects in terms of improving maternal and neonatal health care services in Bangladesh.
2. Background

2.1 Maternal and Neonatal Health in Bangladesh

Bangladesh is making maximum efforts to improve the overall health status of mothers and the newborn. The initiatives of the last two decades have been mainly targeted at reducing the number of deaths. The progress has been impressive, and has been appreciated globally for its sustainability, but the country still needs further progress in reducing maternal and neonatal deaths, which is the mandate of the government.

2.1.1 Maternal health in Bangladesh

Bangladesh has steadily improved with regard to maternal mortality in past decades. Bangladesh is one of the countries on track to achieve MDG 5 (9). The government of Bangladesh has already invested in improving maternal health, with the support of different development partners (34). The lowest-level fixed-location health facilities in the rural community, called community clinics, are providing maternal and child health care, including antenatal care for pregnant mothers, and reproductive health and family planning services. Moreover, the community clinics are also used as hubs for referrals to higher-level primary health care centres in the upazilas and above (10). The Health, Population and Nutrition Sector Development Programme (HPNSDP) of Bangladesh has adopted a national strategy for maternal health, focusing on Emergency Obstetric Care (EOC), in order to reduce maternal mortality, and to promote the early detection of complications and follow-up in a proper referral system (35). Therefore, the government also established collaboration with UNICEF to undertake facility-based emergency obstetric care (EOC) in all districts of Bangladesh. Comprehensive EOC services are also established in all medical college hospitals, most of the district hospitals, and the upazila health complexes (36). Basic emergency obstetric care (BEOC) is provided in the remaining government facilities. As a result, facility-based normal deliveries and caesarean sections have increased (10). In 2007, the government also introduced demand side financing (DSF), which improves access to and use of quality maternal services, ensures safe delivery, and treats complications. The Directorate General of Health Services and the Directorate General of Family Planning jointly pursue maternal and neonatal health initiatives with the assistance of UNICEF, UNFPA and WHO in ten districts of Bangladesh, where the focus is on creating need-based demand and priority-based action though local level planning and implementation. A community-based skilled birth attendants training programme was established in 2003. It has trained government field-level health and family planning staff and similar NGO workers (in the private sector) to ensure normal delivery in the rural community by trained people. In addition, the
government has introduced midwifery course and created posts in the facility.

The country has generated a strong evidence-based improvement in maternal health care. The Bangladesh Maternal Mortality Surveys (BMSS) of 2001 and 2010 can be easily compared to see how the country has gradually reduced the number of deaths. From 2001, maternal mortality fell to 194 in 2010, which represented a 40 percent decline in nine years. The rate of decline was on average 5.5 percent a year. Countdown to 2015 tracking suggests that Bangladesh optimized its level of maternal deaths at 170 in 2013 (37).

The BMSS surveys have shown that facility-seeking care has doubled since 2001 (9% to 23%), which entails that delivery by skilled birth attendants has also doubled. However, increases in awareness and educational level improved the overall situation. There was a substantial increase, to 68 percent, in women experiencing obstetric complications seeking treatment compared with 53 percent in 2001 (13, 34). While there is still a short fall in home deliveries, of which there are around 2.4 million per year, improvement was also made because of greater access to health services (34). That the maternal care-seeking rate is still low in Bangladesh is a challenge in relation to achieving a large reduction in maternal mortality in Bangladesh (36). Moreover, the slow annual reduction rate in mortality and the increasing share of indirect causes of maternal mortality are challenges to achieving MDG 5 in time (38). Therefore, at this stage, it seems to be very difficult for the country to reduce its MMR to 143 by the end of 2015. The context suggest that there is an urgent need to establish a more structured system to reduce maternal deaths in the coming days.

2.1.2 Neonatal health in Bangladesh

Bangladesh has experienced a remarkable decline in infant and under-five mortality. Neonatal deaths also fell to 28 in 2014, compared with 55 in 1990 (11, 39). The national annual decline in the neonatal mortality rate over the time period was 2.1%, greater than both the global and Southern Asian regional average of 2.0%. One study has shown that newborn-related interventions reduce neonatal deaths through the support of community volunteers and low-level health workers in rural settings (40). There has been a sharp increase in the care-seeking behaviour of mothers, and demographic health surveys have shown that antenatal care increased from 43 percent in 2011 to 58 percent in 2014, when a majority of women (64 percent) received antenatal care from a medically trained provider (11). Therefore, facility deliveries also increased rapidly, from only 12 percent in 2004 to 37 percent. Similarly, postnatal care within the first 48 hours after delivery increased to 34 percent in 2014 in comparison with
20 percent in 2007. Essential newborn care has also improved and has noticeable patterns; drying of the newborn within 5 minutes of birth has increased substantially, as have initiation of breast feeding within the first hour and delayed bathing of the newborn (not in the first 72 hours). The country has been congratulated globally for its outstanding performance, and received an award in 2010 (41). The country has already achieved MDG 4, of under-five mortality of 48 deaths per 1000 live births by 2015.

Over the last decade, health policy changes related to newborn care have included introduction of the National Newborn Health Strategy (NNHS). Both facility and community Integrated Management of Childhood Illness (IMCI) have been scaled up. Facility IMCI has been extended to 425 upazilas, initially in all districts with high child mortality, and community IMCI to 150 upazilas mainly in the low-performing districts. With neonatal mortality showing a slow decline, neonatal health has been incorporated into both facility and community IMCI programmes.

The Ministry of Health and Family Welfare (MOHFW), with the support of developmental partners, has invested in the national scale-up of the Helping Baby Breathe (HBB) programme for the prevention and management of newborn deaths due to birth asphyxia. As of April 2013, 40 districts and two city corporations were covered. Logistic equipment, like a penguin sucker, bag and mask, has been distributed. Large-scale maternal, neonatal and child health (MNCH) programmes, along with newborn health interventions, are being carried out in 31 out of 64 districts. Moreover, the MOHFW has established special-care newborn units (SCANU) in 20 hospitals (medical colleges and district hospitals). Although the medical and social causes of these deaths are known, segregated data, in geographic and socioeconomic strata, are not available by district and they are needed as a basis for programme interventions. A majority of newborn are still dying in rural areas, which needs urgent attention (10). The Every Newborn Action Plan (ENAP) has the goal of reaching 12 newborn deaths or less per 1000 live births by 2030 (42). The country still requires a tremendous effort to reduce neonatal deaths in the immediate future.

2.2 Stillbirth in Bangladesh

Stillbirth is an important indicator of access to and quality of care during pregnancy and childbirth. In 2014, a health bulletin in Bangladesh reported a total number of 16 974 stillbirths in government and non-government facilities (10). A study in Bangladesh reported higher risk of stillbirth among deliveries in hospitals (43). Although community death reports are limited, there are indicators that stillbirths are either equal in number or more likely than neonatal deaths (44). One study has observed an associa-
tion between low socio-economic status and increased risk of stillbirth. Maternal illiteracy also influences the occurrence of stillbirths (45).

However, data on stillbirths are scarce, although estimates indicate that the number of stillbirths is similar to that of early neonatal deaths (deaths within 7 days). A limited-scale study of a rural district in Bangladesh has reported a stillbirth rate of 36.3 per 1000 births (33), while another study has shown a stillbirth rate of 25.8 per 1000 total births (45). Most of the stillbirths occur at term gestations, and a majority during the intrapartum period. However, when comparing stillbirth rates between 1995 to 2009 in large countries, some, including Bangladesh, have made progress (46). The five major causes of stillbirth are childbirth complications, maternal infections in pregnancy, maternal disorders (especially hypertension and diabetes), foetal growth restrictions, and congenital abnormalities.

Although the number of deaths involved is huge, stillbirth has been shown to be neglected. The Millennium Development Goals (for 2015) do not include stillbirth. There are weak vital registration systems, especially in the regions where most stillbirths occur, which limit the availability of data and hamper the calculation of precise estimates. Vital registration systems must be improved so that all stillbirths are counted (46). Although the Every Newborn Action plan (ENAP) has been set up a target to reach 10 stillbirth or less per 1000 total births by 2035 (42), Bangladesh requires an urgent focus on stillbirth reduction through review and remedial actions.

2.3 Health Care and Services in Bangladesh

The Government of Bangladesh is investing in the health sector for its sustainable improvement. The key focus has been on improvements to maternal and child health. The country has a solid infrastructure from grass-roots level in the villages through to central level. Moreover, a continuous effort is being made to ensure that doctors and nurses, alongside other health care providers in the villages, serve the rural community. In the past eight years, the Ministry of Health and Family Welfare has been able to establish community clinics, the rural health centres, for ensuring services for pregnant mothers and the newborn. This opened up a new arena in health care delivery in Bangladesh. The initiatives focus on achieving a reduction in maternal and newborn deaths in Bangladesh.
2.3.1 Government initiatives in maternal and neonatal health

The Government of Bangladesh is committed to providing quality health services to all people in the society. The National Maternal Health Strategy of 2001 and the Neonatal Health Strategy and Guidelines 2009 are the key guiding policy documents. The Health Nutrition Population Section Programme (HNPS) during 2011-2016 emphasizes partnership, collaboration, and coordination with development partners and NGOs for wider coverage. The Ministry of Health and Family Welfare, in the HNPSP framework, provides an excellent policy environment for innovation and the implementation of maternal and neonatal health interventions. Intervention is a top priority of the HNPSP, with a particular focus on maternal and neonatal health services in order to contribute directly to achievement of the MDGs.

The HPNSDP has the target of 50 percent of women receiving at least one postnatal visit from a medically trained provider within 48 hours of birth by 2016. In the effort to achieve equity in delivery in a health facility, the HPNSDP sets a ratio of less than 1 to 4 between women in the lowest and the highest quintiles (35).

Over the last five years, the Ministry of Health and Family Welfare in Bangladesh has also taken significant initiatives for improving the management information system at every level to enable the system to deliver timely reliable information to planners, managers and health professionals for evidence-based decision-making and implementation. A web-based management information system provides open access for the general public to see key health indicators. In October 2013, the Directorate General of Health Services incorporated web-based data collection software – the District Health Information System (DHIS2) – which also has scope for including maternal and neonatal death registration online and an improved health system. Bangladesh has also highlighted the digitization of maternal death data, permitting parliament to make accountable the heads of the hospital, which is a powerful motivation to reduce deaths (47).

Moreover, the management information system has also started to publish regular and timely health bulletins at local (upazila health complexes) and central level (national health bulletins). Yearly health statistics from the upazila and district facilitates give estimates of the maternal mortality ratio and neonatal mortality rate (10). The challenge is still to obtain regular upload of all maternal, neonatal deaths and stillbirths in the online system as soon as deaths occur, which will enable strengthening of the health system.
2.3.2 Health infrastructure and service delivery at district level

The Ministry of Health and Family Welfare is responsible for planning and managing curative preventive as well as promotive health services (48). Under the Ministry of Health and Family Welfare, two separate directorates work together to provide the services. The Directorate General of Health Services and the Directorate General of Family Planning are committed to providing free medical services to the people through well-structured and established government facilities.

Bangladesh has a surprisingly extensive health infrastructure, which covers the whole country. The country has seven administrative divisions and 64 districts, while the districts are divided into 485 upazilas, and the upazilas into 4546 unions. Each union consists of approximately 25 000 people, according to government health bulletin 2014, the unions are sub-divided, in most cases, into wards (10, 36).

The lowest-level government primary health care centres are called upazila health complexes, which have 10-51 beds. There are a total of 424 upazila health complexes providing services in the country, and below them there are another 59 facilities. Moreover, at upazila level, there are a further 14 201 outpatient centres. Among them, there are the community clinics at the lowest level (n=12 779 centres), which are stationary health facilities located in the wards (within unions in the upazilas). A centre usually covers a population of around 6000, with home-based services from the community clinic (36). Above that, at district level, there are secondary health referral centres, which have 50-250 beds. However, the districts have fewer facilities than the tertiary medical college hospital or the specialized hospitals at divisional level in the country.

A system has been established for referrals from the community clinics to upgrade the health centres. Community clinics provide routine health and antenatal care in rural areas, and conduct normal deliveries where facilities are available. The community health care provider, the Health Assistant (HA) from the health department and the Family Welfare Assistant (FWA) from the family planning department provide the services. They are the workers at grassroots level, and they are supervised by a first-line supervisor, Health Inspector (HI), and Assistant Health Inspector (AHI) from health services, and Family Planning Inspector (FPI) from family planning.

The upazila health complexes have a number of facilities to cover deliveries, and access to clinical specialists to provide care. The health complexes are led by the Upazila Health and Family Planning Officer (UHFPO). Moreover at each upazila health complex, there is one officer who leads
family planning, called the Upazila Family Planning Officer (UFPO). At district level, the health department is led by the Civil Surgeon (CS) who is in overall charge of the district, whereas the Deputy Director of Family Planning (DDFP) is responsible for the family planning department. At district level, there is also a maternal child welfare centre from the family planning department, dealing mostly with antenatal care, delivery and different contraceptive methods. Complicated patients are usually referred to the tertiary hospitals by the districts (10).

2.4 Maternal and Neonatal Death Review

Maternal and Neonatal Death Review (MNDR) is an evidence-based intervention that first examines causal factors, either medical or social, and follows up with appropriate actions to reduce maternal and neonatal deaths. The process is always participatory and provides ample scope for health managers and providers to plan and develop needs-based strategies and approaches for further improvement, where social and health system factors are considered beyond the medical causes of maternal and perinatal deaths.

It has been found that maternal death reduction is possible in low-income country settings. However, detailed information is needed on what has happened behind the deaths, including underlying factors that led to them. The stories provide indicators of the realistic ways of addressing the problems. Following that, there is a commitment to act upon the findings of the reviews reduce the number of deaths (49).

The Government of Bangladesh is strongly committed to improving the quality of care in all health sectors. Therefore, the country adopted a proposed MNDR system, although mostly focusing on reducing deaths maternal and neonatal deaths, and stillbirths. There must be a functioning MNDR framework to utilize all opportunities in the existing health system to extend collaboration between the health/family planning directorates and non-public partners, so as to improve the quality of maternal and perinatal health care both in facilities and at community level. The proposed MNDR system will rely on identifying and tracking pregnancies from childbirth through to 42 days after birth and their neonates. This will involve notifying maternal and neonatal deaths and stillbirths in the community and at facilities, and performing community-level verbal autopsy and social autopsy, and death review at facility level. The evidence and data from both facility- and community-based maternal and neonatal death reviews will enrich local-level planning for effective interventions.

MNDR approaches do not work only by counting deaths. They develop an understanding of why deaths happen and how they can be averted.
MNDR can take place at all levels, from an individual health care facility up to national level. A fundamental principle of the approaches lie in the importance of a confidential, usually anonymous, non-threatening environment in which we can describe and analyze the factors leading to adverse perinatal outcomes, including maternal ones. Ensuring confidentiality, MNDR leads to openness in reporting which provides a more complete picture of the precise sequence of events. The participants, including health care providers, community workers and family members, will not be threatened, but rather be assured that their solitary purpose is to learn from past misfortunes and save lives in the future. Surveillance provides a continued process for death review, mostly focusing on identification of lapses or failures in the health care system, thereby gradually improving the health situation.

MNDR in Bangladesh can be introduced with the existing government health system as a facilitator. It will promote equitable access to quality health services, with greater attention paid to the poor and vulnerable groups in rural and underserved areas. The intervention will promote ways to identify and rectify the medical and social errors related to maternal and neonatal deaths without attaching any blame.

2.4.1 From MPDR to MNDR: the pathway in Bangladesh

A wide range of acronyms are used in the field of death review. Some countries use the term, maternal and perinatal death review (MPDR) (21, 50), which in fact covers maternal deaths and perinatal deaths. A majority of countries conduct maternal death reviews (MDRs), which are designed to audit facility deaths (24, 51-63). In India, maternal and perinatal death inquiry and response (MAPEDIR) has been used (28). In Bangladesh, the Government initially planned conducting MPDR, which covers maternal and perinatal deaths only (with late neonatal deaths, (> 7 days to 28 days not being counted). But later, after initiation of dialogue at national level, policy-makers convinced the government to cover all neonatal deaths, including stillbirths, which provides unique scope to cover babies until 28 days of life. However, the acronym MPDR had already been set, and it remains widely popular at district and national level, so it was not changed. For this thesis, however, I have used the acronym MNDR for maternal and neonatal death review, which covers the whole neonatal period.

2.4.2 Audit or Review

At the initial phase of development, there was a major terminological discussion on whether to use ‘audit’ or ‘review. This included a discussion of whether the process of doing an autopsy is ‘reviewing’ a death or ‘audit-
ing’ a death. In the context of Bangladesh, there is always misperception or misinterpretation regarding audit or enquiry, which often means to perform in-depth analysis of a case of death to blame or punish someone. Audit is a process to improve quality in systematic reviewing a case of care against explicit criteria and the implementation of change (64). Since the country had no experience of the government running a comprehensive audit system, it was agreed at national level to use the terminology ‘death review’, which would be easy to understand and acceptable in the community to discuss death cases. It would also support field-level health staff in collecting information from deceased family members in a non-blaming environment.

2.4.3 Community Death Review (Verbal Autopsy)

In a majority of cases, deaths occur in the community, outside facilities. There is a scarcity of causes and factors related to death that can be easily determined using community verbal autopsy, but the technique has been widely used to determine causes of death where death registration is low (19).

Since there are large numbers of women and newborn who die outside health care facilities in Bangladesh, identifying the main causes of death and preventable factors can be particularly difficult. These deaths are no less important to investigate, however, since they can provide unique insight into medical and nonmedical factors and barriers to care that lead to death. The barriers include lack of awareness of the need for care, cultural norms and beliefs, the use of dangerous or inappropriate traditional practices, lack of facilities or transportation, and affordability.

Acting on the results of community-based verbal autopsies can save lives not only by introducing or refocusing health education messages and improving community awareness and knowledge, but also by adaptations to clinical practice and reconfiguring local services to make them more acceptable, accessible and available. Community verbal autopsy helps to identify who dies outside the facilities, and to explore possible medical causes of death. Moreover, it determines the factors that contributed to the outcome (64-65).

Structured interviews are best suited for collecting numerical data in areas where much is already known and potential responses are already listed. Less structured interviews are most helpful when trying to discover reasons for behaviours or to look at complex sequences of events. Respondents in the deceased family may feel it easier to describe what happened rather than to answer specific questions related to the death.
2.4.4 Facility Death Review

Facility-based death reviews of maternal and neonatal death are simple and non-condemnatory aspects of death review studies, and are already practiced in many facilities as part of the health system. To investigate certain clinical practices, health care providers in the facilities may work within this system to investigate the level of quality care given to any particular woman measured against existing best practice guidelines or standards agreed in their facility. The system may often suffer from oversophistication or complexity, which require things like written practice guidelines, definitions of severe morbidity, additional resources and personnel with experience in the use of these approaches rather than the development of mechanisms that are feasible for them. However, the approach used in facility death review involves a simpler participatory process, established within the health system to identify causes and factors though recall and medical records. Simultaneously, death review meetings sensitize health system providers and their beneficiaries, and enable the sharing of lessons learned in developing/implementing actions for improvement.

Facility-based approaches can consider both the clinical and non-clinical aspects of maternal and newborn care. They result mainly in beneficial changes to local clinical practice, but may also improve the overall quality of care at the facilities.

2.4.5 Social Autopsy

Social autopsy is an innovative strategy that has been introduced into the arena of maternal and neonatal death. An autopsy is, in fact, a social interaction with people in a place where a maternal or neonatal death has already occurred. Discussion facilitated by a field-level health worker focuses on the social factors, issues and barriers underlying a maternal or neonatal death or stillbirth that can be averted. An interactive session is conducted in a non-blaming environment in which points of discussion concern, for example, what happened due to errors and what initiatives can avoid similar types of complications in the near future in the same community. The interaction prepares the society to understand and decide upon on what decisions are appropriate and realistic to make in a community to provide rectification. Moreover, an autopsy session disseminates some of the key messages related to maternal and neonatal complications (danger signs) and what it is recommended that the community should do in such situations by the community. During an autopsy, people may have difficulty in analyzing and identifying their own feelings and emotions, and the facilitator can assist them in this regard during the meeting. The purpose of a social autopsy is not to generate data on social errors; rather, the platform is based on the finding already obtained from community
verbal autopsies, and is used to intervene in the community in the form of social interaction. Dialogue helps participants in a social autopsy to discuss and understand.

**Figure 1:** The Maternal and Neonatal Death Review System in Bangladesh
2.5 Rationale for the Study

Developing countries like Bangladesh have profound inadequacies in maternal and neonatal care. Although much progress has been made on the state of the art related to antenatal, delivery and postnatal care, challenges still remain for implementation at scale. This demands further research as well as intensive activity in the policy arena. It is time to consider a redesigned and redefined system for providing perinatal care to mothers and the newborn. In Bangladesh, it is now a matter of urgency to define and adapt evidence-based approaches to supplement existing maternal and neonatal health care programmes.

The maternal and neonatal health programme should promote equitable access to quality health services, with greater attention paid to poor and vulnerable groups, especially in rural and under-served areas, mainly because most maternal and perinatal deaths occur in these groups. It is essential to understand the factors related to these deaths for policy formulation in the reduction of maternal and neonatal deaths. There are major challenges to achieving millennium development goals 4 and 5, to reduce maternal and neonatal mortality. The statistics already show difficulties in achieving the goals in time (by the end of 2015).

There are a number of obstacles in the community and in facilities which need to be specified and addressed by making specific intervention to reduce deaths at local level. WHO has recommended maternal death review for exploring medical and social causes, so as to develop a programme directed at reducing such deaths. However, the system has never been trailed in Bangladesh. Therefore, it is still unknown whether the death review system will be applicable to the Bangladeshi country context. So, the WHO framework for maternal death review has to be adapted effectively to introduce a new death review system in the country.

In light of the present maternal mortality ratio and neonatal mortality rate, the under-reporting of stillbirths and the absence of correct reporting of deaths, a system is essential that could enable correct and timely death notification followed by the review of deaths at both community and facility level. A routine surveillance system in maternal and neonatal deaths including stillbirths is a probable solution. Public health decisions and actions can be taken based on a surveillance system. The system is a core public health function to ensure right information at the right time and in the right place (66). Public health surveillance has been defined as the ongoing systematic collection, analysis and interpretation of data, closely integrated with the timely dissemination of these data in order to prevention and control of disease and injury (67).
A major gap in promoting effective surveillance lies between the production of data and the ability to convert those data into usable information, and then initiate the appropriate public health action (68). Surveillance may be used to inform health protection, health improvement and health service delivery, and is equally applicable to assessing acute and chronic disease occurrence and risks (66).

Accordingly, a maternal and neonatal death review system will be a new initiative in Bangladesh, since the country has never come close to formalizing all system requirements. The new system provides a platform to share experiences of and discuss maternal and neonatal deaths and stillbirths to find solutions to how these deaths can be reduced in future. Since the country lacks experiences, this study will develop, implement and educate in MNDR, including consideration of its feasibility, acceptance and effects with regard to reducing maternal and neonatal deaths in Bangladesh. This thesis is a developmental effort to improve the surveillance, analysis and application of information on maternal and neonatal deaths in the health care system of Bangladesh.
3. Objectives

3.1 Overall Objective
To develop, implement and evaluate MNDR with regard to reducing maternal and neonatal deaths.

3.2 Specific Objectives
a. To develop, pilot and evaluate the feasibility and acceptability of community death notification in MNDR [Study I].

b. To explore the effects of community death notification [Study II].

c. To identify the acceptability and effects of community verbal autopsy, social autopsy and facility death review [Study III-V].

d. To calculate economic costs to implement MNDR in Bangladesh [Study VI]
4. Methods

The thesis uses both qualitative and quantitative methods to reach its objectives [figure 2]. Two districts of Bangladesh include Thakurgaon and Jamalpur were included as study area [figure 3]. In papers I and II mixed method were used, whereas papers III to V used only qualitative data. In paper VI, a health economics method was employed [table 1].

In their book, Lawrence and Haluk refer to the purpose of doing mixed-method implementation research in terms of convergence, complementarity, expansion, development and sampling. We used mixed method research as convergence, which involves the simultaneous use of qualitative and quantitative methods to answer one and the same question. On the other hand, as stated by Lawrence A Palinkas, it can also be a compliment to evaluation of outcomes based on qualitative data (69).

Qualitative studies may be useful in exploring “why” rather than “how many”. Therefore, they reflect on research as part of the process of knowledge building and of applying a variety of approaches and methods (70). The advantage of doing qualitative research lies in its ability to probe into the responses needed to obtain the in-depth information, and the descriptions and experiences of behaviour, to answer the question ”why”. By contrast, in mixed method research, integrating methodological approaches strengthens and supplements the overall research design. The results generate more comprehensive and convincing evidence (71). There are various forms of interview design in qualitative studies that can be developed to obtain dense, rich data from a qualitative investigational perspective (72). Our studies also included document reviews, group discussions, focus group discussions, and in-depth interviews. Different techniques were employed to obtain the data because they enable the generation of strong evidence from the different tiers of health staff those who were engaged in MNDR. The study also used interviews with health managers to get to know their views as decision-makers at district level. Moreover, by obtaining real understanding of MNDR activities in the field by conducting community verbal autopsy and social autopsy, we were able to use participant observations. Researchers participated in the autopsy sessions as observers to take notes and record reactions and responses, and thereby acquire in-depth understanding in reality. Research using methods such as participant observation results in narrative and descriptive statements. In this study, participant observations gave a clear picture of how the community behaves and acts, thereby providing data on how health workers interact with the community, and how they gain acceptance in society. This helped to formulate our results in light of other, already ob-
Mixed methods were applied for papers I and II because they would complement and expand our other findings (73).

**Figure 2:** Methodological framework of the thesis
Table 1: Overview of study design and data collection

<table>
<thead>
<tr>
<th>Study</th>
<th>Aim</th>
<th>Design</th>
<th>Participants</th>
<th>Data collection technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>To examine the process of community notification of maternal and neonatal deaths and stillbirths within the government health system, and to explore the feasibility and acceptability of community death notification</td>
<td>Qualitative and Quantitative</td>
<td>HA/FWA HI/AHI/FPI Doctors and Nurses Health managers</td>
<td>FGD, IDI, GD Document review Death notification reported MNDR database</td>
</tr>
<tr>
<td>II</td>
<td>To identify the effects of maternal and neonatal death review in terms of improving maternal and neonatal health at community level</td>
<td>Qualitative and Quantitative</td>
<td>HA/FWA HI/AHI/FPI Community people Doctors and Nurses Health managers</td>
<td>FGD, IDI documents review Death notification reported MNDR database</td>
</tr>
<tr>
<td>III-V</td>
<td>To explore the acceptability of, and experiences and lesson learned from community verbal autopsy, social autopsy, and facility death review</td>
<td>Qualitative</td>
<td>HA/FWA HI/AHI/FPI Community people Doctors and Nurses Health managers</td>
<td>FGD, IDI Document review Observation (III-IV)</td>
</tr>
<tr>
<td>VI</td>
<td>To calculate the cost of maternal and neonatal death review</td>
<td>Cost calculation</td>
<td>-</td>
<td>Financial documents about MNDR</td>
</tr>
</tbody>
</table>

4.1 Different Data Collection Techniques

The study has mainly used focus group discussions, group discussions, in-depth interviews, participant observations and documents reviews to obtain qualitative information. Quantitative data were collected from the yearly death notification reports in Thakurgaon District.
4.1.1 Focus Group Discussions (FGDs)

FGD, when used for public health research, includes the evaluation of a programme or intervention. Focus group discussion is an important method to understand the complex and dynamic social context in which group interviewing takes place. Group cohesiveness, homogeneity and compatibility influence the quality of a focus group discussion (74). The discussion helps to minimize the power differential between researchers and respondents, by force of numbers and consciousness development (75). Field-level health workers were participants in the FGDs in this study. The FGDs were a convenient way of collecting detailed data at group level within a short period of time. Field-level health workers are usually busy in the field, so FGD data collection was the most effective way of gathering large volumes of data. One FGD was performed with doctors and nurses at facility level in study V, which was effective in obtaining detailed information on facility death review. Moreover, at community level, one FGD with members of the community in study II saved time in data collection and also reduced costs. During each of the FGDs, there were detailed discussions of the issues. Respondents were completely free to take part in the discussions because they were implementers of MNDR at community level. The FGDs empowered free discussion in a non-judgmental comfortable environment (76).

The participants followed prompts that supported detailed discussion and understanding of shared knowledge, views, values, perception and practices. All participants could speak out without any feeling of fear (77). FGD was used here for deeper understanding of the insights of the participants through discussion, with a number of interacting individuals having a community involvement demonstrated by seeking more profound information and using a moderator to elicit information (74, 78). The FGD in this study ensured the participation of each of the members of the group in responding and discussing, thereby creating an environment that encouraged detailed discussion.

The advantage of FGD is that it utilizes group interaction to explore people's own experiences and knowledge (70). Perhaps, it is also used as a complement to other methods, like interviewing, where there is a need to compare individual experiences and group context (79). In this study FGDs and IDIs complemented each other by looking at statements at individual and group level.

FGD also prompts participants to present contrasting new knowledge on social processes (79). The resulting data aim to obtain a number of views providing rich quality information, albeit within a time constraint (77). However this study performed two group discussions with the heath
workers and the community people, as in the group discussions, participants were not homogenous, and they participated at different times during the sessions. Therefore, discussion took place from a more general perspective rather than on focused issues.

4.1.2 In-Depth Interviews (IDIs)

In in-depth interviews, each player has a role while a recorder captures the drama. A free flowing narrative depends on creating space and comfort for interviewers to speak. Thus, in a qualitative study, it is minimally structured, and just follows key domains (73). The open-ended questions, using structured guidelines, help people to speak, in detail and in depth, in their own words, about what they understand or perceive (79). In-depth interviews were performed to collect information on MNDR at individual level, which may not have come from focus group discussions. Each of the respondents had full freedom to speak and discuss, which helped to validate the other research methods. The study used guidelines for each of the interviews, which invited more discussion, and probes were used to help the respondents to share in depth the helpful information that was to come from the other data-collection techniques. Guidelines help people to speak in detail and in depth in their own words about what they understand or perceive (73, 79).

In-depth interviewing is a powerful method for achieving insight into the issues by understanding the experiences of the interviewees (70). Moreover, interviewing is most consistent with people’s capability to make meaning through language (80). The study used interviews with upazila and district health managers, and also interviewed doctors and nurses as well as two community people. They were willing to discuss more than what came up in the focus group discussion.

4.1.3 Participant Observations

The observational method has been mentioned as the best method of data collection, since it provides scope for the researcher to see what people actually do, rather than what they say they do (81). It is sensitive to different research settings and can capture the context of people’s experiences. Moreover, it is able to judge people’s behaviour, movement, appearance, expression in different spectrums of discussion. There are different types of observations, which depend on the position of the researcher in the observation settings (81). Observations can be structured or unstructured (narrative). Structured observations produce quantitative data, whereas in unstructured form, the researcher can take field notes about the settings and interactions in the situation as it happened (82). Participant observation has been used for data collection for the studies in this thesis. Each
observation was based on a checklist designed to follow the activities being observed (83).

Participant observation is the preferred tool to evaluate embedded subcultures, where interviews would be difficult to employ due to a deficit of insights into a particular phenomenon. It has the opportunity to facilitate other data collection, and it formulates a cultural contest (79). It is the only way to know what is really happening when conducting a community verbal autopsy of maternal or neonatal deaths, which includes conversation with the deceased family, their expressions and emotions, and their acceptance in providing data with a positive attitude. Moreover, in a social autopsy, how people participated in the autopsy, interacted on the issue, how they made decisions, and how the community became motivated would not be possible to identify without observation.

Research officers participated in the sessions as observers, and an inductive approach was used in naturalistic settings (78).

Participant observations were made when research officers presented in the verbal and social autopsy sessions. Their role in the sessions was that of an observer of the process involved. An observation checklist was used to help the researchers to go into the details of each of the issues that they were really looking for (83). A checklist was followed by the researchers. In addition to this, some key experiences were noted down by the researchers when making the observations. The importance of taking field notes on the behaviour and activities of individuals in the field during observation has been mentioned by Creswell (84). And another study mentioned the utilization of field notes to highlight key points that match areas of interest, which is necessary if there is imperfect representation of what was experienced during observation (73). We took some key field notes for cross-checking against the checklist.
4.1.4 Document review

Document review is a systemic procedure for evaluating documents from which is important to elicit meaning and for understanding, so as to develop empirical knowledge (85). Moreover, all types of documents help researchers to uncover meaning, develop understanding, and discover insights into research objectives (86). We had had the scope to review MNDR tools, guidelines, manuals, meeting minutes, and notes of record, which helped us to understand details of the process through which MNDR has been developed. The reviews supplement other data found using qualitative methods, which can be verified and interpreted.

Existing documents and data have advantages over interviews and observation. Document review takes less time to perform and is emotionally less taxing than interviews and observations (73). It was easy for us to review documents within short periods of time, which helped to develop guidelines for the interviews, observation and focus group discussions. The MNDR guidelines stated clearly who the actors are, to what extent they participate, and the role they have in implementation.

However, document review does have some disadvantages. Some documents may be inaccurate, and information can be missed if they are reviewed in too much of a hurry (73). Most of the documents were structured, and comfortable to review in detail. They provide background data and historical insights into MNDR. Reviewing also provides opportunities to identify new questions for interviews (87). The documents can also be used as supplementary data, which are easily available, efficient and less obstructive, and have broader coverage and exactness.
Figure 3: MNDR Intervention Areas, Bangladesh (2010-2012)
4.2 Data Collection

Paper I

Study design
The study applied a mixed-method approach, both qualitative and quantitative. FGDs and IDIs were performed to obtain qualitative information. Death notification data on maternal and neonatal deaths and stillbirths in 2010 were taken for quantitative study from ongoing MNDR surveillance.

Study duration
The study was started during the 1st week of January 2010 and then continued until final data collection in January 2011.

Study settings and population
The study was conducted in Thakurgaon District, which is situated in the northern part of Bangladesh, approximately 450 kilometres from the capital Dhaka. The district has a population of 1 450 000. Qualitative information on feasibility and acceptability of the death notification system was undertaken in Pirganj Upazila, which was selected purposively from five of the upazilas in Thakurgaon District. To obtain quantitative data on death notification, the entire Thakurgaon population was selected for the study.

Participants
Grassroots-level field staff, including health assistants, family planning assistants, health inspectors, family planning inspectors, EPI technicians, sanitary inspectors and statistician participated with managers from the upazila health and family planning department. These groups of respondents work under the Ministry of Health and Family Welfare. They had participated in two FDGs in 2010 and in 2011.

From the community group, volunteers, clinic management committee members, local elite, school teachers, an Imam, a political leader and an elected official from local government participated in the two FGDs in the same data-collection period. The number of participants in the groups ranged between 9 and 11. In-depth interviews were conducted with the district managers in the health department, the Civil Surgeon and the Deputy Director of Family Planning in the family planning department [table 2].
Table 2: Participants in Study I

<table>
<thead>
<tr>
<th>Qualitative data collection technique</th>
<th>Age range</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>FGD (2)</td>
<td>35 - 55 yrs</td>
<td>Health Assistant (1), Family Planning Assistant (1), Health Inspector (1), Family Planning Inspector (1), EPI Technician (1), Sanitary Inspector (1), Upazila Health and Family Planning Officer (1), Upazila Family Planning Officer (1) and Statistician (1).</td>
</tr>
<tr>
<td>FGD (2)</td>
<td>20 - 62 yrs</td>
<td>Community volunteers (2), Community clinic management committee member (2), local elite (1), school teacher (1), Imam (1), Political leader (1), Elected member from local government (1)</td>
</tr>
<tr>
<td>IDI (4)</td>
<td>50 - 56 yrs</td>
<td>Civil Surgeon, Deputy Director Family Planning</td>
</tr>
</tbody>
</table>

Research instruments

Guidelines for FGD and IDIs were developed to use as research instruments in the study. The guidelines focused on prompts and open-ended issues that could help the respondents to speak out in detail on the discussed issues. To identify the feasibility of the community death notification system, there were certain key areas of discussion: Who can do the reporting? How is it possible? What challenges may arise? What possible process is there for capturing deaths in the community? What responses come from the community if deaths are reported? To explore the acceptability of community death notification, the guidelines used some of the key prompts, like how health workers are doing this, the process, where it is possible to capture deaths, how the community reacts to informed deaths, compliance of health workers in reporting deaths etc. Guidelines were tested in another upazila in Thakurgaon District with a similar population to see how much information could be expected. Finalization of the guidelines was performed after necessary feedback from the field.

For the quantitative data, the MNDR death notification system developed a structured death notification form, which contains name and age of deceased, type of death, and place and time of death. The instrument was used by field-level health staff (health assistants and family welfare assistants) to report deaths and submit them to a focal point in the upazila health complexes where a database was prepared.
Data collection technique

Feasibility data were collected in the first week of January 2010, whereas the acceptability of death notifications was examined at the end of 2010, in January 2011. A group of skilled researchers, including data collectors and anthropologists, were engaged in the qualitative data collection. All FDGs and IDIs were performed in the local language (Bengali). Researchers with the support and permission of upazila health managers and family planning managers organized the FGDs. Government field-level health workers helped to gather the health workers in a family welfare centre at the Pirganj upazila where they are working. Members of the community met in FGDs at a community clinic. Two anthropologists worked in the FGDs, where one facilitated by following guidelines, and another took notes of important points. Before initiation of the discussion, researchers sought informed verbal consent from the participants and permission to do the audio recording. For the IDIs, face-to-face interviews were conducted, and data collectors and an anthropologist worked together to gather the information.

Quantitative data on maternal and neonatal deaths and stillbirths were collected at household level through door-to-door visits by health workers, or by collecting information using community networks following fill up a death notification form. The death notification status of maternal, neonatal deaths and stillbirths were obtained from the focal point at the upazila health complex at the end of 2010.

We also collected MNDR documents related to the development of the community death notification system: government communicating letters, different meeting minutes, death notification form, training of trainers (ToT), manual and guidelines for the health managers. All documents were taken for review.

Paper II

Study design

The study applied a mixed-method approach, both qualitative and quantitative. Focus group discussions, group discussions and in-depth interviews were conducted to obtain qualitative information. Data on maternal, neonatal deaths and stillbirths from notification reports in Kashipur union (a smaller unit than an upazila) of Ranshankoil Upazila during 2010 to 2012 were also collected.
Study duration
Qualitative data were collected in September 2011, while quantitative information was obtained from the MNDR database of 2010-2012.

Study settings
Thakurgaon District, with a population of 1 450 000, is situated in the northern part of Bangladesh with five upazilas. Kashipur Union, a small administrative unit in one of the upazilas, named Ranishankoil, with a population of approximately 28 000 in the District was selected for this study. Qualitative data collection was conducted at the Kashipur Jhapor-tola Community Clinic of Kashipur Union.

Participants
A group of eleven members, including a chairman, membership secretary, and other members of the community clinic committee, participated in a FGD. Another group discussion was conducted with three field-level health workers, including a health assistant, a family welfare assistant and an assistant health inspector who worked in the Jhapor-tola Community Clinic catchment area. The IDIs were conducted with one of the pregnant mother who received antenatal care at the community clinic, the land do-nor of the clinic, and a qualified government medical doctor who was involved in providing care at the Jhapor-tola community clinic [table 3].

<table>
<thead>
<tr>
<th>Qualitative data collection technique</th>
<th>Age range</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>FGD (1)</td>
<td>30–45 years</td>
<td>Community Clinic Committee consisting of Chairman, Membership Secretary (FWA) and nine other members: one school teacher, one religious leader (Imam), one local leader, and six farmers.</td>
</tr>
<tr>
<td>GD (1)</td>
<td>35–50 years</td>
<td>Health Assistant (HA), Family Welfare Assistant (FWA), Assistant Health Inspector (AHI).</td>
</tr>
<tr>
<td>IDIs (3)</td>
<td>25–70 years</td>
<td>One pregnant mother who received antenatal care at the community clinic, one MBBS doctor, and the donor of the land for the Community Clinic.</td>
</tr>
</tbody>
</table>
Research instruments

Researchers, including anthropologists, professional experts and public health specialists, participated in a number of meetings to develop the guidelines to conduct the FGD, GD and IDIs. A number of areas were identified in both FGD and GD, including health care service status in the community clinic at present and before the initiatives were taken, the referral system, the community clinic committee’s role in strengthening the referral system, community participation, challenges, and success. Some of the prompts were used, such as who were involved, who provided care, type of care, how the system has strengthened, how the community plays a role, etc. The guidelines were tested in another upazila in Thakurgaon, and finalized after necessary feedback from the field.

Quantitative data on community death notifications were gathered using a structured death notification form in the MNDR system to collect information on deaths and to report back to the focal point at the upazila health complex.

Data collection technique

The interviewing team consisted of a public-health specialist, an anthropologist and a note taker. The facilitator (anthropologist) in the focus group discussion followed guidelines to cover each area of discussion. Informed verbal consent was obtained from the participants before the discussions and interviews. Prior permission was obtained for audio recording. One focus group took around an hour, but the group discussion took around two hours. During the group discussion, one health worker came late, and another left the discussion in the middle before re-joining before the end of the session. During the IDIs, the facilitator followed the guidelines in face-to-face interviews. Different prompts were used during the FGD, GD and IDIs to obtain detailed information. The interviews were recorded on audio tape, and some of the important points were noted in the minutes. The study used the death notifications reported from Kashipur union in Ranishankiol upazila from 2010 to 2012 collected from MNDR database.

The study also reviewed documents related to preparing an action plan in Kashipur Union, and the minutes of MNDR review meetings at upazila, district and national level. The documents related to community participation in the land donation for the community clinic, referral system, etc. were also reviewed.
Paper III

Study design
A qualitative study was performed.

Study duration
The study started in January 2011 when data on the acceptability of community verbal autopsy were collected. Data on the effects of verbal autopsy were collected in September 2011.

Study settings
MNDR was initially piloted in Thakurgaon District in 2010, then expanded into another three districts in 2011. We chose to pilot in Thakurgaon, which is situated in the northern part of Bangladesh, 450 kilometres from the capital Dhaka. From among the other three districts, we randomly chose Jamalpur, which is about 140 kilometres away from Dhaka. Three of the upazilas were chosen by random sampling from five upazilas in Thakurgaon District, where, as in Jamalpur, another three upazilas were also chosen in the same randomization process from seven upazilas.

Participants
Health inspectors, assistant health inspectors, family planning inspectors participated in FGDs in both districts. Upazila health and family planning officers, upazila family planning officers, the civil surgeon and the deputy director of family planning were interviewed [table 4].
Table 4: Participants in study III

<table>
<thead>
<tr>
<th>Qualitative data collection technique</th>
<th>Thakurgaon [Number]</th>
<th>Jamalpur [Number]</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>FGDs</td>
<td>6</td>
<td>3</td>
<td>Health Inspector Assistant Health Inspector Family Planning Inspector</td>
</tr>
<tr>
<td>IDIs</td>
<td>14</td>
<td>8</td>
<td>Upazila Health and Family Planning Officer Upazila Family Planning Officer Civil Surgeon Deputy Director of Family Planning</td>
</tr>
<tr>
<td>Observation</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Research instruments

Researchers, including anthropologists, professional experts and public health specialists, developed guidelines to conduct the FGDs and IDIs. Some of the key issues focused on the FGD guidelines, including how the health workers accepted conducting verbal autopsy, their compliance with the activity, responses from the community, how medical and social causes were identified, and how and to what extent the information used by the field-level health workers, including its strength and challenges. The in-depth interview focused on how the health and family planning managers in the upazila accepted community verbal autopsy in MNDR, what strengths they found in continuing verbal autopsy in MNDR, and the challenges involved. The Civil Surgeon and Deputy Director of Family Planning were prompted to report on utilization of the findings, strength and challenges in running community verbal autopsy.

In a participant observation session, a checklist was used to observe a verbal autopsy session. The checklist focused on the approaches of health workers and deceased families, consent before an autopsy session, how respondents were selected, sitting position, communication, process of asking different questions, family’s responses to questions, any difficulties in doing a verbal autopsy, etc. The guidelines were vigorously tested in the field and finalized after necessary correction.
Data collection technique

Two research officers were deployed to conduct the FGDs and IDIs. Intensive training was given to orient with the instruments and how to conduct interviews and discussions at field level. Informed verbal consent was taken from each of the participants in the FGDs and interviews. Each session was audio-taped with the respondent’s permission. One of the research officers facilitated the FGD by following the guidelines, while another was engaged to take important notes by hand. The entire process was carried out in local Bengali language. Each of the FGDs took around 45 to 60 minutes. The interviews were performed face-to-face. In the cases of upazila and district managers, prior dates and times were set for them to do the interviews.

In the case of participant observations, research officers collected pre-scheduled verbal autopsy conduction date from the focal point at the upazila health complex during the period of data collection. For each of the upazilas, the research officers randomly chose one of the verbal autopsy cases. Details of the location of the place of verbal autopsy were identified by local people. On the day and time as scheduled, research officers accompanied the field-level first-line supervisor from the health and family planning department to attend the autopsy case. The research officers joined the deceased family members and the health workers in the session. The research officers only observed the session following the checklist, but some of the key information was also noted down. Documents related to the development of verbal autopsy in MNDR, including meeting minutes, different reviewed tools, notes of records, guidelines, and manuals were collected for thorough review so as to understand the process of development.
Paper IV

Study design
A qualitative study was performed.

Study duration
The study was performed in January 2011, in which data on the acceptability of community social autopsy were collected. Data on the effects of social autopsy were collected in October 2011.

Study settings
MNDR was initially piloted in Thakurgaon District in 2010, then expanded into another three districts in 2011. We chose Thakurgaon as the piloted district, which is situated in the northern part of Bangladesh, 450 kilometres from the capital Dhaka. Among other three districts, we randomly chose Jamalpur District, which is about 140 kilometres away from Dhaka. Three of the upazilas were chosen by random sampling from five upazilas in Thakurgaon District, whereas in Jamalpur, another three upazilas were also chosen in the same randomization process from seven upazilas.

Participants
Health inspectors, assistant health inspectors, and family planning inspectors involved in the FGDs participated in both districts. Upazila health and family planning officers and upazila family planning officers, were interviewed. Social autopsy participants were also interviewed with regard to their acceptance of doing social autopsy in the community [table 5].

Photograph: A FGD session with field level health staff
Table 5: Participants in study IV

<table>
<thead>
<tr>
<th>Qualitative data collection technique</th>
<th>Thakurgaon [ Number ]</th>
<th>Jamalpur [ Number ]</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>FGDs</td>
<td>6</td>
<td>3</td>
<td>Health Inspector Assistant Health Inspector Family Planning Inspector</td>
</tr>
<tr>
<td>Group discussion</td>
<td>2</td>
<td>2</td>
<td>Villagers participating in social autopsy</td>
</tr>
<tr>
<td>IDIs</td>
<td>28</td>
<td>8</td>
<td>Community participants in social autopsy Upazila Health and Family Planning Officer Upazila Family Planning Officer</td>
</tr>
<tr>
<td>Observation</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Research instruments**

Researchers, including anthropologists, professional experts and public health specialists, developed the guidelines to conduct the focus group discussions, group discussions and in-depth interviews. Some of the key issues focused upon in the FGD guidelines included how health workers accepted social autopsy conduction, their compliance to doing the activity, responses from the community, how the social barriers and practice identified, how and to what extent the information shared and discussed by the field level health workers, including its strength and challenges. Group discussion with the villagers who participated in social autopsy focused on issues like how they identified their errors and barriers during the discussion, the process of taking decisions, and an action plan for future prevention. By contrast, the in-depth interview focused on how the health and family planning managers in the upazila and district managers accepted social autopsy in MNDR, what strengths they found to continue social autopsy in MNDR, and the challenges involved.
Data collection technique

Two research officers were deployed to conduct FGDs, GDs and IDIs. Details of training were given to get oriented with the instruments and how to conduct interviews and discussions at field level. Informed verbal consent was obtained from each of the participants who participated in the FGDs, GDs and interviews. Each session was audio-taped with the respondent’s permission. One of the research officers facilitated the FGD or GD following guidelines, another was engaged in taking important hand notes.

The entire process was carried out in local Bengali language. Each of the FGDs took around 45 to 60 minutes. Group discussions took around an hour for each. By contrast, in-depth interviews took an average of 20 minutes. The interviews were performed face-to-face. In the case of upazila and district managers, a prior date and time was obtained from them to do the interviews.

In the case of participant observations, research officers collected pre-scheduled social autopsy conduction dates from the focal point at the upazila health complex during the period of data collection. For each of the upazilas, the research officers randomly chose one of the social autopsy cases. Details of the location of the place of social autopsy were identified through local people. On the day and time as scheduled, research officers accompanied the field level first-line supervisor from health and family planning department to attend the autopsy case. The research officers joined with the deceased family members and the health workers in the session. The research officers only observed the session following the checklist, some of the key information also noted down. Documents related to the development of social autopsy in MNDR, including meeting minutes, different reviewed tools, notes of records, training guidelines,
manuals and behavioural change communication materials, were collected thoroughly to understand the process of development.

**Paper V**

**Study design**
A qualitative study was performed.

**Study duration**
The study was performed in January 2011, where acceptability of facility death review data was collected, and the effects of facility death review were assessed in November 2011.

**Study settings**
MNDR was initially piloted in Thakurgaon District in 2010, then expanded to another three districts in 2011. We chose Thakurgaon as the pilot district, which is situated in the northern part of Bangladesh, 450 kilometres from the capital Dhaka. Among other three districts, we randomly chose Jamalpur District, which is about 140 kilometres away from Dhaka. Three of the upazilas were chosen by random sampling from five upazilas in Thakurgaon District, where, as in Jamalpur, another three upazilas were also chosen in the same randomization process from seven upazilas. Participants were interviewed from each of the upazila health complexes and district hospitals in both districts.

**Participants**
Hospital administrators or managers, consultants from gynaecology and obstetrics, paediatrics and the anaesthesia department, and nurses of the facilities and participants in the study. Doctors and nurses at the district
hospital in Thakurgaon participated in a focus group discussion. Doctors and nurses, including the upazila health and family planning officers, Civil Surgeon and the Deputy Director of Family Planning performed in-depth interviews [table 6].

Table 6: Participants in study V

<table>
<thead>
<tr>
<th>Qualitative data collection technique</th>
<th>Thakurgaon [ Number ]</th>
<th>Jamalpur [ Number ]</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>FGD</td>
<td>1</td>
<td></td>
<td>Doctors and nurses at Thakurgaon district hospital.</td>
</tr>
<tr>
<td>IDIs</td>
<td>24</td>
<td>11</td>
<td>Doctor and nurses Upazila Health and Family Planning Officer Civil Surgeon Deputy Director of Family Planning</td>
</tr>
</tbody>
</table>

Research instruments
Researchers, including anthropologists, professional experts and public health specialists, developed the guidelines to conduct the focus group discussion and in-depth interviews. Some of the key issues were focused upon in the FGD guideline, including how doctors and nurses accepted the facility death review, process of conduction of review, how the data were collected, etc. In-depth interviews with the doctors and nurses also focused on issues like acceptance by the health workers, the process of death review conduction, and collection of data. Moreover, the participants include upazila health and family planning officers, civil surgeon and deputy director of family planning, focusing on points like the effects of doing death review, lessons learned so far, and challenges.

Data collection technique
Two research officers (anthropologists) were deployed to conduct the FGD and IDIs. Detailed training was given to get oriented with the instruments, and how to conduct interviews and focus group discussion at district hospital. Informed verbal consent was obtained from each of participants who participated in the FGD and interviews. Each session was audiotaped, with the respondents’ permission. One of the research officers facilitated the FGD following guideline, while another was engaged to take important hand notes. The entire process was carried out in local
Bengali language. The FGD took around one hour, whereas in-depth interviews took an average of 20 minutes. The interviews were performed face-to-face. In the case of upazila and district managers, a prior date and time was set to do the interviews.

Research officers made formal appointments with district and upazila health managers before the interviews. In hospital working hours it was difficult to spend time to take written consent from each of the participants (doctors and nurses); rather, they were comfortable to provide verbal consent before the initiation of interview. However, FGD for doctors and nurses was only done during January 2011 to get to know acceptance of facility death review at district hospital. But, in November 2011 it was not possible to organize a focus group discussion with the doctors and nurses working at the district hospital because of limitation of time to arrange.

Documents related to the development of facility death review in MNDR include meeting minutes, different reviewed national and international tools, notes of records, training guidelines, and manuals were reviewed. Each of the document was reviewed thoroughly to understand the process of development of facility death review.

**Paper VI**

**Study design**
A health economic cost of MNDR in a district was calculated in the study.

**Study duration**
The cost-related data were collected between 2010 and 2012.

**Study settings**
MNDR was initially piloted in Thakurgaon District in 2010 and then expanded to another three districts during 2011-12, based on experiences in the piloted district. The study used the cost-related data of 2010-12 in Thakurgaon District only.

**Research instruments**
A Microsoft Excel form was developed, based on the MNDR’s budget different line items. The form was used to calculate the cost of MNDR in three different years.
Data collection technique
The study used the intervention budget expenditures of three years. In each of the years, against the planned budget, there was a summary of expenditure under key line items. Those expenditures were reserved in the finance and administration section of the technical organization in implementing MNDR, named CIPRB. All summary reports of expenditures were collected, and then data were entered into the newly developed Excel form after extraction from the expenditure files.

4.3 Analysis
The study used both qualitative and quantitative data, with a mixed method, as used in studies I and II. Qualitative data were collected from several document reviews, participant observations, focus group discussions, group discussions, and in-depth interviews. Quantitative data found from yearly reported maternal, neonatal deaths and stillbirths notification database in the district.

A descriptive analysis was performed for the quantitative (frequency) data, which were entered into the statistical software SPSS windows version 21 for windows. Therefore it was easy to calculate the death distribution at upazila level. For the qualitative data, we used different analytical techniques to formulate the data. It was tried to triangulate the analysis using results of different qualitative methods used in the study (72). In mixed method, sequential and concurrent designs are used. We used concurrent design where datasets are not dependent on one another and are integrated at the same time within the analysis. It determined whether findings between the datasets converged, diverged, or were contradictory (71).

For the document review, there were guidelines and manuals for training of trainers, death notification, verbal autopsy, social autopsy, facility death review, and review meetings: MNDR tools for death notification at community and in facility, verbal autopsy, social autopsy, facility death review, and minutes of MNDR review meetings. The data were first superficially examined on their content, then read through, and then interpreted. A content analysis (88) and a thematic analysis (89) were performed. Content analysis is an appropriate method to use for text analysis (90). Thematic analysis was performed, which involved a careful, focused re-reading and review of each of the documents, finally uncovering the theme relevant to the phenomenon. That contained meaningful and relevant information.

Thematic analysis is widely used, but there is no specific agreement about how it can be performed (91). A theme captures something about the data in relation to the research questions and finally represents a meaning with-
in the data. The thematic approach was employed as a flexible method of analysis to get a collective picture of rich data, obtained through mapping the data on the basis of prior objectives and determine themes in a number of ways. The data were constructed and interpreted within the framework of understanding and initial research questions (92). The thematic approach has been employed as a flexible method of analysis by which a collective picture of data is obtained. The data were constructed and interpreted within the framework of understanding and initial research questions (92). Thematic analysis does not strictly depend on the theoretical and technological obligations of grounded theory. Rather, a theme captures something important about the data in relation to the research questions.

In the observations, the researchers jotted down key points in the notebook following the checklist. Later on, using the key noted down point, the researchers memories and jotted down details description of the observation as per set objectives which they have been observed. Data were read in detail to understand and identify codes. From the several codes, a number of themes were identified and was analyzed also thematically.

For FGDs and IDIs, each of the audio recorded interviews and group discussions were transcribed into local Bengali by the research officers. After that, the Bengali transcribed documents were translated into English. After that, initial open coding followed by selective coding was done in a systematic manner by constantly moving back and forward in the entire data set. Then, the codes were organized into different potential themes. Coding is the process of organizing the material into segments of text before bringing meaning to information (84). Later on, checking of the themes was performed. Each theme was defined and finally analysis was completed manually (80) and aligned with objectives. Thematic analysis was performed by careful reading of data material to identify themes (93). Then categories of the data, meaning units in relation to the research questions, were identified. This allows flexibility and broad application regardless of one’s theoretical and epistemological position. The analysis did not use a formal grounded theory approach, but drew some of the principals associated with grounded theory, such as data-led analysis. An inductive approach to analysis was pursued, which focused on the process of coding the data rather than using a pre-existing coding frame or preconception.

For estimating the cost of MNDR, year of costing and costing per component of MNDR were calculated. Component costs covered community death notification, verbal autopsy, social autopsy, facility death notification, facility death review, and review meetings. Capacity development was in the first year of intervention, so the cost was equally distributed over the next six years until the end of the intervention period (2015).
Moreover, the development cost of MNDR, including development of tools, guidelines, manuals, and other instruments related to MNDR, were required only in first year. Therefore, these costs of development were equally distributed over the next six years.

4.4 Ethical Considerations

The institutional ethical review committee of the Centre of Injury Prevention and Research, Bangladesh in Bangladesh reviewed and approved the research study on 17th January 2010. MNDR has been implemented by the Directorate General of Health Services and Directorate General of Family Planning. Therefore, both directorates also provided official endorsement of the research to be performed in the districts. Participants in the study were included in the FGDs, GDs and IDIs. In all cases, informed verbal consent was obtained. Researchers used a consistent form, which was read out before starting interviews or discussions. Upazila and district level health and family planning managers were officially informed early to get their dates and times before they were interviewed. In each of the studies, the objective of the study was described, and utilization of findings was also shared. Participants were given freedom in providing information, and they had scope to stop the interview at any point. They did not have to answer any of the prompts, and they could refuse to provide information at any point. They also ensured that their personal identities would not be disclosed. All information in the study would remain anonymous, and the collected data would be used for this research only. Interviews were audio-recorded and permission was taken before the interview. For each of the photos used in this thesis, informed consent was taken from the participants in the photos. Bengali and English transcript hard copies were kept in a secure place, and the electronic database was secured by a password in the computer. Access was limited to the principal researcher and data manager.
5. Summary of Results

Paper I

Community Notification of Maternal, Neonatal Deaths and Stillbirths in Maternal and Neonatal Death Review (MNDR) System: Experiences in Bangladesh

The community death notification in MNDR was implemented jointly by the Directorate General of Health Services and Directorate General of Family Planning services in Bangladesh in a supportive policy environment. A death notification instrument was developed by a national technical team. Notification of maternal, neonatal deaths and stillbirths were performed within the exiting government health system, conducted by field-level health and family planning staff (health assistants and family planning assistants). Death notification was initially piloted in the Thakurgaon District of Bangladesh in 2010. The field-level health staff and their managers at upazila level found that death notification is possible to perform in the rural community. Field-level health staff received one day’s training in how to notify deaths in the community.

Community deaths were planned to report within three to seven days to the upazila health complex. An upazila-level MNDR committee for each of the upazilas in the district and another district committee was developed to supervise and monitor progress. Field staff reported community death-notification information to an assigned focal point in the upazila health complex. The review committee at each Upazila was also responsible for discussing death numbers and preparing a local-level action plan.

Working areas were distributed among the health and family planning field-level staff. This joint micro planning helped to prevent overlapping of reporting. The field-level health staff used community networking to obtain information of a death [figure 4]. The death was also confirmed by a home visit before final submission of the death notification form.

Health workers in the upazila found notification feasible and possible to perform within their routine work. Nevertheless, they argued that the death notification might take longer due to their household visits on a monthly basis for the family planning department. However, health workers are very well known to the community, therefore notification can be easily possible. Work overload, human resource constraints, geographic distribution, and social barriers are still challenges to correct and timely death reporting.
After implementation of death notification in MNDR in 2010, it was found to be highly accepted by field-level health workers and their managers. Health staff started to report without any blaming risk. Therefore, a high number of deaths were reported in 2010, which covered under-reporting.

In 2010, 59 maternal deaths, 739 neonatal deaths and 633 stillbirths were reported [table 7]. The death notification process was accepted both by the field level health and family planning staff and the community. People agreed to provide information related to deaths to the health workers. The upazila health managers and district managers showed their satisfaction to work integratedly by the health department and family planning department together at field level. Moreover, deaths number helped the managers to monitor progress and to use the findings to take proper initiatives in the areas where death numbers were higher.

Table 7: Community death notification in Thakurgaon District, 2010

<table>
<thead>
<tr>
<th>Upazilas</th>
<th>Maternal Death</th>
<th>Neonatal Death</th>
<th>Stillbirth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sadar</td>
<td>23</td>
<td>207</td>
<td>162</td>
</tr>
<tr>
<td>Baliadangi</td>
<td>7</td>
<td>131</td>
<td>107</td>
</tr>
<tr>
<td>Pirganj</td>
<td>6</td>
<td>132</td>
<td>120</td>
</tr>
<tr>
<td>Ranishankoi</td>
<td>13</td>
<td>172</td>
<td>122</td>
</tr>
<tr>
<td>Haripur</td>
<td>10</td>
<td>97</td>
<td>122</td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>739</td>
<td>633</td>
</tr>
</tbody>
</table>
Figure 4: Process of death information collection at community
Maternal and Neonatal Death Review (MNDR): A useful approach to identifying appropriate and effective maternal and neonatal health initiatives in Bangladesh

Kashipur Union, a small unit of Ranishankoil upazila in Thakurgaon district was identified as having the highest number of deaths in 2010. Death notification data showed that four maternal deaths, 21 neonatal deaths and 15 stillbirths were reported. Upazila death mapping revealed a higher density of deaths in Kashipur than in the remaining unions of the upazila. The findings were initially discussed at the Ranishankoil upazila MNDR review meeting. A local action plan was taken based on high death numbers as per recommendation made at district level and national level. The committee identified four maternal deaths in a village of Kashipur. It was found that the community clinic (CC) in Kashipur did not provide maternal and neonatal health (MNH) services, and there was a discussion over whether the high death toll could be due to the union being situated 30 kilometres away from Ranishankoil Upazila. Kashipur Union is a bordering union adjacent to India, with very poor socio-economic conditions, a low level of education, and a dense population; it is agriculture-based, and its mud roads are submerged during the rainy season. People living in the villages also have superstitions about maternal-health issues.

Considering the context, the local committee recommended upgrading the CC in Kashipur. A district MNDR committee meeting agreed with that recommendation, and participated in a national-level meeting that took the initiative for the upgrade. A national-level meeting was held at the Directorate General of Health Services. The meeting determined to renovate and upgrade the functioning of the CC in Kashipur. A trained community skilled birth attendant (CSBA) from the family planning department Family Welfare Assistant was deployed to perform antenatal care, normal delivery, and postnatal care at that facility. In 2011, quality antenatal care was provided in the community clinic located in Kashipur Union. Pregnancy mothers came to the community clinic for regular check-ups. Four complicated mothers were referred during the CC visit to the referral centre.

Community people also had confidence and sent their mothers for care during pregnancy. The Kashipur community clinic committee informed the health department that the community clinic was to be extended into a ten-bed hospital, which was a demand from the community to the government to save mothers and the newborn. The committee talked to villagers living around the community clinic about land donation, since the
government had only minimal capacity. Following that the land owner of the CC donated additional land for the proposed hospital.

The pregnant mothers who came to seek antenatal care showed high satisfaction with care. Upazila Health mangers decided to deploy a MBBS doctor from the upazila health complex to the community clinic once a week which helped with the diagnosis of high-risk complicated mothers earlier, followed by strengthening of the referral system. The community clinic once in a week provided ANC to 30 mothers every month. The findings also showed that 110 normal deliveries were conducted during 2011-12 at community clinics in Kashipur union, which helped to reduce maternal deaths. As result, community death notification data of 2011 and 2012 have shown that only one maternal death occurred in 2011, and another one in 2012. Similarly, neonatal deaths and stillbirths were also reduced in 2011 compared with 2010.

**Paper III**

**Experiences of community verbal autopsy in maternal and newborn health of Bangladesh**

Verbal autopsy of maternal, neonatal deaths and stillbirths was performed by first-line supervisors from the health and family planning department at community level. Observations showed that health workers undertook the sessions in day time. In the majority of cases, health workers were called as the local doctor and they were found to be well known to the household. Family members welcome and cordially accepted and provided information.

The health workers visited the family of the deceased person, and described the reasons behind their coming to the house, and sought proper permission from the family members before the interview. Written content was obtained from the main respondent before interview. Respondents were the family members who were present at or before the time of death, and in neonatal death cases the mother was the respondent in all cases. Verbal autopsy maintained confidentially and anonymity.

The verbal autopsies took from 20 minutes to 45 minutes depending upon how the health workers talked to the family members. It was observed that the health workers used local dialect for interactions and asking questions, and used prompts to understand the questions. The interview took place in a convenient place so that family members were able to interact. However, in most VA cases, there were always a few people outside, waiting to observe what was happening.
During the entire verbal autopsy sessions, observation findings showed that there was no resistance or reluctance to provide information. Also, there was no refusal to participate in the verbal autopsy sessions. However, in a few cases, it was found that deceased family members were working at the time of doing a verbal autopsy, and these cases took a little more time than usual.

Health workers found verbal autopsy a new experience to find out the medical causes and social errors, including delays related to decision-making and transferring the patient to the facility. However, at the beginning, health workers had some difficulty in using verbal autopsy instruments. Later, it became familiar, and was used comfortably. The findings of the verbal autopsies were found to be useful for the health workers and managers for planning, who took initiatives based on the findings and implemented decisions at local level. A number of health camps, awareness meetings with pregnant mothers, referrals of complicated cases from the community to the facilities in areas where deaths are higher, focused more on maternal deaths.

Moreover, review findings also supported recommendations for policy dialogue and further planning at national level. However, at community level, doing verbal autopsy sometimes took more time than usual; recall bias was found to be another challenge in some cases when they were conducted after a month. Sometimes, information related to care-seeking behaviour was missed due to extended recall time. Moreover, in hard-to-reach areas, it was difficult to go out and collect information.

**Paper IV**

**Social Autopsy - A Social Intervention to Generate Community Awareness of Maternal and Neonatal Deaths**

Social autopsy in the community was performed by the first-line supervisor by the Health Department and the Family Planning Department (health inspector, assistant health inspector, family planning inspector). Participant observation findings showed that social autopsy was conducted with 20-30 families surrounding the deceased household. Locations of the session were chosen in the courtyards near to the homes of the deceased. Heads of households, reproductive age group mothers and their husbands, and adolescents were usually present in the sessions. Health workers facilitated the sessions during early morning or afternoon to ensure participation of some of the males who are decision-makers in the family. Initially, the cases were presented by neighbours or relatives. After
that, an open discussion was offered. Community people discussed their own errors, social stigma, and also what could be done in future by knowing corrective measures. The health worker used a behavioural change communication material (flipchart) to share information about maternal and neonatal complications and what to do immediately if any complications arose.

The community accepted discussion of social barriers. Interactive discussion helped them to decide how to act to prevent future deaths. Community active participation and arrangements also supported the organization of social autopsy. Thus, social autopsy helped to identify social barriers, and factors related to death. Moreover, social autopsy was also used as a powerful platform for sharing knowledge and lessons learned from a specific death in the community. Community perception was also found to be changed. Thus, interaction sensitized the community and committed it to take appropriate and timely action.

Moreover, the platform brought the different groups together, from adolescent to more senior, from the reproductive age group and pregnant mothers to male decision-makers. The presence of local elites or leaders of local government made social autopsy more powerful. Community ownership developed through this process of engagement of local government and members of the community. This also strengthened the decision-making capacity of the people. However, challenges remain to involve more male participants, who are decision-makers in the family. The time it took to conduct a social autopsy was sometimes an issue for the health workers.

**Paper V**

**Facility death review of maternal and neonatal deaths in Bangladesh**

After one year of piloting in Thakurgaon District, it was found that senior staff nurses were doing facility death review with the support of doctors in the district hospital, maternal and child welfare centre, and in the upazila health complexes. Senior staff nurses used a structured notification form filled up immediately after any of the maternal, neonatal deaths or stillbirths. After that, death review was performed by recall to the health providers who treated or managed the patient during admission or during treating. The review process were completed within seven days of a death occurring. The nurses also checked records containing the treatment card and investigation reports to review each of the cases. Nurses took necessary support and feedback from the doctor or consultant to assign causes of death. Moreover, health care providers, including doctors and nurses,
discussed with each other during the death review process. After conduction of the death review, causes were identified and discussed among the providers. This helped them to understand and identify human resources, logistics or equipment gaps and errors in the facility, including delays. Periodic facility death review meetings with the review team in the facility helped in the taking of corrective measures to improve quality of care at facility level. Moreover, it also strengthened the capacity of health workers in documentation of death records. It was also found that the facility death review process strengthened improved supervision and monitoring system in the facilities by the health managers.

Facility death review in the district hospital identified 12 maternal deaths in 2010 in Thakurgaon, mostly due to post-partum haemorrhage and the fact that blood couldn’t be provided at the right time. Facility death review discussed detailed findings, and at the meetings it was decided to form a 24 hour blood-donor and functional blood-availability list. After a mother was saved after being admitted to the district hospital with post-partum haemorrhage, the mother was given 19 bags of whole blood from hospital-listed donors.

However, standard documentation is still a barrier with a deficit of human resources. This delayed the process of doing facility death review, which also causes a lengthy recall period and makes it difficult to get missing information.

**Paper VI**

**The economic cost of implementing maternal and neonatal death review in a district of Bangladesh**

MNDR cost was estimated from 2010 (the piloting year) until 2012 in Thakurgaon District in Bangladesh. In the piloting year, total cost spent to implement the programme was 10902754 BDT (138010 USD). A total number of 3551 activities were performed in this year. Different activities included death identification and reporting, performance of verbal and social autopsy, facility death notification and review and meetings at upazila and district level. Unit cost of each activity was 3070 BDT. In the second year, total cost to implement the programme was 8208995 BDT (103911 USD); number of unit activities increased to 4351. Overall unit cost for each of the activities was 1887 BDT. In the third year of implementation, MNDR required 6622166 BDT (83825 USD). In this year, 3001 unit activities were performed. Therefore, unit cost per activity slightly increased to 2207 BDT [table 8]. Among the programme costs, the
cost of development of tools and guidelines and capacity development were spent just for the developmental stage in 2010, whereas intervention continue until 2015. Therefore, those expenditures were calculated on year basis. However, field-level health workers received 100 BDT for each death notification, 200 BDT for the conduct of verbal autopsy, and 400 BDT for social autopsy. Nurses received 50BDT for facility death notification, and nurses and doctors 500 BDT for each facility death review [table 9].

Table 8: MNDR summary expenditure as per activities
[Bangladeshi currency Taka]

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2010</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost</td>
<td>1,09,02754</td>
<td>82,08995</td>
<td>66,22166</td>
</tr>
<tr>
<td>Unit cost</td>
<td>3070</td>
<td>1887</td>
<td>2207</td>
</tr>
<tr>
<td>Community Death notification</td>
<td>3170</td>
<td>1987</td>
<td>2307</td>
</tr>
<tr>
<td>Verbal autopsy</td>
<td>3270</td>
<td>2087</td>
<td>2407</td>
</tr>
<tr>
<td>Social autopsy</td>
<td>3470</td>
<td>2287</td>
<td>2607</td>
</tr>
<tr>
<td>Facility death notification</td>
<td>3120</td>
<td>1937</td>
<td>2257</td>
</tr>
<tr>
<td>Facility death review</td>
<td>3570</td>
<td>2387</td>
<td>2707</td>
</tr>
</tbody>
</table>

Table 9: Actual field implementation cost

<table>
<thead>
<tr>
<th>Implementation cost</th>
<th>Cost (in BDT)</th>
<th>Cost (in USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community death notification</td>
<td>100</td>
<td>1.27</td>
</tr>
<tr>
<td>Conduction of verbal autopsy</td>
<td>200</td>
<td>2.53</td>
</tr>
<tr>
<td>Conduction of social autopsy</td>
<td>400</td>
<td>5.06</td>
</tr>
<tr>
<td>Facility death notification</td>
<td>50</td>
<td>0.63</td>
</tr>
<tr>
<td>Facility death review meeting</td>
<td>500</td>
<td>6.33</td>
</tr>
</tbody>
</table>
6. Discussion

Using existing government infrastructure and resources, Maternal and Neonatal Death Review (MNDR) was found to be feasible/implementable in Bangladesh. The system was found to be well accepted by the health managers and health workers of the Directorate General of Health Services (DGHS) and Directorate General of Family Planning (DGFP). The system enables an excellent partnership between government and development partners, including non-government organizations. Sincere partnership requires willingness of different stakeholders to learn from each other’s and that could bring benefits from the research activities for all partners (94).

The system, implemented within the government health system, shows excellent collaboration between the health department and family planning department from grass-roots to national level. Field-level health workers accepted the process of implementation of MNDR in the district, and the community was also encouraged to provide necessary information related to a death. Health and family planning managers at district and upazila level utilized the findings for initiating appropriate action plans to improve maternal and neonatal health. Thus, MNDR has a positive effect on the progress of death reduction in the country.

MNDR was able to notify all maternal and neonatal deaths and stillbirths from the community and facilities. Verbal autopsy helps to identify medical and social causes. Social autopsy plays a key role in social interaction with the community to discuss social errors and barriers. Thus, social autopsy helps the community to take corrective measures for the future in its own society. Facility death review in MNDR explores causes, gaps and challenges in the facilities to improve quality of care.

Death review for maternal and neonatal has been practiced earlier on a small scale in a particular population in Bangladesh (95-97). The Directorate General of Health Services performed population-based surveys to identify causes of maternal deaths twice in past decades in 2001 and 2010 (33-34). Bangladesh Demographic Health Survey (BDHS) have been conducted on a periodic basis, usually every three to four years, to calculate the neonatal mortality rate and causes of neonatal deaths (11). The Ministry of Health and Family Welfare initiated the MNDR comprehensive death review system in 2010, with the technical support of a national level health research organization named CIPRB and UNICEF, Bangladesh. “Beyond the number” by WHO for maternal death surveillance (2004) (1) was the main basis for designing MNDR for Bangladesh.
Although the terminology used in Bangladesh is MPDR (Maternal and Perinatal Death Review), which does not have coverage of neonatal deaths in its name, the government has covered death review for neonates. Therefore, using MNDR in this study includes coverage of neonatal deaths.

One-year findings on MNDR in Thakurgaon District has encouraged the government to roll out another new three districts during 2011-12. This study has looked for experiences in Bangladesh, including the effects and challenges of MNDR implementation, which can be replicable nationwide and in countries with similar settings. Different components of the MNDR system have effects in improving maternal and neonatal health, though a number of challenges have been identified to overcome.

The aim of the thesis is that research can have an impact on the maternal and neonatal health care system in Bangladesh. In analysis, the impact of the developmental efforts impact oriented monitoring following inputs, intervention activities, outputs, and immediate, short term and long term effects (98). This payback model originally categorized the types of benefits of research in five domains: knowledge production; research targeting and capacity building; informing policy and product development; health and health sector benefits; and broader economic benefits. The six papers in the thesis have contributed to developing a system that contributes to payback in all these five respects.

The thesis has described community death notification, verbal autopsy, social autopsy, facility death review, and utilization of findings separately (see below).
6.1 Community Death Notification

Field-level health and family planning staff reported community maternal, neonatal deaths and stillbirths by visiting the community or using a community network to collect death information. A death was reported within seven days from its occurrence to the assigned focal point in the upazila health complex. A structured death notification form was used to report the death. Government-level health and family planning staff (health assistants and family welfare assistants) felt motivated, and were encouraged to identify deaths within their routine activity as per assigned geographical catchment area. That certainly restricted overlapping of reporting. Death numbers, manually plotted on the upazila geographical map, attracted upazila health managers to initiate discussion on death-dense areas and to identify need-based local action plans to intervene.

Globally, a civil registration system with medical causes of death identification is not well established (6, 99, 100). A civil registration system is most important and brings multiple benefits, but two-thirds of annual deaths are still not registered (101). In Bangladesh, the structured vital registration system is poor, although effective vital registration is crucial to understanding mortality and planning interventions (102). That causes deaths to be under-reported, and work to mitigate the challenges cannot be pursued (103-4). The international consensus is that maternal deaths are usually under-registered with great variability across geographic areas (15, 55, 105). The MNDR system has shown that death registration can easily strengthen health systems in low income country settings.

A study in Pakistan has mentioned the scarcity of maternal death reports, and stillbirths are even more infrequently reported (29). India has experienced notification of community maternal and perinatal deaths using both
government and NGO partnership (28). In Bangladesh, although the present government health system has provision for the monthly death reporting of all types of deaths, there is a little reporting at local level, and stillbirth reports are also very low. Health department and family planning departments report deaths separately, and, in most cases, there is an obvious difference between the two departments’ death reports. Using MNDR, excellent coordination and synchronization between the two departments in reporting deaths has been established. This is noted as a major strength in capturing community maternal and neonatal deaths and stillbirths.

Effective local level planning and coordination minimize over-reporting or the duplicate reporting of community deaths. Community death notification is able to minimize the overlapping of deaths. Death notification in turn leads to exploration of medical and social causes, a difficult process especially in developing countries (106). In this study, the local health managers used the deaths numbers for mapping and took remedial action plan based on high-death zones. Kashipur created evidence on how death numbers influenced the health managers to plan and to implement. Improved quality of services, supportive monitoring and supervision and community empowerment in Kashipur union shifted the health-seeking behaviour of mothers and their families in the community [figure 5].

The involvement of government field-level health workers in contributing to community death notification is ideal for future sustainability. One study has shown that the community-level maternal death review process increases the number of death notifications with the support of the community in comparison with health-system notification only (57). There are major challenges to reporting death. Sometimes, there is misjudgement between neonatal death and stillbirth due to misunderstanding and misclassification, and neonatal deaths are reported as stillbirths. Studies have shown that the number of stillbirths is equal to the number of neonatal deaths (6). In our study, due to misclassification and misunderstanding, there may have been variation in the total numbers of neonatal deaths and stillbirths reported. Another challenge that will take time is to report deaths beyond the usual recommended time of within seven days.

6.2 Community Verbal Autopsy (VA)
Verbal autopsies for maternal, neonatal deaths, including stillbirths, are performed by the government field-level health workers (health inspectors, assistant health inspectors and family planning inspectors) at community level. The focal point in the upazila health complex assigned the health workers to conduct a verbal autopsy after a death was reported to the focal point (107). Educational status of the interviewer influenced the
outcome of verbal autopsy (108). A built-in government system creates a positive environment for health workers who are educated, have at least a degree, and are very well-known in the community. The people living in the locality call them in many cases as doctors, and speak in local dialect. Therefore, they are highly accepted at household level to interact and discuss a death.

A simple verbal autopsy tool was utilized to interact with members of the deceased family at household level. A majority of maternal, neonatal deaths including stillbirths occur for which causes and contributing factors related to death are not identified in the community. Verbal autopsy is suitable when deaths mostly occur at home to assign cause of death (109). Community-level verbal autopsy is a useful tool to identify major symptoms, complications, health-seeking behaviours and social factors (100, 110). It can help to assign a probable cause of death in the community (99). Therefore, verbal autopsy has been used quite often in low-income country settings to define causes of death (6, 111).

Verbal autopsy has been found to be useful in assigning community deaths in India (28). Community-based death review (verbal autopsy) is an excellent method for finding out medical causes of death and ascertaining the personal, family or community factors that may have contributed to the deaths in women who died outside of a medical facility. Community-based case reviews are undertaken through interviews with the woman’s family (1, 64). Verbal autopsy is a method of ascertaining probable causes of death based on an interview with primary caregivers about the signs, symptoms and circumstances preceding maternal, neonatal deaths or stillbirths (64, 112).

Meanwhile, WHO has revised its verbal autopsy instrument for the automated assigning of causes of death following ICD-10 (17). But, in this study, a community verbal autopsy tool was developed considering the

Photograph: Community verbal autopsy
Bangladesh context and also considering its method of data collection (i.e., from the deceased family). Therefore, the present verbal autopsy instruments focuses more on identifying community delays and sign symptoms that, later on, physicians can work to assign causes of death on autopsy forms (65).

This study identified some of the challenges, including time delays, not getting appropriate respondents and recall bias, when deaths were reviewed many days after a death had been notified. Similarly, other studies reveal that to conduct community verbal autopsy, there are a number of challenges to address like recall bias (113) or misclassification of causes of death (105). The most powerful elements in doing verbal autopsy are to adopt a non-blaming approach and to maintain confidentiality. Moreover, health workers must be well accepted in the community and comfortable to provide all information related to death. Several studies mention that the closest relative provided all information during interviewing (107). In this study, verbal autopsy in the community usually took place at least after seven days of death occurrence, but one study describes verbal autopsy of stillbirths taking place 4-6 weeks after death (96). Studies also show that the time of verbal autopsy is a major factor in its outcome, and some studies show that longer recall is as reliable as shorter recall (107). Further, the context of doing verbal autopsy of maternal and newborn deaths differs in the rural community. In some cases, there is a disparity in social customs. A husband and his family may recover sooner from a mother’s death and re-marry within a few months. Or, a mother may get pregnant again within a few months of the death of a newborn or stillbirth. In such cases, it is preferable to conduct an autopsy within a month.

Using the community verbal autopsy tool, it usually took 30 minutes to one hour to complete an interview, and one of the studies reports that it takes an average of 30 minutes to complete a verbal autopsy for stillbirth (6). Uniqueness of verbal autopsy in MNDR has explored government health workers’ contributions in reviewing deaths. Community verbal autopsy also covers maternal and neonatal deaths and stillbirths in this study. There is evidence of future sustainability in the government’s efforts to run a verbal autopsy system within the management information system.
6.3 Social Autopsy (SA)

Social autopsy of maternal and neonatal deaths and stillbirths is performed by government field-level health workers (health inspectors, assistant health inspectors and family planning inspectors) at community level. It occurs after a death is reported to the focal point in the upazila health complex following the performance of a verbal autopsy. Usually, a social autopsy takes place within a month of a death. It does not produce mortality data; rather, social autopsy is a medium to get in social contact with the community people where a death has already occurred. Thus, social autopsy helps to identify the social barriers and errors that caused a death.

The community interaction close to the deceased family members resides in their understanding of what happened in a specific case, how complications could be averted in future, and the role of society in decision-making. Therefore, social autopsy implies a response to a death in a specific place, which sensitizes community people to make a focused intervention. Studies have shown that community participation is a key component of health promotion and health intervention. Moreover, community-based participatory research is designed to reduce disparities (94). Studies also shown that communities have a significant role in reducing maternal and neonatal death if the community participates in planning and takes community actions. This study shows that community involvement led to a reduction in maternal and neonatal deaths through social autopsy (57).

WHO developed maternal death surveillance and response (MDSR) in 2013, which shifted from the previously developed “Beyond the Numbers”, which concentrated on responses based on maternal deaths (1, 114). A similar model of intervention using social autopsy for child injury-related deaths has already been used in Bangladesh. Thus, social autopsy has helped to reduce injury deaths in children, including drowning and road-traffic injury, by sensitizing the community (46, 115). Social autopsy has used Kala-azar during pregnancy in Bangladesh, which has illustrated
complex factors that ended in the death of a mother using FDG. The social autopsy tool has also been used for dengue mortality (116 -17). In this study, social autopsy was used as an intervention to interact with the community. Detailed discussion of social factors related to death helped the community to act and decide upon future prevention.

Kenya has experienced social autopsy to investigate causes and contributing factors by using INDEPTH NETWORK tools for social autopsy (118-19). In India, social audit and verbal autopsy of maternal deaths were performed by professional experts and physicians at community level (120). In this study, social autopsy was conducted by government field-level health workers. The approach creates an environment to discuss social dilemmas and barriers in front of the society where a death occurred. Community interaction helped participants to think of and take corrective measure based on what they had learned.

Each social autopsy ends with a message to bring back home to the people residing in the community. The messages concern maternal and neonatal complications and danger signs. The messages related to what really needs to be done during complications changed people’s perceptions of and willingness to seek facility care. But, in developing countries, utilization of health facilities is very low for facility-based delivery and emergency medical obstetric care (EMOC). This is because of a lack of awareness of the people about the availability of facility services and the quality of care (121).

One study has mentioned that the term ‘social autopsy’ implies social diagnosis of important social, behavioural and health-system determinants of mortality (122). In this study, social autopsy was used as a catalyst for responses by society to prevent the future unwanted deaths of mothers and newborn, and for changing health-seeking behaviour in the community towards a facility. According to WHO's social autopsy has not been widely practiced and still lacks a standard method. At present, however, it addresses delays and generates care-seeking data (16). In this study, social autopsy was used for community mobilization, building awareness and developing knowledge, and changing the attitudes of the community so as to shift their practices. The event sensitizes the community and influences society to rectify itself for future events of a similar kind. However, WHO has predicted that future social autopsy studies should maximize awareness potential though participatory data-sharing and the development of interventions (16).
6.4 Facility Death Review (FDR)

Facility death reviews for maternal, neonatal deaths and stillbirths took place in district hospitals and upazila health complexes and in maternal and child welfare centres in the districts. Senior staff nurses notified a death using a notification form immediately after a death occurred. After that, within seven days, nurses performed facility death review. Nurses with the support of doctors in the facility assign causes of death and identify factors associated with death. This has been performed using a semi-structured questionnaire within a supportive environment, maintaining a non-blaming approach, and confidentiality. Facility-based maternal death review is a commonly used method in 15 countries in Africa (123), and many other countries use maternal death inquiry at facility level (28, 58, 124-128). Facility death review in this study was adapted from WHO’s “Beyond the Number” (1).

In this study, facility death reviews were not restricted to identifying the causes of death. They went on to identify the gaps and challenges in the facility to improve facility-level quality of care. FDR findings have been used to improve facility care in India (28). The United Kingdom practices monthly multidisciplinary meetings to review perinatal deaths (129). In this study, health care providers at facility level accepted FDR and actively participated in the periodic review meetings to discuss maternal and neonatal deaths, including stillbirths. Other studies have also shown acceptance and the use of facility death review by health professionals (130). However, like in other studies, facility MNDR was found to face a number of challenges, which include poor documentation, and delays in reviewing deaths by health care providers (which increase the chance of recall bias). Transfers of nurses and doctors from the facility raise difficulties in conducting FDR appropriately. Similar contexts, described in many other countries, face the same challenges in addressing death review, mostly maternal deaths (55, 61, 123, 130-31). In MNDR, facility death review is performed in an enabling environment, with the active participation of doctors and nurses, and is accountable for the reviewing of neonatal deaths.

Photograph: Facility death review
and stillbirths. The key strength of this study is the direct involvement of health care providers in the process of doing death review with a non-blaming approach. Interviewing other health care providers who have treated the patient by recalling and using records is the main source of information. Moreover, the death review process has influenced the hospital authorities to take initiatives based on causes of death, which has helped to improve facility services in the district.

6.5 Effects of MNDR on Health System Improvement

The study explored whether community death notification data were used as one of the key initiatives at community level. Using simple death mapping with a plotted red dot for maternal death, a yellow dot for neonatal death, and a blue dot for stillbirth enabled the upazila and district managers to see immediately when death numbers go up in the map [figure 6]. Some of the areas with high deaths were focused upon within the map. That is, the managers were sensitized to think about and immediately plan for the area. The study identified some of the innovative approaches taken by the health managers to help to reduce maternal deaths by a good number. Initiatives included community sensitization, improving health care services in the community clinic, ensuring the quality of antenatal care, provision of normal deliveries and right-time referrals of mothers with complications to a higher centre. They were useful and had an effect on death reduction. In one previous study of community-linked maternal death review in rural Malawi, it was shown that community meetings explored traditional beliefs, educating men to improve responsibilities in supporting women, community funds for bicycle
ambulance maintenance, organizing a youth club, and providing a female counsellor for aware pregnant mothers (61).

In this study, the health managers and planners could also estimate the maternal mortality ratio (MMR) and the neonatal mortality rate (NMR) to see the progress of the district compared with the national mortality survey. However, estimation of MMR and NMR is not possible from facility death numbers, because a majority of mothers and newborn still die in the community in Bangladesh. There are similar findings in other studies (124). To estimate trends in MMR and NMR, it is suitable to use community death notification data, which is reliable and reported without any overlapping from the upazilas.

Verbal autopsy findings are used by the upazila and district managers for effective planning and considering corrective measures at community level for community maternal and neonatal deaths. It is most effective in identifying causes related to death in countries where deaths are mostly unregistered and unattended by medical professionals (133). Another study mentions that causes of death from verbal autopsy are an essential source of information for public health planning and intervention (134). In this study initiatives like organizing health camps, awareness programmes with pregnant mothers, and identification of mothers with complications for referral help to reduce death numbers due to specific causes. The study refers to the use of verbal autopsy data at different levels by communities, health care planners and managers, researchers, global decision-makers, and donors. Health managers want to examine causes of death for planning, resource allocation, and the monitoring of progress (135). One study in Indonesia has described utilization of maternal death audit data; it has shown that the main cause of eclampsia is the unavailability of appropriate medication, which causes the death of many mothers. In response to the audit, magnesium sulphate was supplied to village midwives (106). A study in Kerala using community verbal autopsy for maternal death identified first and second delays (112). The study, performed during 2007 in Bangladesh, analysed some of the maternal verbal autopsies conducted at community level to identify contributing factors related to maternal death (96). In this study, the findings of community verbal autopsies helped managers to identify delays and social barriers related to deaths that enable the health workers to focus on interventions with regard to the dominant factors. A study in Ethiopia describes the role of the village leader in the verbal autopsy of a maternal death to motivate mothers to obtain facility care during pregnancy (62). It was also found in the study that using different partner NGOs in maternal health in the district worked in the areas where definite causes and contributing factors of death had been identified for maternal and neonatal deaths.
Social autopsy in MNDR is used as an intervention when a death has occurred in the community. It has the effect on society of learning and knowing about social errors and barriers. The villagers participating in a social autopsy themselves discuss a specific death in the community where they live. Therefore, the community discusses how to change the community and find solutions to prevent future deaths. A meeting is also an open avenue for taking decisions by the community about what to do and how to do it in the future. This develops community empowerment and leadership. The community owns its problems and explores solutions. Social autopsy in MNDR has great potential sustainably to utilize MNDR data, and thus can help to reach the sustainable developmental goal by 2030. A community-based participatory approach is mostly used in poor communities or neighbourhoods where people need to build knowledge, capacity and skill to improve the overall health situation (136-37).

The facility death review process in the district hospitals, upazila health complexes and maternal and child welfare centres improved the quality of services for the health workers in the study, and it also improved the documentation process for patients. The review meetings also identified gaps and challenges to overcome at the facilities. Another study mentioned that review meetings at facility level help people to learn lessons and decide on steps that need to be taken that require careful planning with quality team work and guidelines (64). Twelve maternal deaths in the Thakurgaon district hospital in 2010 were due to post-partum haemorrhage. Blood could not be provided at the right time. A facility death review meeting discussed the issue to establish a 24-hour blood donor and functional blood-availability list. Immediately after the initiative was taken, a mother’s and newborn’s lives was saved by providing 19 bags of blood from the donor lists who came to the district hospital with post-partum haemorrhage. Thus, facility death reviews helped to improve the quality of services in the hospital. One study in Bangladesh has shown that health care providers at the facility acknowledged the effect of the absence of a blood transfusion system on the quality of diagnosis and treatment of patients in the facilities (14). Similar initiatives have been taken in Kenya, where 24/7 service ensures that emergency medicine is available in the labour room (24). Another study in Pakistan refers to using facility death review for public health monitoring to reduce maternal deaths (99). In the facilities, some studies describe actions undertaken using death review findings (55).

A study from Senegal shows that the facility death review process followed a number of recommendations, including 24-hour availability of drugs and supplies, haemoglobin and coagulation tests, buying a blood bank refrigerator, etc. The availability of basic emergency obstetric care caused a significant decrease in maternal mortality within a three-year period,
particularly deaths related to haemorrhage and hypertensive disorders (138). It also acts as a powerful tool to maintain accountability; the process improved team spirit and documentation, and initiated periodic review of deaths in a technical team for discussion and preparation of action plans (20).

Reducing social inequality in health is a major concern and is central to the millennium development goals as well as the new sustainable development goals recently adopted by the United Nations. The MNDR addresses one of the remaining challenges: maternal and neonatal deaths, which both have a social gradient and are closely related to poverty. Therefore, the development of tools such as community death review (verbal autopsy) and facility death review as well as social intervention at community level (social autopsy) all contribute to in-depth knowledge of preventable conditions, which could lessen social inequality in maternal and neonatal health.

The initial cost of implementation of MNDR required development cost, but in the subsequent year the unit cost of MNDR was reduced. This intervention was financially supported by the developmental partners; therefore, within the government health system, there was complementary remuneration for doing activities in the field. The study found that actual remuneration of a death notification took 100 BDT (1.27 USD), community verbal autopsy took 200 BDT (2.53 USD), social autopsy took 400 BDT (5.06 USD), and facility death notification and review took 550 BDT (7.26 USD). The majority of the cost was expended on human resource management, procurement of furniture and logistics, rental of office, maintenance, and organization. One study in India has found that verbal autopsy-based mortality surveillance in rural community is at low cost (139).

There is an opportunity for the government to take over MNDR within the government’s operating plan for the coming days. There is scope to reduce human resources cost, which means that the death review process can be easily sustained in the routine health system. Present evidence from African countries is that only seven countries’ governments allocated funds for doing maternal death review only. In 18 countries it was financially supported by developmental partners. Similarly, India has observed MAPDIER with the financial support of the United Nations.
6.6 Methodological Considerations

Both quantitative and qualitative methods were used. Thakurgaon District was chosen as the piloted district, which implemented MNDR in 2010, and one further district, Jamalpur, was randomly chosen from three expanded districts in 2010. Within the districts, upazilas were also selected by random selection. The purpose was to minimize bias towards selecting good performing districts or upazilas for the research.

Using a quantitative approach, death notification data were collected from the yearly reported death notifications obtained from the upazila health complexes. The focal point at upazila health complexes stored the community death notification data of the district. Maternal and neonatal deaths or stillbirths reported in the upazila health complexes were entered into the database after they were verified in the field. A health assistant or family planning assistant confirmed the death notification by a household visit, and clarified the per-operational definition of deaths. After that, first line supervisors also randomly verified the deaths as per definition during their field visits. However, since the intervention was designed to conduct verbal autopsy of each of the maternal deaths by the health inspector or family planning inspector, this number was validated and entered into the final database. This method was used to supplement the qualitative data. The death notification number showed the notification system to be functional, and follow-up of the death notification number in the following year reflected the effect of community death notification in the MNDR system on death reduction in Bangladesh. Therefore, the mixed method used in studies I and II validated MNDR death notifications and the reporting system that has been operated by health staff working in MNDR.

Using a qualitative method, a different data collection was performed, including focus group/group discussions, in-depth interviews, documents review and participant observations. Respondents participated in the study mostly from the health and family planning department at grassroots level up to the district level managers. In focus group discussions and in-depth interviews, the upazila health managers were officially informed about the interviews. The government had taken the steps necessary to conduct FGDs. Participants in the FGDs maintained homogeneity, and were randomly chosen by the upazila managers who felt interested in participating in the discussion. FGDs helped to deepen understanding of the issues involved in MNDR, and their expression, mode of participation and interaction also indicated their involvement in the process.

Time of data collection was challenging, and it was decided to opt for FGDs to minimize the time of data collection and gather more information.
within a short period of time. However, a key challenge was to organize the time for the FGDs. All FGDs were conducted in working hours. Health and family planning staff always had field-level engagement, and those who participated spared their time to join the discussions. A place for the study was chosen in the community, which was convenient to them to participate in a short time within their working area. This also lowered cost. During the discussions, the health workers raised related issues. Some of the information was supplementary and was very relevant to the research topic. However, the research officers were able to keep them on track. The research officers had to rely on the statements given by the health workers in the FGDs. Cross validation of the data was performed when triangulated with in-depth interviews.

In two cases, instead of FGD, we held a group discussion. There are not wide differences between focus group discussion and group discussion. However, in the GD in Study II, only three respondents from the health and family planning department working in Kashipur Japartola community clinic participated. Three health and family planning staff were present at that time. Due to time constraints, one of the health workers came a little late, whereas another health worker left the discussion early due to an official engagement.

In study IV, group discussions took place in the rural community. Participants in the discussions were chosen purposively based on who wanted to take part. Participants were chosen from those who were present at the time of a social autopsy. Therefore, the researchers went to a place where social autopsy of a maternal or neonatal death took place. Researchers obtained information from the upazila focal point, and they waited in the place until the social autopsy session was completed.

During a social autopsy session, different categories of people of different ages participated, and homogeneity of the participants was not possible to ensure. Therefore, group discussion was planned instead of focus group discussion. The community-level group discussion took place in a courtyard of a household in the village; therefore, some other interested people came to see what was happening. However, they did not interrupt the discussion; rather, they were present to see the process of discussion. It was required to consider the social context in Bangladesh, and it was not possible to maintain high privacy in the interview session.

In study V, FGD with doctors and nurses to know the effects of facility death review could not be organized because of time constraints, and it was difficult to gather doctors and nurses in the district hospital during working hours. Therefore, in-depth interviews were performed in this case.
In-depth interviews were conducted with the upazila and district health managers. Before interview, they were requested officially to book a time of interview, and the objectives of the interview were clearly stated. Upon receiving permission from the government health managers, interviews took place in their offices. Therefore, time frames for the interviews were set depending on their availability. Moreover, during the interviewing process, in a few cases, health staff entered the office to meet with health managers, and sometimes health managers also had an emergency that interrupted the interview for a while. However, that was not reflected in the outcomes of the interviews.

In study II, one interview was conducted with a mother who received pregnancy care in the Kashipur Japartola community clinic. The researchers selected the woman randomly on the day she visited the community clinic so as to have one pregnant mother from those who came to receive pregnancy care.

In participant observations, the research officers were presented, and they acted as observers in the verbal autopsy and social autopsy sessions. However, they did not participate in dialogue during the process. In order to deeply understand the steps in verbal autopsy and social autopsy, research officers were focused on observations rather than on taking notes. Only key notes were taken as per the checklist. Later on, the research officers jotted down details of their observations from their memory and key notes. Research officers’ recall was relied upon to note down all observation outcomes. In document review, an inductive approach was used where the objectives of the review were identified before going through each of the documents.

The key strength of qualitative study was people’s active participation. In no case was an interview refused. FGD and IDI supplemented each other for deeper understanding and validating the information.

Different methods were also used in the study for its reliability. They were recognized as relating to the stability of data-collection measures, which remains an important notion (140). Collective results from FGD were compared and triangulated with the individual comments on mentioned objectives received from the interviews. Different sources of information from the data and different groups were discussed in relation to MNDR, which made the data reliable. Moreover, to retrieve the quality of data from the participants, peer debriefing was performed. A percentage of transcripts of IDIs and FGDs were taken to ensure reliability.

Observations also validated the process of verbal and social autopsy that were not restricted to what the health care providers said. Rather, observ-
ing made the verbal and social autopsy session more understandable to view and observe different acts in the community, including responses. A study has also shown that focus group discussion retains elements of detailed understanding of the facts while maintaining its own peculiarity and uniqueness (141). By contrast, in-depth interviewing is designed to elicit a vivid picture of the participant’s perspective.

However, there was difficulty in summarizing all the findings together to come to a conclusion. That challenge had to be overcome. One study mentioned that focus group discussion has some difficulties, including coordination with respondents, dealing with gate keepers, and also managing the discussion (81). Creswell has stated that desired results as per objectives are to some extent difficult to obtain (84).

All interviews and discussions were conducted in local Bengali; they were transcribed into Bangla first and then translated into English. Later on, they were coded and analysed using open coding to sort the themes. There was a challenge during translating into English from Bengali. Some of the expressions and internal meanings mentioned during the interviews faced the risk of being missed due to translation. The key constraints on conducting focus groups are related to the poor skills of the moderator, inappropriate note taking, and the inaccurate transcription of the discussions (142). In this study, all research officers were anthropologists; they were specialists in qualitative research, and they were trained properly before implementing the instruments in the field. Before real-field practice, the research officers used the tools in testing, which helped them to get familiar with the instruments. Research officers used probes to get desired information in the interviews and FGDs. All the FGDs and IDIs were recorded on audio tape recorders; one note taker (research officer) in each of the discussions took down key points in a note book to cross check with the transcripts. Ten percent of the transcripts were checked by the researchers for their quality and to ensure that each of the statements was clearly documented. Validity in research is concerned with the accuracy and truthfulness of scientific findings (143). The presence of the principal researcher during development of the guidelines, training, and data collection and analysis ensured validity of the research, which gave trustworthiness to the data.

Overall, in the entire qualitative research, data were collected on death review for mothers, neonates and stillbirths. The procedure was sensitive to discussion. Especially in the cases of discussions and interviews at community level, the research officer considered the people’s emotions and behaviours before continuing the research. Ethical issues are challenging in qualitative research, where interpersonal relationships develop with the researcher and the participants (144). However, the study had a weakness
in not interviewing the different stakeholders, including higher government officials at national level. That would have helped to identify policy feedback and future perspectives on the country. Researchers working in the study were transparent to collecting information as per guideline. Whereas, it was necessary to rely on the statements of the health care providers or community people about their experiences MNDR in the districts. Quantitative data may have indicated functionality of the death notification system in MNDR and its effect in the district.

6.7 Strengths of the Study

MNDR in a Bangladesh context is possible and has been implemented in a supportive environment. The government health system has the infrastructure and human resources capable of identifying each of the maternal, neonatal deaths and stillbirths in the community and at facilities. The study also identified a strong relationship and integration of work between two different wings under the Ministry of Health and Family Welfare of Bangladesh to work from field level up to national level. Using the term ‘death review’ rather than ‘death audit’ or ‘enquiry’ was found to be more comfortable for health and family planning staff in the field to come up with details on death issues. The respondents were also responsive to knowing that the question was of review, not investigation.

Therefore, a single death reporting system was generated by both directorates without overlapping of deaths and covering entire districts. Death mapping on a routine basis at upazila level sensitizes the upazila health managers to think of the death situation on a regular basis. The MNDR Review Committee played a crucial role in discussion and decision-making to reduce deaths in upazilas and districts. The meetings also forwarded recommendations for the national level committee to implement.

Verbal autopsy in the community was able to identify medical and social causes of deaths using a simple data collection questionnaire utilized at household level by health workers. The community has found good acceptance of responses to deaths and discussion. Furthermore, social autopsy brings up a platform to share and discuss in detail social errors and barriers that influence the community to build knowledge and to act upon. The interaction with the relatives of the family of the deceased and community people helped understanding and decisions on what to do in future to prevent complications. That is, responses following MNDR built readiness in the community to respond. Facility death review demonstrated facility gaps, errors and the causes of deaths. Some action taken at facility level demonstrated utilization of the MNDR findings in improving quality of care. All steps in MNDR have maintained confidentiality, anonymity
and a non-blaming approach throughout, which gives freedom to health workers to report deaths and do reviews. Acceptance of health workers in the community was important. Active community participation in the entire process reinforced the study.

MNDR was able to exert influence at national level to scale up in four districts of Bangladesh after initial piloting in Thakurgaon in 2010. Community engagement created demand for seeking health care at facility level. Therefore, quality of service by the health workers also increased. The cost of doing MNDR was low, and has implications for other countries with similar settings. Overall, existing MNDR has represented government ownership to implement the intervention with the financial support of donors and the technical assistance of CIPRB and UNICEF, Bangladesh.

6.8 Challenges

The MNDR research study explored a number of challenges. It was observed that death notification sometimes took longer to report to the focal points at upazila health complexes, which made for delays in the conduct of verbal autopsy and social autopsy. Delay in performing verbal autopsy increased the risk of recall bias. Sometimes, it was a challenge to find suitable respondents to conduct verbal autopsy, whereas, in social autopsy, it took time to gather people in one place. In the case of social autopsy, the challenge remains to engage more male participants, who are the decision-makers in the family in the majority of cases. Field-level health workers conducting social autopsy mentioned the necessity of refreshers’ training to improve the quality of communication skills of health workers so as to interact with the community.

It was found that cause assignment of deaths was sometimes difficult. In a few cases, the community tried to blame the health system for a death that had occurred. Their perception on non-blaming is still not complete. In facilities, suitable patient records of each of the deaths were missing, which made it difficult to review facility deaths. The complete addresses of patients were missing in many cases, which made it difficult to track mother or newborn deaths in the community. It was also found that a deficit in human resources led to delays in the performance of facility death review.

6.9 Implications and Recommendations

MNDR in Bangladesh has created evidence for the establishment of a comprehensive MNDR package that reflects vital death registration, identifies under-reported deaths, and covers a wide spectrum of deaths, including maternal, neonatal deaths and stillbirths, at both community and facil-
ity level. The lessons learned from the existing MNDR model of implementation are clearly illustrated in its process of implementation, barriers and challenges, and also some of its key successes.

Effective utilization of death mapping and the findings of death review is able to improve the maternal and neonatal health situation of countries with similar socio-economic and geographic context. Moreover, the present MNDR approach, using the government to build the health system, has great potential to be sustainable for a longer duration at a minimum cost. It can also be embedded in the routine management information system through the reproductive health programme of the Directorate General of Health Services in Bangladesh, rather than through a vertical programme. Thus, MNDR will be able to meet the sustainable developmental goal by 2030.

6.10 Further Research

The present comprehensive model needs to be tested for its cost effectiveness to run similar models in other countries. Moreover, further investigations are required to make the verbal autopsy and facility death review instruments more concise in order to shorten the time for doing death review at community and facility levels. Research is also required to improve the documentation of facility deaths. Furthermore, advanced research is required to integrate MNDR death review findings into the government’s health management information system to maintain sustainability. An impact evaluation on MNDR would provide more information for future scale up in Bangladesh and in other low income countries.
7. Conclusion

MNDR in Bangladesh has great potential to support maternal and neonatal death reduction, including stillbirths. The comprehensiveness of the system is already identified to be feasible and acceptable by the government for it to be run within the government health system. MNDR has created evidence on how its findings can be utilized for planning, implementation and improvement of service and care. It has a direct effect on the local health system where MNDR data are utilized by local health and family planning managers for their improvement. The indicator of death reduction can be followed up periodically, which effectively strengthens the health system. Thus, an MNDR system in Bangladesh will contribute to achieving the sustainable development goals by 2030. Moreover, government can run this intervention at low cost within the existing health system. This is replicable in other countries with similar settings.
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References


36. El Arifeen S, Hill K, Ahsan KZ, Jamil K, Nahar Q, Streatfield PK.


38. UNICEF. Community support system brings better healthcare to villagers [Internet]. 2014 [cited 2015 Feb 6]. Available from: http://www.unicef.org/bangladesh/media_9131.htm


73. Padgett DK. Qualitative and mixed methods in public health. SAGE publications; 2012.

74. David W. Stewart PNS. Focus groups theory and practice. SAGE publications; 2015.
78. David P. Using mixed methods: frameworks for an integrated methodology. SAGE publications;


141. Colucci E. “Focus groups can be fun”: the use of activity-oriented questions in focus group discussions. Qual Health Res. 2007 Dec;17(10):1422–33.
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