IMPACT OF SKILLED MIDWIVES ON SAVING MATERNAL AND NEWBORN LIVES IN BANGLADESH

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Acronyms

Acronym	Meaning
ANC	Antenatal Care
ARI	Acute Respiratory Infection
BDHS	Bangladesh Demographic and Health Survey
BNMC	Bangladesh Nursing and Midwifery Council
BSPH	Johns Hopkins Bloomberg School of Public Health
DG-FP	Directorate General of Family Planning
DG-HS	Directorate General of Health Services
DGNM	Directorate General of Nursing and Midwifery
FCDO	Foreign, Commonwealth & Development Office
KMC	Kangaroo Mother Care
LiST	Lives Saved Tool
LMICs	Low- and Middle-Income Countries
MAR/PAC	Menstrual Regulation and Post-Abortion Care
MMR	Maternal Mortality Ratio
NMR	Neonatal Mortality Rate
PNC	Postnatal Care
PPH	Postpartum Haemorrhage
PROM	Premature Rupture of Membranes
SDG	Sustainable Development Goals
SOP	Standard Operating Procedures
SRHR	Sexual and Reproductive Health and Rights
TFR	Total Fertility Rate
UNFPA	United Nations Population Fund
UzHC	Upazila Health Complex

Executive Summary

Background

Bangladesh has significantly reduced maternal and neonatal mortality rates, with Maternal Mortality Ratio (MMR) decreasing from 318 per 100,000 live births in 2000 to 153 in 2022, and Neonatal Mortality Rate (NMR) dropping from 39 per 1,000 live births in 2001 to 16 per 1,000 live births in 2022 (BBS 2023) Despite these advances, achieving the SDG targets of MMR below 70 and NMR below 12 by 2030 requires accelerated efforts. Predominant causes of mortality are preventable and addressable through skilled midwifery care, which includes comprehensive reproductive health services. Globally, only a modest increase in coverage of midwife-led facility-based deliveries could avert up to 22% of maternal deaths, 23% of neonatal deaths, and 14% of stillbirths by 2035.

In Bangladesh, 82% of urban and 65% of rural births are attended by skilled birth attendants, far below the near-universal coverage of facility-based deliveries attended by midwives and other skilled personnel in high-income countries. The government has recognised the importance of professional midwifery since 2010, leading to the establishment of various midwifery educational institutions. Midwives were first deployed in government health facilities in 2018. Over 8,000 midwives are currently licensed in Bangladesh, but only 2,557 are active in public health facilities.

The current study employed a mixed methods approach to explore the impact of midwives on health outcomes. The quantitative components, Components 1A and 1B, retrospectively and prospectively modelled the impact of midwives on maternal and neonatal lives saved. The qualitative component involved interviews with various stakeholders to identify the barriers and facilitators that affect the pathway to impact of midwifery services on maternal and neonatal lived saved.

The quantitative components are based on The Lives Saved Tool (LiST), developed by Johns Hopkins Bloomberg School of Public Health (BSPH). LiST evaluates the impact of health interventions on reducing maternal, neonatal, and child mortality, and stillbirths. It calculates lives saved by assessing changes in intervention coverage, with detailed regional analysis facilitated by the LiST Subnational Wizard.

Component 1A - Modelling of impact from deployment of midwives in Bangladesh 2019-2023 in eight districts

Objectives

To estimate the maternal and neonatal lives saved by scaling up midwifery deployment from 2019 to 2023 in eight districts of Bangladesh

Methods

Through review of peer-reviewed articles and other resources, we developed a preliminary list of the midwifery services that can be matched into evidence-based interventions in the Lives Saved Tool (LiST): a multi-cause mathematical model that estimates maternal, neonatal, and child lives and stillbirths averted or saved from increases in coverage of life-saving interventions. We obtained a list of districts from

the United Nations Population Fund (UNFPA) officials in the local branch in Dhaka where midwives are known to practice to their full scope (Bagerhat, Barguna, Bogura, Chattogram, Cox's Bazar, Mymensingh, Narayanganj and Noakhali). We finalised the list of midwifery services that can be matched to evidence-based interventions in LiST through consultation with UNFPA Bangladesh. We identified data that are relatively reliable and valid to provide coverage estimation of evidence-based interventions in LiST. We decided to include facility delivery data only, as it allows us to estimate the additional lives saved through scale-up of the 12 matched midwifery interventions during childbirth. Coverage was defined by percentage of the deliveries in a district conducted by midwives out of total live births in that district.

Results

The average change in coverage for midwife-led facility-based deliveries per year was +3.0% across the 8 districts, after weighting for population size per district. Taking 2019 as the baseline year, there are 892 total additional neonatal lives saved and 151 total additional maternal lives saved between 2019 to 2023 in the 8 districts. The estimated total number of lives saved varies from 38 in Narayanganj to 246 in Chattogram and Cox's Bazar, reflecting both differences in population size and extent of a change in coverage of midwife-led facility-based deliveries at the district level.

Component 1B: Prospective modelling of the impact of training and deployment of midwives nationally 2024-2030

Objectives

To project the neonatal and maternal deaths that can be averted in rural Bangladesh by scaling up of deployment of midwives between 2024 and 2030 based on three scenarios for district levels of deployment.

Methods

Building on the BSPH team's effort on the retrospective modelling, we conducted prospective modelling based on three scenarios for growth in coverage. The scenarios were constructed in consultation with Foreign, Commonwealth & Development Office (FCDO) and United Nations Population Fund (UNFPA) and the Bangladesh Demographic and Health Survey Key (BDHS) Indicators Report 2022 which found that 65% of deliveries are taking place at the facility with 12.5% facilities having midwifery led care. The BDHS estimates were taken as the Baseline scenario.

- Scenario 1 assumed 65% of deliveries will be taking place in facilities with 50% of facilities offering midwifery-led care.
- Scenario 2 assumed 70% of deliveries will be taking place in facilities with 75% of facilities offering midwifery-led care.
- Scenario 3 assumed 75% of deliveries will be taking place in facilities with 100% of facilities offering midwifery-led care.

Results

Under Scenario 1, with 50% of facilities offering midwifery-led care and 65% of deliveries in facilities, 11,052 neonatal and 995 maternal lives can be saved. Scenario

2, with 75% of facilities and 70% of deliveries in facilities, saves 19,689 neonatal and 1,733 maternal lives. Scenario 3, with 100% of facilities and 75% of deliveries in facilities, saves 28,855 neonatal and 2,480 maternal lives. Total maternal and neonatal lives saved are 12,047, 21,422, and 31,335 for Scenarios 1, 2, and 3, respectively.

Component 2: Qualitative Research on barriers and facilitators to enabling environment for midwifery full scope of practice

Objectives

To explore the barriers and facilitators to midwives' full scope of practice

Methods

We conducted in-depth interviews to explore the contributions of midwives to maternal and neonatal health outcomes in Bangladesh. Our respondents included midwives, recently delivered women, pregnant women, and other healthcare providers such as nurses, doctors and health facility heads from sub-district level public health facilities known as Upazila Health Complexes (UzHCs). We selected UzHCs within Dhaka, Chattogram, and Sylhet districts. Facility heads were contacted using contact information from Government of Bangladesh, MoHFW website. We also spoke to stakeholders from government and development organisations engaged with midwifery programs in Bangladesh.

Results

Increasing the number of midwives is crucial but insufficient without providing an enabling environment that allows them to perform to their full scope of practice.

On one hand, barriers to an enabling environment for midwifery full scope of practice include inadequate equipment, cramped facilities, and limited training opportunities. The lack of essential resources hinders midwives from delivering optimal care and often forces them to operate under stressful conditions. High workloads and staff shortages mean midwives often juggle multiple responsibilities at once, confirming earlier research on workforce inadequacies as a significant barrier to effective maternal healthcare. These barriers negatively affect service users' outcomes and highlight the need for collaboration and support. On the other hand, facilitators of an enabling environment include effective engagement within the healthcare team, fostering a safe, valued, and encouraging atmosphere. Clear communication, continuous mentoring, and strategic collaboration enable midwives to thrive despite resource limitations. Teamwork is crucial for efficient service delivery, particularly in high-pressure labour ward environments.

Broad Conclusion

The deployment, training, and recruitment of midwives have has significantly impacted maternal and neonatal health in Bangladesh, particularly in UzHCs. Despite the substantial number of lives saved, the current levels of midwife-assisted deliveries remain low due to data limitations and operational challenges. Scenario 1 appears most achievable with current resources, but scaling up to Scenarios 2 or 3 is necessary for Bangladesh to meet the SDG targets for maternal mortality by 2030.

This requires not only promoting facility deliveries and increasing midwifery deployment, but also creating an enabling environment will help midwives deliver quality maternal care despite existing barriers. The study has identified a wide range of barriers acting at different levels (individual level, community level, institutional level and policy level), such as inadequate resources, high workloads, and limited training. Findings also show that fostering an enabling environment with effective teamwork, communication, supervision, and mentoring, will empower midwives to deliver high-quality care. Investment in training, infrastructure, and strategic collaboration is essential to maximize midwives' potential and improve maternal and neonatal health outcomes. A limitation of the study is that barriers identified through convenience sampling in the three districts studied may not represent those experienced by midwives across Bangladesh. The findings should be interpreted as specific to these three districts only.

BACKGROUND

Bangladesh has made notable strides in reducing maternal and neonatal mortality rates, a key health and development challenge Bangladesh has significantly reduced maternal and neonatal mortality rates, with Maternal Mortality Ratio (MMR) decreasing from 318 per 100,000 live births in 2000 to 153 in 2022, and Neonatal Mortality Rate (NMR) dropping from 39 per 1,000 live births in 2001 to 16 per 1,000 live births in 2022 (!!! INVALID CITATION !!! (BBS 2023)). Despite these advances, meeting the Sustainable Development Goal (SDG) target of reducing the MMR to fewer than 70 deaths per 100,000 live births, and reducing NMR to 12 deaths per 1000 by 2030, requires accelerated efforts.

The top causes of neonatal mortality in 2015 were preterm birth complications, intrapartum-related complications, and sepsis or meningitis and congenital (Liu et al. 2016). The primary causes of maternal mortality in Bangladesh are largely attributed to haemorrhage and eclampsia, with significant contributions from indirect causes such as chronic diseases. Haemorrhage (31%) and eclampsia (23%) were the leading causes of maternal mortality in Bangladesh, with 21% of deaths due to indirect causes like anaemia and infections (Hossain et al. 2023). These are largely preventable complications, addressable through enhanced access to skilled midwifery care.

Midwives effectively manage postpartum haemorrhage through timely interventions and medication, significantly reducing maternal deaths (Fikre et al. 2023). They continuously monitor and treat pre-eclampsia and eclampsia, preventing complications (Beckingham et al. 2022). For neonatal health, midwives help reduce preterm births and manage birth asphyxia, ensuring immediate and effective care during childbirth (Vedam et al. 2022). Midwife-led telemedicine services also maintain care continuity during crises, addressing service gaps and improving outcomes (Turkmani, Nove, et al. 2023).

Globally, midwives are recognised as pivotal in providing almost 90% of essential sexual, reproductive, maternal, newborn, and adolescent health (SRMNAH) interventions. Their role is crucial in delivering comprehensive care that spans from pre-pregnancy to childbirth and beyond, addressing critical health needs and reducing mortality rates (Lassi et al. 2014). Midwives are pivotal in high-income countries where near-universal coverage by skilled birth attendants is the norm (Joseph et al. 2016). Unfortunately, in low- and middle-income countries (LMICs), such as Bangladesh, only 82% of births in urban areas and 65% in rural areas are attended by skilled birth attendants (*Bangladesh Demographic and Health Survey 2022: Key Indicators Report*. 2023). Nationally, at facilities where midwives are deployed, they are attending around 82-87% of births and the number of births they are attending is steadily increasing (Begum et al. 2023).

Before 2008, midwifery in Bangladesh was largely informal and unregulated. Nurse-midwives, who were trained within the broader nursing education system, also played a role in maternal care, but their training did not fully align with international midwifery standards, and their midwifery skills were often overshadowed by their broader nursing responsibilities. In 2008, Bangladesh initiated a significant transition to professionalize midwifery, aiming to improve maternal and newborn health outcomes. The process began with the creation of the "Strategic Directions for Midwifery" plan, approved in

2008. This led to the development of a six-month post-basic advanced midwifery certificate program for existing nurse-midwives in 2010; one thousand six hundred (1,600) certified midwives graduated from the post-basic program. In the same year, during the "Every Woman Every Child" initiative at the United Nations General Assembly, the Prime Minister of Bangladesh committed to deploying 3,000 midwives by 2015. In 2013, a three-year Diploma in Midwifery was launched, aligned with International Confederation of Midwives (ICM) standards. The program started with 525 students and expanded to 38 institutions by 2016. One thousand six hundred 1,600 midwives now have graduated from the post-basic program. Even though approximately 9,000 midwives have now graduated from the diploma programme, their deployment into public facilities has been slow. A total of 2,557 midwives have been deployed (1149 in the first phase of deployment in 2018 and then 1408 in 2021) and are currently active in public health facilities, while others practice in humanitarian contexts and private facilities (Begum et al. 2023). Around 8000 midwives are licensed to date.

The Bangladesh Nursing and Midwifery Council (BNMC) oversees the regulation, licensing, and education of midwives in Bangladesh. According to the "National Guidelines for Midwives 2017" by the Directorate General of Nursing and Midwifery (DGNM), midwives provide comprehensive care across various stages of pregnancy, childbirth, and postpartum periods. They offer antenatal care, identifying and managing normal and high-risk pregnancies, and ensuring safe deliveries. Midwives are also trained to manage emergency obstetric situations, such as newborn resuscitation, administering uterotonic drugs to manage eclampsia, and performing the initial management and referral for postpartum haemorrhage (PPH) and performing manual removal of the placenta when necessary. Additionally, they conduct cervical cancer screenings. provide family planning services, and manage Menstrual Regulation and Post-Abortion Care (MAR/PAC) services and address gender-based violence, providing support and referrals for affected women. Their scope of practice therefore includes comprehensive sexual and reproductive health and rights (SRHR), and they operate in both facility and community settings. Midwives' work in Bangladesh extends to health education, family planning, and advocating for women's health and rights including climate change and humanitarian context.

Midwives in Bangladesh encounter significant barriers that restrict their practice. These include limited training opportunities, lack of professional recognition, and inadequate support within the health system (Zaman et al. 2020). Addressing these barriers and leveraging facilitators is crucial for maximizing the positive impact of midwives on maternal and neonatal health outcomes.

Globally, only a modest increase in midwife coverage could avert up to 22% of maternal deaths, 23% of neonatal deaths, and 14% of stillbirths by 2035 (A. Nove et al. 2021). While global data underscore the effectiveness of midwives, country-specific research on the impact of midwifery in Bangladesh remains limited. Furthermore, for the scaling up of midwifery programs to be feasible and effective, a deeper understanding of the current conditions and experiences of practising midwives is necessary. Midwives need to function within enabling environments. Effectively promoting midwifery thus involves not only expanding training and deployment programs, but also enhancing the support structures and recognition that underpin professional midwifery.

OBJECTIVES

The broad objective of the study is to retrospectively and prospectively estimate the impact of scaling up midwives on maternal and neonatal lives saved and explore the underlying mechanisms for this impact.

The specific objectives include:

- Component 1: Modelling of lives saved from deployment of midwives
    - Component 1A – Retrospective analysis: To estimate the maternal and neonatal mortalities and morbidities averted by scaling up midwifery education and deployment from 2019 to 2023 in eight selected districts of Bangladesh.
    - Component 1B – Prospective analysis: To project the neonatal and maternal deaths that can be averted by scaling up of deployment of midwives between 2024 and 2030 based on three scenarios with varying levels of magnitude in facility delivery coverage and percentage of facilities providing midwifery-led care in rural areas of Bangladesh.
- Component 2: Exploring the barriers and facilitators to midwives' full scope of practice in Bangladesh

COMPONENT 1: Modelling of lives saved from deployment of midwives

- **Component 1A – Retrospective analysis**: To estimate the maternal and neonatal mortalities and morbidities averted by scaling up midwifery education and deployment from 2019 to 2023 in eight selected districts of Bangladesh.
- **Component 1B – Prospective analysis**: To project the neonatal and maternal deaths that can be averted by scaling up of deployment of midwives between 2024 and 2030 based on three scenarios with varying levels of magnitude in facility delivery coverage and percentage of facilities providing midwifery-led care in rural areas of Bangladesh.

Figure 1. Objectives of retrospective and prospective analysis of neonatal and maternal lives saved

The Lives Saved Tool (LiST)

The Lives Saved Tool (LiST) is a multi-cause mortality model that has been developed and maintained by the team at the BSPH since 2008. LiST is designed to assess the impact of scaling up coverage of health interventions that are feasibly implemented in LMICs and are effective in reducing maternal, neonatal, and child mortality, and stillbirths. The pathways through which health interventions reduce mortality are derived from evidence in the published literature.

LiST has been utilised in over 20 countries by Ministries of Health and their partners, with nearly two hundred peer-reviewed articles using it for mortality impact estimation, validating its widespread application. Further validation studies and the methodology for coverage computation are available on the LiST website (https://www.livessavedtool.org/).

How additional lives saved are estimated with the Lives Saved Tool

LiST considers the causes of death, the interventions that are effective against each cause of death, and the sequence in which the interventions are received. These are reflected in the impact models that are built into LiST.

The following figures show the impact models for the four modules in The LiST tool for estimation of effect of midwives on neonatal and maternal mortality: proven interventions grouped by three periods according to the continuum of care - periconceptual, pregnancy, and childbirth, plus the impact model for family planning.

Figure 2. Impact model in LiST: Periconceptual interventions

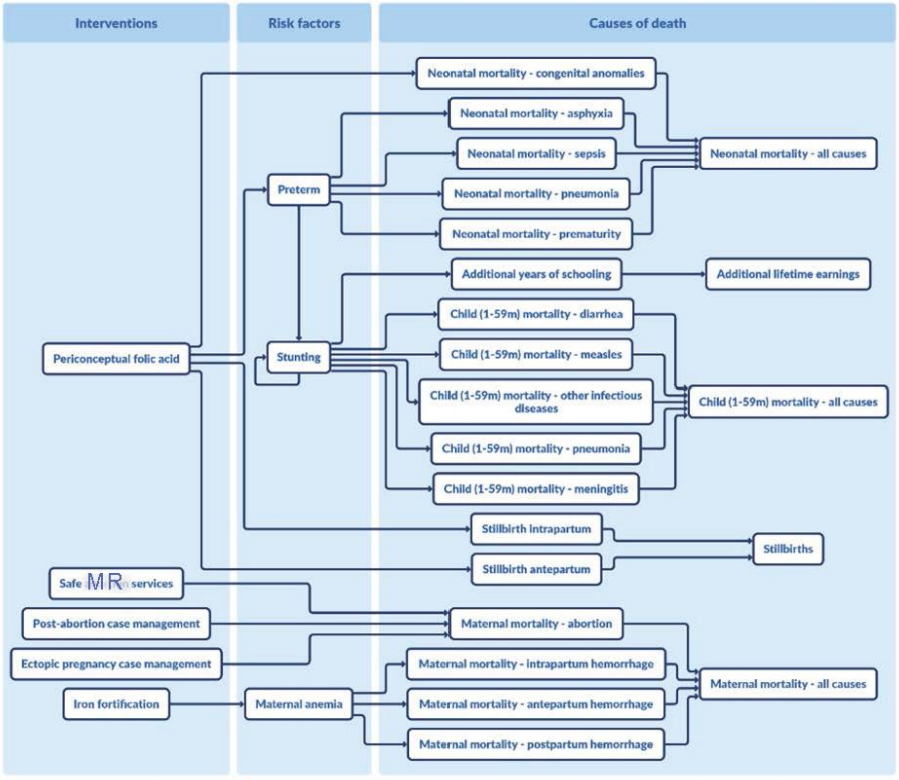


Figure 3. Impact model in LiST: Pregnancy interventions

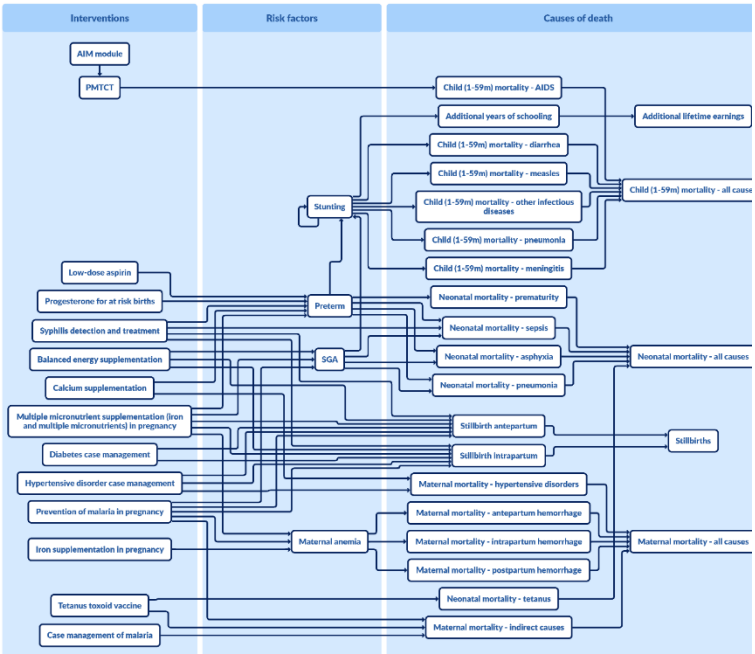
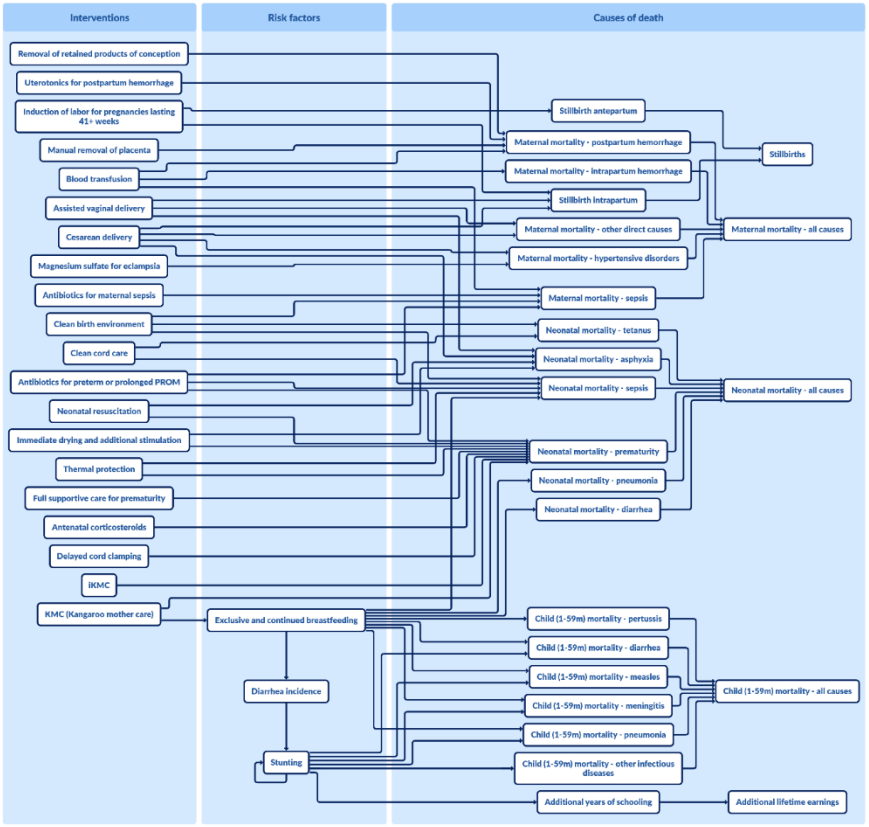


Figure 4. Impact model in LiST: Childbirth interventions



For example, multiple factors are at play in any maternal death, acting at different points in the continuum of care – pre-conception, pregnancy, labour and delivery, immediate postpartum period, and later in the postpartum period. Deaths from postpartum haemorrhage (PPH) can be affected by haemoglobin levels at onset of labour, events during labour and delivery, time to recognize and adequately treat haemorrhage, and availability of life-saving interventions including intravenous fluids, blood transfusion, administration of uterotonics, and removal of retained placental fragments. Haemoglobin levels at onset of labour can be affected by pre-conception anaemia, diet and micronutrient supplementation during pregnancy, malaria in pregnancy, and inherited haemoglobinopathies. The LiST tool contains impact models based on distinct types of interventions. The impact models specify the life-saving interventions being implemented, and whether they affect health outcomes indirectly through their effect on risk factors, or directly impact health outcomes (Figure 2-4). The pieces of the model contained in the LiST include prevention interventions, treatments, and risk factors. Each prevention intervention prevents a death. Each treatment stops a death from occurring. And each risk factor modifies the probability of a child dying from that specific cause.

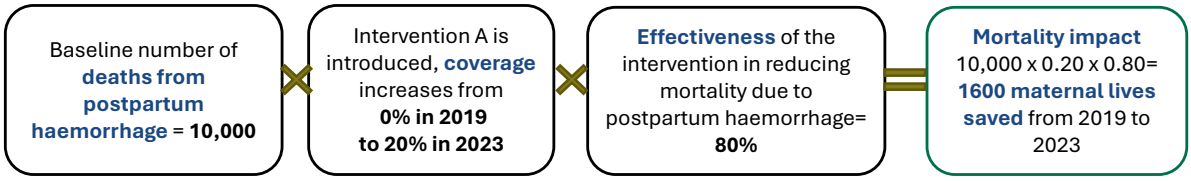
To calculate the lives saved from a single intervention, the equation is:

- (Cause-specific deaths) x (Change in coverage) x (Intervention effectiveness x affected fraction)

We now take as an example an intervention to reduce deaths from PPH. In the next Figure, 10,000 deaths are estimated to occur between 2019 and 2023 from PPH in a

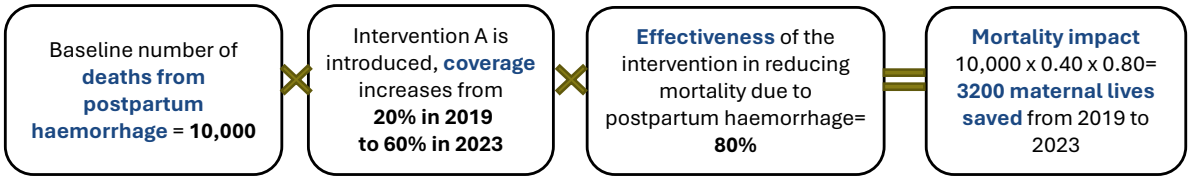
country. A new intervention is introduced that has been demonstrated to prevent 80% of the deaths. Coverage of the intervention increases from 0% in 2019 to 20% in 2023. Although the intervention is highly effective, only 20% coverage is achieved. The mortality impact is 10,000 deaths x 20% coverage x 80% effectiveness = 1600 maternal lives saved.

Figure 5. Introduction of new intervention to reduce deaths from PPH



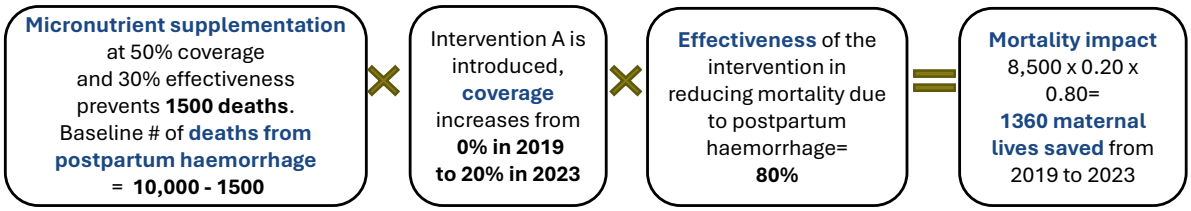
In a further example, the intervention already exists in the country. It is scaled up, so that coverage increases from 20% to 60%, for an increase in coverage of 40%. This results in a mortality impact (additional lives saved) or 10,000 x 40% increase in coverage x 80% effectiveness = 3200 additional maternal lives saved. It should be noted that the 1600 lives saved already with the existing coverage of 20% are not included in the estimate of the lives saved from increase in coverage from 20% to 60%. Thus, the increase in coverage of the intervention only impacts lives which were not already being saved as a result of the existing coverage. The increase in coverage only affects "residual lives" that were not already being saved at baseline.

Figure 6. Increasing coverage of an existing intervention to reduce deaths from PPH



Where a preventive intervention is implemented during pregnancy, the effect of that intervention is calculated first. The treatment intervention during the postpartum period then acts to reduce the remaining deaths. In the next figure, micronutrient supplementation has prevented 1500 of the 10,000 deaths from PPH. Intervention A then can only act to reduce the remaining 8500 maternal deaths, so the mortality impact of introducing Intervention A and reaching 20% coverage is 1360 lives saved.

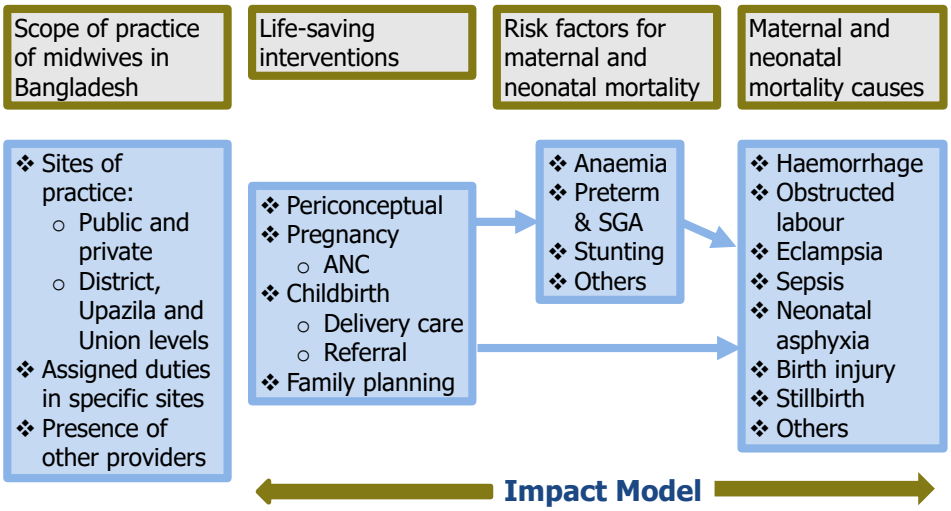
Figure 7. Introduction of new intervention to reduce deaths from PPH, on top of existing 50% coverage of micronutrient supplementation during pregnancy



Implementation of LiST analyses to estimate impact of midwives on lives saved

For the purposes of this study, we were interested in interventions specifically related to midwifery scope of practice. As such, we linked the midwifery scope of practice with life-saving interventions that could be matched to the impact models within LiST (Figure 5).

Figure 8. Links between scope of practice for midwives, and impact model for life-saving interventions delivered by midwives



For this project, which aims to estimate the mortality impact through training and deployment of skilled midwives, coverage is defined as below:

$$Coverage = \frac{numerator}{denominator} = \frac{All\ who\ need\ and\ \ received\ an\ intervention\ from\ midwives}{All\ who\ needed\ an\ interveniton}$$

A key challenge in the current project is to make links between the left side of Figure 8 (scope of practice) and the second column (life-saving interventions). If midwives play a role in delivery of antenatal care (ANC), we need to know the specific interventions provided during ANC visits, to estimate the impact of provision of ANC by midwives on risk factors for maternal and neonatal mortality, and direct causes of maternal and neonatal mortality. In Spectrum, the software for modelling of mortality impact, almost all the scope of practice of midwives in Bangladesh is represented in two modules– 1) LiST tool - Periconceptual, Pregnancy and Childbirth, and 2) Family Planning.

Methods for Component 1A: Steps to conduct the retrospective analyses

Step #1 – Literature reviews and stakeholder consultations identifying the preliminary set of midwifery interventions that can be matched into LiST.

To identify suitable midwifery interventions for the LiST, we conducted literature reviews and stakeholder consultations. Initially, the LiST team reviewed two key peer-reviewed journal articles by Homer et al. (2014) and Nove et al. (2021) (Homer et al. 2014; A. Nove et al. 2021), which provided modelling methodologies and a set of interventions aligned with the International Confederation of Midwives (ICM) essential competencies(ICM 2019; A. Nove et al. 2021). The Standard Operating Procedures (SOP) for Midwives in Bangladesh, adapted from ICM competencies, also informed the preliminary list of interventions. Subsequently, stakeholder consultations with UNFPA colleagues helped to refine this list. These discussions highlighted the varying levels of autonomy midwives have over different interventions, from independent performance to emergency management and referral(DGNM 2024). Based on these insights, interventions were categorised by the level of midwifery autonomy: those that can be performed independently, those that can be performed independently pending updated SOP approval, initial stabilisation and then referral of emergency cases, promotion activities, and those outside current SOP capabilities.

Step #2 – Selection of the high-performing 8 districts

We requested from UNFPA colleagues an initial list of districts where midwives are known to practice to their full scope. They provided us with 8 districts, taking into account based on reachability, of districts to explore geographical influence on service delivery, evaluating those districts with a large population of refugees, and considering model districts under the Better Health Programme for insights into midwives' scope of practice at both Union and Upazila (subdistrict) levels.

In two districts with a large population of refugees – Cox's Bazar and Noakhali, - greater investments have been made in recent years in the quality and coverage of health services for the host population, and this extends to maternal health services and support for midwife services. Therefore, to some extent these two districts represent better conditions for delivery of services by midwives.

Table 1. Eight selected districts for retrospective modelling of impact of midwives in Bangladesh 2019-2023

District	#MWs	#UZHC	#UZHCS with MWs	#Midwife-led Centres	MWs at Union level	Nursing/ midwifery college	Climate vulner-ability	Large refugee numbers
Mymensingh	45	12	12	1 - Muktagacha	No Yes	1	No	No
Chattogram	52	14	14	1 - Fatikcchari	Yes	2	Yes	No
Cox's Bazar	29	7	7	No	Yes	1 (New)	Yes	Yes
Noakhali	24	7	7	1 - Chatkhil	Yes	1	Yes	Yes
Narayanganj	17	5	5	1 - Rupganj	Yes	0	No	No
Bagerhat	30	8	8	No	Yes	1 (New)	Yes	No
Barguna	19	4	?	No	Yes	1 (New)	Yes	No
Bogura	43	11	11	No	Yes	2	No	No

Step #3 – Data availability and data source

Users conducting subnational analyses with LiST need to input data including population size, total fertility rate (TFR), contraceptive prevalence, mortality rates and causes of deaths in the baseline year, and coverage of matched interventions for each year during the project period. Most of these data are publicly available except for intervention coverage, which was obtained from UNFPA Bangladesh. They provided information on coverage data for 35 matched interventions, including definitions of denominator and numerator for each intervention. UNFPA obtained this information from data that they collect internally, and from the Bangladesh Health Management Information Systems data from the Directorate General of Health Services (DG-HS) and the Directorate General of Family Planning (DG-FP) that they have institutional permission to access.

Table 2. Data extracted from Health Management Information Systems for DG-HS and DG-FP

Data extracted from DG-HS DHIS2

From 2019-2023 per year per DG-HS facility

- #Midwives_No. of Normal Deliveries
- #Midwives_ANC
- #Midwives_Post-Partum Family Planning (PPFP)
- #Midwives_Support provided to Gender Based Violence Case
- #Midwives_Total Number of Post Abortion Care
- #Midwives_Women received Menstrual regulation (MR) service

From 2021 to 2023, per year per DG-HS facility

- #Midwives_Adolescent delivery (15-19 Years)
- #Midwives_CBCSP_Total VIA Negative
- #Midwives_Eclampsia Initial Management and refer
- #Midwives_Eclampsia Patient received from community
- #Midwives_Newborn resuscitation
- #Midwives_No. of mother received ANC 1
- #Midwives_No. of mother received ANC 2
- #Midwives_No. of mother received ANC 3
- #Midwives_No. of mother received ANC 4
- #Midwives_ women received Post Natal Care (PNC)
- #Midwives_PPH Initial Management and refer
- #Midwives_PPH Patient received from community
- #Midwives_Total VIA Positive
- # AnyHW_ postpartum FP method was used
- # AnyHW_mother received ANC 1
- # AnyHW _ mother received ANC 2
- # AnyHW_ mother received ANC 3
- # AnyHW _ mother received ANC 4
- # AnyHW_ Caesarean Section
- # AnyHW_ Destructive Operation
- # AnyHW_ Forceps/ Vacuum/ Breech delivery
- # AnyHW_ Normal Deliveries
- # Post-Partum Haemorrhage
- # Pre-Eclampsia/ Eclampsia
- # Maternal Deaths (MD)
- # Total Neonatal Deaths
- # AnyHW_ mother received PNC 1 services at facility
- # AnyHW_ mother received PNC 2 services at facility

Data extracted from DG-FP HMIS

From 2019 to 2023, per district

- Total home births
- Total facility births
- Total live births
- Total stillbirths

Through in-depth review of the above data, we identified the preliminary list of the matched interventions with available denominator AND numerator data in the next table.

Table 3. Variable name, data source, and catchment area of each of the data for matched interventions with available denominator AND numerators data.

		Variable name	Data source	Catchment area of data	Available year
Facility delivery by midwives	Numerator	#Midwives_No. of Normal Deliveries	DG-HS DHIS2	DG-HS facilities only	Each year from 2019-2023
	Denominator	#Total live births + total stillbirths	DG-FP HMIS	Across the entire district	Each year from 2019-2023
Uterotonics for post-partum haemorrhage	Numerator	#Midwives_Eclampsia Initial Management and refer	DG-HS DHIS2	DG-HS facilities only	Each year from 2021-2023
	Denominator	# # Post-Partum Haemorrhage	DG-HS DHIS2	DG-HS facilities only	Each year from 2021-2023
MgSO4 for eclampsia	Numerator	#Midwives_Eclampsia Initial Management and refer	DG-HS DHIS2	DG-HS facilities only	Each year from 2021-2023
	Denominator	# Pre-Eclampsia/ Eclampsia	DG-HS DHIS2	DG-HS facilities only	Each year from 2021-2023

We identified data that are 1) relatively reliable and valid in terms of the sample size, and 2) provide relatively conservative estimation.

We excluded data for uterotonics and magnesium sulphate due to unavailability and limitations in facility-based reporting. Notably, facility deliveries assisted by midwives were not accounted for in the numerator, potentially underestimating the lives saved.

In our final modelling therefore, we focused solely on data on facility delivery by midwives to estimate lives saved through scaling up midwifery interventions. This allows us to estimate the additional lives saved through scale-up of the 12 matched midwifery interventions during childbirth (Table 4). Detailed methodology concerning this form of modelling is provided in a separate LiST technical note(LiST 2020).

Table 4. Final list of interventions included in retrospective model.

Category*	Name of an intervention in LiST
Childbirth	Clean birth environment
Childbirth	Clean cord care
Childbirth	Delayed cord clamping
Childbirth	Immediate drying and additional stimulation
Childbirth	Thermal protection
Childbirth	Antibiotics for maternal sepsis
Childbirth	Antibiotics for preterm or prolonged Premature Rupture of Membranes (PROM)

Category*	Name of an intervention in LiST
Childbirth	MgSO4 for eclampsia
Childbirth	Neonatal resuscitation
Childbirth	Uterotonics for PPH
Childbirth	Blood transfusion
Childbirth	Kangaroo mother care (KMC)

*12 interventions from the childbirth category estimated using coverage of %facility delivery by midwives

Additionally, the facility delivery data were relatively valid regarding the sample size. Definition of facility delivery for this project is provided below.

% facility delivery by midwives = $\frac{\#\ facility\ births\ assisted\ by\ a\ midwife\ in\ a\ district}{\#\ total\ births\ in\ a\ district}$

Below we summarize data sources that were inputs for the retrospective modelling.

Table 5. Summary of data sources for the retrospective modelling

Category	Data type	Source
Population (2019)	Population size	2011 Census, 2022 Census, 2019 UN World Population Prospect
Fertility (2019)	TFR Contraceptive prevalence	2019 SVRS, respective division
Mortality (2019)	NMR and MMR	2019 SVRS, respective division
	Causes of neonatal death	Perin J, et al. Lancet Child Adolesc Health. 2022 Feb;6(2):106-115.
	Causes of maternal death	Say L, et al. Lancet Glob Health 2014; 2(6): e323-33.
Intervention effectiveness	Efficacy and affected fraction	Based on systematic reviews, meta-analysis, Delphi method, and randomised-controlled trials, which have been summarised and published in 5 supplements. • Walker N et al. Int J Epidemiol 2010;39 (Suppl 1) . • Walker N (Ed. BMC Public Health 2011; 11(Suppl 3) • Walker N (Ed). J Nutr 2017;147 (Suppl): 2132S-40S • Walker N. et al. BMC Public Health 2017 17(Suppl 4),
Coverage (2019-2023)	Facility delivery assisted by midwives	DG-HS DHIS2 (numerator) • https://dghs.portal.gov.bd/ • https://dghs.portal.gov.bd/site/page/492255ac-64e8-4a48-ac34-173ebe6a4290 DG-FP HMIS (denominator) • http://mis.dgfp.gov.bd/

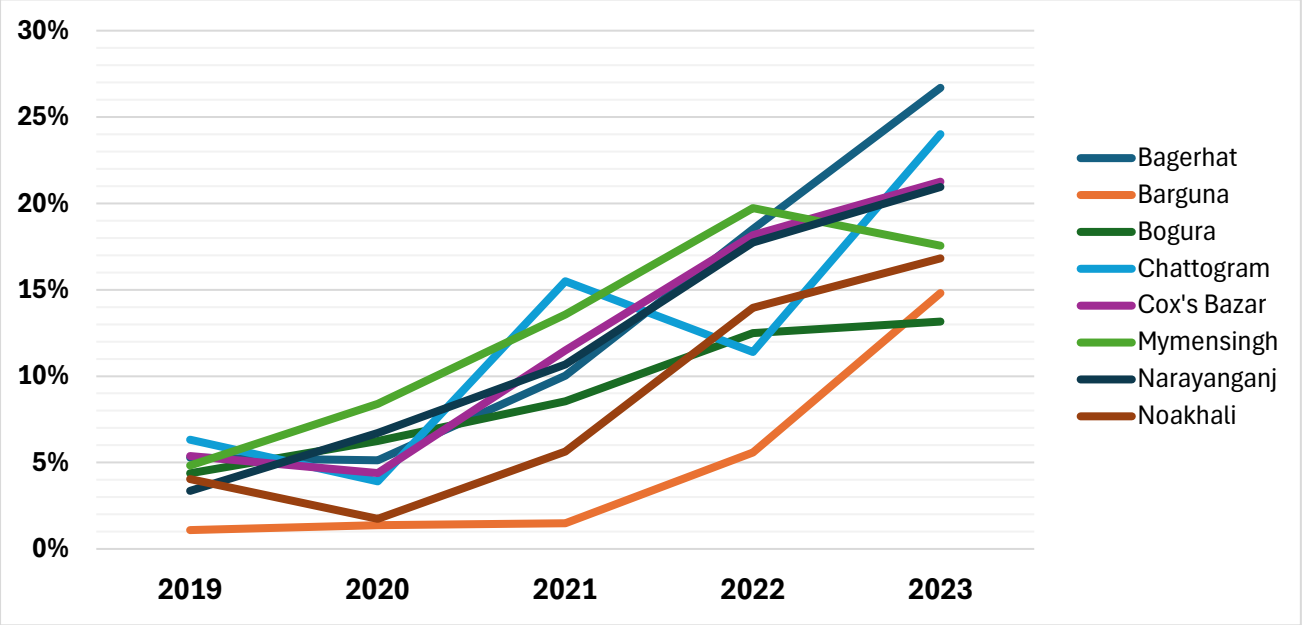
Results for Component 1A - Modelling of impact from deployment of midwives 2019-2023 in eight districts

In this section, we present coverage of facility delivery in the selected 8 districts from 2019 to 2023 and the modelled number of maternal and neonatal lives saved during the same period (Table 6). The coverage increased from around 15% to 25% in the selected 8 districts during the period considered. The average change in coverage per year was +3.0% across the 8 districts, after weighing by the population size per district. Bagerhat, Chattogram, and Noakhali experienced a coverage drop from 2019 to 2020. Cox's Bazar experienced coverage drops in 2020 and 2022.

Table 6. Percentage of facility deliveries attended by midwives relative to total live births across the eight chosen districts from 2019 to 2023.

	2019	2020	2021	2022	2023	Average change per year
Bagerhat	5.3%	5.1%	10.0%	18.5%	26.7%	5.3%
Chattogram	6.3%	3.9%	15.5%	11.4%	24.0%	4.8%
Cox's Bazar	5.4%	4.4%	11.5%	18.2%	21.3%	4.3%
Narayanganj	3.4%	6.7%	10.7%	17.7%	21.0%	4.2%
Mymensingh	4.8%	8.4%	13.6%	19.7%	17.6%	3.5%
Noakhali	4.0%	1.7%	5.6%	14.0%	16.8%	3.4%
Barguna	1.1%	1.4%	1.5%	5.6%	14.8%	3.0%
Bogura	4.4%	6.2%	8.5%	12.5%	13.2%	2.6%

Figure 9. Trends in percent of facility deliveries performed by midwives from 2019 to 2023



The modelled number of lives saved is presented in the tables and figure below (Table 7 and 8; Figure 10). Taking 2019 as the baseline year, there are 892 total additional neonatal lives saved and 151 total additional maternal lives saved between 2019 to 2023 in the 8 districts.

The estimated number of lives saved varies ranges between districts according to the number of cause-specific deaths and the change in coverage of interventions, as shown in Tables 7 and 8. As a result of small coverage drops in 2020, negative lives saved (i.e. additional deaths) were produced through the modelling for Bagerhat, Chattogram, Cox's Bazar and Noakhali.

In Chattogram and Cox's Bazar, the greatest increase in additional lives saved was produced through the modelling, primarily due to the large population size and the larger increase in proportion of facility deliveries assisted by midwives

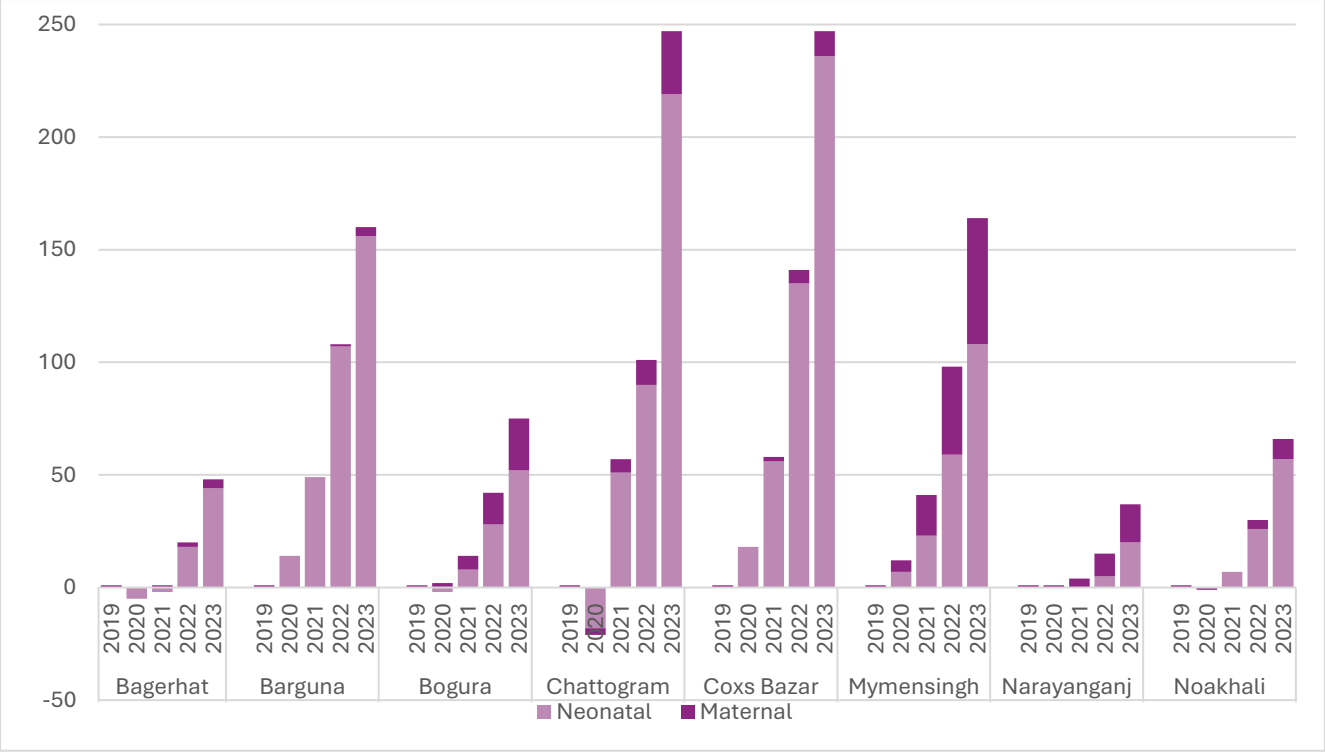
Table 7. Additional neonatal lives saved, taking 2019 as baseline year

	2019	2020	2021	2022	2023	Total (2019-23)
Bagerhat	0	-5	3	20	26	44
Barguna	0	14	35	58	49	157
Bogura	0	-2	10	20	24	51
Chattogram	0	-18	69	39	129	218
Cox's Bazar	0	18	38	79	101	236
Mymensingh	0	7	16	36	49	108
Narayanganj	0	0	0	5	15	21
Noakhali	0	0	7	19	31	57
					TOTAL	892

Table 8. Additional maternal lives saved, taking 2019 as baseline year

	2019	2020	2021	2022	2023	Total (2019-23)
Bagerhat	0	0	1	1	2	4
Barguna	0	0	0	1	3	4
Bogura	0	2	4	8	9	23
Chattogram	0	-3	9	5	17	28
Cox's Bazar	0	0	2	4	5	10
Mymensingh	0	5	13	21	17	56
Narayanganj	0	1	3	6	7	17
Noakhali	0	-1	1	4	5	9
					TOTAL	151

Figure 10. Cumulative number of additional maternal and neonatal lives saved with 2019 as baseline year



Methods for Component 1B: Prospective modelling of the impact of training and deployment of midwives 2024-2030

Settings and three scenarios for prospective modelling

To address Aim 2, prospective analyses were conducted to predict the number of maternal and neonatal lives saved through various levels of increased facility-based deliveries and increased facility-based normal deliveries conducted by midwives. Three distinct scenarios spanning from 2024 to 2030 across rural Bangladesh were formulated in consultation with stakeholders from the Foreign, Commonwealth & Development Office (FCDO), aligning with current and prospective midwife recruitment plans by the government. These scenarios represent reflect progressive increases in coverage, with each subsequent scenario representing a more ambitious target:

1. Scenario 1 maintains the 2024 baseline of 65% of deliveries occurring in facilities but increases the proportion of facility deliveries by midwives to 50% by 2030
2. Scenario 2 increases the percentage of facility deliveries to 70% and extends the proportion of facility deliveries by midwives to 75% of facilities by 2030.
3. Scenario 3 assumes an increase in the percentage of facility deliveries to 75% of all deliveries, with 100% of facility deliveries being conducted by midwives by 2030.

The three scenarios are summarised in Table 9. The baseline assumptions for 2024 were derived from the 2022 Bangladesh Demographic and Health Survey (BDHS) Key Indicator Report, which found that 65% of all deliveries in rural areas are facility-based deliveries.

The number of midwives required for each scenario was calculated by estimating the total number of live births in a district in each year, determining the percentage of these births that would be facility-based and assisted by midwives, and then dividing this figure by the average number of births a midwife can conduct annually.

We calculated the total deliveries per midwife by first selecting the 8 districts from Component 1 (Bagerhat, Barguna, Bogura, Chattogram, Cox's Bazar, Mymensingh, Narayanganj, Noakhali). Then, for each of these 8 districts, we identified the total number of midwife-assisted vaginal deliveries and the total number of midwives working in that district the year 2023. We then divided the total deliveries by midwives by the number of midwives for each district to find the average deliveries per midwife. Finally, we calculated the overall average deliveries per midwife across all districts by averaging the district-specific averages, resulting in a figure of 201.2 deliveries per midwife (Table 10 and Figure 11).

Therefore, assuming that each midwife can conduct 201 deliveries, we calculated that 898 midwives would be required to conduct 247,829 deliveries. For instance, in 2024, with a baseline of 65% of all deliveries taking place in facilities, and 12.5% of those facility-based deliveries being conducted by midwives, the percentage of deliveries conducted in facility by midwives out of all live births in a district is 8.4%, which equates to 247,829 births.

By 2030, Scenario 1 projects 32.5% of facility deliveries assisted by midwives, requiring 3,294 midwives; Scenario 2 projects 52.5%, requiring 5,322 midwives; and Scenario 3, with

75% of facility deliveries assisted by midwives, requires 7,602 midwives. The details for the estimated midwives required are provided in Table 11.

These projections help to quantify the workforce expansion needed to support enhanced midwifery services, illustrating the practical implications and resource requirements for achieving significant reductions in maternal and neonatal mortality through increased midwife deployment.

Table 9. Settings and scenarios used for prospective modelling.

Settings	Bangladesh, nation-wide (Geographic area) From 2024 to 2030 (Timeline)
Baseline assumption (2024)	65% of deliveries are taking place at the facility with 12.5% facility births being assisted by midwives
Scenario 1 (2030)	65% of deliveries are taking place at the facility with 50% facility births being assisted by midwives
Scenario 2 (2030)	70% of deliveries are taking place at the facility with 75% facility births being assisted by midwives
Scenario 3 (2030)	75% of deliveries are taking place at the facility with 100% facility births being assisted by midwives

Table 10. Average number of deliveries assisted per midwife in the 8 selected districts

2023 data			
District	#MW_assisted vaginal delivery	#MWs	#assisted vaginal delivery per MW
Bagerhat District	2938	30	97.9
Barguna District	1160	19	61.1
Bogura District	3196	43	74.3
Chattogram District	14037	52	269.9
Coxs Bazar District	8773	29	302.5
Mymensingh District	14052	45	312.3
Narayanganj District	3671	17	215.9
Noakhali District	6622	24	275.9
Average deliveries per MW			201.2

Figure 11. Average deliveries per midwife in the 8 selected Districts

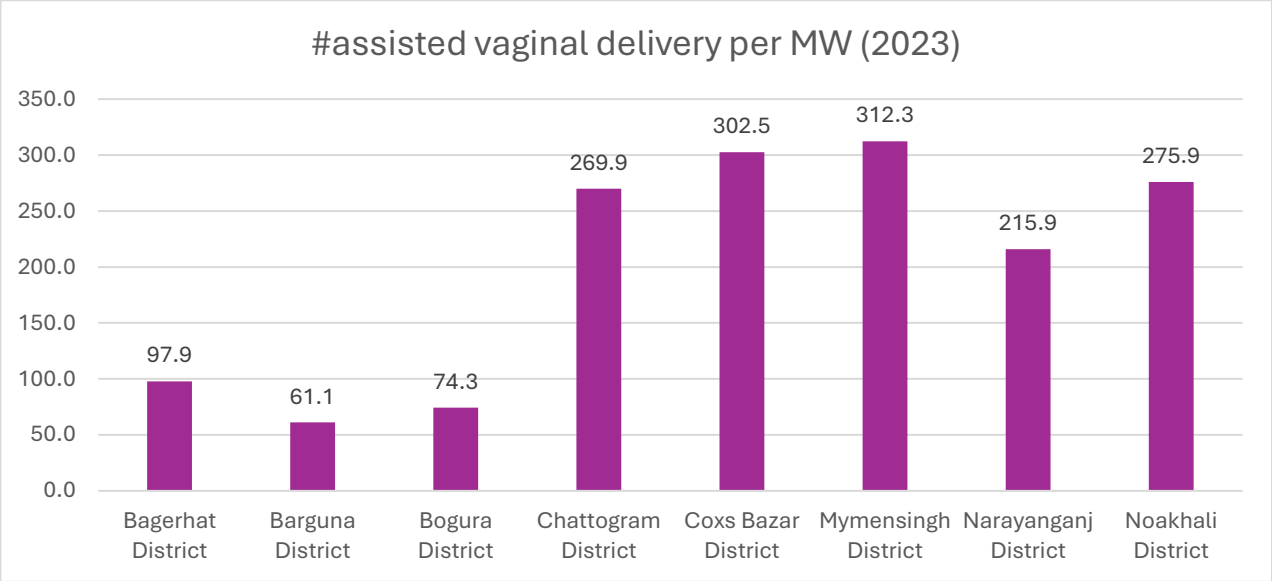


Table 11. Estimated number of midwives required for each scenario in the prospective modelling

	Total live births (Male+female, any methods, any places)			% facility births assisted by midwives among all births			#live births due to assists by midwives in facilities			# midwives needed		
Scenario	**SC1**	**SC2**	**SC3**	**SC1**	**SC2**	**SC3**	**SC1**	**SC2**	**SC3**	**SC1**	**SC2**	**SC3**
2024	2,955,618	2,955,618	2,955,618	8.4%	8.4%	8.4%	247829	247829	247829	898	898	898
2025	2,937,436	2,937,436	2,937,436	12.4%	15.7%	19.5%	364365	462279	572433	1321	1675	2075
2026	2,910,228	2,910,228	2,910,228	16.4%	23.1%	30.6%	477956	671972	890239	1732	2435	3226
2027	2,889,000	2,889,000	2,889,000	20.4%	30.4%	41.7%	590584	879484	1204496	2140	3187	4365
2028	2,860,070	2,860,070	2,860,070	24.5%	37.8%	52.8%	699621	1080963	1509974	2536	3918	5473
2029	2,836,918	2,836,918	2,836,918	28.5%	45.1%	63.9%	807978	1280798	1812720	2928	4642	6570
2030	2,796,773	2,796,773	2,796,773	32.5%	52.5%	75.0%	908951	1468306	2097580	3294	5322	7602

Table 12. Data sources for the prospective modelling

Category	Data type	Source
Population	**Population size**	The United Nations World Population Prospect 2022 • https://population.un.org/wpp/
Baseline Fertility	**TFR**	The United Nations World Population Prospect 2022 • https://population.un.org/wpp/
Baseline mortality	**NMR and MMR**	NMR: United Nations Inter-Agency Group for Child Mortality Estimation GME estimates • https://childmortality.org/ MMR: Trends in maternal mortality: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Geneva: World Health Organisation • https://data.unicef.org/topic/maternal-health/maternal-mortality/
	Causes of neonatal death	Perin J, et al. Lancet Child Adolesc Health. 2022 Feb;6(2):106-115.
	Causes of maternal death	Say L, et al. Lancet Glob Health 2014; 2(6): e323-33.
Intervention effectiveness	**Efficacy and affected fraction**	Based on systematic reviews, meta-analysis, Delphi method, and randomised-controlled trials, which have been summarised and published in 5 supplements. • Walker N et al. Int J Epidemiol 2010;39 (Suppl 1) . • Walker N (Ed). BMC Public Health 2011; 11(Suppl 3) • Walker N (Ed). J Nutr 2017;147 (Suppl): 2132S-40S • Walker N. et al. BMC Public Health 2017 17(Suppl 4),
Baseline Coverage	**MNCH interventions**	Facility delivery, baseline assumption: 2022 Bangladesh DHS Key Indicator Report • https://dhsprogram.com/methodology/survey/survey-display-584.cfm Facility readiness: Bangladesh SPA 2014 • https://dhsprogram.com/methodology/survey/survey-display-441.cfm

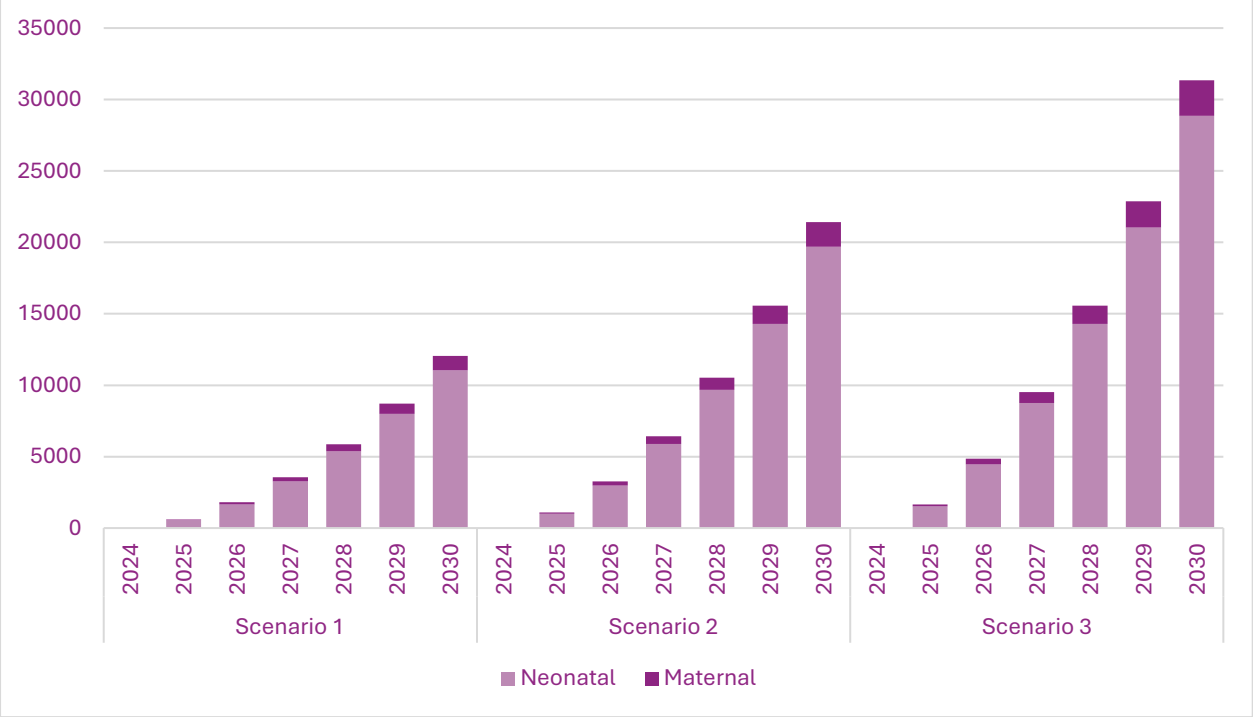
Results for Component 1B: Prospective modelling of the impact of training and deployment of midwives 2024-2030

The modelled number of additional lives saved is presented below. A total of additional 12,047 lives saved was estimated in scenario 1, in which the proportion of facilities with midwife-led care would increase from 12.5% in 2024 to 50% in 2030. In scenario 2, a total of 21,422 additional lives saved was estimated, in which 70% of deliveries are taking place at the facility with 75% facilities having midwifery led care by 2030. Finally in scenario 3, a total of 31,335 additional lives saved was estimated, in which 75% of deliveries are taking place at the facility with 100% facilities having midwifery led care by 2030.

Table 13. Additional number of lives to be saved per year between 2024 and 2030 according to three coverage scenarios of midwife-led facility-based deliveries

Scenario (SC)	Category	2024	2025	2026	2027	2028	2029	2030	Total (2024-30)
SC 1 (3294 midwives by 2030)	Neonatal	0	556	1,094	1,617	2,117	2,606	3,062	11,052
	Maternal	0	50	101	146	191	234	273	995
	Total	0	606	1;195	1763	2,308	2,840	3,335	12,047
SC 2 (5322 midwives by 2030)	Neonatal	0	1,011	1,975	2,903	3,780	4,623	5,397	19,689
	Maternal	0	93	180	258	333	404	465	1,733
	Total	0	1,104	2,155	3,161	4,113	5,027	5,862	21,422
SC 3 (7602 midwives by 2030)	Neonatal	0	1,515	2,942	4,292	5,550	6,742	7,814	28,855
	Maternal	0	139	264	377	480	571	649	2,480
	Total	0	1,654	3,206	4,669	6,030	7,313	8,463	31,335

Figure 12. Cumulative number of additional neonatal and maternal lives saved between 2024 and 2030 for three coverage scenarios of midwife-led facility-based deliveries



Discussion for Component 1

Retrospective modelling revealed an increase in midwifery-led childbirth coverage from 15% to 25% between 2019 and 2023 across eight districts in Bangladesh, and this increase resulted in 892 neonatal and 151 maternal lives saved, despite some fluctuations in coverage of midwife-led facility-based deliveries during specific years. The midwifery profession in Bangladesh, officially separated from nursing in 2013, has

rapidly demonstrated significant impact in improving maternal and neonatal outcomes within a relatively brief period.

The fluctuations in coverage can be explained by the demographic profile of midwives. Midwives in Bangladesh are typically young, starting their training and careers in their early twenties due to the requirement to begin midwifery training early and be employed by the age of 30 as per government recruitment rules. Many midwives are of childbearing age, leading to frequent maternity leaves, which impacts the continuity of care and coverage as they temporarily leave the workforce. The healthcare system must accommodate these leaves, often resulting in gaps in service delivery, explaining some fluctuations in coverage. Additionally, early marriage is prevalent in Bangladesh, and many midwives marry young. This cultural norm affects their career continuity as they juggle family responsibilities with professional duties, leading to early motherhood and further influencing the rates of maternity leave and career interruptions. Additionally, the post-basic Bachelors programme in Midwifery was introduced in 2022 and 160 midwives are absent from their government-deployed posts whilst they undertake higher education.

In the retrospective modelling analysis, Chattogram and Cox's Bazar emerged with the most substantial increase in lives saved over the five-year period, attributable primarily to two key factors. Firstly, the significant population size of these districts contributed to a broader impact on maternal and neonatal health outcomes. With larger populations, the potential for positive interventions and more lives saved naturally increases. Secondly, these districts witnessed a considerable surge in the percentage of facility deliveries assisted by midwives. From 2017 onwards, Cox's Bazar and Chattogram experienced a high surge of midwives due to the influx of Rohingya refugees, which necessitated increased healthcare services to address the significant reproductive health needs of the displaced population and host communities (Purno et al. 2023). This increase in skilled birth attendance directly correlated with improved maternal and neonatal health outcomes, leading to a notable rise in lives saved.

The greater proportion of additional maternal lives saved was modelled in Mymensingh, primarily due to relatively high TFR (2.25) and high mortality (MMR 251 per 100,000 live births) at baseline. Mymensingh started with a high maternal mortality ratio, which, when reduced, resulted in more lives saved proportionate to its baseline conditions.

The negative numbers in the maternal and neonatal lives saved table can be attributed to the impact of the COVID-19 pandemic, which significantly disrupted healthcare services globally. During the pandemic, midwives and other healthcare professionals faced numerous challenges, including resource shortages, redeployment to COVID-19 care and vaccination campaigns, and reduced service user visits, service user attendance due to lockdowns and fear of infection. These factors likely contributed to midwives not being able to perform to their full potential, resulting in fewer neonatal and maternal lives saved in some regions. These reductions highlight the pandemic's impact on maternal health services. However, the overall trend shows recovery and improvement in the following years as healthcare systems adapted and midwives resumed their roles more effectively.

These findings are consistent with recent research in Bangladesh. The deployment of professional midwives in Bangladesh has significantly improved maternal and neonatal

health outcomes by enhancing the quality and availability of maternity care. A longitudinal study by Anderson et al. (2022) demonstrated that the introduction of midwifery services in tertiary medical college hospitals in Dhaka led to a substantial increase in the use of WHO-recommended birth practices(Anderson, Williams, et al. 2023). This improvement was observed immediately following the introduction of midwives and continued after one year, benefiting births attended by midwives, doctors, and nurses. The quality of care improved not only for births attended by midwives but also for those attended by doctors and nurses. . Additionally, a mixed-methods study by Anderson and Zaman (2022) revealed that the introduction of professional midwives, along with facility mentoring, in rural sub-district hospitals increased adherence to quality maternity care practices, such as upright labour positioning, delayed cord clamping, and skin-to-skin contact(Anderson et al. 2022). These improvements were further enhanced by the presence of mentors, who supported midwives in implementing evidence-based practices effectively, resulting in better maternal and neonatal outcomes. Together, these studies highlight the critical role of midwives in improving the overall quality of maternity care and reducing maternal and neonatal mortality rates in Bangladesh (Anderson and Zaman 2022).

The prospective modelling from this study indicated that deploying midwives could save between 12,046 and 31,335 maternal and neonatal lives, depending on the levels of facility deliveries and midwifery-led care. The least ambitious scenario requires 3,294 midwives, while the most ambitious needs 7,602 midwives nationally. These estimates align well with the staffing needs outlined in the Bangladesh National Strategy for Maternal Health 2019-2030, which calls for deploying 2 midwives per Union Health & Family Welfare Centre, 8 per Upazila Health Complex, and 8 per Maternal & Child Welfare Centre, totalling 5,764 midwives in primary healthcare facilities.

By 2022, the government and private sectors had initiated 62 public and 105 private midwifery education programs, graduating 1,800 students annually. WHO's recommends 1 midwife per 175 annual births. Currently, around 8,000 registered midwives are available to help meet these requirements. The Ministry of Health and Family Welfare (MOHFW) has approved 5,000 midwifery posts in health settings and 2000 in family planning settings, with an additional 20,000 awaiting approval. In May 2024, at a UNFPA Global Dialogue Summit in Bangladesh, the Prime Minister of Bangladesh committed to the deployment of 10,000 more midwives over the next 2 years.

A recent analysis exploring the relationship between density of midwives (number of midwives per 10,000 population) and key maternal and newborn health indicators, (such as maternal mortality, neonatal mortality, and caesarean birth rates), in LMICs found that higher availability of midwives is generally associated with lower maternal and neonatal mortality in LMICs, especially in low-income countries. found that higher availability of midwives is generally associated with lower maternal and neonatal mortality in LMICs, especially in low-income countries(Andrea Nove et al. 2024). Similarly, a study by Gausman et al. (2023) emphasizes the importance of not just of the number but the competency and distribution of midwives in achieving adequate healthcare coverage(Gausman et al. 2023). Midwives need to possess the necessary competencies and be well-distributed geographically to address healthcare needs effectively.

Limitations

The current modelling used percentage of facility delivery conducted by midwives as a proxy for 12 evidenced based life-saving childbirth interventions. These estimates took into account only a narrow scope of interventions that midwives trained at ICM standards can provide. We were not able to obtain coverage data for periconceptual, pregnancy, curative, preventative, and breastfeeding interventions between 2019-2023. If we had those data, we could assemble more realistic prospective projection scenarios, and vary coverage for more variables, thus better informing the policy options. The current estimates in that regard are under-estimates.

We are limited to lives saved as that is the primary output of LiST. Nonetheless there can be other long-term benefits of midwifery-led care that we are not reporting here, that are worth investigating to provide a full account of the impact of midwifery-led care. For example, midwives provide essential gender-based violence related services, which are not included in LiST modelling estimates due to lack of evidence linking these interventions to mortality outcomes. These interventions are essential and have benefits beyond just lives saved.

Furthermore, we were not able to obtain data for the number of midwives deployed in a district per year between 2019 and 2023, which would allow us to examine the relationship between the number of midwives deployed and any change in the proportion of facility deliveries assisted by midwives in the past. One reason for this is shifting of midwives between different health facilities. The yearly aggregates for midwives and their place of work are therefore difficult to calculate in any meaningful way.

COMPONENT 2: Qualitative study on barriers and facilitators to enabling environment for midwifery full scope of practice

Objective

To explore the barriers and facilitators to midwives' full scope of practice

Methods

We conducted in-depth interviews in Bangla to explore the contributions of midwives to maternal and neonatal health outcomes in Bangladesh. Our respondents included midwives, recently delivered women, pregnant women, and other healthcare providers such as nurses, doctors and health facility heads from sub-district level public health facilities known as Upazila Health Complexes (UzHCs). Through convenience sampling, we selected Upazila Health Complexes within Dhaka, Chattogram and Sylhet districts. Facility heads were contacted using contact information from Government of Bangladesh, MoHFW website. We also spoke to stakeholders from government and development organisations engaged with midwifery programs in Bangladesh.

We applied the socio-ecological model (SEM) to guide both the design and the analysis of the study. The SEM contains multiple levels: individual (focusing on attitude and beliefs towards care), interpersonal (focusing on community and social norms), organisational (focusing on the role of healthcare systems), and policy level (focusing on programmes and policies). These various levels were considered when identifying relevant stakeholders and these levels also guided the data analysis process.

The qualitative data were collected through audio-recorded interviews. Ethical considerations were observed by securing informed consent from all participants and maintaining strict confidentiality protocols to protect sensitive information.

Results

Our study identifies several barriers and facilitators at individual, interpersonal, organisational, and policy levels that impact the full scope of midwifery practice in Bangladesh. A summary of these barriers and facilitators is depicted in Figure 12 (Annex 1), and Figure 13 (Annex 2) represents a preliminary pathways to change diagram for impact of midwives on health outcomes. Both the figures have been organised using the socio-ecological model, and we included

Individual level barriers from women of reproductive age in the community

Economic barriers and misconceptions deter families from using hospital-based deliveries, despite available free services. Midwives and doctors note that families fear hidden costs and ancillary expenses like travel and loss of wages. This lack of awareness about the affordability and quality of care provided at government hospitals contributes to low utilisation rates. Additionally, some believe free services imply lower quality, though users of these services affirm the competence and dedication of the medical healthcare staff.

> "Economic problems can be a major reason. Often people think that going to the doctor will cost money. In government hospitals, it really doesn't cost that much; just the nominal fees required by the government. Due to not knowing they just sit at home." – midwife

> "Many families avoid hospital deliveries, not only due to the direct costs associated but also because of the ancillary expenses like travel and loss of daily wages. Even when we explain that our services are free, they fear hidden charges or costly prescriptions" – doctor

> "It's unfortunate that many people are unaware of the free services provided here, leading them to overlook the quality of care available. There seems to be a misconception that because services are free, the doctors may not be as skilled or competent. However, my experience tells me otherwise. In my view, the doctors at this hospital are highly capable and dedicated" – pregnant woman

Midwives reported facing challenge when service users are impatient or distrustful, requiring midwives to assure and educate service users about their capabilities and the role they play in maternity care.

> "Sometimes some service users want a doctor for their delivery. Then we counsel them that we are the midwife, we are responsible for conducting delivery. We will assess the patient and if any complication will arise and we identify any complication we will inform the doctor. We assure them that they don't need to worry." - midwife

> "Doctors explained that service users tend to be impatient, expecting immediate attention upon arrival at the hospital. Unlike at [tertiary care hospitals], where service users tolerate a 3-4 day wait, service users here demand instant service, becoming biased to leave if asked to wait. They expect a guaranteed normal delivery without complications, which is unrealistic given the unpredictable nature of childbirth." - midwife

> "People are impatient. Additionally, they are not local being outsiders from different districts midwives often face insecurity. Sometimes the patient's party may make scene that if they have the patience midwives can attempt a normal delivery. That's barriers they face often. At Chittagong Medical College (CMC) patients typically endure a wait of 3-4 days for their delivery. However, they're not willing to accept such delays here. Upon arrival they demand immediate attention expecting their delivery to commence right away. Waiting even a few hours is intolerable for them. While they might endure a 3-day wait for a normal delivery (NVD) at other hospitals or private facilities they simply cannot tolerate any delay here." - midwife

> "Their psychology is so difficult. They want that whenever they come here their delivery will be conducted immediately. If we take time, they become biased to leave the hospital. We cannot compel them to stay. Our nurses and midwives make efforts to persuade them. When they come at night our staffs tell them to

> stay doctor ma'am will come in the morning. She will check your health conditions. There nothing to worry. When they come here, they want 100% guarantee that it will be a normal delivery there will be no complications. Tell me is that realistic? Can any hospital give that guaranty? An NBD is a miracle. The unpredictability of childbirth means no guarantees can be made. Despite initial smooth progress complications can arise leading to a non-normal delivery. Even in the case of a caesarean section unforeseen complications may occur. Chances of on accident is always there. I saw in last 5 years that patient become impatient so fast." - midwife

Barriers: Interpersonal Level

Cultural norms, based on privacy concerns and disinclination to avail services from male doctors, also shape the preference for home births over hospital deliveries. Even when the patient herself expresses preference for institutional delivery, she can be deterred by other family members. The preference for home births is readily catered to by local traditional birth attendants (referred to as *dhatri* in Bangla/ Bengali).

> "We see that we provide prenatal care to about 1200-1300 people but only about 50 to 60 undergo delivery. The number of deliveries is much less compared to the number of patients we see (for ANC)." – midwife

> "Sometimes the patient tells us that they tried to come to us. They tell their guardian to bring them to the UZHCS, but the guardian doesn't respond on time or call us. Especially during the night because of the unavailability of vehicles the guardian doesn't want to bring the patient to the hospital." - midwife

> "If she comes here for delivery, many people will see her. She can't keep her veil if she comes here. That's why she chooses home delivery" — a pregnant woman talking about her sister-in-law

> "People are increasingly choosing our hospital for deliveries even those who previously opted for home births. With two midwives and a doctor present in every shift, patients receive optimal care. However, the presence of a male doctor can deter some patients, necessitating us to make decisions independently." - midwife

> "Despite having everything our delivery rates haven't increased. The main reason seems to be home deliveries. When we receive patients with infant mortality or uterine problems we inquire about where they delivered. Often, they mention home deliveries. There are 'dhatris' (traditional birth attendants) without formal training who discourage patients from coming to the hospital claiming they can handle deliveries themselves. They dissuade patients from seeking hospital care. It can be seen that the patient is that dhatri's relative or neighbour. When she delivers, 8 out of 10 deliveries are good. But in the case of the remaining 2, she did a massacre. Unfortunately the community tends to overlook the occasional failures of these dhatri (traditional birth attendants). They only focus

> on the successful cases, ignoring the risks. In summary our main challenge is home deliveries."– midwife

Health facility respondents explained that travelling to the health facility is seen as a last resort for service users, and they only avail themselves of this option if some emergency arises because of otherwise being able to obtain services from traditional birth attendants.

> "The patient doesn't want to come to the UZHCS for normal delivery; they try it (delivery) with someone unskilled woman from nearby. If any problem arises during the home delivery, only then they come to us for our services." - midwife

Barriers: Organisational Level

Insufficient healthcare infrastructure, underlined by a critical lack of necessary equipment and inadequate staffing levels, significantly impedes the quality of medical maternity services delivery. Increased workload for healthcare providers which further compromises patient care and can heighten risks during medical procedures. These deficits in turn affect the morale and efficiency of healthcare providers.

> "I can handle [deliveries] alone but if there are more than one delivery patient I need assistance. Sometimes at night I have to handle 4-5 delivery patients with 2 on the bed and one or two on the floor. At those times I definitely need assistance. How can I manage 4-5 patients alone?" – midwife

> "We have two sets of delivery equipment available. However, we only have two delivery beds in our facility. Yesterday we had to manage three deliveries simultaneously. As the only midwife on duty, I sought assistance from a nurse. In addition to the two delivery beds, we also have one examination bed for diagnosing patients. Due to the high demand, one of the deliveries had to be conducted on this examination bed." – doctor

> "If someone takes leave then we have to work extra hours. We don't have any cleaner specifically for the delivery-related services. This is not only for us but also for the whole hospital. Maintaining hygiene in the delivery sector is another challenge." – midwife

Inadequate administrative oversight and miscommunication lead to inefficiencies in scheduling shifts and training scheduling, which also affects the morale and efficiency of midwives. For example, a midwife highlighted a significant communication issue where a nurse attended midwife-specific training due to miscommunication, underscoring the need for better coordination and oversight.

> "Occasionally nurses end up attending midwife-related training sessions. Just recently our facility received an invitation for KMC training specifically meant for midwives, but a nurse attended instead. This was due to a communication gap… Neither the supervisor nor the midwife informed me about it. This highlights a significant communication issue" - midwife

Barriers: Policy Level

Midwives in Bangladesh encounter substantial barriers to career advancement, reflected in the stagnation of their professional roles compared to nurses. Unlike nurses, who have a clear trajectory leading to senior roles such as senior staff nurse and director positions, midwives are confined to a static role without current prospects for advancement. A key informant elaborates:

> "Midwives only started, their salary grade is 10. They are second class officers, just like nurses are second class officers, but the nurse's grade increases. Unlike nurses whose career paths are quite clear, for midwives, the government positions are just for midwives, there's no career path planned yet, I haven't seen any documents or evidence regarding it. It might just be a draft for now." -policymaker/advocate

The lack of clarity in roles and responsibilities often forces midwives to take on tasks beyond their scope without proper support. The supervisory structure for midwives further complicates their professional environment. Typically, midwives are supervised by senior staff nurses, creating a hierarchy that does not favour midwife autonomy or authority within healthcare facilities. The informant specifies:

> "Officially the direct supervisor is a nurse. It's the senior staff nurse who, if you go to a Union health centre, ideally, which should have a midwife. So in the Union health centre, the nurses who supervise the midwives, they are the senior staff nurses." -policymaker/advocate

> "But in those areas, the single midwife that is there, works under a year, there's a medical officer in the sub-centre. But the medical officer isn't actually the one they report to, they still report to the senior staff nurse." -policymaker/advocate

> "In this UZHCS they don’t have enough helping hands to support their services and for that the output isn’t appropriate…Working with a minimal workforce is hampering the services. The hospital is now 50-seated but on paper it is still a 31-seated hospital. For this reason, they can’t deploy more midwives and cleaners in the hospital." – midwife

One policymaker/advocate engaged with the midwifery explained that the lack of recognition and limited career progression are also reasons for demotivation among nurses, experiencing similar constraints to midwives.

> “For 25-40 years in a government job, for 39-40 years, there is no promotion. They are retiring. If I do BSc, MSc, PhD, or anything else, it will not affect. Because there is a criterion in seniority. If there is promotion, it is sequentially promoted." – policymaker/ advocate

Another policymaker/advocate warned about the quality-related concerns if the number of educational institutions conferring midwifery diploma degrees continue to increase rapidly without much oversight:

> “In the last few years, due to COVID-19, many institutions have emerged, and we have given a lot of permissions. However, the number has increased significantly. The government has 62 institutions, and it is a practice-based, skill-based profession with 60% practical classes and 40% theory classes. If the practice is not done properly, if the labs are not equipped, if the resources are not there, and if the faculty is not ready, then this profession will face difficulties. Now, with 62 government institutions, it is still somewhat possible to ensure quality. But the same level of oversight cannot be exercised in private institutions. There are two private institutions, for example, (anonymous) and (anonymous), where the private classes are good. But there are other institutions like (anonymous). Can we assess the status of those? This is not a study, so I cannot give a precise estimate for this. But I have noticed that the quality is not ensured. There is no support for them, no facilities. They have to practice and do at least 40 normal deliveries during their student period, but it is not possible. There may be a gap in competency."

Other policy-level barriers mentioned include bureaucratic processes and administration delays. One policymaker/advocate explained the process of position creation and recruitment and deployment for midwives:

> "For (anonymous institution/department 1), from our (anonymous institution/department 2), from the recruitment part, we go to the (anonymous institution/department 3). From the (anonymous institution/department 3), we go to the (anonymous institution/department 4). Then we go to the (anonymous institution/department 5). From there, we go to (anonymous institution/department 6). (anonymous institution/department 6) again processes the recruitment. When the recruitment process is over, then we go to the (anonymous institution/department 3). again. From there, we go to the (anonymous institution/department 2) and so on...
>
> We are involved with many stakeholders...
>
> So, this group, from the (anonymous institution/department 1) to (anonymous institution/department 6), has sent a circular to fill up the vacant midwife posts. The candidates have applied, and in the middle, they have extended the date. After that, they have also applied again. But then, the exam scheduling and processing have to be done, and the interview process. For each of these steps, we have to go through all these different institutions/departments." – policymaker/ advocate

Facilitators: Individual Level

Midwives often develop a deep passion for their profession through their educational journey and experiences. Initially, the distinction between nursing and midwifery may not be clear, leading to a period of adjustment and learning. As one midwife explained,

> "After enrolling in the first class, I learned that nursing and midwifery are different. Initially, to be honest, I didn't like it. It took me a lot of time to understand the difference between nursing and midwifery. Anyway, later

> gradually, I understood as I studied. Then I started to like it, and now I really like my profession. I like my profession much more than the nursing profession." - midwife

> "Our teachers explained it so nicely to us. I'm happy to be in this profession. Here we can save both mother and child's lives." - midwife

Midwives derive significant satisfaction and a sense of accomplishment from their direct impact on mothers and children. Their role allows them to provide comprehensive care, which they find deeply fulfilling.

One midwife expressed this sentiment, stating,

> "One thing I liked is that mother and child are very dear to us. So I thought that my work should only be about mothers and children. When we can deliver a mother safely and send her home safely or when we can place a healthy baby in a mother's arms, their smile is where the success or completeness lies." - midwife

This intrinsic motivation is further highlighted by their ability to understand and address the unique needs of their service users.

> "The presence of midwives in the care of a mother and a child is beneficial. During the ANC services, we can identify what kind of problems a mother is facing. And we can understand this because of our midwifery study. Other people will not understand as like as we can. As midwives can understand the mother and the child and can identify any problem, so the presence of midwives is helpful for the mother and the child's health." explained another midwife.

> "Recently, my sister completed her HSC exams. I told her to apply for the midwife degree. She saw both circulars of nurses and the midwives. She was in a dilemma about which one to choose. I told her that by working with mother and child, you will get self-satisfaction. But on the other services, you will not get that. That's why I told her to choose midwives to study." - midwife

Midwives experience significant community recognition and trust, which enhances their job satisfaction and effectiveness. Service users often seek out specific midwives based on positive past interactions, demonstrating a strong bond and trust in their capabilities. This trust is built through consistent, quality care and effective communication.

> "We have built a bond with them. They come to us, look for us. If they don't find us, they ask for us. And if I worked in another department, I wouldn't have that understanding about that patient, right?" - midwife

Facilitators: Interpersonal Level

Effective communication and counselling by midwives enhance trust and comfort among communities, encouraging hospital health facility deliveries over home births.

Supportive family networks and guardianship improve maternal care by facilitating more women to seek care in hospitals.

> "We have to increase the communication more and more. By doing the communication it will be possible to bring them in the UZHCS. Sometimes the patient tells us that they tried to come to us. They tell their guardian to bring them to the UZHCS, but the guardian doesn't respond on time or call us. Especially during the night because of the unavailability of vehicles the guardian doesn't want to bring the patient to the hospital." – midwife

Midwives have played a crucial role in increasing the number of normal deliveries and improving the quality of maternal and child healthcare. Their specialised training allows them to manage deliveries skilfully, resulting in higher delivery rates and better health outcomes. Multiple healthcare providers have therefore attributed the increase in preference for normal deliveries by community members to these specialised services that midwives provide.

> "The number of normal deliveries has increased, and its credit goes to midwives. Before the deployment of midwives the responsibility of normal deliveries was on senior nurses but now it is the responsibility of midwives. And they are specially trained to do so."- doctor

> "The role of midwives is very important, especially in deliveries. In many upazilas, midwives handle normal deliveries skilfully. Every month we see 30-40 normal deliveries here, though the number varies. This is considered a credit to the hospital. We encourage all midwives to counsel service users during ANC care to come to the hospital for normal deliveries. Our hospital has advanced significantly with an increasing rate of normal deliveries." -nurse

> "The delivery rate is increased now. C-sections are also conducted here. We counsel the patient to do their delivery here who visit for ANC service. We encourage them to come here. We tell them we have midwife doctors. They will get the services." -midwife

> "Nowadays many people understand that there is a significant difference between midwives and traditional birth attendants (dais). We are trained and educated unlike the spiritual era's traditional birth attendants. No one uses dais for deliveries anymore. They understand the difference between a *dai* (traditional birth attendant) and a midwife." -midwife

One advocate/policymaker also confirmed this trend in increasing preference for normal deliveries from midwives:

> "Many patients come and ask for specific midwives they've seen before saying 'I want to see that nurse. She's very good.' The midwives take a lot of time to explain things which patients appreciate. They trust them and seek them out." -midwife

Facilitators: Organisational Level

A team-based approach with sufficient and well-maintained equipment improves the quality of care. Effective teamwork between midwives, nurses, and doctors is essential for delivering quality healthcare services. Midwives handle initial evaluations and counselling, while referring complicated cases to doctors, ensuring a collaborative approach to patient care.

> "Absolutely, teamwork is crucial in our profession. Midwives and sisters handle deliveries and keep me informed about them and any referrals. If there are complications, they seek my assistance. So teamwork is essential, especially during the delivery process." -doctor

> "Midwives and two nurses along with me were present there at that time. Someone set the oxygen, another one called the doctor. With the help of everyone, we supported the patient and referred her to the district hospital. One of our midwives was with the patient while going to the district hospital." -nurse

A positive work environment and dedicated support from authorities and colleagues are crucial facilitators for the success of midwifery programs. Supportive internal relationships and ample resources contribute to the smooth functioning of healthcare facilities.

> "Our authority provides ample support. They support in all aspects. If anything is lacking and we inform the sir, he only says 'Just let me know what else is needed.' Often, they provide the necessary funds. We just have to tell the sir what we are missing. The authority is very good. When the officers are good, the work goes smoothly. Our sir is a very good person." - midwife

Facilitators: Policy Level

Government support and advocacy have been crucial for the successful implementation of the midwifery program, with significant backing from high-level political stakeholders and strong collaboration with international partners. This support extends to resource allocation and capacity building, where continuous efforts have been made to equip institutions with necessary facilities, including labs and libraries, and to provide extensive training programs for faculty and staff.

Institutional and educational support has been strengthened through partnerships with global organisations, ensuring the development of comprehensive curricula and adherence to rigorous accreditation and quality assurance processes. Furthermore, midwifery professional associations and networks play a critical role in advocacy, capacity development, and maintaining high standards in practice, supported by a broad range of stakeholders committed to funding and advancing the midwifery profession.

> "I think the connection between the [international development partners] and the government is very strong. It is fully supported. The government body is supported by the [international development partners] and vice versa."

> "From the beginning, the [international development partners] started with the proposal curriculum syllabus exam system institutional preparation faculty development capacity building Wi-Fi support lab support and library support. All of these are provided by the [international development partners]."
>
> "This certified midwifery preparation was totally supported by the [international development partners]. They have relocated it to many areas. The most important point is that this certified midwifery was created by the faculty, which was a great achievement. They had three months of advanced training, three
>
> "As far as I know, [international universities] have been supporting...the [international development partners] and the local implementing partners have also been supporting the local educational institution for midwifery and conducting trainings."

Discussion for Component 2

The qualitative study identified barriers and facilitators across four levels: policy, organisational, interpersonal, and individual. These findings align with prior research on barriers and facilitators from Bangladesh and other LMICs. A recent systematic review that included 31 studies from 21 LMICs identified that barriers to implementing midwife-led care in LMICs include lack of knowledge and negative attitudes among women, inadequate skills and confidence among midwives, resistant attitudes from stakeholders, and systemic issues such as poor infrastructure and funding shortages. Facilitators include creating awareness through community engagement, providing proper education and support for midwives, positive stakeholder involvement, strong leadership, and continuous funding. Addressing these factors is crucial for the successful implementation and sustainability of midwife-led care models in LMICs (Sangy et al. 2023).

The barriers and facilitators, and the pathways to change diagrams (Figures 12 and 13) operate through dynamic interactions across multiple levels: —policy formulation, health facility, community, and individual. These interactions create a comprehensive framework where each level influences and is influenced by the others. This bidirectional influence is depicted by the purple pathways in the diagram, emphasizing the feedback loops that enhance overall system functionality. For instance, when midwives perform to their full scope of practice within an enabling environment, it not only directly improves health outcomes but also indirectly contributes to improvements in facility readiness. This aligns with prior research findings that demonstrate how empowered and well-supported midwives can lead to better facility management, resource allocation, and overall quality of care (Anderson, Williams, et al. 2023; Anderson, Zaman, et al. 2023; Anderson, Zaman, and Limmer 2023). In addition to deployment, mentoring programs that assist the integration of midwives into the health systems further improve maternity care quality and availability, increasing evidence-based practices(Anderson, Williams, et al. 2023; Anderson, Zaman, et al. 2023; Anderson, Zaman, and Limmer 2023; Turkmani, Nove, et al. 2023; Turkmani, Smith, et al. 2023).

Similarly, policies that generate skilled midwives and provide adequate infrastructure facilitate midwives' ability to perform effectively. This, in turn, boosts client satisfaction and trust in midwifery services, which feeds back into increased utilisation of these services(Exley et al. 2016). As midwives become more integrated into the health system and demonstrate their value, this can lead to further policy support and investment in midwifery services, showcasing the interconnected nature of the SEM.

Collectively, these studies show that midwife availability enhances maternal and neonatal outcomes, but sustaining improvements requires supportive policies, continuous professional development, and robust health system infrastructures.

The SEM's approach ensures that interventions at one level can trigger beneficial changes at other levels, creating a holistic and sustainable improvement in midwifery services and maternal health outcomes. This interconnectedness is crucial for understanding the complex ecosystem of healthcare delivery and for designing interventions that leverage these relationships to maximize impact.

Limitations

This study has several limitations that must be considered when interpreting the findings. First, the use of convenience sampling for selecting Upazila Health Complexes in Dhaka, Chattogram, and Sylhet may introduce selection bias, limiting the generalizability of the results to other regions. Second, the study's qualitative nature, while providing in-depth insights, may limit the ability to draw broad quantitative conclusions. Additionally, potential biases in self-reported data from respondents, including midwives, pregnant women, recently delivered women, and healthcare providers, may affect the accuracy of the findings. The socio-ecological model (SEM) guided both the design and analysis, but the application of SEM may not capture all nuances of individual and systemic factors affecting midwifery practice.

Future Research

Finally, we have shared the draft pathways to change diagram with key stakeholders to gather their feedback. Moving forward, we plan to share it with additional stakeholders to gather more comprehensive input. This feedback will be crucial in refining and developing the a theory of change (ToC) further to ensure it meets the needs and expectations of all parties involved.

Broad Conclusion

The combined retrospective and prospective analyses underscore the transformative impact of midwifery services on maternal and neonatal health in Bangladesh. The retrospective modelling demonstrated a significant increase in facility-based deliveries attended by midwives, from 15% to 25% between 2019 and 2023, resulting in 892 neonatal and 151 maternal lives saved. Despite fluctuations due to factors such as maternity leaves and the COVID-19 pandemic, the overall trend indicates a positive impact of midwifery-led care on health outcomes. Key districts like Chattogram and Cox's Bazar showed the most substantial improvements, attributed to their larger populations and increased skilled birth attendance.

The qualitative study revealed barriers at various levels, including economic constraints, cultural norms favouring home births, inadequate healthcare infrastructure, and policy-level issues like limited career advancement and administrative inefficiencies. However, facilitators such as effective communication, community trust, teamwork, government support, and robust educational programs have significantly contributed to the success of midwifery services.

Prospective modelling for 2024-2030 projected further substantial benefits with increased midwife deployment. Depending on the scenario, an estimated 12,046 to 31,335 additional maternal and neonatal lives could be saved by 2030, highlighting the critical need for an expanded midwifery workforce. Achieving these targets requires a concerted effort in addressing identified barriers, enhancing midwifery training and deployment, and ensuring sustained governmental and international support.

In conclusion, the evidence strongly supports scaling up midwifery services as a strategic priority for improving maternal and neonatal health outcomes in Bangladesh. Addressing the multi-level barriers and leveraging the identified facilitators can enhance the full scope of midwifery practice, ultimately leading to substantial health benefits for mothers and newborns nationwide.

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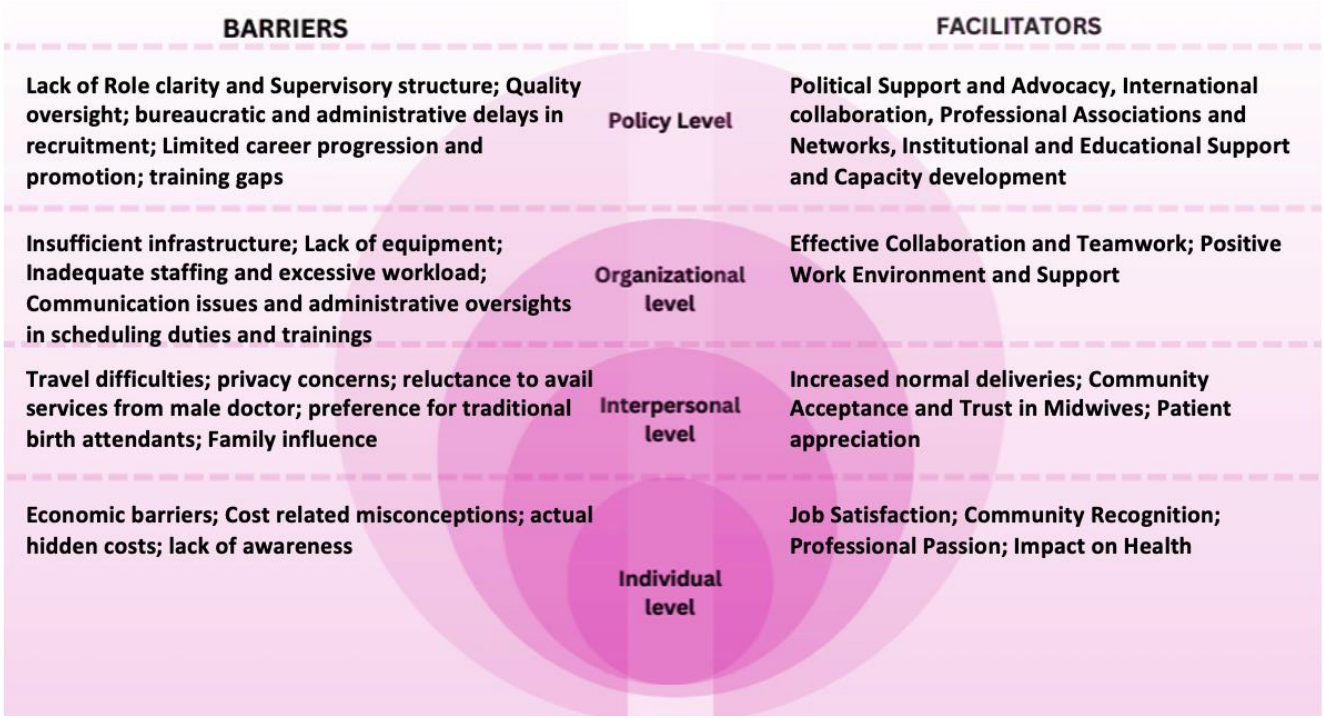
Annexes

Annex 1

Figure 13. Barriers and facilitators to midwifery led care across all levels of the socio-ecological model (SEM)



Annex 2:

Figure 14. Pathways to health impacts of midwifery-led care at various levels of the socio-ecological model

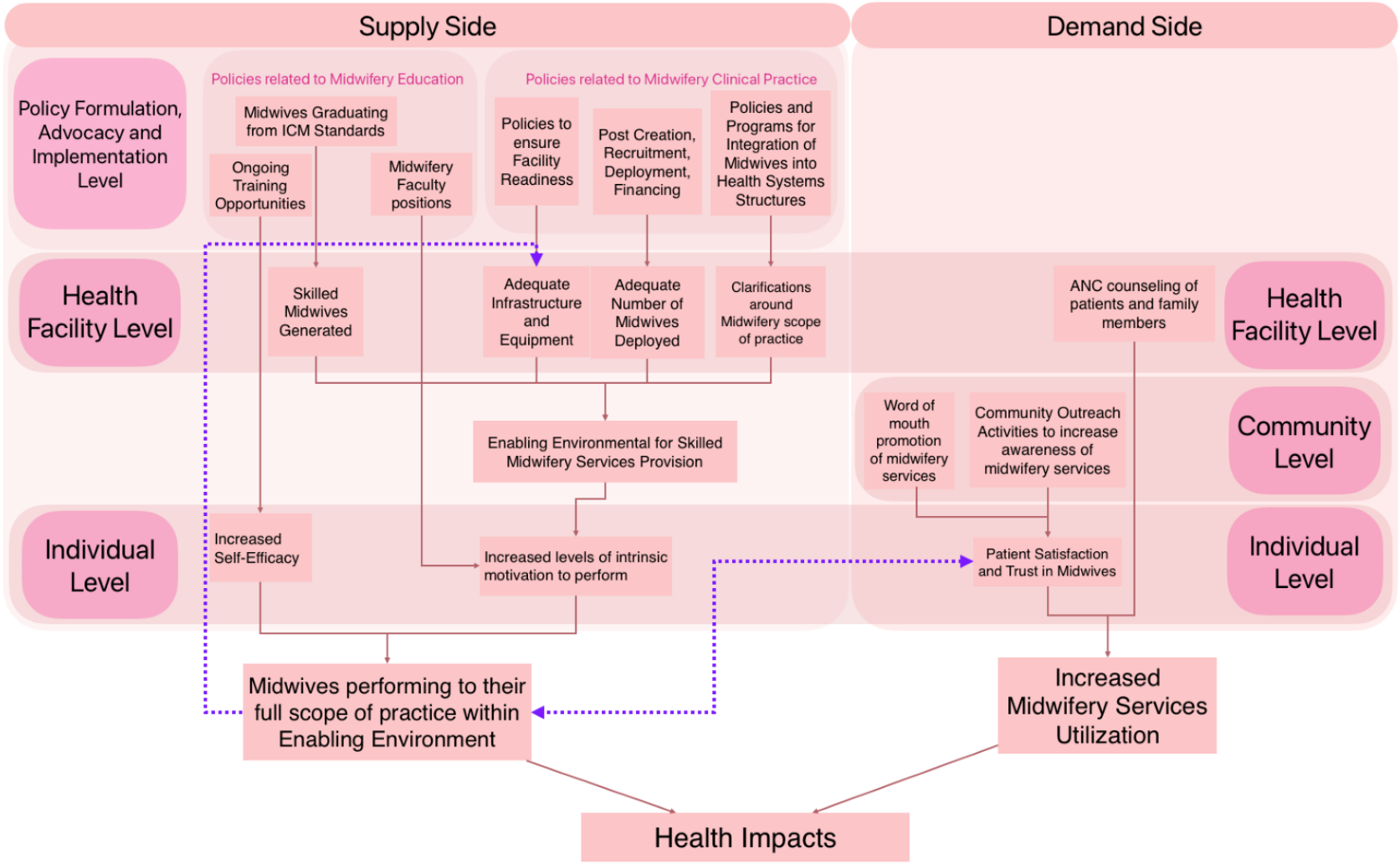


Table 14. Midwife deployment by district

District	Total Midwives Deployed in Phase 1 (2018)	Total Midwives Deployed in Phase 2 (2021)	Estimated # of midwives working in each district in 2023	Total Deliveries By Midwives 2019	Total Deliveries By Midwives 2020	Total Deliveries By Midwives 2021	Total Deliveries By Midwives 2022	Total Deliveries By Midwives 2023
Bagerhat	8	30	38	607	483	562	1833	2938
Bandarban	1	17	17	13	0	192	596	718
Barguna	43	43	28	113	119	82	396	1160
Barishal	6	19	27	1117	1072	999	1898	2730
Bhola	22	21		1901	1402	608	2265	3846
Bogra			79	1479	1494	974	2904	3196
Brahmanbaria	17	21	25	282	446	156	821	1416
Chandpur	24	36	68	409	425	968	1256	1910
Chapai Nawabganj	20	21	21	1409	1000	1265	1931	2082
Chittagong (Chattogram)	18	18	65	3993	2302	6134	12320	14037
Chuadanga	51	52	13	468	492	503	678	786
Cox's Bazar	5	9	40	607	1486	2538	6753	8773
Cumilla	18	29	39	2832	1310	1914	7020	7843
Dhaka	24	24	80	782	1283	731	1689	2067
Dinajpur	46	56	81	2283	1451	2198	4992	5208
Faridpur	40	50	39	1757	1177	726	1774	2723
Feni	28	21	26	876	642	1532	3193	4007
Gaibandha	13	23	56	1399	634	413	2207	3029
Gazipur	18	20	32	1281	1411	870	2277	2951
Gopalganj	14	24	37	164	214	621	1049	1547
Habiganj	5	14	41	98	795	1492	1734	3440
Jamalpur	15	17	27	2230	2083	1685	5020	6146
Jessore	4	6	6	2002	1788	2290	4120	4132
Jhalakati [Jhalokati]	16	26	50	292	155	41	668	855

Jhenaidah	28	28	46	907	640	835	1945	2669
Jaipurhat [Joypurhat]	9	26	14	355	513	422	868	1256
Khagrachhari	5	10	21	249	191	340	555	938
Khulna	14	17	52	1553	1390	644	1215	1479
Kishoreganj	36	37	67	1179	1280	1331	4536	7625
Kurigram	22	50	47	420	609	1324	2907	3559
Kushtia	13	34	48	782	920	873	1769	2007
Lakshmipur	16	24	8	722	1918	145	1958	2903
Lalmonirhat	8	7	28	1039	725	1088	1636	1768
Madaripur	16	16	23	407	333	157	336	374
Magura	6	11	17	187	127	756	1475	1796
Manikganj	4	10	52	466	677	256	1155	1884
Maulvi Bazar [Moulvibazar]	13	23	31	1297	2019	2151	3275	3582
Meherpur	16	20	46	477	482	299	517	428
Munshiganj	21	19	11	813	981	502	1084	1170
Mymensingh	8	8	86	3346	4202	4762	11087	14052
Naogaon	29	45	79	766	876	1349	2550	3578
Narail	15	15	33	236	294	147	446	461
Narayanganj	8	8	34	523	786	877	2339	3671
Narsingdi	15	24	38	1486	1112	1246	3848	5092
Natore	20	41	27	997	735	657	1185	1537
Netrakona [Netrokona]	12	15	35	853	963	341	2365	3893
Nilphamari	23	21	26	1577	1462	1417	3156	3623
Noakhali	16	17	9	640	619	1466	4974	6622
Pabna	19	19	38	2436	1903	1541	4393	5422
Panchagarh	32	31	40	501	732	1760	2900	3062
Patuakhali	15	15	31	506	716	768	1603	2036
Pirojpur	13	25	37	286	128	564	1155	1309
Rajbari	4	2		272	554	281	417	673
Rajshahi	19	31	27	1174	944	899	2290	2655

Rangamati			3			194	408	436
Rangpur	8	21	65	1312	1062	1293	2756	2814
Satkhira	11	16	33	94	333	241	820	1355
Shariatpur	35	35	63	777	872	8	905	1795
Sherpur	15	16	32	1326	786	757	1999	3052
Sirajganj	9	24	32	665	1266	1165	3127	4590
Sunamganj	13	15	17	303	690	778	3033	4625
Sylhet	11	35	62	556	1240	2115	5778	6955
Tangail	6	33	52	1929	2036	698	2920	3998
Thakurgaon	21	47	61	884	930	866	2054	1929
Totals	1060	1488	2406	62692	61710	66807	163133	210213