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Risk-Benefit Ratios in Public Health Programs: A Comparative Study of Outcomes in Maternal Health Interventions

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ABSTRACT

Introduction: Global maternal and newborn health continues to be an area of concern, due to high levels of Maternal Mortality Rate (MMR) and Neonatal Mortality Rate (NMR).

Aim: This study aimed to assess the impact of Maternal Health interventions, Antenatal Care (ANC), Skilled Birth Attendant (SBA), Emergency Obstetric Care **(**EmOC), Postnatal Care (PNC), and Maternal Nutrition Support (MNS) on MMR, NMR, and the incidence of maternal complications.

Methods: A sequential comparison of MMR, NMR, and maternal complications was conducted before and after five intervention programs. Quantitative data were obtained and compared to determine the percent reduction in MMR, NMR, and incidence of complications.

Result: This cross-sectional study established a decline in MMR, NMR, and maternal complications across the five interventions assessed. The specific MMR reduction rates were 39% for ANC, 41% for SBA, 52% for EmOC, 37% for PNC, and 31% for MNS. NMR reported the following reduction figures as 43%, 45%, 61%, 39%, and 30%. The material complications decreased by 56% in ANC, 57% in SBA, 75% in EmOC, 52 % in PNC, and 40 % in MNS. All five maternal health interventions reduced maternal as well as neonatal mortality and complications among women.

Conclusions: These findings underscore more specific and integrated community maternal and neonatal health efforts and underline the benefits of implementing all five interventions tested in this study.

KEYWORDS: Antenatal, Skilled Birth Attendant, Postnatal, Masterial Nutrition Support, Maternal Mortality Rate, Neonatal Mortality Rate.

Introduction

Inequalities in maternal and neonatal health remain one of the biggest problems of international concern in the field of public health. Huge progress in access to health care fails to prevent high rates of maternal and neonatal mortality in Low- and Middle-Income Countries (LMIC). As estimated by the WHO, on average, 283000 women die every year during pregnancy or childbirth, the greater part of these women are in Sub-Saharan Africa and South Asia, in 2017 (295,000).[1] The main causes that result in maternal mortality are postpartum hemorrhage, Eclampsia (EO), pre-eclampsia (PE), sepsis, and complications arising from unsafe abortions. Neonatal deaths are those that occur in the first 28 days of life and are strongly associated with maternal and perinatal care.[2] These challenges are central to the issues addressed by maternal health interventions and the outcomes of maternal and neonatal care. Others including ANC, SBA, EmOC, PNC, and MNS have been carried out in many countries to lessen maternal and neonatal mortality and to decrease the adverse effects of childbearing.[3] The evaluation of such interventions and determination of the impact of all these interventions on the enhancement of maternal health remains a limitation in the field of public health research.[4]

More focus has been directed towards the utilization of ANC in critically addressing maternal and neonatal mortality. Various studies have as presented indicated that good ANC reduces pre-term complications by identifying early abnormalities, encouraging behavior changes, and linking women to appropriate health facilities.[5] SBA has been known to reduce maternal mortality since complication management during childbirth is effectively handled by a professional.

SBA is also involved in the detection of obstetric complications to avoid complications that may be fatal during childbirth.[6] EmOC is one of the most valuable services and has been analyzed regarding its impact on the amount of maternal mortality, the intervention can help manage complications like obstructed labor, severe bleeding, and preeclampsia. EmOC services should be available in the health facilities to treat complications during Obstetrics emergencies.[7]

The fourth key area of maternal care referred to as PNC has attracted increasing attention in the recent past despite being frequently neglected because it is central in the management of early maternal complications such as infections, hemorrhage, and post-natal mental health.[8] MNS has also been acknowledged as another critical aspect of the maternal system by identifying maternal malnutrition status as a factor causative of complications in pregnancy, preterm births, and low birth weight. Studies have revealed that there is a big decline in MMR in SBA practice in such contexts, and other investigations have revealed that EmOC has catastrophically helped to avert maternal deaths from obstetric complications.[9] There is emerging evidence that again comprehensive PNC reduces neonatal mortality by identifying and managing post neonatal infections, asphyxia, and other conditions. Although single-intension interventions have shown success in cutting down the mortality rates of both maternal and neonatal, excerpts learned that a combined intervention strategy is vital.[10]

Though the efficacy of single and discrete maternal health interventions (MHI) has been demonstrated, there is a lack of evidence regarding the potential synergistic outcomes of integrated maternal health intercessions in MINO.[11] Many LMICs, even today face high MMR and NMR even after the initiation for the betterment of maternal health. The relative efficacy of different interventional measures and the overall balance between benefits and risks that accepting or rejecting applications entails, are essential factors to be considered for making rational choices of the healthcare policies and resource provision in these areas.[12] The combination of these interventions may hold the potential for introducing more extensive and long-lasting changes to the area of maternal health.[13]

The main aim of this study was to assess the outcomes of different kinds of maternal health intervention programs in terms of MMR, NMR, and cases of maternal complications. The study focused on five key interventions, institutional delivery, ANC, SBA, EmOC, PNC, and MNS. The two specific research goals are maternal mortality rate and neonatal mortality rate. Every of these intervention programmes led to a decline in the level of both MMR and NMR which shows that maternal health interventions are central in determining pregnancy outcomes. The findings of this study support the rationale for individual-level interventions and underscore the need to promote a package of interventions that is multisectoral for improved maternal and neonatal health.

MATERIAL AND METHODS

Study Design

Intermittent screening using a self-completed questionnaire was carried out every 6 months over 24 months for a direct comparative assessment of the risk-benefit ratios of different maternal health interventions among the various regions. Specific interventions included in this study were 5 maternal health programs targeted at reducing MMR, NMR, and maternal complications. The evaluation was designed to generate impacts produced by these interventions in boosting the standards of maternal care and limiting negative consequences in the regions of the study.

Intervention Programs

There was the use of five maternal health intervention programs in the study. The ANC gets involved in the early identification and control of health complications through check-ups, dietary advice, and folic acid. SBA was designed to encourage facility-based and skilled birth attendant-reported deliveries to minimize complications. The proposed EmOC program was directed to enhance the provision of emergency care for women with such complications. PNC focused on the follow-ups 2-6 weeks after delivery, and MNS was an intervention that offered nutrition and counseling for pregnant and breastfeeding mothers.

Study Population

The sample was comprised of 1500 pregnant women with an equal distribution across 5 intervention groups. The participants were even as differentiated by their socio-economic background and geographical proximity to urban or remote areas as possible. This approach made it possible to compare the impacts of the interventions within and across the various environments given the differences in the health care accessibility, lifestyles, and cultural beliefs that may negatively affect maternal health.

Data Collection

Data were collected at three stages: pre-intervention, and post-intervention at 12 and 24 months using a cross-sectional design. These inlude MMR, NMR, complications such as PE and anemia, and biomarkers off birth outcomes including preterm birth and low birth weight. Such data were useful for determining the status of the intervention programs after the 24-month study period and their efficacies in enhancing the health status of mothers and newborns.

Statistical Analysis

To make a risk-benefit analysis risk of deterioration, death, and complications were compared to the benefit of reduced mortality and complications in patients treated by PC. Data for this study was analyzed using IBM SPSS version 25. To test the differences in means of the intervention groups, Analysis of variance (ANOVA) was used and logistic regression was used to establish the factors that may affect the outcome variable. This statistical method made it possible to determine the real impact of those interventions on the health of mothers and newborns and also to evaluate the efficiency of each program.

RESULTS

Maternal Mortality Rate (MMR) Across Intervention Programs

Table 1 illustrates the study had many intervention programs for MMR under analysis and focused on the degree of its decrease. This means that clinics visited during the first trimester of pregnancy also reduced visits known as ANC by 39%, and MMR reduced from 230 to 140. A 41% reduction was achieved in MMR due to the contribution of the SBA the MMR was reduced from 220 to 130. The largest improvement was EmOC with a 52% decreased MMR from 250 to 120. A reduction was also observed in both PNC and MNS, which indicated the efficacy of these intervention Proportions, where PNC was reduced by 37%, and MNS was reduced by 31%.

Table 1: Maternal Mortality Rate (MMR) Across Intervention Programs

Intervention	Baseline MMR (per 100,000 live births)	Midpoint MMR	Endline MMR	% Reduction in MMR
Antenatal Care (ANC)	230	190	140	39%
Skilled Birth Attendant (SBA)	220	180	130	41%
Emergency Obstetric Care (EmOC)	250	200	120	52%
Postnatal Care (PNC)	240	200	150	37%
Maternal Nutrition Support (MNS)	260	210	180	31%

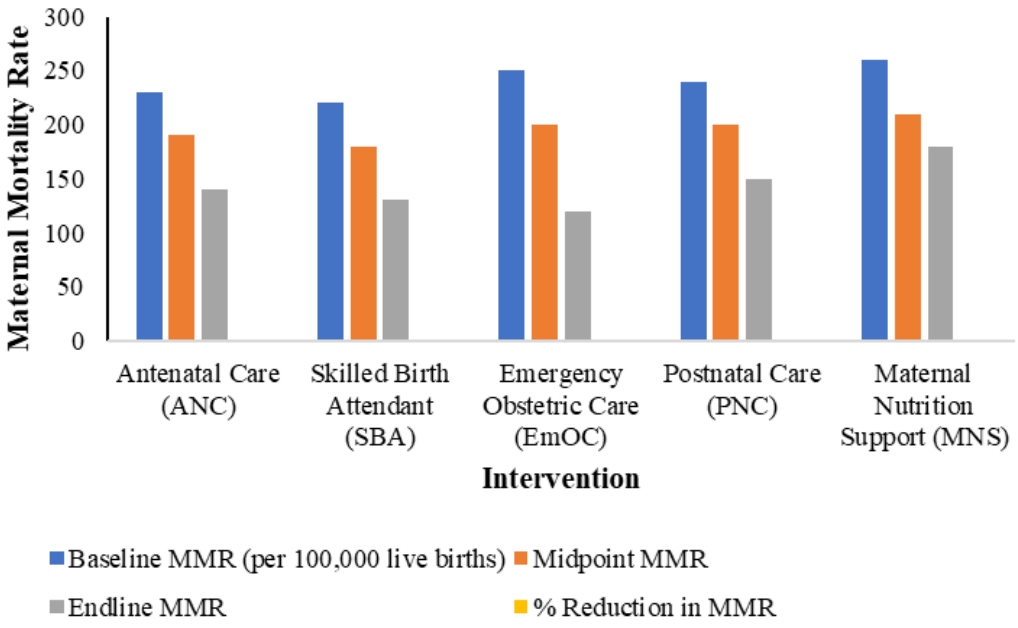

Figure 1: Maternal Mortality Rate (MMR) Across Intervention Programs

Figure 1 depicts that analyzed the trends in MMR of the different intervention programs. In ANC there was a noticeable change from baseline MMR of 230 to endline MMR of 140. According to SBA interventions, MMR was decreased to 130 cases from 220. EmOC had the most improvement right from 250 to 120. Maternal Child Health including PNC contributed to a reduced MMR from 240 to 150 while the real MNS was reduced from 260 to 180. Overall, the results

indicated that each of the programs caused a decrease in MMR from the baseline, midpoint, to end line. The percentage reduction achieved by each model is shown in the figure below, EmOC scored the highest percentage reduction of 52%.

Neonatal Mortality Rate (NMR) Across Intervention Programs

Table 2 illustrates the NMR was determined to compare different intervention programs concerning their impact on mortality rates. The NMR for ANC was 35 per 1,000 live births, it reduced to 20 NMR by the end of the program, meaning there was a 43% improvement. The same was seen in the figure for the SBA intervention which declined from 33 to 18, an improvement of 45%. Among the available measures of facility-based care, the indicator that showed the most improvement was EmOC, with the number of facilities reducing from 38 to just 15, a 61% decrease. The rollout of the PNC, of interest in this research, led to a 39% reduction from 36 to 22. MNS program also has been reducing the percentage by 30%, with the NMR reducing from 40 to 28. All these interventions helped to a great extent in enhancing neonatal trends.

Table 2: Neonatal Mortality Rate (NMR) Across Intervention Programs

Intervention	Baseline NMR (per 1,000 live births)	Midpoint NMR	Endline NMR	% Reduction in NMR
Antenatal Care (ANC)	35	30	20	43%
Skilled Birth Attendant (SBA)	33	28	18	45%
Emergency Obstetric Care (EmOC)	38	32	15	61%
Postnatal Care (PNC)	36	31	22	39%
Maternal Nutrition Support (MNS)	40	34	28	30%

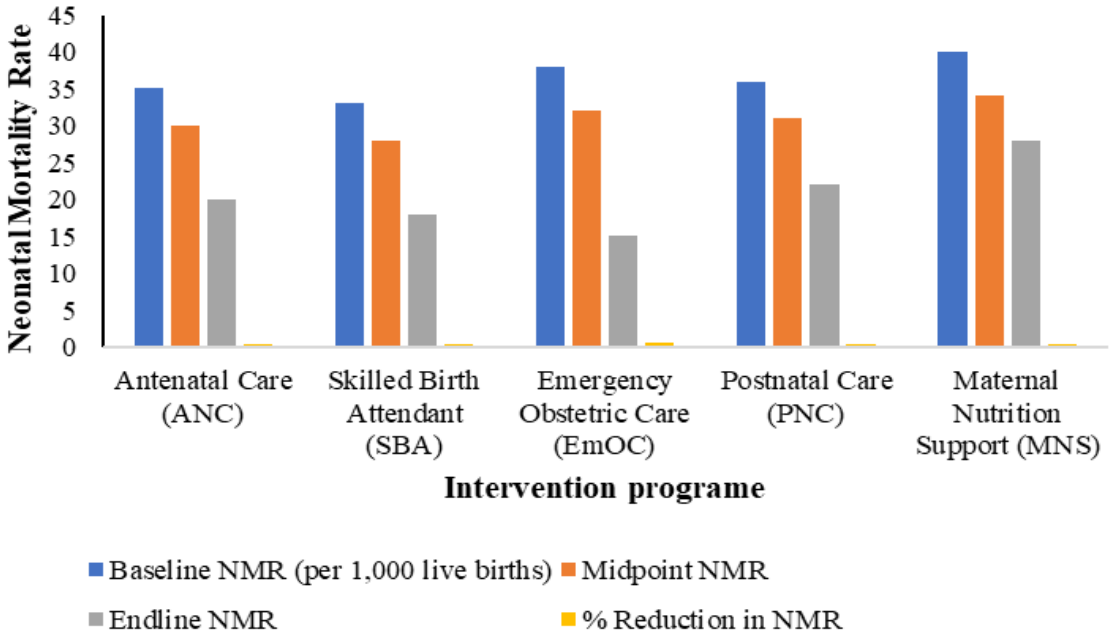

Figure 2: Neonatal Mortality Rate (NMR) Across Intervention Programs

Figure 2 illustrates the NMR per 1,000 live births across five intervention programs, including the four key postal basic ANC, SBA, EmOC, PNC, and MNS. At baseline, there were significantly higher NMRs in all the interventions, where they began to decline at the midline and further decrease again at the end line. The improvement in neonatal mortality rate revealed the highest reduction in YEMRD for emergency obstetric care compared to SBA and ANC services. With prenatal care, both postnatal care and MNS also bore a rapid decrease. The proportional change that we recorded for the NMR reduction rate was significantly higher in cases where interventions included emergency care and SBA. These findings emphasized the role of mother and neonatal care in the decrease of mortality rates among newborns.

Incidence of Maternal Complications

Table 3 depicts the maternal complication rate; the study compared various intervention programs and demonstrated a decline in the development of these complications. The intervention therefore impacted the ANC by reducing the level of incidence of complications by 56% from a baseline of 45% to 20% at the end of the program. The percentage of maternal

deaths decreased from 42% to 18% with the help of the SBA program down to 57%. The biggest improvement was again seen in EmOC, which improved from 48% to 12%, a three-quarters reduction. The PNC intervention saw a 52% decrease in complications down from 46 percent to 22 percent. The MNS program led to the desired benefits with an incidence reduction of 40%, the incidence reducing from 50% to 30%.

Table 3: Incidence of Maternal Complications

Intervention	Baseline Incidence (%)	Midpoint Incidence (%)	Endline Incidence (%)	% Reduction
Antenatal Care (ANC)	45%	30%	20%	56%
Skilled Birth Attendant (SBA)	42%	28%	18%	57%
Emergency Obstetric Care (EmOC)	48%	32%	12%	75%
Postnatal Care (PNC)	46%	34%	22%	52%
Maternal Nutrition Support (MNS)	50%	38%	30%	40%

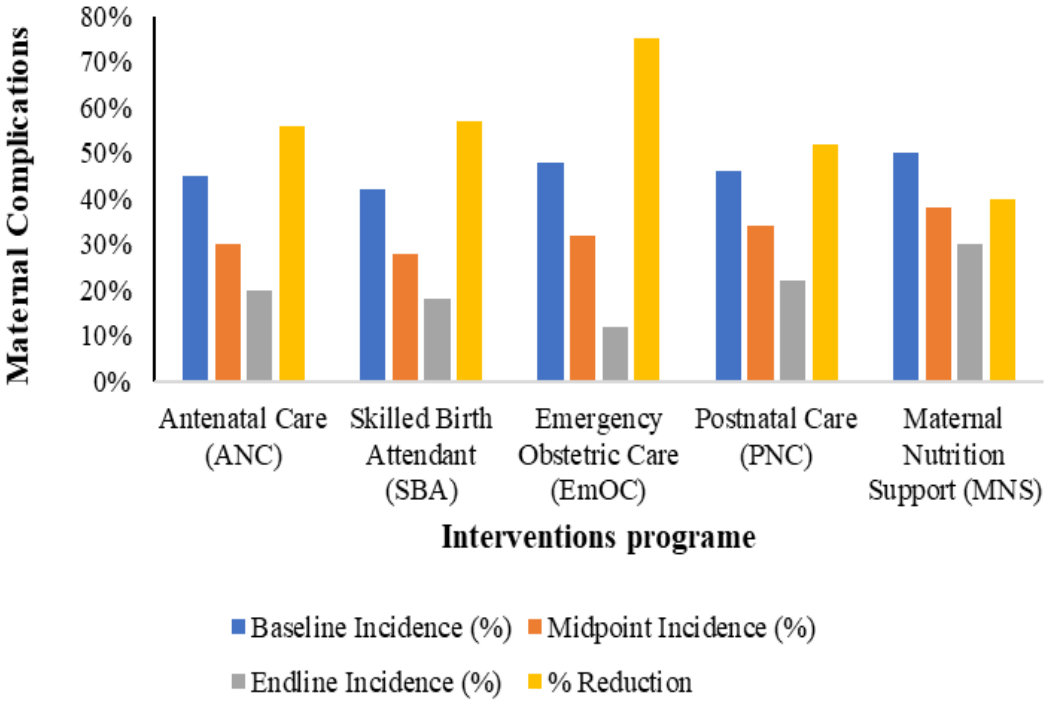

Figure 3: Incidence of Maternal Complications

Figure 3 depicts the result of the maternal complication rate of the interrelated intervention programs across the different years. On ANC, the initial observation yielded about 45% incidence which reduced to 30% at the midpoint and 20% at the end line, giving a 55% improvement. SBA intervention alone reduced complication at the midpoint from 42% to 28% and at the end line it was at 22% showing a reduction of 57%. This revealed a significant improvement from the baseline to the Mid-point and Endline of a 75% improvement in the proportion of facilities providing EmOC right from 48% at the baseline to as low as 12% at the end line. PNC interventions were able to reduce complications from 40% to 34%, to 20 % in total bearing a 51% reduction. MNS had a small decrease from 38% to 30%, achieving 40% less.

DISCUSSION

The main aim of this study was to assess the impact of different forms of maternal health intervention programs in preventing MMR, NMR, and maternal complications. The study focused on five key interventions, almost all Royal Health Systems Women and Child clients as potential beneficiaries availed the following services, ANC, SBA or delivery,

EmOC, PNC, and MNS. All the special intervention programs supported the decrease of MMR and NMR and proved the efficiency of maternal health interventions in pregnancy outcomes.

The outcomes of the analysis reveal the benefits of each intervention on the health of mothers and neonates. The EmOC program registered the most improvement in the MMR, with a 52% relative improvement between the baseline and end-line metrics. This implies that timely and appropriate emergency care for high-risk pregnancies is an important preventative measure of maternal mortality. Like the SBA program, the proportion of the ANC program also has vast reductions in MMR by 41%. Analyzing NMR by the actionable programs, the EmOC program decreased by 61% in NMR, SBA by 45%, and ANC by 43%. Women Friendly Maternal Healthcare Service Delivery also made a significant impact on NMR by slashing it by 39% followed by the PNC by 39% while MNS cut the figure by 30 %. The exception was the EmOC program which showed the most disproportionate reduction in maternal complications indicating a 75% improvement from the baseline to the end line. ANC, SAB, and PNC programs also caused significant reductions as follows 56%, 57% and 52% respectively. MNS is proposed to reduce the level of complications by 40%.

The results of this study correspond with those of the prior studies aimed at probing the efficiency of Maternal health interventions in cutting down the current rates of maternity and newborn death. A study conducted by the World Health Organization WHO (2016) highlighted that the chances of non-health skilled birth attendance and risky obstetric-emergency care are important variables in reducing maternal and neonatal mortality while this research stressed that both SBA and EmOC interventions showed positive health-related improvements.[14] Monsen et al. (2010), noted that antenatal care programs have emerged as strong in reducing maternal complications, in line with a 56% reduction in the maternal complication rate in the ANC program.[15] The outcomes of MNS programs are more or less effective in other research studies. A survey done by Kana et al. (2015) showed that despite nutrition support programs being critical, their contribution to changes in MMR and NMR could be modest compared with that which can be made by emergency obstetric care and skilled birth attendance.[16] MNS has the lowest proportional reductions in both MMR and complications by affording, 31% and 40% respectively. This implies that though MNS is necessary for enhancing the health of women of childbearing age, it requires augmenting by other strategies
to bring about enhanced changes.[17]

Antenatal, intrapartum, postpartum, and newborn care are important in the care of women and newborns to help the achievement of low maternal and neonatal mortality. Appropriate strategies derived from the results include involving skilled birth attendants and better access to emergency facilities which are all most needed by women residing in the regions that are still underserved.[18] MNS approach registered a lesser reduction as compared to other interventions, the existing maternal complications still warrant a multi-sectoral strategy, diet included, for ante and postnatal females.[19] It is recommended that these interventions should be used in combination since issues affecting the health of mothers are usually happening simultaneously.

Studies should extend the understanding of the educational interventions on maternal-neonatal health and whether these impacts are enduring or can be sustained in the future.[20] Although this current study demonstrates improvements that were observed over 24 months, knowledge of whether these changes persist over the years of the study would be valuable regarding the consistently reduced maternal and neonatal mortality and complications.[21] Future research could explore the cost-utility of the proposed intervention programs, assessing the challenges associated with the implementation of the programs in other parts of the world to identify how best they could be taken to scale.[22] The other research area that could be considered for future studies relates to the use of digital health technologies in maternal health programs. Mobile health or mHealth comprising communication techniques and tools for antenatal clinic appointments, contraceptive support, postnatal care, and nutrition has been very useful in enhancing the health of mothers in low-resource regions.[23]

The limitations of this study were observational, and the analysis to define outcomes and their relation to the intervention can be constrained by causality. Although the indices of mortality and complications continued to decline while the interventions were ongoing, the study cannot establish beyond a doubt that the interventions were solely responsible for the improvements. The study used data from only five intervention programs which seem not to be representative of all the types of maternal health intervention that could help to reduce the mortality rate.

CONCLUSION

The importance of this study has effectively captured the effect of 5 standardized mother care interventions which include ANC, SBA, EmOC, PNC, and MNS on MMR and NMR and maternal complications rate with every one of the indices appreciating a significantly reduced figure. The findings reveal that there was a decline in the MMR through five intervented programs, with a higher percentage improvement noted in EmOC followed by SBA, and ANC. Such reductions demonstrate the significance of affordable quality health care services in the promotion of better health, and therefore reduction of preventable maternal deaths. The under 28 days NMR declined in all the interventions, though EmOC had the most pronounced decline (61% reduction) again pointing to the importance of emergency obstetrics in improving neonatal outcomes. The levels of maternal complication were also improved and noticed significantly, EmOC improved by 75%, and SBA and ANC interventions also indicated a sign of improvement. The value of multisector family-

centered and Integrated Maternal and Neonatal (IMN) intervention where each intervention is critically important in enhancing outcome. The overall findings imply there is a potential advantage in adopting a continuum of maternal health care services entailing ANC, SBA, EmOC, PNC, and MNS, which may bring a significant improvement in decreasing both maternal and neonatal mortality as well as low birth weight, and decline in maternal complications in various health care systems.

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