Reducing MMR and NMR in an Eco-Ethnographically Diverse District of Nepal (Kapilvastu) through Engaged Digitalized Comprehensive Continuum of Care

Abstract

This study applied the modified Motherhood Method, complemented by GIS mapping and the Ama-ko-Maya digital application, to generate census-equivalent data on maternal and neonatal mortality in Kapilvastu District, Lumbini Province. By integrating community-based surveillance with digitized reporting tools, the approach provided granular insights into mortality patterns across municipalities. The findings reveal persistently high mortality rates despite increased institutional deliveries, underscoring that access to facilities alone does not guarantee improved outcomes. In 2023, the district recorded 10,164 live births, 52 stillbirths, 139 early neonatal deaths, 165 neonatal deaths, 196 infant deaths, and 29 maternal deaths, translating into ratios that remain above national averages. Municipality-level variation was striking, with some areas reporting zero maternal deaths while others, such as Municipality A, exhibited extremely high maternal mortality ratios, highlighting inequities in service quality and referral systems.

The majority of pregnant women belonged to the Madhesi community, followed by Muslims, pointing to the need for culturally sensitive interventions that address social determinants of health. Despite high institutional delivery rates, mortality persisted, suggesting systemic gaps linked to the "Three Delays" model—delays in seeking, reaching, and receiving appropriate care. The hub-and-spoke model piloted in this study, integrating community engagement, digitized data systems, and tele-counseling, demonstrated feasibility and effectiveness in strengthening maternal and neonatal health outcomes. Importantly, the modified Motherhood Method proved robust in generating actionable data for program planning and policy development, filling a longstanding gap in district-level monitoring.

From a policy perspective, the results emphasize the need to move beyond coverage-focused strategies toward quality-focused interventions. Strengthening emergency obstetric and newborn care, improving referral mechanisms, and addressing inequities across municipalities are critical. Institutionalizing the modified Motherhood Method within provincial health systems could ensure reliable surveillance, evidence-driven resource allocation, and accountability, ultimately contributing to reductions in maternal and neonatal mortality in high-burden districts like Kapilvastu.

Background and Rationale

Nepal's maternal mortality ratio (MMR) is 151 per 100,000 live births and neonatal mortality rate (NMR) is 21 per 1,000 live births (New ERA, 2023). The national target under SDG3 is to reduce MMR to 70 and NMR to 12 by 2030.. The Maternal Mortality at the Lumbini Province is 207 per 100000 live birth and Neonatal mortality rate of 24-27 per 1000 live births. Avoiding Three Delays i.e. delays in the decision to seek care by the individual, the family, or

both; in reaching an adequate health care facility; and in receiving adequate care at a health facility, is crucial for meeting these SDG3 MNMR targets. Direct obstetric complications during childbirth and postnatal period are significant contributors to maternal and neonatal mortality in Nepal.

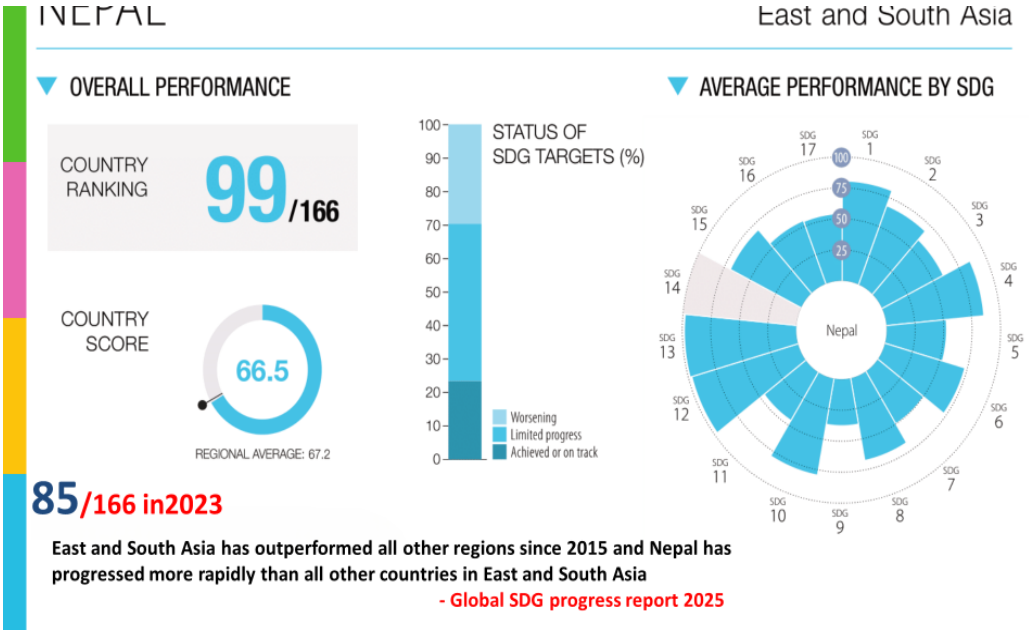
There has not been any change in neonatal mortality rate between 2016 to 2022 and 31% of neonatal deaths were found to be caused due to complications of pregnancy, labor and delivery.(2017) this stagnation highlights the lack of completion of continuum of care from ANC to institutional delivery and ultimately to postpartum checkups. Disparities in coverage between socioeconomic strata, underscore the importance of addressing healthcare gaps and improving service readiness with equity focus. Achieving these targets requires ongoing monitoring of pregnancies and prompt, timely interventions. This study piloted the modified Motherhood Method to generate actionable data and strengthen continuum of care as only five years have remained to meet these targets.

This research project aims to apply an innovative method for generating census equivalent data using the modified ***Motherhood Method*** (Maskey MK, LangJ,.Rothman KJ. 2011) This method can be used to monitor progress towards achieving SDG3 targets and for reducing maternal and neonatal mortality by adapting a hub and spoke model for strengthening the continuum of care through community engaged data driven intervention.

Nepal Public Health Foundation in collaboration with Nepal Health Research council adapted a multipronged intervention of quality continuum of care backed by digitized data recording system, tele-counselling, engaged community participation approach to achieve the reduction of maternal and neonatal mortality at Kapilvastu district of Lumbini Province. Modified motherhood method followed a three-step approach:

i. pregnant, and postpartum women were listed using existing health facility records.
ii. this list was verified and updated through Focus Group Discussions with FCHVs and health workers.
iii. home visits were conducted for GIS mapping and additional data collection from the pregnant and postpartum women themselves.

Combined with GIS mapping and Ama-ko-Maya apps that facilitate in digitizing health institution data and integrating with the Health Information Management System of Health Ministry of Nepal, this method presents and innovative cost effective and efficient collection tool to for census-equivalent data of pregnant and postpartum women.



Objectives

1. Generate census-equivalent data using the modified Motherhood Method for monitoring MNMR progress towards SDG3 targets.
2. Identify factors influencing high and low MNMR in communities through comparative mixed-method analysis.
3. Reduce MNMR by strengthening continuum of care through community-engaged, data-driven interventions using a hub-and-spoke model.

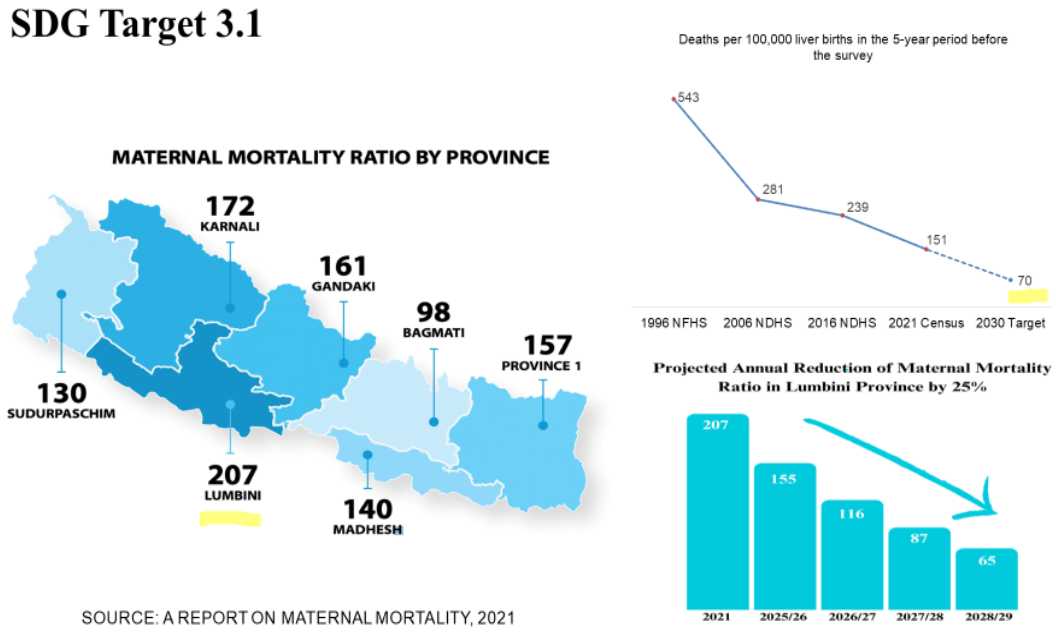
Study Site: Kapilvastu District

Socio-economic-ethnic diversity

Kapilvastu district, situated in the southwestern part of Lumbini Province, Nepal, is characterized by its rich eco-ethnographic diversity and strategic location bordering India. The district covers an area of approximately 1,738 square kilometers and hosts a population of over 600,000 people, comprising various ethnic and socio-cultural groups. The urban municipalities are Banganga with 96,714 people, Buddhabhumi with 76,507, Kapilvastu with 88,874, Krishnanagar with 76,280, Maharajgunj with 66,671, and Shivaraj with 66,781. The rural municipalities are Bijaynagar with 43,291, Mayadevi with 49,595, Yashodhara with 45,483, and Suddhodhan with 54,961. Among them, Banganga is the largest municipality by population, while Bijaynagar is the smallest.

The district headquarters lies in Kapilvastu Municipality, which includes the historically significant Tilaurakot area, known as the ancient capital of the Shakya kingdom and closely associated with the early life of Lord Buddha.The population of Kapilvastu is predominantly

composed of Madhesi communities, including Tharu, Yadav, and other Terai ethnic groups, alongside a significant Muslim minority. The district also includes hill-origin communities and indigenous groups, contributing to a mosaic of languages, traditions, and cultural practices. Nepali and Awadhi are widely spoken languages, with Maithili and Urdu also prevalent among specific communities.



Kapilvastu's economy is primarily agrarian, with the majority of residents engaged in subsistence farming, cultivating crops such as rice, wheat, maize, and sugarcane. Small-scale trade and cross-border commerce with India play a vital role in the local economy, facilitated by the district's proximity to the Indian border. Despite these economic activities, Kapilvastu faces challenges including poverty, limited industrial development, and infrastructural deficits. The district experiences disparities in access to education, healthcare, and employment opportunities, which are further influenced by socio-ethnic stratification. Seasonal migration for labor, both within Nepal and to India, is common among economically disadvantaged groups.

Health Infrastructure and Social Context

Health services in Kapilvastu include a network of birthing centers, primary health care facilities, and a few hospitals. However, disparities in quality and accessibility persist, particularly in remote and marginalized communities. Social determinants such as gender norms, caste-based discrimination, and economic barriers affect health-seeking behaviors and outcomes.The district's cross-border dynamics also influence health patterns, with frequent movement of people impacting disease transmission and access to care.

Kapilvastu District has one major district hospital, several primary health centers, more than 40 health posts, and a network of birthing centers spread across its municipalities and rural areas. Together, these facilities form the backbone of healthcare delivery in the district, though many reports highlight gaps in infrastructure and staffing. each war of the municipality have around 9 female community health voluteers (FCHVs)

The main government hospital in the district, Kapilvastu Hospitalis located in Taulihawa, Kapilvastu Municipality. It provides general inpatient and outpatient services, maternal and child health care, emergency services, and limited surgical facilities. Smaller private hospitals and nursing homes exist in urban centers like Krishnanagar and Banganga, though they are fewer compared to neighboring districts like Rupandehi.

Target and Indicators		2015	2019	2022	2025	2030
Target 3.1 By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births						
3.1.1	Maternal mortality ratio	258[i]	125	116	99	70
3.1.2	Proportion of births attended by skilled health personnel	55.6[n]	69	73	79	90

Kapilvastu has several Primary Health Care Centers (PHCCs) strategically located in larger municipalities. These centers provide outpatient care, maternal and child health services, immunization, and minor emergency care.Examples include PHCCs in Maharajgunj, Shivaraj, and Buddhabhumi municipalities, serving as referral points between health posts and the district hospital.

Health Posts: The district has over 40 health posts, distributed across rural municipalities such as Bijaynagar, Mayadevi, Yashodhara, and Suddhodhan. Health posts are the most accessible facilities for rural populations, offering basic services like immunization, antenatal care, family planning, and treatment of common illnesses. Staffing Health Assitants, Auxiliary Health Workers (AHWs), Auxiliary Nurse Midwives (ANMs), and occasionally staff nurses supported by community arms of FCHVs

Birthing Centers

Kapilvastu hosts multiple birthing centers, usually attached to health posts or PHCCs. These centers provide normal delivery services, antenatal and postnatal care, and referral support for complicated cases. According to national data, Nepal has over 2,800 registered birthing centers, and Kapilvastu contributes several dozen to this network. Most rural municipalities (e.g., Mayadevi, Yashodhara, Suddhodhan) have at least one functional birthing center.

Challenges: Infrastructure gaps: Many health posts and birthing centers lack adequate equipment and trained staff. **Maternal health concerns**: Kapilvastu has been identified as a high-priority district due to elevated maternal mortality rates, prompting government inspections and reform plans.

Methodology

The modified Motherhood Method was employed to generate census equivalent data of all pregnant and postpartum women in the municipalities of Kapilvastu District by listing pregnant and postpartum women using health facility records, verification through focus group discussions with FCHVs and health workers and home visits for Ama-ko-Maya integrated GIS mapping and direct data collection.

Hub and Spoke model based in Municipality and Nepal Public Health Foundation for following each Pregnant/ Postpartum women for birth preparedness, referral/transportation/social support. Analyze data of ANC/PNC visits, MPDSR and DHIS2 for better care

Data collection and analysis

Data were collected retro-prospectively for FY 2023/24 and five months of FY 2024/25. A total of 10216 births were recorded and tallied with the data form the municipalities and wards out of which 10,164 were live births, 52 stillbirths

Data were digitized and integrated with tele-counseling systems. Analysis included mortality rates per 1,000 live births and per 100,000 maternal cases. ANC/PNC visits, MPDSR, and DHIS2 data were triangulated for quality assurance. Stata 18 software was use for data cleaning and analysis.

Ethical approval

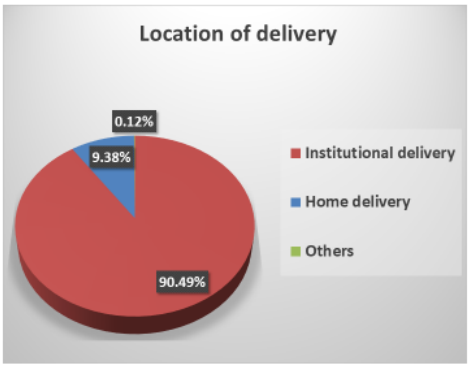
Ethical approvals were obtained, and community engagement was integral to the process.

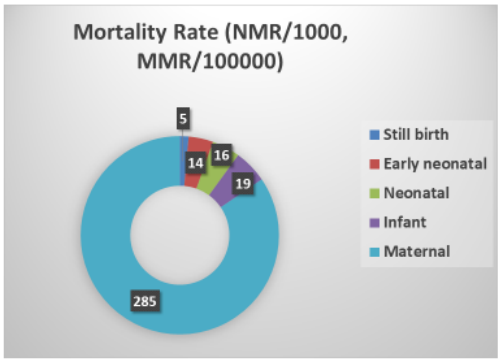
Results*[1]

- **Overall District Data (2023):** 10,164 live births, 52 stillbirths (5/1,000), 139 early neonatal deaths (14/1,000), 165 neonatal deaths (16/1,000), 196 infant deaths (19/1,000), 29 maternal deaths (285/100,000).

[1] The data of selected municipalities are presented in attached graphs in the appendix.

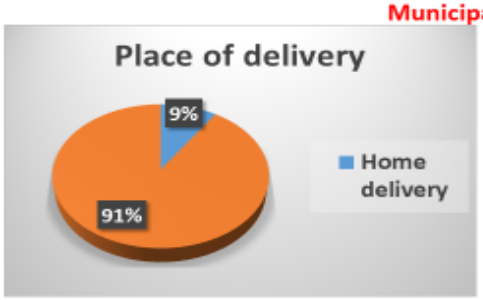
Kapilvastu district overview

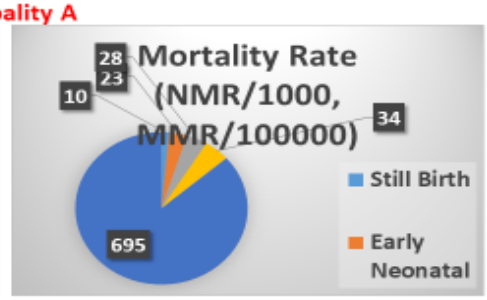




Variable	Frequency	Mortality Rate
Live Birth	10,164	
Still Birth	52	5 / 1000
Early Neonatal	139	14 / 1000
Neonatal	165	16 / 1000
Infant	196	19 / 1000
Maternal	29	285/ 100000

Municipality A

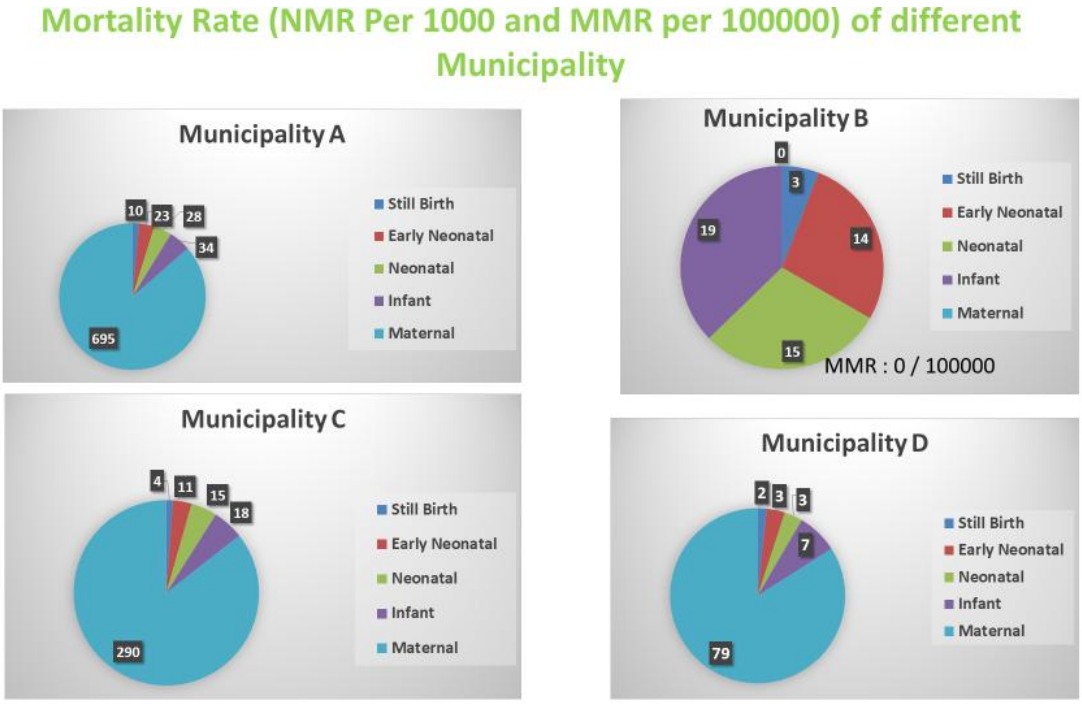




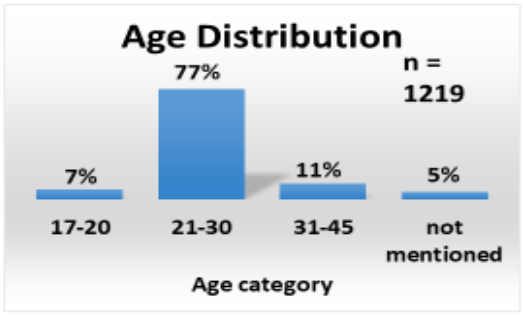
Variable	Frequency	Mortality Rate
Live Birth	1151	
Still Birth	12	10 / 1000
Early Neonatal	27	23 / 1000
Neonatal	32	28 / 1000
Infant	39	34 / 1000
Maternal	8	695/ 100000

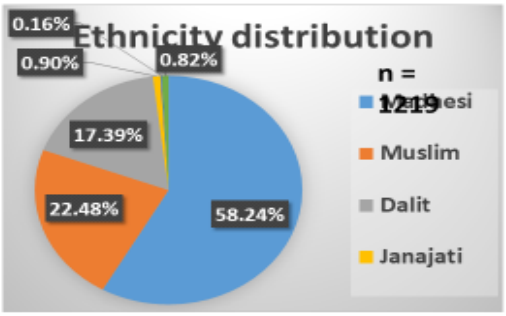
- **Municipality A*[2] (highest MMR):** 1,151 live births, 12 stillbirths (10/1,000), 27 early neonatal deaths (23/1,000), 32 neonatal deaths (28/1,000), 39 infant deaths (34/1,000), 8 maternal deaths (695/100,000).

[2] The names of the individual municipalities are kept confidential, though they are presentation has been made to these Muncipalities. For the purpose of this concise report data of only 4 municipalities are presented for the



- **Mortality varied across municipalities, with some reporting zero maternal deaths and others showing high rates (e.g., Municipality A and C).**



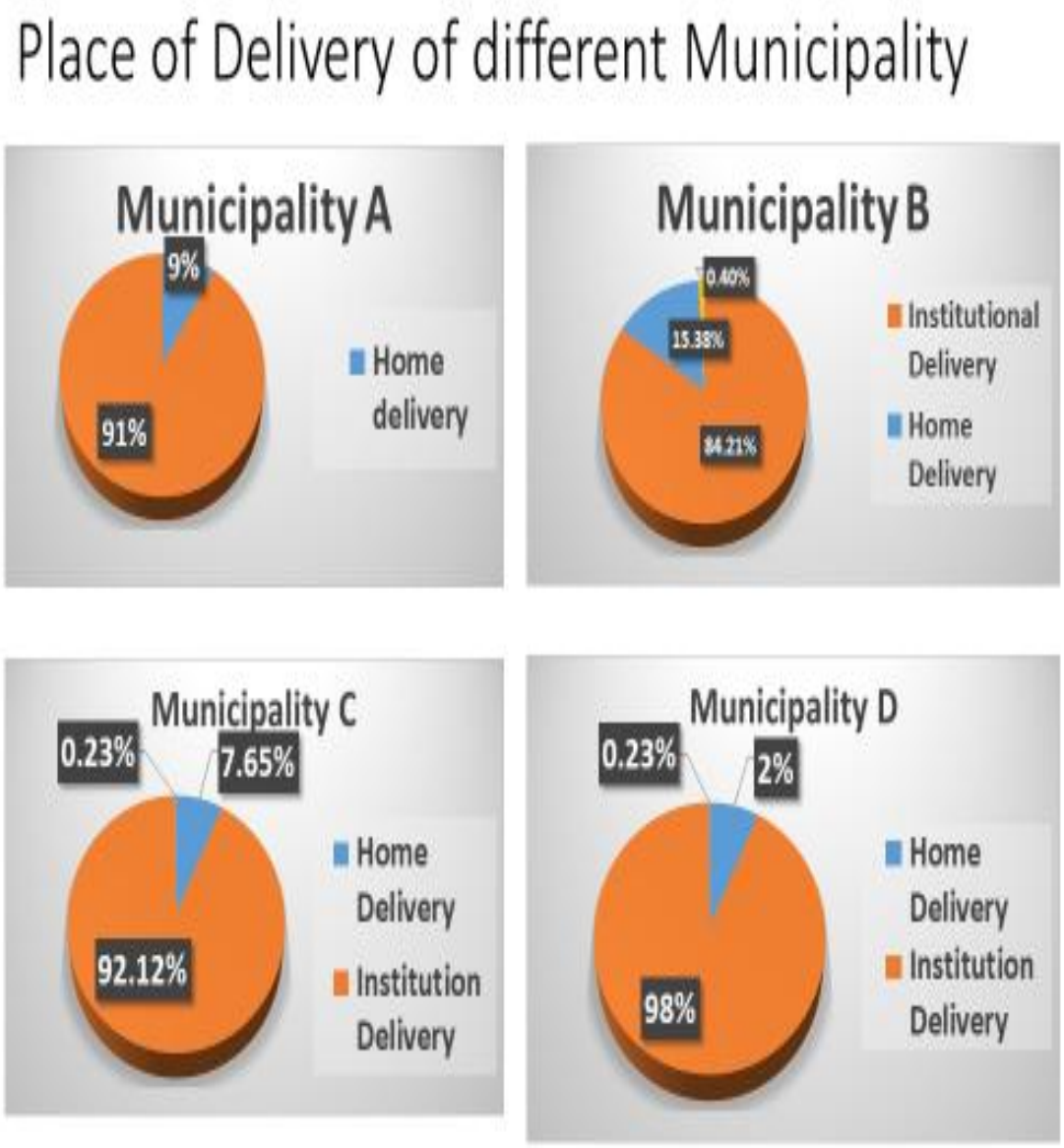


The age of pregnant women ranged from 17 to 45 years. The age of 55(5%) pregnant women was not mentioned. Almost 7% of the pregnant women belongs to age group 17-20.

This indicates that the majority of pregnant women in the dataset belong to the Madhesi community which was followed by Muslim community.

purpose of comparison. 8 out of 10 municipalities had provided the data hence complete result will be presented in the full report.

- **Majority of pregnant women belonged to Madhesi community, followed by Muslims**.



- **Institutional delivery rates were high, yet mortality remained significant, indicating gaps in quality of care.**

Mortality frequency of different municipality

Municipality A	Still Birth	Neonatal	Infant	Maternal
ward 1	1	3	5	1
ward 2	1	4	6	0
ward 3	1	4	4	2
ward 4	1	0	0	0
ward 5	0	4	5	0
ward 6	0	1	1	0
ward 7	0	5	6	1
ward 8	3	3	4	3
ward 9	2	2	2	0
ward 10	2	4	4	1
ward 11	1	2	2	0

Municipality B	Still birth	Neonatal	Infant	Maternal
Ward 1	0	3	3	0
Ward 2	0	1	2	0
Ward 3	0	3	3	0
Ward 4	3	1	1	0
Ward 5	0	3	3	0
Ward 6	0	1	1	0
Ward 7	0	2	2	0
Ward 8	0	1	4	0

Municipality C	Still Birth	Neonatal	Infant	Maternal
ward 1	1	8	12	2
ward 2	0	1	1	0
ward 3	0	1	1	0
ward 4	0	0	0	1
ward 5	0	1	1	0
ward 6	1	6	7	0
ward 7	1	1	1	1
ward 8	0	0	0	0
ward 9	1	2	2	0
ward 10	0	2	2	1
ward 11	1	7	7	0
ward 12	3	3	4	1

Municipality D	Still Birth	Neonatal	Infant	Maternal
ward 1	0	1	1	0
ward 2	0	0	0	0
ward 3	0	0	0	0
ward 4	0	0	0	0
ward 5	0	1	2	0
ward 6	0	0	1	0
ward 7	0	0	2	0
ward 8	0	0	0	0
ward 9	0	0	0	1
ward 10	1	1	1	0
ward 11	1	1	2	0

- **The Motherhood Method was able to generate census equivalent data even for the ward level.**

Discussion

The discussion of Kapilvastu's 2023 mortality data underscores several critical insights for maternal and child health. Despite high institutional delivery rates, mortality indicators remain troubling, suggesting that access alone does not equate to safe outcomes. The persistence of elevated neonatal and maternal deaths points to systemic weaknesses, particularly those explained by the "Three Delays" model—delays in seeking care, reaching facilities, and receiving appropriate treatment once there. Municipality-level variation, with some reporting zero maternal deaths and others showing alarmingly high rates such as Municipality A, highlights inequities in service quality and resource distribution. The disproportionate burden among Madhesi and Muslim women further reflects underlying social determinants of health, including marginalization and barriers to timely care.

The data also reveal that while Kapilvastu Hospital and peripheral facilities are functional, quality of care remains inconsistent, with gaps in emergency obstetric services, referral mechanisms, and skilled personnel. The high stillbirth and neonatal death rates suggest deficiencies in intrapartum monitoring, newborn resuscitation, and postnatal follow-up. Moreover, the maternal mortality ratio in Municipality A—nearly 700 per 100,000 live births—signals urgent need for targeted interventions, including strengthening birthing centers, ensuring timely referrals, and addressing socio-cultural barriers.

Importantly, the modified Motherhood Method proved feasible in generating reliable, actionable data, filling a longstanding gap in district-level monitoring. However, limitations such as incomplete age records, short follow-up duration, and possible underreporting in certain wards remind us that surveillance systems must be further strengthened. Overall, the findings emphasize that reducing mortality in Kapilvastu requires not only expanding institutional deliveries but also improving the quality, equity, and responsiveness of maternal and newborn care across all municipalities.

From a policy perspective, the findings from Kapilvastu District underscore the urgent need for a shift from access-focused strategies to quality-focused interventions. While institutional delivery coverage is commendably high, the persistently elevated maternal and neonatal mortality rates reveal systemic gaps in emergency obstetric and newborn care. Provincial and national health planners should prioritize in identifying high risk pregnancy as early as possible, strengthening referral systems, ensuring the availability of skilled personnel, and equipping birthing centers with essential supplies for safe deliveries. Targeted investments are particularly necessary in municipalities with disproportionately high mortality, such as Municipality A, to reduce inequities across the district. Furthermore, the data highlight the importance of culturally sensitive approaches, given the predominance of Madhesi and Muslim women among the affected population. Policies must therefore integrate community engagement, health education, and social inclusion strategies to address barriers rooted in socio-cultural contexts. Finally, institutionalizing the modified Motherhood Method as a routine monitoring tool can provide reliable, actionable data for program design, resource allocation, and accountability, ensuring that maternal and child health policies are evidence-driven and responsive to local realities.

Limitations

- Data quality issues and incomplete age records.
- Short duration of follow-up.
- Potential underreporting in certain wards.

Future Directions

- Expansion to other districts.
- Longitudinal monitoring.
- Integration with national health information systems.

Conclusion

This study shows that the modified Motherhood Method, supported by GIS mapping and digital applications, can serve as a practical and reliable tool for district-level surveillance of maternal and neonatal mortality. By capturing census-equivalent data, it provides a sharper picture of local realities than routine reporting systems. The results make clear that while institutional delivery

coverage has expanded, mortality remains unacceptably high, pointing to deeper systemic challenges. These include delays in care-seeking, weak referral pathways, and inconsistent quality of services once women reach facilities.

Improving outcomes in Kapilvastu and similar high-burden districts requires more than increasing facility-based births. A stronger continuum of care—spanning pregnancy, childbirth, and the postnatal period—must be ensured through community engagement, responsive referral networks, and better-equipped health facilities. The hub-and-spoke model piloted here illustrates how peripheral centers can be linked to district hospitals, supported by tele-counseling and digitized monitoring systems. Such innovations can help address inequities, especially for marginalized groups like Madhesi and Muslim women who face additional barriers to timely care.

For policymakers and health planners, the evidence calls for a decisive shift toward quality-focused interventions. Investments in emergency obstetric and newborn care, equitable distribution of skilled personnel, and culturally sensitive community outreach are critical to reducing preventable deaths. Institutionalizing the modified Motherhood Method within provincial health systems would strengthen accountability and ensure that maternal and child health policies are guided by robust, locally generated evidence. Achieving the Sustainable Development Goal 3 targets in Nepal will depend not only on expanding access but on transforming the quality and equity of care across all municipalities.

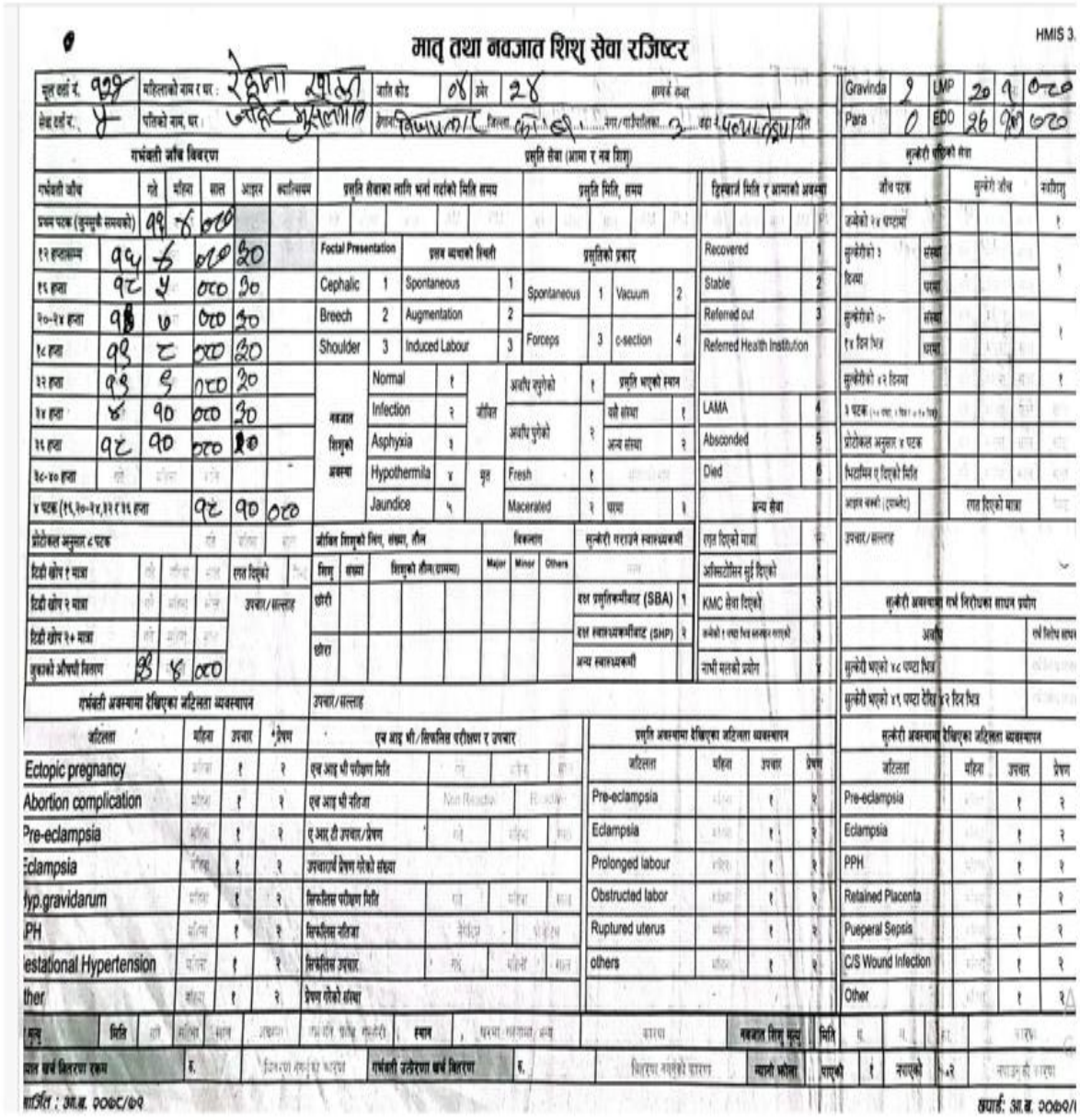
Acknowledgements

Nepal Public Health Foundation has received consistent support from Nepal Health Research Council for financial assistance and supervision in the process of data collection and evidence generation as collaborating organization. The chair of NHRC also presented these data and slides in Indian Council of Medical Research Seminar (2025). We also are thankful to provincial and municipal governments, FCHVs, health workers, and community participants for their consistent support throughout the research period.

References

1. Maskey MK, Baral KP, ShahR, Shrestha BD, Lang J, Rothman KJ. ***Field test results of the motherhood method to measure maternal mortality.*** Indian Journal of Medical Research, January, 2011.

Appendix1.

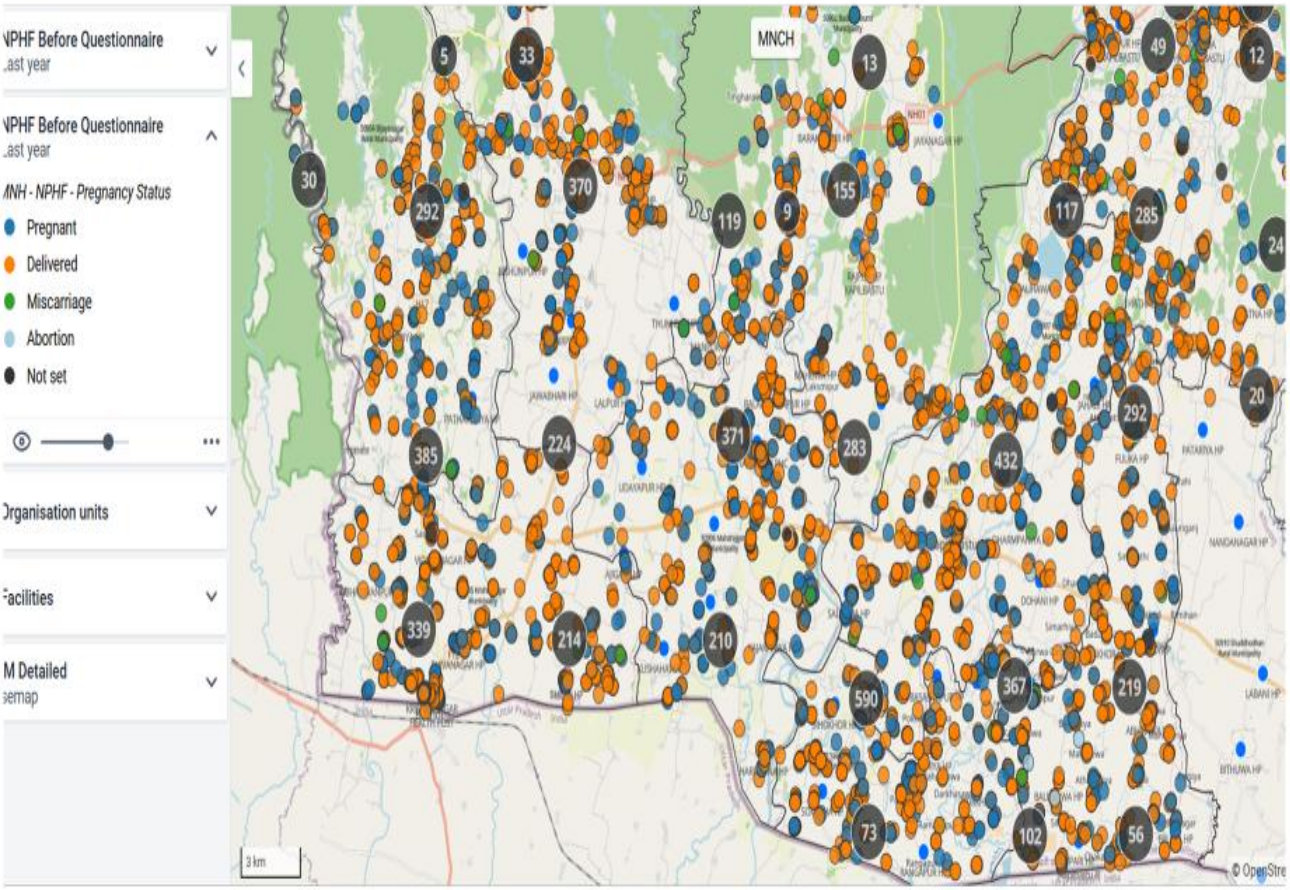


मातृ तथा नवजात शिशु सेवा रजिष्टर

HMIS 3.

HMIS 3.6 Registry of HP

Kapilvastu District



GIS mapping of pregnant and postpartum Women of Kapilvastu District

Appendix 2: Survey Questionnaire

Description:

The digital application incorporated all the information available in the ANC/PNC records of pregnant women, in alignment with the Government of Nepal's standard maternal health recording system. As part of the "Motherhood method," after the collection of information from the health facility record, an initial round of verification of the information was conducted with health workers and FCHVs. Following this, a survey was administered to validate and confirm the information collected on pregnant women, alongside GIS mapping to geographically locate and track cases.

This tool functioned as both a confirmatory and verification mechanism. It was designed to collect comprehensive information on maternal and neonatal health at individual and community levels, including demographic characteristics, reproductive history, pregnancy status, delivery outcomes, and records of maternal and neonatal deaths within households and surrounding communities. The data generated through this tool supported a deeper understanding of health patterns, service utilization, and key risk factors influencing maternal and neonatal outcomes.

Name of Health Facility:
Address:

Name
Age:
Ethnicity:
Contact number:
Ward:
Area:

Age at Marriage:
Age at First Pregnancy:
Gravida (Total number of pregnancies):
Parity (Number of births):
Number of Living Children:

Pregnancy Status (Pregnant / Delivered):
Current Month of Pregnancy (if pregnant):
Last Menstrual Period (LMP):
Expected Date of Delivery (EDD):

Place of Delivery:
Date and Time of Delivery:
Birth Status (Live birth / Stillbirth):
If baby was born deceased, was there any breathing at birth? (Yes / No):

Has there been any neonatal or infant death? (Yes / No):
If yes, how many days after birth did the baby die?:

Are you aware of any neonatal deaths in your neighborhood? (Yes / No):
If yes, please provide details:

Are you aware of any maternal deaths in your neighborhood? (Yes / No):
If yes, please provide details:

Is there any mother having ANC or Delivery or PNC Checkups who are present in the community except this list that we have shown?

Address Area: