NATIONAL HEALTH MISSION
राष्ट्रीय स्वास्थ्य मिशन

Ministry of Health & Family Welfare
Government of India

NHSRC
National Health Systems Resource Centre

Exemplars in Maternal and Newborn Health India Study

National Report

2023

EXEMPLARS IN GLOBAL HEALTH

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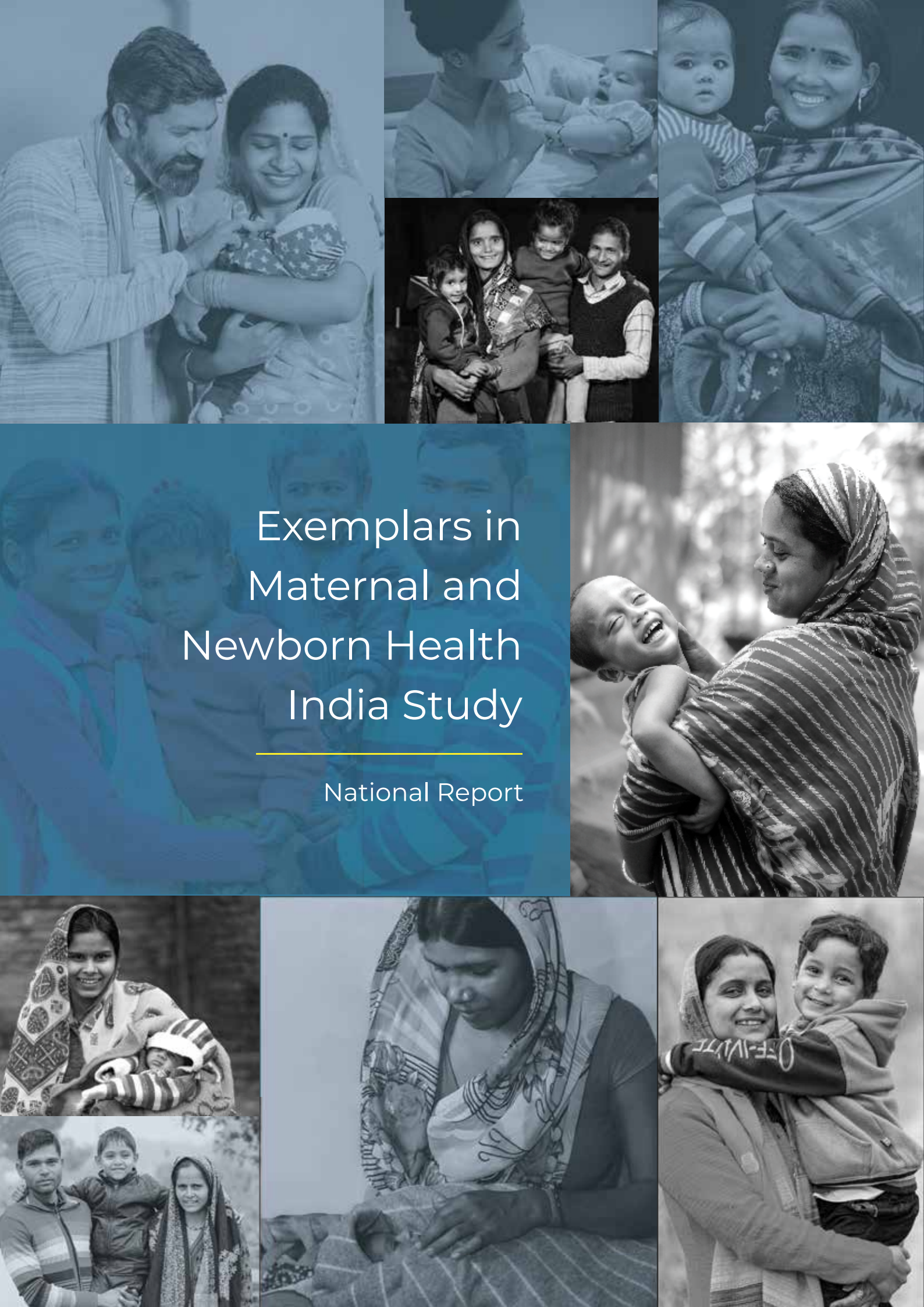
Countdown to 2030
Women's, Children's & Adolescents' Health

University of Manitoba



Exemplars in Maternal and Newborn Health India Study

National Report

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Message

In the last two decades, India has achieved remarkable strides in improving maternal and newborn health outcomes, surpassing global declines in mortality rates. This transformative progress is evident as India's share of global maternal deaths decreased from approximately 23% in 2000 to 12% in 2017, and neonatal deaths reduced from 31% to 22% during the same period. As we work towards Sustainable Development Goal 3, our visionary target is to further reduce maternal mortality to an impressive 70 per 100,000 live births and neonatal mortality to 12 per 1000 live births.

India must continue building on its past successes and embrace transformative changes in the maternal and newborn health sector to accomplish this ambitious goal. As we look forward to the future, our country must take bold steps to establish a highly efficient and integrated care system for mothers and newborns.

The MNH Exemplar study sheds light on the pivotal role played by the National Rural Health Mission (National Health Mission) since its inception in 2005. The mission's high focus on maternity and newborn health (MNH) catalyzed administrative improvements, additional resources, pro-poor commitments, and enhanced accountability. These initiatives coincided with decreased family sizes, improved macroeconomic expansion, enhanced mobile and road infrastructure, women empowerment, and improved nutrition. Together, these factors contributed to reduced preterm births and improved access to healthcare, especially for the underprivileged.

I am delighted that this report will enable brainstorming and discussions on maternal and neonatal issues across the states/UTs. Through international collaboration and knowledge sharing, India will continue to lead the way in MNH progress, inspiring and supporting nations worldwide in developing effective health policies.

By leveraging the expertise of collaborators from various sectors, we will forge a brighter, healthier, and happier world for mothers and newborns. We shall achieve the ambitious targets set before us through our collective efforts, unwavering commitment, and determination.

Let us march together with renewed dedication, striving to give every mother and newborn the care and support they deserve. As we celebrate our achievements, let us keep our vision focused on creating a healthier and more prosperous future for our nation and the world.

(Vinod Paul)

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MESSAGE

I am pleased to present this comprehensive study on Maternal and Newborn Health (MNH) in India, which sheds light on our remarkable journey towards achieving the health-related Sustainable Development Goals (SDGs) outlined by the National Health Policy 2017. As one of the signatories to the SDGs, India is committed to transforming the nation into a more prosperous, equitable and secure society by 2030.

At the core of our efforts lies the vision of Universal Health Coverage, ensuring affordable, equitable, accessible and high-quality healthcare for all citizens. Initiatives like Ayushman Bharat have played a pivotal role in promoting wellness, enhancing physical and digital infrastructure and providing financial assurance through PM-JAY, steering our health systems toward a promising future.

Documenting and celebrating our achievements becomes crucial in shaping our strategies for the future. The significant progress made in reducing mortality rates, particularly maternal, neonatal and under-five mortalities, reflects the overall development of our nation and offers invaluable insights for the path ahead.

The National Rural Health Mission (NRHM) is a testimony to the transformation in health service delivery, facilitated by increased resource allocation and the integration of national health programs. It has been crucial in driving down maternal and neonatal mortality rates, among other notable achievements.

I am delighted to note that this study, a first-of-its-kind analysis of data and public health policies spanning the last three decades, has been conducted with utmost dedication. It underscores how government-led public health policies and programmatic initiatives have accelerated the decline in mortality rates and brought us closer to achieving our targeted maternal and neonatal health goals.

I extend my heartfelt congratulations to all the collaborators involved in conducting this study, as their findings will help shape our future roadmap towards further improving maternal and neonatal mortality indicators, ultimately guiding us in achieving our SDG targets.

Together, let us continue our commitment to ensuring the health and well-being of every citizen, leaving no one behind on the path to a healthier and brighter India.

Sudhansh Pant

Date : 7th August, 2023

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Message

I am pleased to share the highlights of the remarkable journey of the National Rural Health Mission (NRHM), initiated by the Ministry of Health and Family Welfare, Government of India, in 2005, through this report on maternal and newborn health in India. The mission has been vital in ensuring better healthcare in rural areas, especially for mothers and newborns. The impact of NRHM has been significant in bridging gaps in healthcare access and quality, leading to a notable reduction in maternal and infant mortality.

With evolving policies and newer initiatives like Ayushman Bharat, our efforts have expanded beyond rural regions, now including urban areas. This wider approach aims to enhance the well-being of citizens across all age groups. Over the years, we have taken concrete steps based on evidence and thoughtful policies to improve maternal and neonatal outcomes. These measures include addressing anaemia, spreading awareness about contraceptives, providing proper nutrition, and building a strong network of healthcare workers.

Our initiatives like Anaemia Mukt Bharat, Pradhan Mantri Matru Vandana Yojana, LaQshya, and Surakshit Matritva Aashwasan, further enrich our maternal and neonatal health focus. These initiatives have been transformative, sparking innovation, leveraging resources, and reinforcing our commitment to the less privileged. This has led to better accountability and progress in maternal and neonatal health. It is noteworthy that our Maternal Mortality Ratio (MMR) has decreased to 97 per 1 lakh live births as per the latest statistics from as high as 400 in 2005, and our Neonatal Mortality Rate (NMR) which was 37 per 1000 live births in 2005 is now 20 per 1000 live births. As we strive towards the Sustainable Development Goals (SDGs) for 2030, I am confident in our workforce's dedication to improving our healthcare scenario. With the ongoing momentum, we are on track to achieve these targets.

I extend my heartfelt gratitude to all who have contributed to this report – researchers, health professionals, policymakers, and engaged communities. Their tireless efforts have highlighted our nation's determination and provided valuable insights that will guide us toward a healthier and fairer society. I hope that these insights serve as an inspiration for other nations working to enhance maternal and neonatal health. Together, we can achieve global success in our healthcare endeavors.

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Message

Over the past two decades, India has significantly improved Maternal and Newborn Health (MNH) outcomes, surpassing the global decline in mortality rates. In 2000, India accounted for 23% of global maternal deaths and 31% of neonatal deaths. By 2017, these figures decreased to 12% and 22%, respectively. This success offers valuable lessons for India and other countries seeking to accelerate progress in MNH.

The Ministry of Health and Family Welfare, under the guidance of the Secretary HFW, constituted a steering committee to conduct a study on 'Exemplars in Maternal and Newborn Health (MNH). The study examined national-level data and analyzed two clusters of states—one with higher mortality and lower per capita income and the other with lower mortality and higher per capita income—demonstrating exemplary progress since 2000. The study systematically investigated factors associated with rapid maternal and neonatal mortality reductions by employing a positive public health approach.

Using a mixed-methods approach, the study combined quantitative trend analyses of mortality and intervention coverage with qualitative insights from policy documents and key informant interviews. This comprehensive approach shed light on the factors contributing to India's remarkable maternal and neonatal mortality reduction.

The study developed the MNH transition model, a tool that guides discussions on progress, current situations, and future strategies related to mortality transition. This model covers six key dimensions: mortality levels, causes of mortality, intervention coverage, inequalities, fertility, and socioeconomic development.

The study's call for States/Union Territories (UTs) to leverage its insights and develop action plans for further accelerating progress in MNH is of utmost importance. By building on successes and incorporating lessons from the exemplars, India can continue to enhance MNH outcomes and move closer to achieving universal health coverage.

To achieve this goal, policymakers, health professionals, and stakeholders must collaborate and implement evidence-based interventions, reforms, and policies to ensure equitable access to quality MNH services nationwide. By doing so, India can continue its journey towards universal health coverage and serve as an inspiring example for other nations striving to improve their MNH outcomes.

(Vishal Chauhan)

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MESSAGE

I take pride in putting forth that India has made remarkable strides in improving its healthcare landscape over the years. With a population of approximately 1.38 billion as of 2020, two-thirds of which reside in rural areas, the nation's life expectancy has surged by seven years, reaching 69.4 between 2014 and 2018—nearing the global average. The most noteworthy achievements in the healthcare sector are the substantial reductions in maternal and neonatal mortality rates.

India's maternal mortality ratio (MMR) has plummeted from 412 to 97 maternal deaths per 100,000 live births spanning 1997-98 to 2018-20. The decline in MMR has steadily accelerated, peaking at -7.7% during 2012-18. Correspondingly, the neonatal mortality rate (NMR) has also seen substantial improvement, dropping from 46 deaths per 1,000 live births in the early 1990s to 20 deaths per 1,000 live births in 2020.

These findings shed light on the noteworthy advancements in promoting the health and well-being of women and children throughout the nation, contributing to the observed statistics. The collaborative approach undertaken in this study has successfully amalgamated an extensive array of data and fostered critical partnerships and networks. This comprehensive report is invaluable for policymakers and researchers, presenting insights and recommendations to enhance health outcomes for women and children at all life stages.

I extend my sincere congratulations and gratitude to the authors and the entire India Exemplars MNH study team for their unwavering dedication and strenuous efforts in conducting this research. The facts presented in this report will significantly bolster ongoing endeavours to fortify our healthcare system for the millions of annual births in India.

With unwavering confidence and insights garnered from this report, we can persistently advance our efforts to curtail maternal and newborn mortality. By prioritizing the health and well-being of women and children across the nation, we are poised to achieve the Sustainable Development Goals (SDGs) and foster a brighter and healthier future for all.

(Dr P. Ashok Babu)

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MESSAGE

I am pleased to share that the NHSRC team has achieved a significant milestone by completing the comprehensive report on the 'Exemplars in Maternal and Newborn Health India Study.' This report highlights India's remarkable maternal and newborn survival progress over the past two decades. I extend my heartfelt congratulations to the entire team for their dedication and hard work.

Through a national-level analysis, we successfully attained our primary aim of understanding the drivers of past progress in maternal and neonatal health. The report showcases the remarkable implementation and achievements of the National Rural Health Mission (NRHM), a crucial initiative by the Ministry of Health and Family Welfare, Government of India, which has played a pivotal role in reducing healthcare inequities in rural regions. Quantitative and qualitative evidence reveals that India's national policies and reforms, especially since the launch of NRHM in 2005, have substantially increased coverage of Maternal and Newborn Health (MNH) services. This progress has also led to reduced inequalities and a decline in maternal and neonatal mortality rates.

The journey toward Universal Health Coverage has brought us closer to achieving affordable, equitable, accessible, and high-quality healthcare for all citizens. Our ever-evolving evidence-based health policies and implementation strategies have driven these positive outcomes. The reduction in mortality rates is a testament to the overall development of our nation and offers invaluable insights for our future endeavours.

I extend my warm congratulations and heartfelt gratitude to all our collaborators, namely the International Institute of Population Sciences (IIPS) Mumbai, the University of Manitoba, Canada, India Health Action Trust (IHAT), and the Bill and Melinda Gates Foundation (BMGF), for their invaluable contributions to this study. Their collaboration with the Ministry of Health and Family Welfare (MoHFW) and the NHSRC has made this effort worthwhile, fostering knowledge-sharing and cross-learning opportunities for all stakeholders involved.

The findings presented in this report will serve as a valuable precursor and guide ongoing efforts to strengthen our health system. These insights will assist various stakeholders in shaping the future roadmap towards further improving maternal and neonatal mortality indicators, thereby helping us achieve the Sustainable Development Goals (SDGs).

Once again, my sincere appreciation goes out to the entire team for their dedication and commitment to this crucial study.

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ABBREVIATIONS

AARC	Average Annual Rate of Change
AMTSL	Active Management of Third Stage of Labour
ANC	Antenatal Care
ANM	Auxiliary Nurse Midwife
ASHA	Accredited Social Health Activist
AWW	Anganwadi Worker
AYUSH	Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy
BEmONC	Basic Emergency Obstetric & Newborn Care
BMI	Body Mass Index
CBO	Community-Based Organization
CBR	Crude Birth Rate
CEmONC	Comprehensive Emergency Obstetric & Newborn Care
CHC	Community Health Centre
CSSM	Child Survival and Safe Motherhood
DLHS	District Level Household Survey
EAG	Empowered Action Group
EmOC	Emergency Obstetric Care
EU	European Union
FRU	First Referral Unit
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GIS	Geographic Information System
GHEx	Global Health Expenditure
GNI	Gross National Income
GPS	Global Positioning System
HBNC	Home-Based Newborn Care
HMIS	Health Management Information System
HMS	Higher Mortality State
HRH	Human Resources for Health
HSC	Health Sub-Centre
ICDS	Integrated Child Development Services
ICMR	Indian Council of Medical Research
IFA	Iron Folic Acid
IHAT	India Health Action Trust
IIPS	International Institute for Population Sciences
IMNCI	Integrated Management of Newborn and Childhood Illness
IPHS	Indian Public Health Standards
JSSK	Janani Shishu Suraksha Karyakaram
JSY	Janani Suraksha Yojana
KI(I)	Key Informant (Interview)
LaQshya	Labour Room Quality Improvement Initiative
LHV	Lady Health Visitor
LiST	Lives Saved Tool
LMS	Lower Mortality State
LSAS	Life-Saving Anesthetic Skills
MBA	Master of Business Administration
MBBS	Bachelor of Medicine and Bachelor of Surgery
MCCD	Medical Certification of Cause of Death
MCEE	Maternal Child Epidemiology Estimation

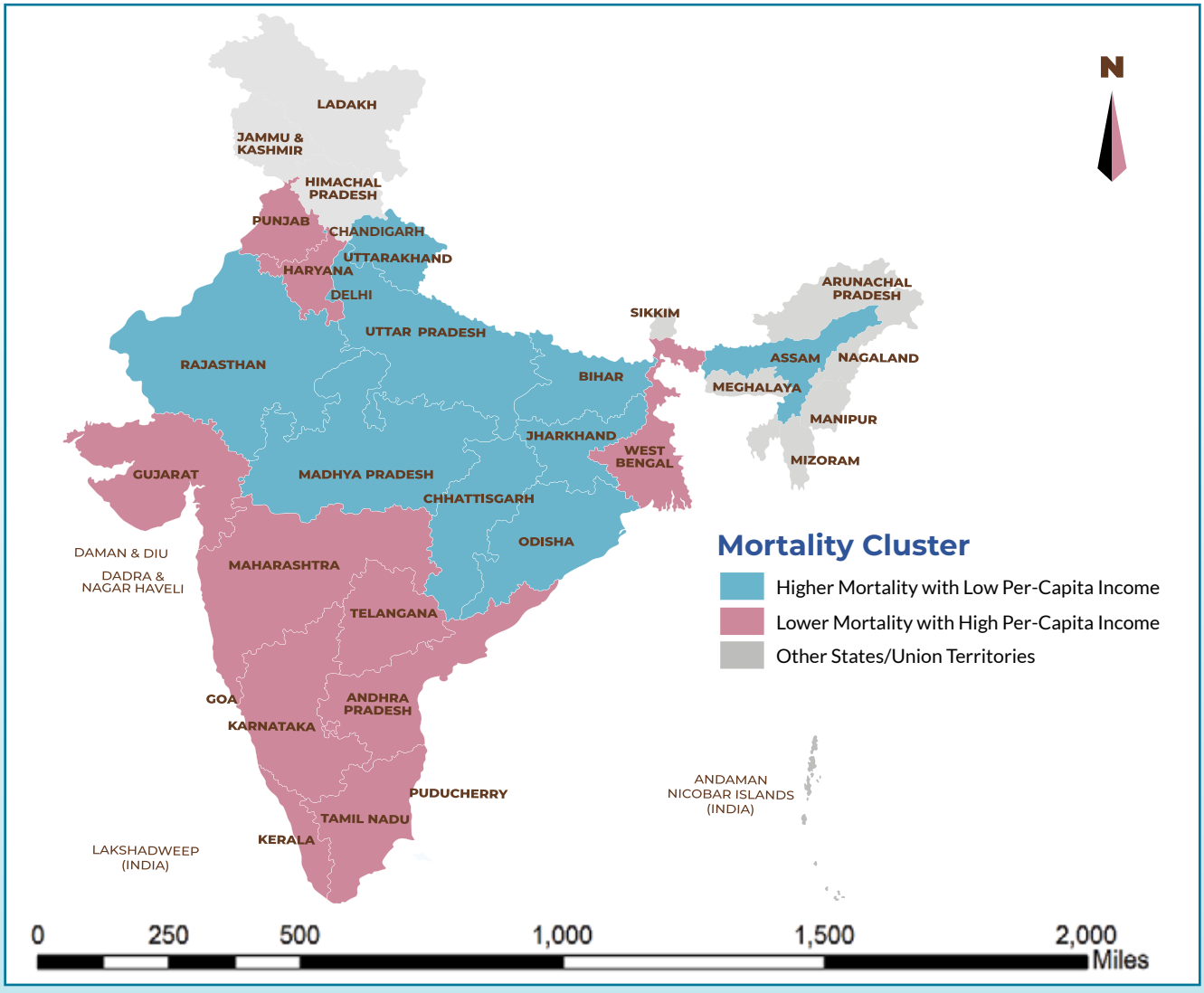
MDS	Million Death Study
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MgSO4	Magnesium Sulfate
MO	Medical Officer
MoHFW	Ministry of Health and Family Welfare
MMR	Maternal Mortality Ratio
MNH	Maternal and Newborn Health
MTP	Medical Termination of Pregnancy
NBSU	Newborn Stabilization Unit
NFHS	National Family Health Survey
NGO	Non-Governmental Organization
NHM	National Health Mission
NHSRC	National Health Systems Resource Centre
NHWA	National Health Workforce Account
NICU	Neonatal Intensive Care Unit
NMR	Neonatal Mortality Rate
NNF	National Neonatology Forum
NRHM	National Rural Health Mission
NSSK	Navjaat Shishu Suraksha Karyakram
NSSO	National Sample Survey Office
NQAS	National Quality Assurance Standards
OOPE	Out Of Pocket Expenditure
PAF	Population Attributable Fraction
PCI	Per Capita Income
PHC	Primary Health Centre
PIP	Programme Implementation Plan
PNC	Postnatal Care
PROM	Premature rupture of membrane
RCH	Reproductive and Child Health
RKS	Rogi Kalyan Samiti
RMNCH(+A)	Reproductive, Maternal, Newborn and Child Health (and Adolescents)
Rs.	Indian Rupees
SBA	Skilled Birth Attendance
SBR	Still Birth Rate
SC/ST	Scheduled Caste/Scheduled Tribe
SDG	Sustainable Development Goals
SNCU	Special Newborn Care Unit
SRS	Sample Registration System
SUMAN	Surakshit Matritva Aashwasan
TBA	Traditional Birth Attendant
TFR	Total Fertility Rate
TT	Tetanus Toxoid
VHND	Village Health and Nutrition Day
VHSNC	Village Health, Sanitation and Nutrition Committee
WaSH	Water, Sanitation and Hygiene
WHO	World Health Organization
USD	United States Dollar
UN	United Nations
UN-IGME	United Nation Inter-Agency Group for Child Mortality Estimation
UNICEF	United Nations Children's Fund

EXECUTIVE SUMMARY

What has enabled India's exemplary progress in maternal and newborn survival over the past two decades. To answer this question, the India Exemplars in Maternal and Newborn Health (MNH) study conducted a national level analysis, including an analysis of two clusters of states (one with higher mortality and lower per capita income and the other with lower mortality and higher per capita income), which both made exemplary progress since 2000 (Figure 1). We further conducted analyses of exemplary states (Maharashtra, Tamil Nadu, Rajasthan, Odisha, Uttar Pradesh, and Madhya Pradesh) (results to follow). Even though the primary aim of the exemplar study was to understand the drivers of past progress, the report also reflects on some implications for current and future strategies using a mortality transition framework.

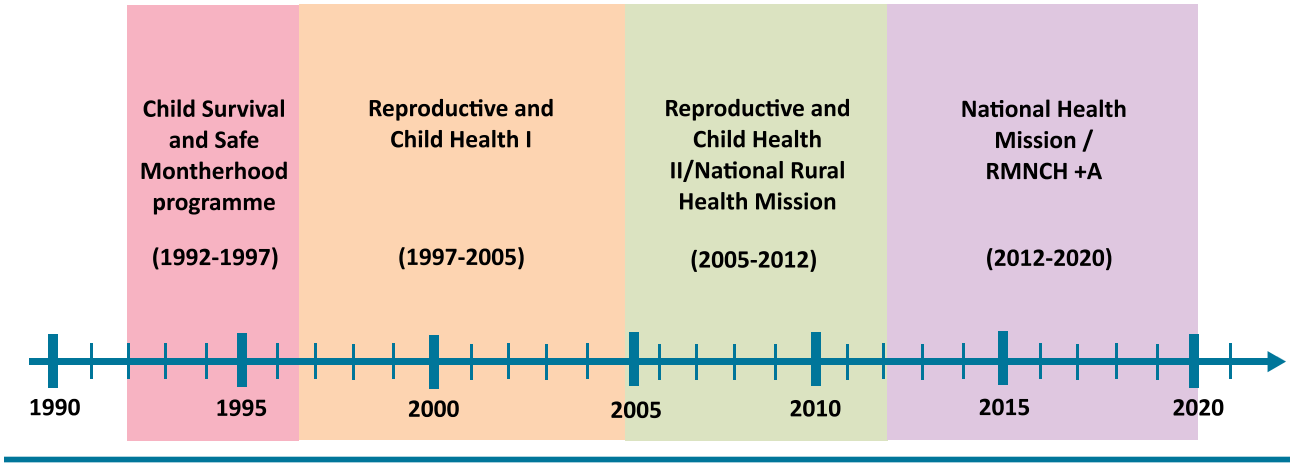
The India MNH Exemplars is part of a global initiative to examine progress in maternal and newborn survival in multiple countries (https://www.exemplars.health/). The study was guided by a conceptual framework to systematically examine distal (context, policies), intermediate (system and service changes, household factors) and proximate (service coverage) drivers of change in mortality and used a mixed-methods approach, including quantitative analysis of national and state-specific data (NFHS and DLHS), qualitative analysis of literature and document review, key informant interviews, and expert round table discussions at national and state levels.

Figure 1: Map of India showing higher and lower mortality state clusters



The analysis focused on the period from 1990, and especially post 2000. To assess the impact of major policy and program changes implemented through the National Health Mission (NHM; erstwhile NRHM) to deliver MNH services across India, four health policy periods are of particular interest (Figure 2).

Figure 2: India's health policy periods



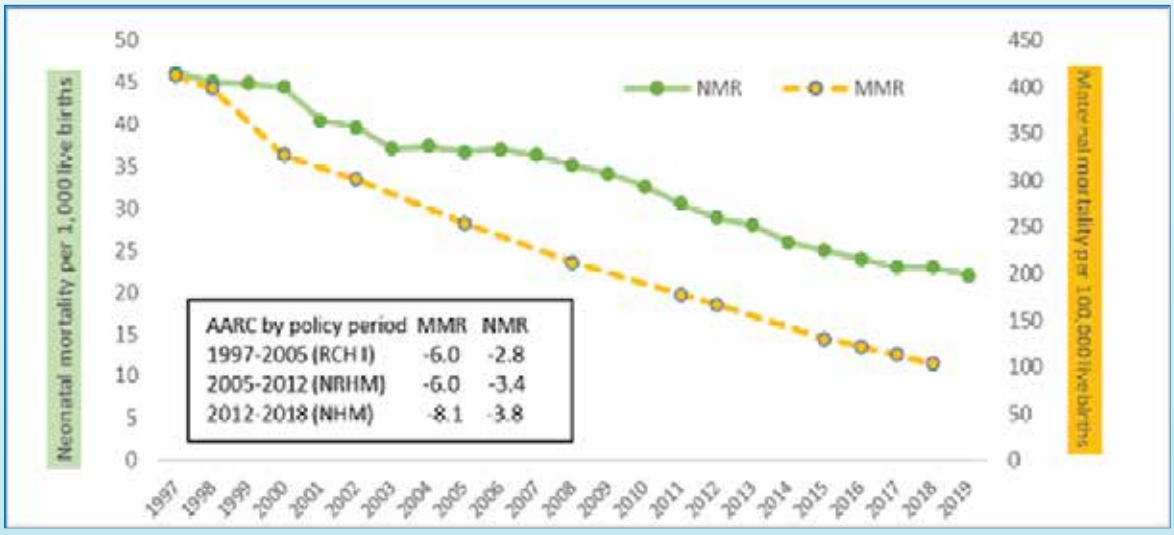
Maternal and Neonatal Mortality: Strong declines everywhere

The Sample Registration System data showed that the maternal mortality ratio (MMR) declined somewhat faster than the NMR in India, with the greatest acceleration during 2012-18 (Figure 3). The MMR declined from 327 during 1999-2001 to 103 maternal deaths per 100,000 live births during 2017-19. Earlier estimates indicated that India's MMR was already on a declining path before 2000, but the pace of the decline accelerated in subsequent periods. The lower mortality state cluster reached the global overall SDG target for MMR (below 70), with an MMR of 69 in 2018. Population-based studies suggest that deaths due to direct causes (especially haemorrhage, the leading cause) declined relative to indirect causes such as anaemia and other maternal conditions.

Ever since India's SRS reported neonatal mortality rates (NMR) of 79 per 1,000 live births in the late 1970s, there has been a downward trend to 44 per 1,000 live births in 2000 to 22 per 1,000 in 2019. The lower mortality states are close to meeting the SDG target for NMR (below 12), with an NMR of 15 in 2019. India's NMR decline was greatest in the first days of life (0-2 days) in the lower mortality state cluster, but for days 3-27 in the higher mortality state cluster. This relates to greater declines in prematurity and low birth weight in lower mortality states, and greater predominance of infectious diseases in 2000 in the higher mortality states. Stillbirth rates declined in parallel to neonatal mortality, but quality disaggregated data are too limited for detailed analysis in this report.

The maternal and neonatal mortality gaps reduced between the higher and lower mortality state clusters, and between states within the clusters. However, even though major neonatal mortality reductions occurred in all population subgroups, inequalities by wealth and urban-rural residence persisted.

Figure 3: Maternal mortality per 100,000 live births and neonatal mortality rate per 1,000 live births during 1997-2019 (SRS), with average annual rate of change (AARC) by policy period



Intervention Coverage: Major increases in institutional delivery, driven by improved coverage among the poorest and rural women

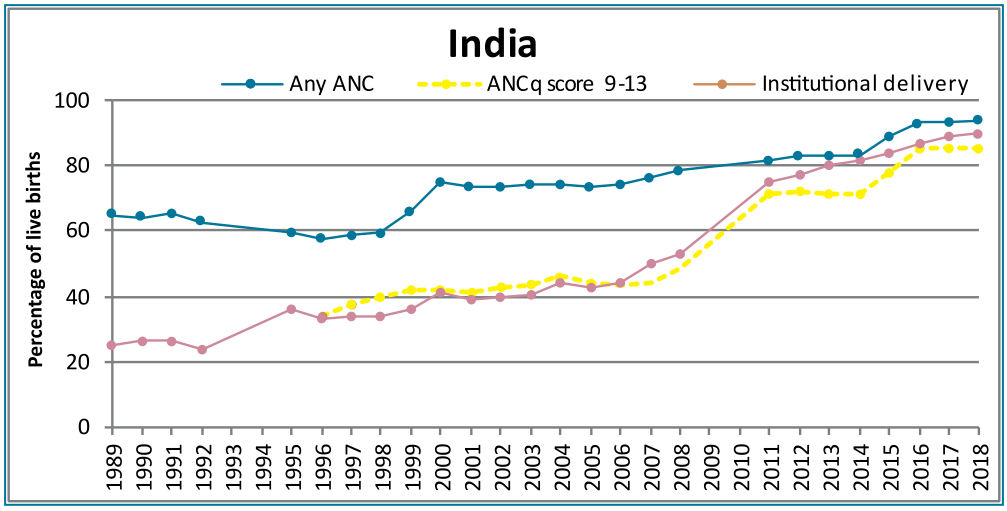
The increases in coverage of maternal and newborn health services have been impressive. Any antenatal care reached near universality. The coverage of ANC with contents and institutional delivery doubled since the 1990s, accelerating between 2005-12 (Figure 4). Postnatal care (PNC) check-up within 0-2 days for the mother or newborn increased more than six-fold from 13% for births during 1998-99 to 83% during 2019-21. Essential newborn care practices also improved, including clean cord care, delayed bathing, immediate wrapping, and early initiation of breastfeeding. The rural, poorer, marginalized castes/tribes and less educated women and children benefitted most, resulting in major reductions in inequalities.

The increase in institutional deliveries was driven by the public sector (89% of the increase). Deliveries in lower-level non-hospital facilities (government health sub-centres, primary health centres, and community health centres) contributed most to the increase (62%), followed by public hospitals (27%) and private hospitals (11%).

Hospital deliveries accounted for more than half of all deliveries in India in 2018, including an increase from 53% to 73% coverage in the lower mortality states during 2008-18, which may be a critical factor explaining the continued mortality decline in these states. Hospital delivery coverage increased from 23% to 40% in the higher mortality states during 2008-18. Notably, neonatal mortality declined significantly in all facility births between 2005-06 and 2019-21, in both the state clusters, while neonatal mortality among home-based births remained as high as 35 per 1,000 live births.

C-sections nearly tripled, from 8% in 2000 to 22% in 2018, largely driven by the private sector and increasing rates in public tertiary hospitals. C-section rates remained higher among wealthier and urban groups, indicative of major use of non-medically indicated C-sections. A better indicator of the extent to which the need for C-section is met are the rates among deliveries the poorest, where a rate of 10-15% is indicative of met need. Among the poorest wealth tertile, C-section rates increased from 2% in NFHS 1998/99 to 9% in NFHS 2019/21, with the fastest increase occurring during 2005-2015.

Figure 4: National trends in coverage of antenatal care visits (any ANC), institutional deliveries and ANC with contents (ANCq), pooled NHFS and DLHS surveys (%), with average annual rate of change (AARC) by policy period



According to Lives Saved Tool (LiST) analyses using default values of effectiveness of specific interventions, uterotonics (30% of lives saved between 2000 and 2018, antibiotics (14%), contraceptive use (14%), clean birth environment (11%) and C-section (7%) were the lead interventions for maternal lives saved. For newborns, the greatest number of lives were saved through case management of sepsis/pneumonia (21%), C-section (15%), thermal protection (11%), case management of premature babies (10%) and clean cord care (9%), and more so especially from 2007-08 to 2014-15.

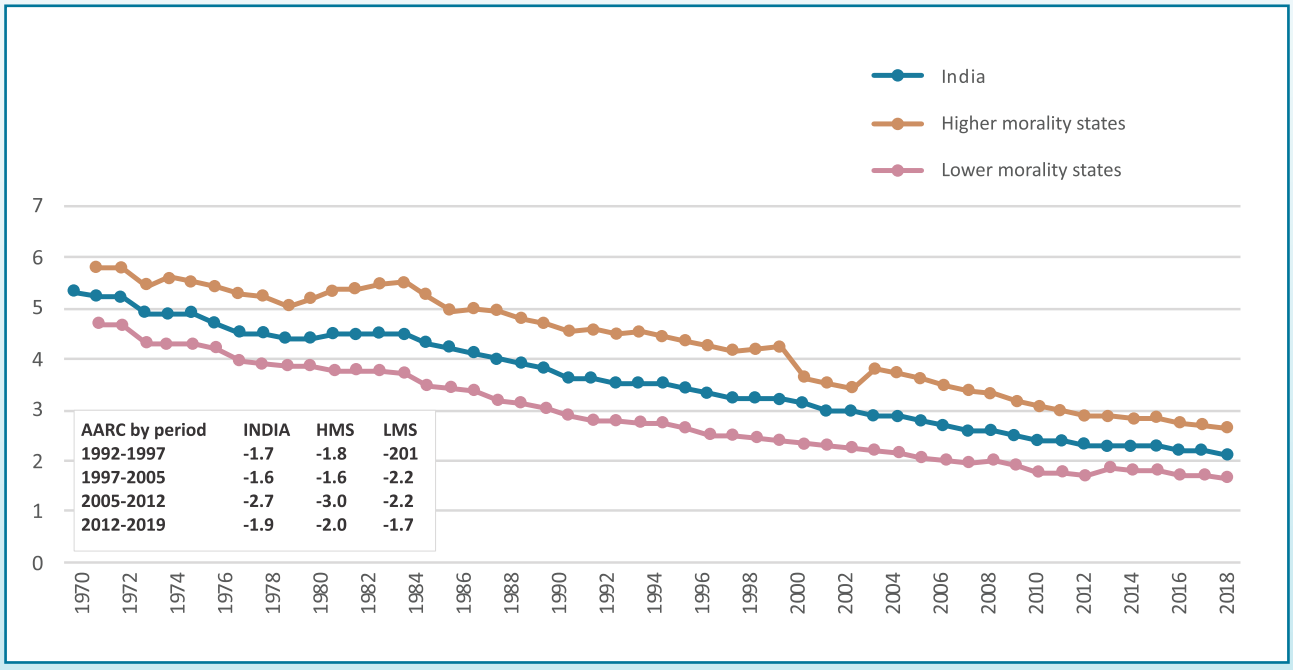
Fertility and Family planning: An important contributor to mortality decline

India's fertility decline has been sustained, reaching 2.1 in 2019, with the fastest rate of decline during 2005-2012 (Figure 5). In the higher mortality state cluster, the TFR declined 2.6 in 2019, a level observed in the lower mortality states in the mid-nineties. Despite the fertility decline, the number of live births remained constant between 2000 and 2019 at around 26 million births due to population momentum. Fertility differences narrowed between rural and urban and by household wealth groups.

Declining fertility has been linked to improving education, nutrition, and economic status, as well as shifting cultural norms and related use of family planning methods to limit family size. Demand for family planning satisfied by modern methods among currently married women increased marginally from 64-67% in the 1990s to 72% in 2015, and accelerated rapidly by 2019, reaching 84% nationally (78% and 90%, respectively, in higher and lower mortality states clusters).

India's fertility decline is an important contributor to the maternal and neonatal mortality decline not only by reducing the numbers of women and babies at risk, but also through relatively fewer high-risk births such as very young or old maternal age or high birth order. In a univariate decomposition, we estimated that fertility reduced neonatal mortality rates by 14% during 2000 and 2015. Jain's decomposition method gives higher results: 27% of the reductions in MMR and NMR due to fertility decline.

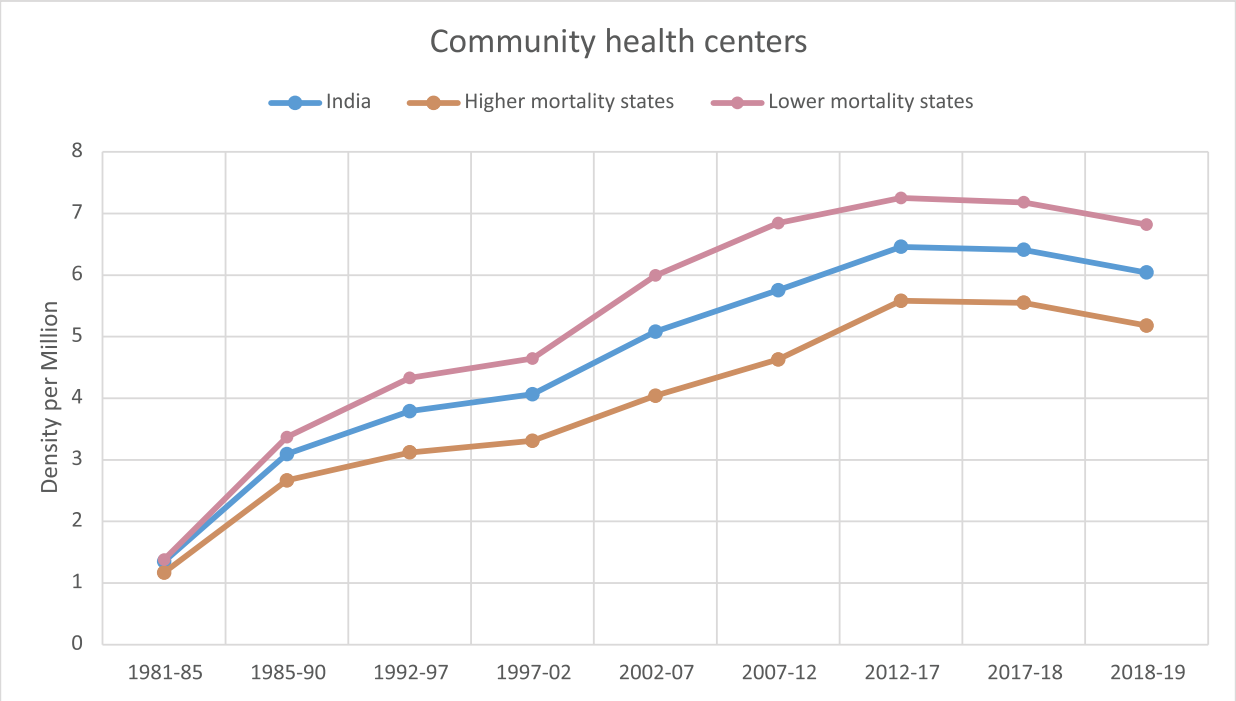
Figure 5: Trends in total fertility rate in India and the two state clusters, with average annual rate of change (AARC) by policy period



Health Service and Programme Levers: Increasingly accessible, Integrated, and high quality care

India expanded the availability of antenatal, delivery and postnatal care services by increasing the number of health facilities and increasing training and task shifting for nurses and doctors to provide skilled delivery and newborn care. The rise in CHC density at district level (and not lower-level PHC centers or subcenters) facilitated the increase in institutional deliveries, especially in the higher mortality state cluster (Figure 6). The fastest period of increase was from 2002-07 to 2012-17. The density of physicians and nurse-midwives increased from 11.4 to 16.7 per 10,000 population, according to available data.

Figure 6: Density of public community health centres per million population, India and the two state clusters



The 2005 conditional cash transfer scheme Janani Suraksha Yojana (JSY), and community health worker outreach through the Accredited Social Health Activist (ASHA) program, were important drivers of increasing institutional delivery particularly in the public sector and among the poorest. These schemes varied by state cluster in terms of design and impact. In higher mortality states, all women were eligible for cash transfers, and the scheme drove overall increases in institutional delivery. In lower mortality states, only poorer women were eligible, which likely influenced the pro-equity improvements in these states with already higher institutional delivery coverage. Contact with a frontline health worker (such as an auxiliary nurse midwife or ASHA) during the third trimester increased from 34% in both lower and higher mortality states in 2005-06 to 71% in low and 68% in high mortality states in 2019-21.

Overall spending on health increased from $30 in 2000 to $64 in 2019 (US$ 2019 Constant), of which the government's contribution increased from $6 per person in 2000 (20% of the total) to $20 in 2019 (31% of the total). Out of pocket expenditure as a share of overall health expenditure remained high but decreased from almost 75% of current health expenditure before 2005 to 55% by 2017-18. Other evidence points to role of the GPS-fitted "108" ambulance service from 2008 in improving access to hospitals.

Concurrent progress in Women's Nutrition, Empowerment, Education and Economic growth

The nutritional status of mothers and newborns improved as the proportion of mothers with low body mass index declined from 39% in 2005-06 to 20% in 2019-21, although maternal anaemia remained common (60-61% in the same period). The percentage of babies reported to be small in size at birth declined from 21% to 11% between 2005-06 and 2019-21; this decrease contributed as much as 30% to the decline in neonatal mortality, according to univariate decomposition. Research in India has linked nutritional improvements to increasing education and economic opportunities for women and programmes to provide supplementary food and nutrients for pregnant women over the past few decades.

Several indicators suggest progress in women's empowerment in India between 2005-06 and 2019-21, such as a reduction in child marriages (median age at first cohabitation increased from 17 to 19 years), greater educational attainment (literacy rate increased from 55% to 72%), and increased involvement in decision making on their own healthcare (from 70% to 84%). These have all been associated with higher utilization of MNH services and better pregnancy outcomes in academic literature. The composition of births by education shifted dramatically, as the percentage of women with at least some education increased from 50% to 79%, contributing about 24% to the overall NMR decline.

Incomes and household living conditions (electrification, clean water source and cooking fuel, and to a lesser extent sanitation) have also generally improved both through economic development and intentional public programmes, which was linked to better financial access to MNH services as well as women's and newborn's health status and outcomes according to existing research.

Although economic inequality has increased, India has seen rapid economic growth over the past two decades, with per capita gross national income rising from $440 in 2000 to $1900 in 2020. Expanded mobile communication infrastructure, household phone ownership for women who recently delivered (23% to 93% from 2005-06 to 2019-21), and improved road networks directly improved communication about MNH services at facilities and between health workers and families, and indirectly impacted MNH by improving economic development more broadly.

Health Policy and Systems Reform as Drivers of Progress

The steady increase in the coverage of MNH services, and associated mortality decline, since the late nineties accelerated in a major way during the period that marked the NRHM (2005-2012). This acceleration of progress happened in the lower mortality states, which are approaching the SDG mortality targets, and in the higher mortality states which follow a similar track as the lower mortality states but with a time lag of one to two decades.

The NRHM was specifically highlighted as a "pivotal moment" or "tipping point" with the reforms it introduced, particularly for community engagement (through the ASHA program, JSY, and ANM outreach through village health and nutrition days), health service access (including expanding skilled birth attendant training), and administrative responsiveness (including state level planning and financial flexibility). Declaring the initiative a national mission with MNH as a priority, it became synonymous with bureaucratic innovation, additional resources, pro-poor commitments and accountability.

Administrative reforms were clustered around four areas: decentralization and associated administrative capacity building; human resource policies to increase health worker availability and expand their legal scope of work; increased financial flexibility; and government program accountability through increased data use and monitoring. These changes promoted local ownership and innovation, as well as accountability for results.

National policies increased the focus on integrating evidence and guidelines from international and national research on life-saving interventions at the facility and community levels. Information systems were also instrumental in strengthening the integration of services through emergency transportation and readiness through drug and equipment procurement and distribution systems. There was also an increased focus on monitoring outcomes to guide strategic planning, innovations, monitoring, and investment at the state and district levels, with more intentional prioritization of geographies and socio-economic groups with lagging indicators.

These NHRM driven reforms led to expanded availability and access to MNH services both through supply and demand side efforts. Community health workers and conditional cash transfers widely increased demand and linkages to delivery services, particularly among the most marginalized. At the same time, service delivery points were expanding to increase financial and geographical accessibility. In addition, the availability and accessibility of tertiary care for emergencies was enhanced, particularly in the lower mortality states which also focus on improving the quality of care for emergencies and small or sick newborns. The higher mortality states expanded availability of essential and basic emergency obstetric and neonatal care at community health centres.

There was much investment in strengthening and expanding training of public health cadres, flexible deployment, payments, and upskilling of nurses and general doctors in life-saving procedures to address shortages in human resources. There was also a growing focus on essential newborn care following institutional deliveries, training ASHAs in home-based newborn care, and increasingly, linkages for specialized newborn care at hospitals where available, particularly in lower mortality states.

In summary, the quantitative and qualitative evidence shows how India's national policies and reforms since the late nineties, but especially since 2005 with the NRHM, have resulted in major increases in the coverage of MNH services with reduced inequalities, and related reductions in maternal and neonatal mortality. Such advances were made in both the higher and lower mortality states, but at different stages of a mortality transition. These health sector efforts were enabled by societal changes such as changing norms favouring smaller family size and increased women's empowerment and education, as well as economic and technological progress with expanded mobile and road networks in rural areas. These changes have combined to support the health sector progress in coverage and survival of women and newborns in India. The India exemplar study provides a solid basis for planning of future strategies to further reduce maternal and neonatal mortality. Even though the primary aim of the exemplar study was to understand the drivers of past progress, the final section of the report also provides some reflection on the implications for current and future strategies using the maternal and newborn mortality transition framework.

1

BACKGROUND

BACKGROUND

The Exemplars in maternal and newborn health (MNH) study aims to systematically and comprehensively research and document factors associated with rapid reductions in maternal and neonatal mortality over the past two decades in a few countries that have experienced more rapid declines than countries with similar socio-economic progress. This study contributes to a Gates Ventures initiative on Exemplars in Global Health, which includes other subject areas such as child mortality, stunting, community health worker programs, and vaccine delivery. The study is an international effort to learn from success and understand positive outliers to inform policy and practice.

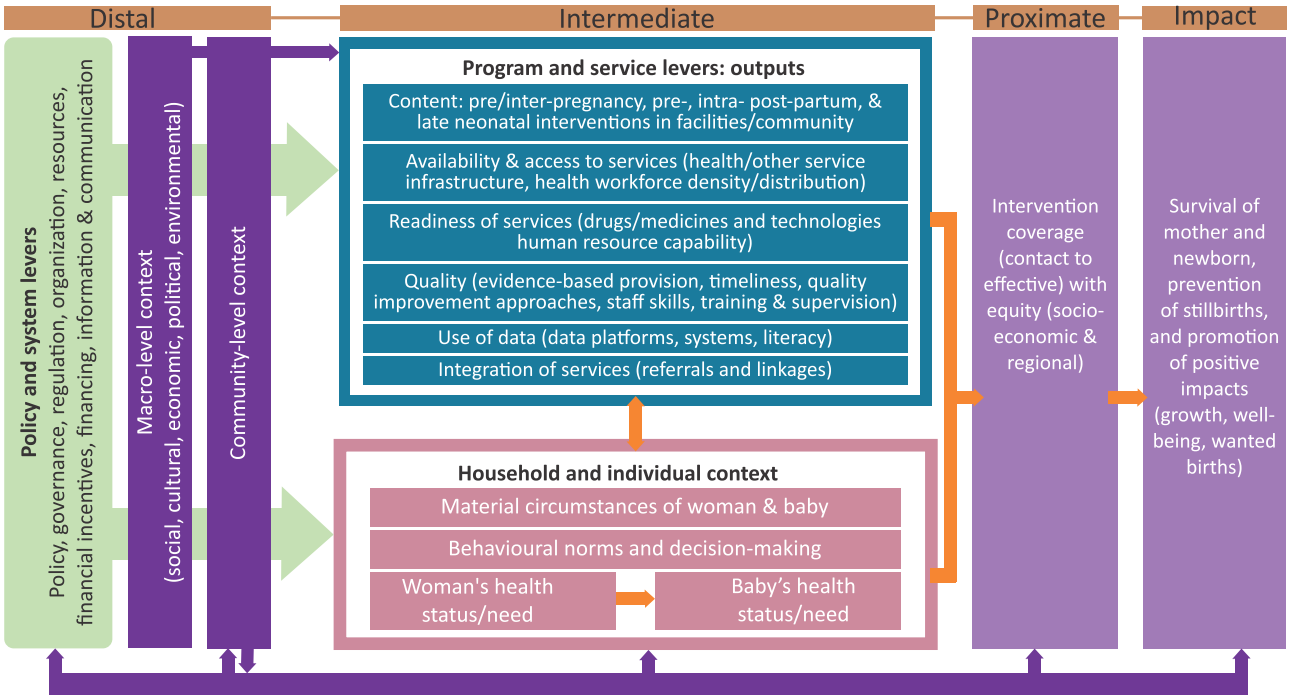
India has made major progress in improving maternal and newborn health outcomes over the past two decades. According to India's Sample Registration System (SRS), maternal mortality dropped from 327 to 103 per 100,000 live births during 2000-2018 and neonatal mortality from 44 to 23 per 1,000 live births during 2000-2018. India's decline in mortality outpaced the global and regional decline, with or without adjustment for economic growth. In 2000, India accounted for 23% of maternal deaths and 31% of neonatal deaths globally. By 2017, these proportions had reduced to 12% of maternal deaths and 22% of neonatal deaths globally.[1,2] Therefore, important lessons can be learned from a systematic investigation of the drivers of India's progress, nationally and sub-nationally, for India to build on its success and for other countries seeking to accelerate progress in MNH.

The primary objective is to systematically investigate, document and comparethe contribution of health policies and systems, programs, and services, as well as changes in coverage, quality, and equity of reproductive, maternal, newborn, and child health (RMNCH) interventions and contextual factors, to the reduction in maternal and neonatal mortality in India over the past two decades nationally and sub-nationally. The study was implemented by a team led by the National Health Systems Resource Centre in collaboration with the International Institute for Population Sciences, the University of Manitoba, and the India Health Action Trust. The Ministry of Health and Family Welfare, Government of India, is supporting the study under the guidance of a steering committee supported by a technical working group and a core implementation team. Annex A describes the study objectives, data, and methods.

Conceptual framework for the Exemplars MNH study

The Exemplars in MNH study was guided by a conceptual framework that was developed to identify the drivers of change, dividing the interrelated factors hierarchically in distal, intermediate and proximate drivers of maternal and neonatal mortality decline (Figure 1.1).[3]

Figure 1.1: Conceptual framework for the study of drivers of the maternal and neonatal mortality decline, MNH Exemplars study



On the far left of the framework, the health policy and system levers are the tools used by governments to improve MNH specifically, as well as decisions which are not taken with a focus on MNH but may have an enormous impact on MNH. Government actions include changes in policy, services, and financial resources with direct or indirect linkages to MNH. Direct changes include strategies to strengthen the health system, while indirect changes include efforts to enhance gender equity or infrastructure in underserved parts of the country that would affect the MNH outcomes.

Macro- and community-level contextual factors (e.g., social, cultural, economic, political, or geographical) at the distal level may moderate the effects of health policy and system changes on program and service outputs for MNH and their impact on coverage of key MNH interventions and health outcomes. They can also directly influence the levels and equity of intervention coverage and/or maternal and newborn survival.

The health policy and system levers at the distal level aim to specifically influence program and service levers at the intermediate level, which are the concrete outputs of government actions in the health sector. These outputs include actual changes in service contents or program strategies, including access, readiness, quality and integration of health services, necessary to increase intervention coverage and equity, and ultimately impact MNH.

Contextual factors at the intermediate level include the household and individual-level characteristics, including material circumstances (such as household assets and income), behavioural norms and decision-making, and health status/need of the women and babies concerned, which are seen to directly or indirectly affect intervention coverage and mortality outcomes.

These distal and intermediate factors are conceptualized as influencing the proximate factors, namely the coverage of interventions at promotive, preventive, and curative levels. This includes quality-adjusted coverage, and the degree that these are equitable between socio-economic groups and geographical regions. Coverage of interventions is considered most directly associated with a positive impact on maternal and newborn survival.

This report presents the results of these analyses according to the framework from right to left. This presentation order reflects the iterative approach to the analyses, working from observed trends in mortality outcomes and intervention coverage to describing hypothesized changes in health policy, systems, and service levers, as well as relevant contextual factors in India over the last two decades. Then the study analyzed the linkages between drivers and outcomes to explain how major drivers combined to influence India's maternal and neonatal mortality declines.

Background Context

India experienced major demographic and socioeconomic changes over the past two decades (Table 1.1). While the population has grown by 30%, from 1.06 billion in 2000 to an estimated 1.38 billion in 2020, fertility has declined from an average of 3.2 children per woman to 2.1 in 2019. Life expectancy rose by nearly seven years, from 62.9 years in 2000 to 69.4 years in 2014-18, and under-five mortality declined from 89 deaths per 1000 live births in 2000 to 35 in 2019. While women's literacy continues to trail men's, both genders improved considerably: in 2001, 73% of men and just 48% of women were literate; by 2018, these indicators rose to 82% among men and 66% among women.

Table 1.1: Changes in India over the past two decades on selected demographic and socioeconomic indicators

	2000	2020
Population[4]	1.06 billion	1.38 billion
Fertility[5]	3.2 births per woman	2.1 births per woman (2019)
Life expectancy[6]	62.9 years (1998-2002)	69.4 (2014-18)
Under five mortality[7]	89 per 1000 live births	35 per 1000 live births (2019)
Literacy: Male (age 15+)[8]	73% (2001)	82% (2018)
Literacy: Female (age 15+)[9]	48% (2001)	66% (2018)
GNI per capita (current USD)[10]	$440	$1,900
GNI per capita, PPP (current international $)[11]	$2,070	$6,920
Gini coefficient[12]	74.7	82.3
Rural population[13]	72%	65%

India is considered a global emerging economy, due to the growth of its gross domestic product by almost 6% per year since the 1990s.[14] The gross national income (GNI) per capita has risen rapidly, from approximately US $440 in 2000 to US $1,900 in 2020. However, this increase in national wealth has been distributed in an unequal manner.[15] India's Gini coefficient, a common measure of income inequality, has tracked a rise in inequality. [16] The share of the country's wealth held by the rich has grown: the wealthiest 1% of the population held 34% of India's wealth in 2000 and 41% in 2020.[17] Although India is urbanizing, the rural population remained large throughout the last two decades at 72% of the Indian population in 2000 and an estimated 65% in 2020.

India's health sector is pluralistic, composed of informal private, formal private, and public providers across allopathic and indigenous systems of medicine.[18] Informal (unqualified) private providers are the most frequent first source of care for rural residents[19,20] and over 50% of active healthcare workers in rural India are without formal qualifications or training.[21] The Indian formal private sector employs 75% of India's physicians,[22] is concentrated in urban and semi-urban areas, and is focused on curative care.[23,24] While about 25% of India's doctors work in the public sector, and only around 25% of out-patient and 38% of in-patient healthcare is provided by the public sector,[25] the government is the predominant provider of immunization[26], antenatal care[27] and institutional delivery.[28] Government services seek wide geographic coverage, particularly in rural areas, with community health workers (accredited social health activists (ASHAs) and anganwadi workers (AWWs)) working at the village or neighbourhood level.[29] Every 5,000 people are to be served by a health sub-centre (HSC) staffed by one or two auxiliary nurse midwives (ANMs), who also conduct outreach visits in their catchment. Each administrative block is served by several primary health centres (PHCs) at a ratio of one PHC to 30,000 people, each of which should be staffed by a medical doctor and several nurses, and one community health centre (CHC) at a ratio of 1 CHC to 100,000 people, which is to offer secondary care through a staff of 25 including four specialist doctors. The highest level of tertiary and speciality care is provided by district hospitals and medical colleges at the state level.[30,31]

State clusters

To assess the drivers of change in maternal and neonatal mortality over time at the national level and capture diversity within India, we identified two clusters of states according to levels of mortality and economic development. The states can be compared based on their baseline mortality levels (in either or both NMR and MMR) and with different socio-economic and geographical contexts. Figure 1.2 shows the MMR levels by state in 2000 and 2018 by per capita income (PCI) in 2000 (left side) and 2018 (right side). Two major clusters of states were identified – the group of states with higher MMR, lower PCI, and the lower MMR, higher PCI states. NMR shows a similar pattern (Figure 1.3). A couple of exceptions are worth noting. First, West Bengal had reduced mortality to similar levels by 2018, but had not progressed as fast in increasing its per capita income as the other states with lower mortality baselines in 2000. Second, Uttarakhand had been combined with Uttar Pradesh in the 2000 estimates of mortality, but they were separated by 2018. Therefore, while it was considered a higher mortality state based on the combined baseline, it falls within the lower mortality/higher PCI state cluster in 2018. Yet because Uttarakhand's population is much smaller than Uttar Pradesh, it did not noticeably affect the Uttar Pradesh estimates before or after being combined.

Figure 1.2: Comparison of state-specific MMR levels in 2000 and 2018 by state per capita income

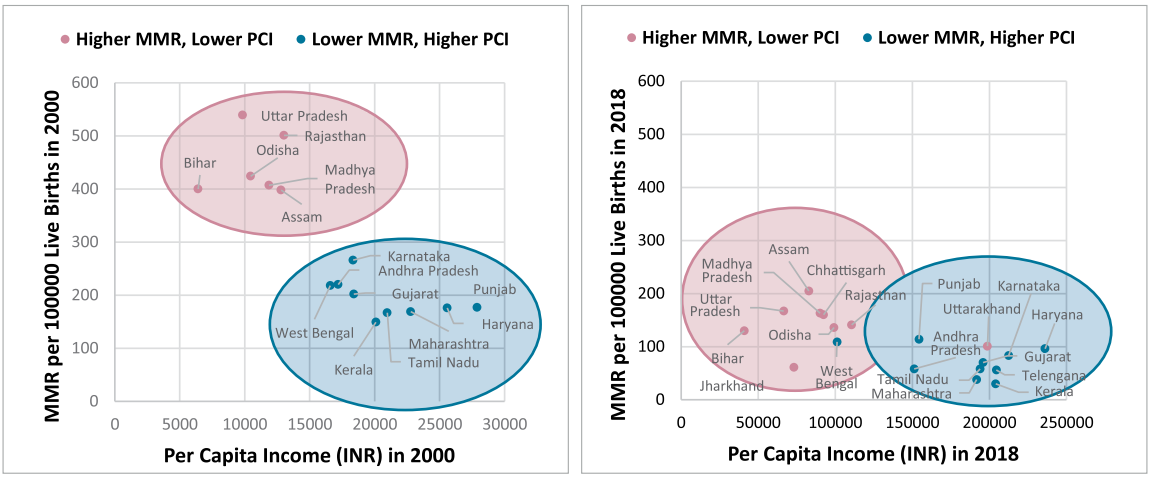
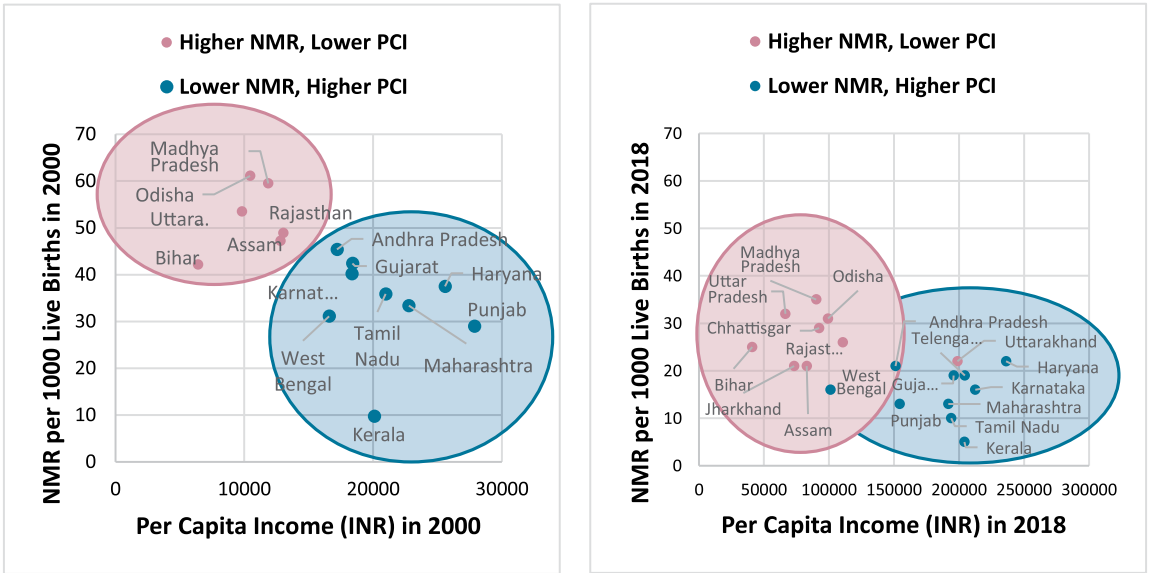


Figure 1.3: Comparison of state-specific NMR levels in 2000 and 2018 by state per capita income



This classification should help to understand the drivers of change, which are likely to vary at different levels of mortality, to align with India's overall strategies of geographic prioritization (such as Empowered Action Group[i,32], and High Focus states[ii,33]), and to facilitate selection for the planned six in-depth state studies. It is notable that the higher mortality states were at a similar mortality level by 2015 as the lower mortality states in 2000. Therefore, the lessons learned in the lower mortality states on the drivers of the decline may be particularly relevant to current and future efforts in the higher mortality states. The following criteria[iii] were used to select the two groups of states:

- Higher and lower baseline mortality levels in 2000
- Good fit with the level of economic development (per capita income)
- Relationships holding over time
- Applies to both maternal and neonatal mortality

The two state clusters resulting from this approach are (also shown in Figure 1.4):

Lower mortality with higher per capita income **(47% of India's population)**

10 States

Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab, Tamilnadu, Telangana[iv] and West Bengal[v]

Higher mortality with lower per capita income (49% of India's population)

9 Sates

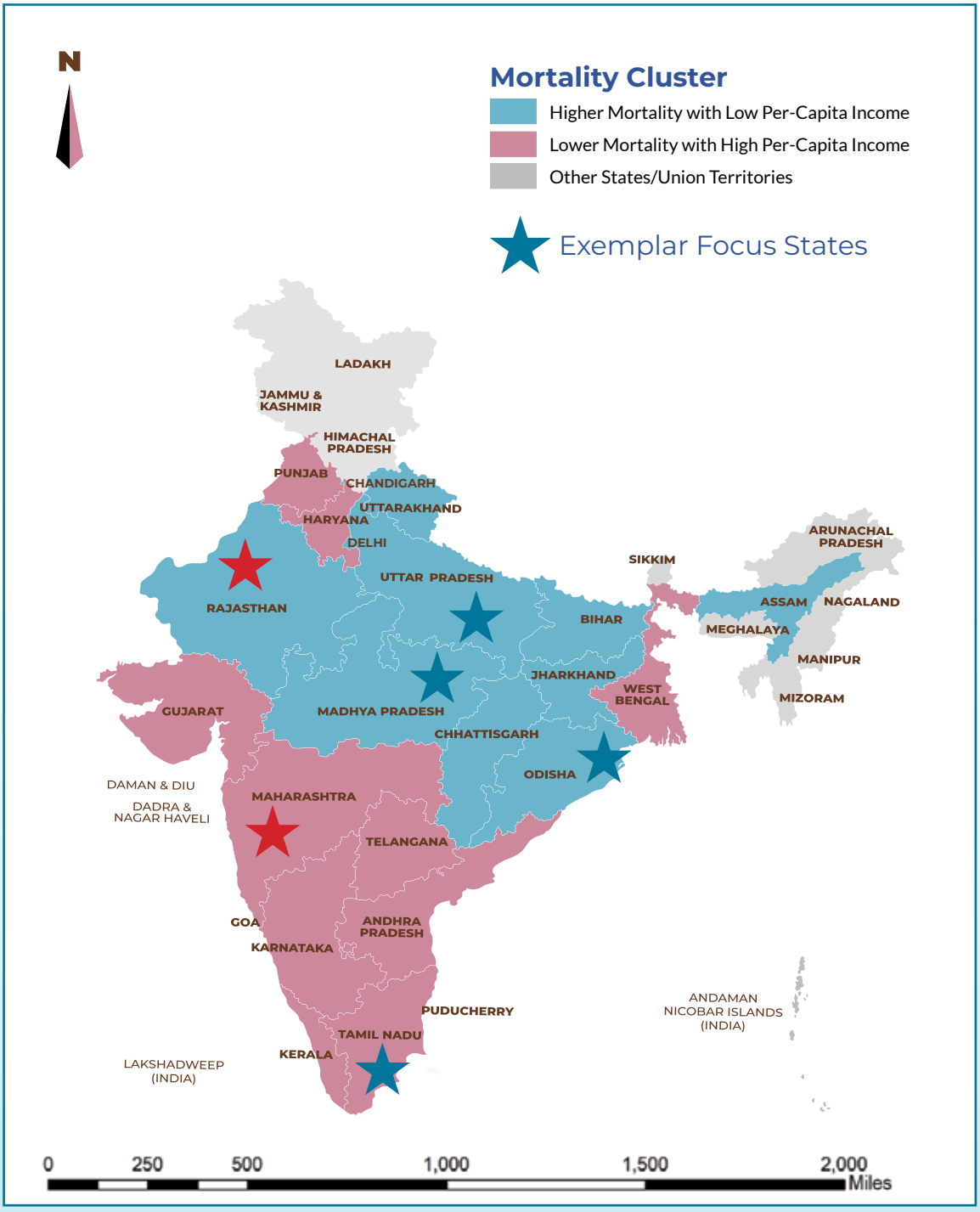
Bihar, Chhattisgarh[vi], Jharkhand[vii], Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh, Uttarakhand[vii] and Assam[x]

The state clusters were also used to select states for in-depth study: two in the lower and four in the higher mortality cluster. The analyses underpinning the state selection process are shown in Annex A.

In all national-level analyses, the data for the two state clusters are weighted by the population sizes of the states. When using the Sample Registration System (SRS), separate trend lines are provided for the two state clusters by pooling the individual state estimates based on the estimated number of live births (using annual population estimates/projections and the SRS crude birth rates). When using survey data, the national weights are used.

[i] Government of India constituted the Empowered Action Group (EAG) in 2001 in the Ministry of Health and Family Welfare, consisting of members from the ministry, related ministries and the eight states: Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa (currently called Odisha), Rajasthan, Uttarakhand and Uttar Pradesh. These states were thought to be lagging behind the demographic transition, still experiencing higher fertility and mortality.
[ii] High Focus states include EAG states plus Assam, in addition to other states. Our higher mortality state cluster excludes two of the NHM's High Focus States that have higher PCI (Himachal Pradesh and Jammu & Kashmir) because they fall outside our two clusters. It also excludes 8 small high focus states in the North East because their small populations resulted in minimal contribution to national trends. The lower mortality state cluster excludes 8 non high focus small states and Union Territories (https://nhm.gov.in/index4.php?lang=1&level=0&linkid=36&lid=40), again because of their small populations and associated minimal contribution to national trends.
[iii] Did not include other variables such as fertility (used in IHME's socio-demographic index (SDI) as it is one of the proximate drivers to examine).
[iv] Telangana was formed out of Andhra Pradesh in 2014.
[vi] In terms of MMR, West Bengal was similar to the other low MMR states in 2000, but had a lower reduction during 2000-15 compared to its peers. The pattern was similar in case of NMR. We have included West Bengal in lower mortality group.
[vii] Chhattisgarh was formed out of Madhya Pradesh in 2000.
[viii] Jharkhand was formed out of Bihar in 2000.
[ix] Uttarakhand was formed out of Uttar Pradesh in 2000.
Assam was included along with the EAG states for the three Annual Health Surveys (equivalent to the DLHS), in 2010-12.

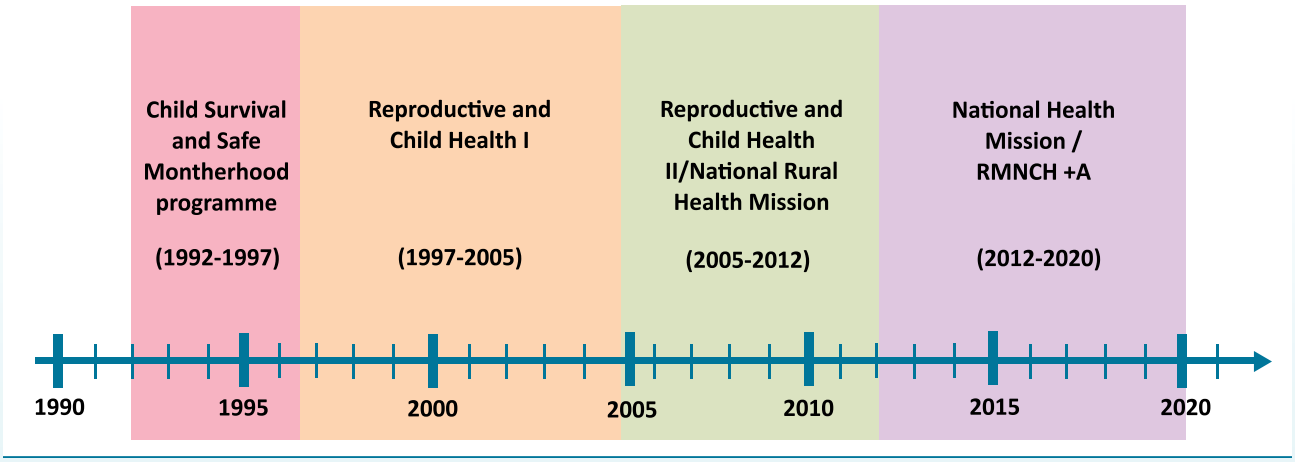
Figure 1.4: Map of India showing higher and lower mortality state clusters



Identifying Critical Periods Of Policy Change

The time period of primary interest is 2000 to 2020, or the year the latest data was available. Levels and trends prior to 2000 are also relevant to understand whether there were changes in pace of decline post-2000. To assess the possible impact of major policy and program changes implemented through the National Health Mission (NHM; erstwhile NRHM) to deliver services across the RMNCAH+N continuum of care across India, we divided the time period into four intervals to guide the mixed-method analysis: the Child Survival and Safe Motherhood (CSSM) program from 1992 to 1997, the Reproductive and Child Health I (RCH I) program from 1997 to 2005, the Reproductive and Child Health II (RCH II) program and the National Rural Health Mission (NRHM) from 2005 to 2012; and the Reproductive, Maternal, Neonatal, Child and Adolescent Health (RMNCH+A) program and NHM from 2012 to 2020 (Figure 1.5). In addition, we assessed all annual or five-year time trends (depending on the indicator) for inflection points, to identify periods of acceleration or deceleration of the decline in the relevant indicator (using the average annual rate of change).

Figure 1.5: India's health policy periods



2

MATERNAL AND NEONATAL SURVIVAL GAINS: WHERE, WHEN, WHO

MATERNAL AND NEONATAL SURVIVAL GAINS: WHERE, WHEN, WHO

Highlights

Maternal mortality declined faster than neonatal mortality (AARC -6.4% and -3.7%, respectively), and this was the case in both higher and lower mortality states clusters. The fastest period of decline was 2012-18 (NHM/RMNCH+A) for both maternal and neonatal mortality.

Both maternal and neonatal mortality converged with reductions in the gaps between the higher and lower mortality state clusters, and between states (and districts) within the clusters. For maternal mortality, the higher mortality states cluster experienced a faster rate of reduction than the lower mortality states, reducing the gap. For the neonatal mortality, on the other hand, the lower mortality states experienced a faster rate of reduction than the higher mortality states.

Age and cause-specific trend data are limited but suggest that hemorrhage, the leading obstetric cause, declined most prominently as a cause of maternal death and that, among neonates, infections and intrapartum causes (asphyxia) declined faster than prematurity/low birth weight, while neonatal mortality decline at 0-2 days stagnated in higher mortality states. Survival gains were large among normal weight babies and were absent among small size babies.

Socio-economic drivers of change could only be examined for neonatal mortality. Major mortality reductions were observed in all subgroups and increasing education benefitted the overall mortality decline. There was however little evidence of reducing inequalities by rural-urban residence and household wealth.

India's fertility decline continued to 2000-2018 and contributed an estimated 29% to the declines in both maternal mortality ratio and neonatal mortality rate. The number of maternal and newborn lives saved between 2000 and 2018 due to the fertility decline was 37% and 46%, respectively. Similar fertility decline contributions were recorded in higher and lower mortality states.

Maternal nutrition improvements were modest and had a limited contribution to the NMR decline. The major decrease in the number of babies reported as small size at birth contributed as much as 30% to the NMR decline.

Overview

This chapter presents the trends in levels, timing, causes of maternal and then neonatal mortality, as well as their drivers of change using disaggregated analyses by socio-economic and fertility characteristics. The main data source for maternal mortality trends is the SRS, which provides state-level estimates of the maternal mortality ratio (MMR) by combining data for three-year periods (for methods see Annex A and for detailed results see Annex B). There are multiple sources of information on causes of maternal death in India, such as special studies related to the SRS, based on verbal autopsy, conducted in 2001-3[34] and 2005-06[35], the Registrar General of India's Medical Certification of Causes of Death (MCCD) from a variable subset of reporting hospitals[36], health facility data reported as part of the HMIS, and multiple subnational research studies.[37,38,39] However, a comprehensive assessment of cause-specific trends during 2000-2019 is challenging. A detailed synthesis of the maternal causes of death analysis is presented in Annex B.

The SRS was used as the primary source for neonatal mortality trend analysis, as data are annual, and completeness of death reporting is considered high (for methods see Annex A and for detailed results see Annex C).[40,x] Cause-specific trend data are available from the national population-based Million Death Study (MDS, verbal autopsy), the national facility-based MCCD (with more representation of urban health facilities), and community studies that provide data on levels of neonatal mortality and cause distributions.[41,42,43] In addition, trends have been estimated with inputs from all data sources.[44,45] The disaggregated analyses for maternal mortality is based on existing evidence, and for neonatal mortality we rely primarily on data from NFHS-3, NFHS-4 and NFHS-5, and detailed tables and graphs are shown in Annex C.

[x]While the SRS data provides annual state-level trends in NMR and MMR for the past 30 years or longer, it does not provide mortality trends for any population subgroups below state level, except for urban and rural areas. It also does not provide data on intervention coverage. Furthermore, primary data were not available for this study. On the other hand, the NFHS primary data is publicly available, and was used to study disaggregated mortality trends and intervention coverage.

Maternal Mortality

Trends

Mortality declined from a high of 327 during 1999-2001 to 103 maternal deaths per 100,000 live births during 2017-19 (Figure 2.1). Earlier estimates indicated that India's MMR was already on a declining path before 2000 but in subsequent periods the pace of the decline accelerated[46,47] and reached a peak of -8.1% average annual rate of change (AARC) during 2012-18 (Table 2.1).[xi,xii]

Both the lower and higher mortality state clusters experienced major declines. The fastest decline was recorded in the high mortality states during 2012-18 (AARC of -8.8%). Heterogeneity in mortality between individual states narrowed down considerably (Annex B). By 2018, the higher mortality states were at the level of 145, similar to the lower mortality states in 2005. From an MMR of 151 in 2005, it took the lower mortality states 13 years to reach the SDG 2030 target of 70 in 2018. If the higher mortality states achieve a similar level of decline as the lower mortality states, the SDG target will be reached by 2030.

According to two measures of inequality (interquartile range and mean distance from the mean), the gap between states decreased gradually in India as a whole, especially post-2005, and between higher and lower mortality states (Annex B). The gaps remained considerable due to differences in risk and in fertility. Although the higher mortality states constitute nearly half of the country's population, they still accounted for about 60% of live births and 84% of the maternal deaths in India in 2018.

Figure 2.1: Trends in maternal mortality ratio, India and state clusters (SRS, 1997-2018)

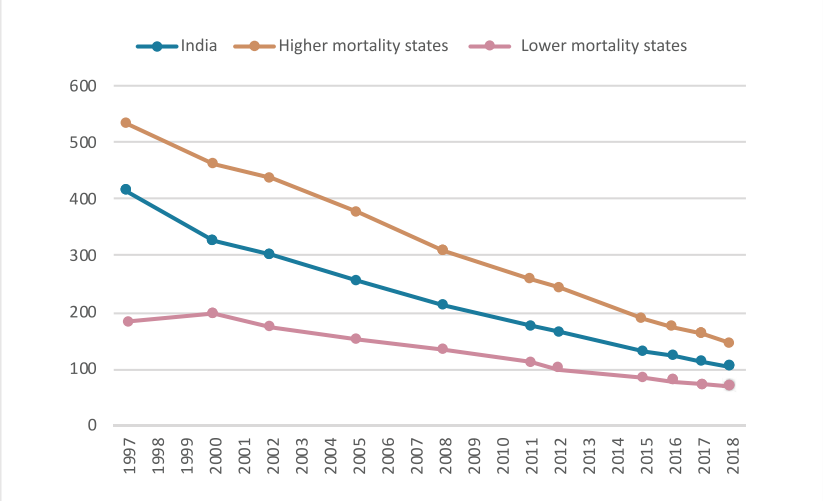


Table 2.1: Average annual rates of change (AARC) in MMR by policy period, India and state clusters (SRS, 2000-2018)

Period	India	Higher mortality states	Lower mortality states
2000-2005 (part of RCH-I)	-5.1	-4.1	-5.4
2005-2012 (RCH-II/NRHM)	-6.0	-6.0	-6.0
2012-2018 (NHM/RMNCH+A)	-8.1	-8.8	-6.0
2000-2018	-6.4	-6.4	-5.9

[xi]Global estimates show a similar picture. During the pre-NRHM period, the UN Maternal Mortality Estimation Group estimated that India's MMR declined from 370 to 286 between 2000 and 2005 (AARC: -2.6%). Post-NRHM, it showed the MMR decreased faster between 2005 to 2017 from 286 to 145, or an AARC of 6.6%. Available from: doi:https://doi.org/10.1016/S0140-6736(15)00838-7. https://www.who.int/gho/maternal_health/countries/ind.pdf See also Tabutin D, Masquelier B. Mortality inequalities and trends in low-and middle-income countries, 1990-2015. Population. 2017;72(2):227-307. Alkema L, Chou D, Hogan D, Zhang S, Moller A-B, Gemmill A, et al. Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. The Lancet. 2016;387(10017):462-74. The Global Burden of Disease Study estimates showed less drastic reductions, from 482 (441-527) to 245 (214-300) between 1990 to 2015, or -2.7% per annum. The average rate of reduction was again faster (-3.5% per annum) between 2000 and 2015. [Kassebaum NJ, Barber RM, Dandona L, Hay SI, Larson HJ, Lim SS, et al. Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. The Lancet. 2016;388(10053):1775-812.]

[xii]The analysis was also conducted using the 1997-1999 SRS estimates of MMR. We however observed some inconsistencies between the national and state level estimates and decided to not use these data as the starting point for this analysis.

Cause-Specific Mortality

The leading causes were hemorrhage (mostly postpartum), pregnancy-related infection, hypertensive disorders of pregnancy, abortion-related complications, obstructed labour or other complications of labour and delivery, and indirect causes (such as anaemia, malaria, diabetes or heart disease). The cause patterns in lower and higher mortality states were similar.

All mortality rates due to obstetric causes decreased. Empirical evidence suggests that greater than average declines may have occurred for hemorrhage, sepsis, abortion complications and intra-partum complications such as obstructed labour than for pregnancy related hypertensive disorders. Modelled estimates suggest that hemorrhage was the only cause declining faster than average during 1990-2013.[48]

Maternal deaths due to indirect causes became more common in population-based studies, with an increase of the median from 15% to 39% in national studies, and from 27% to 45% in regional studies, before and after 2010, respectively. An increasing proportion of maternal deaths took place in health facilities, as expected from the major increase in facility deliveries; 35-50% of total maternal deaths occurred in tertiary facilities, either public or private.[49,50,51,52,53,54]

Drivers of Change

Socio-Economic Determinants

MMR is a relatively rare event, and data on inequalities are limited. No national trend data are available by urban-rural residence or socioeconomic status. One estimate based on data from the Million Death Study (MDS), linked to the SRS 2004-2006, showed that rural MMR was 1.6 times higher than urban MMR in both poorer and richer states.[55] Most studies indicate that MMR was higher among women in Scheduled Caste/ Scheduled Tribe (SC/ST) compared to non-SC/ST groups, Hindu versus non-Hindu religion, those not literate versus having primary and especially secondary education (woman and husband), those who were employed (woman and husband), and with higher wealth or income (and clean fuel or sanitation). [56,57,58] There are, however, no trend data to assess if large-scale convergence has occurred.

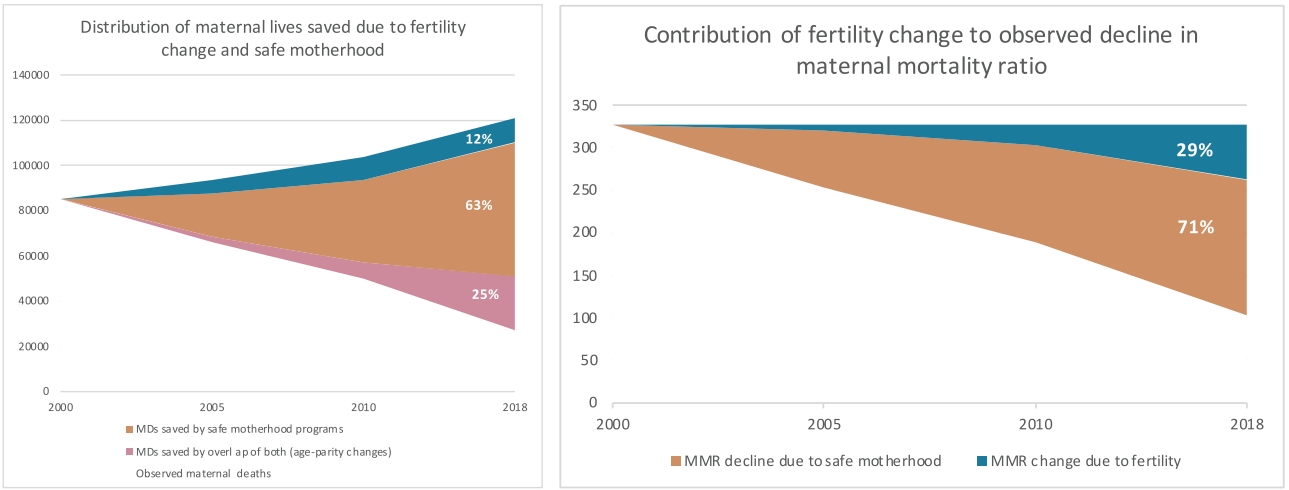
Fertility Decline

India experienced a major fertility decline during 2000-2018 even though the number of live births remained more or less constant at around 26 million births, due to the population momentum. The number of maternal deaths decreased from an estimated 85,000 to 27,000 during 2000-2018.[xiii] In higher mortality states, the crude birth rate (CBR) reduced from 31.2 to 24.2 between 2000 and 2018. Births increased from 14.8 million to 15.7 million. Maternal deaths reduced from 68,000 to 23,000. In lower mortality states, on the other hand, the CBR reduced from 21.4 to 16.2, births from 10.5 million to 9.8 million, and maternal deaths from 21,000 to 6800. Population momentum was different in the two clusters.

India's fertility decline may have contributed to the decrease in the numbers of maternal deaths and to the risk of maternal death in multiple ways. First, a lower number of births results in lower numbers of maternal deaths. This, however, was only a small factor in India overall and mostly occurred in the lower mortality states.[xiv] Second, the fertility decline may be associated with a shift in the age-parity distribution of births that reduced maternal mortality risk, since risks tends to be higher at younger maternal age[59] and higher parity. [60]

Using the Jain method of decomposition,[61] we estimated the contribution of the fertility decline to the reduction in the maternal mortality risk, measured by the MMR, as 29% (Figure 2.2). The remaining 71% would be due to what Jain calls "safe motherhood", improvements in the quality of maternity care and maternal health. The number of maternal lives saved between 2000 and 2018 due to the fertility decline is 37% for India, including 12% due to fewer births (compared to no decline in fertility) and 25% due to relatively fewer high-risk births. We also analyzed the contribution of fertility in the higher and lower mortality states and found no major differences with the national trend (Annex B).

Figure 2.2: Contribution of changes in fertility in maternal lives saved and MMR reduction in India, 2000-2018



[xiii] These numbers are derived from our analysis of contribution of fertility to maternal mortality reductions in India using our population projections and SRS MMR and CBR estimates. The estimated numbers are different, however, in the time trend analysis by the WHO Interagency Group for maternal mortality estimation (MMEIG). CBR declined from 25.8 to 19.7 per 1000 between 2000 and 2019.

[xiv] Although the decomposition results are somewhat similar, the patterns are different. In HMS, the CBR reduced from 31.2 to 24.4 between 2000 and 2019. Births increased from 14.8 million to 15.8 million. Maternal deaths reduced from 68,000 to 23,000. In LMS, on the other hand, CBR reduced from 21.4 to 16.0, births from 10.5 million to 9.8 million, and maternal deaths from 21,000 to 7,000. Population momentum was different in the two clusters.

Neonatal Mortality

Trends

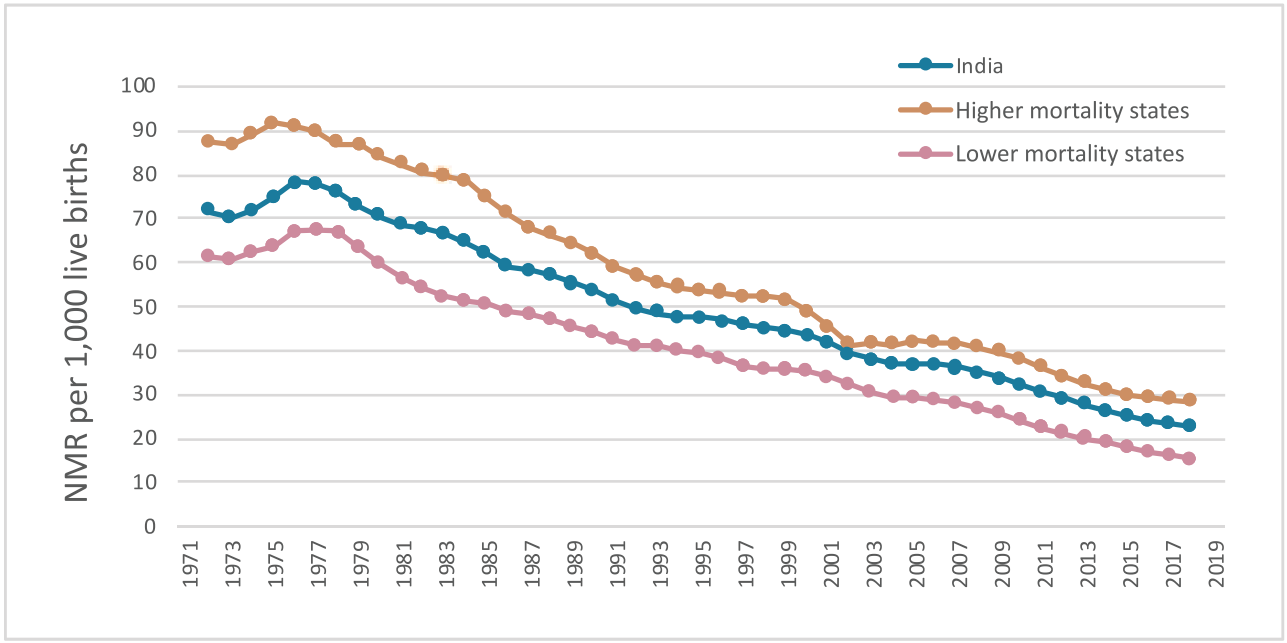
Ever since India's SRS reported neonatal mortality rates (NMR) as high as 79 per 1,000 live births in the late seventies, there has been a downward trend to 43 and 23 per 1,000 live births in 2000 and 2018, respectively, based on three-year moving averages (Figure 2.3). The AARC was variable with generally faster declines post-2000 compared to the preceding three decades (Table 2.2). The fastest decline was recorded for 2012-19 (3.9% reduction per year).

By state cluster, NMR declined from 49 to 28 per 1,000 live births among higher mortality states, and from 35 to 15 per 1,000 live births among lower mortality states during 2000-2018 (Figure 2.3). The pace of the NMR decline was as fast as 5% per year in the lower mortality state cluster from 2005 during the NRHM and NHM program periods, bringing the states close to the SDG target of 12, more than a decade before 2030. The higher mortality states have maintained a decline of -3.4% per year during 2000-2019. These findings have been corroborated by multiple studies using SRS and NFHS data.[62,63,64,65,67,68,69,xvi]

We can describe the difference in NMR levels between the two state clusters in terms of a time lag. The lag between the two state clusters in the time when they achieved an NMR of 30 per 1000 live births was 12 years (2003 and 2015). [xvii]

Because under-five mortality declined faster than NMR, the share of neonatal mortality in the under-five mortality increased from 51% in 2008 to 63% in 2019. The pattern was similar in both state clusters but occurred at a faster rate in higher mortality states than in lower mortality states.[xviii]

Figure 2.3: NMR trends (3-year moving averages) in India and state clusters (SRS, 1971-2019)



[xv] The time lag is reducing even though the AARC is greater in lower mortality cluster, due to higher baseline mortality in higher mortality cluster.
[xvi] The Million Death Study (MDS), which analyzed SRS estimates adjusted by UN-IGME birth estimates for India, reported a slightly slower NMR reduction during 2005-12 (NRHM period) than during 2012-17 (NHM period) (MDS 2017).
[xvii] In terms of trends, there was a major dip in NMR during 2000-2003 among the high mortality states, followed by stagnation until 2008. The dip seems largely due to the sudden drop in NMR between 2000 and 2001 in the rural areas of Uttar Pradesh and Madhya Pradesh, two large states within the high mortality state cluster. This could be in part due to a data quality issue in the SRS. There were no sampling design changes in the SRS except in 2004 when it was updated using the 2001 Census, so this could not have led to these uneven trends.

Table 2.2: Average annual rates of change (AARC) in NMR in India and the two state clusters (SRS, 1971-2019)

Periods	India	Higher mortality states[a]	Lower mortality states[b]
1971-1980	-0.9	-0.4	-0.8
1980-1990	-2.8	-3.3	-3.1
1990-2000	-1.7	-1.8	-1.7
2000-2019	-3.7	-3.4	-4.7
1992-97 (CSSM)	-1.6	-1.2	-3.0
1997-2005 (RCH-I)	-2.8	-3.1	-3.0
2005-2012 (RCH-II/NRHM)	-3.4	-2.8	-4.7
2012-2019 (NHM/RMNCH+A)	-3.9	-3.1	-5.3
1971-2019	-2.6	-2.5	-3.0

[a]Estimates for Uttarakhand included with Uttar Pradesh in the SRS before 2014.
[b]Estimates for Telangana included with Andhra Pradesh in the SRS before divided in 2015.

We examined the gaps among 19 major states for the period 2000-19 in further detail (Table 2.3). Neonatal mortality gaps between states have become smaller in India during 2000-2019, which is largely due to reductions in inequality between states within the higher mortality states cluster, based on SRS data, as indicated by both the inter-quartile range and absolute mean difference from overall mean. In the higher mortality states, inequalities reached their lowest level during 2012-2019 (NHM/RMNCH+A period, with HPD focus). An analysis of NMR in 677 districts in India, using estimates from the India GBD study[xix], also showed that inequalities were shrinking. The greatest reduction in district heterogeneity, as measured by inter-quartile range and absolute difference from the overall mean, was observed after 2012, in both the state clusters (Annex C).

Table 2.3: State inequality in neonatal mortality rate, according to state cluster and policy periods (SRS)

Year	Number of states with NMR estimate	Inter-quartile range			Absolute mean difference from overall mean		
		India	Higher mortality states	Lower mortality states	India	Higher mortality states	Lower mortality states
1992	15	14.3	16.9	6.6	10.8	7.8	8.1
1997	15	13.8	12.9	8.3	10.8	6.2	7.4
2005	17	7.0	15.0	8.6	8.2	8.0	5.0
2012	17	9.9	9.7	10.3	6.8	4.4	5.5
2019	19	10.0	10.0	5.0	6.5	4.7	3.3

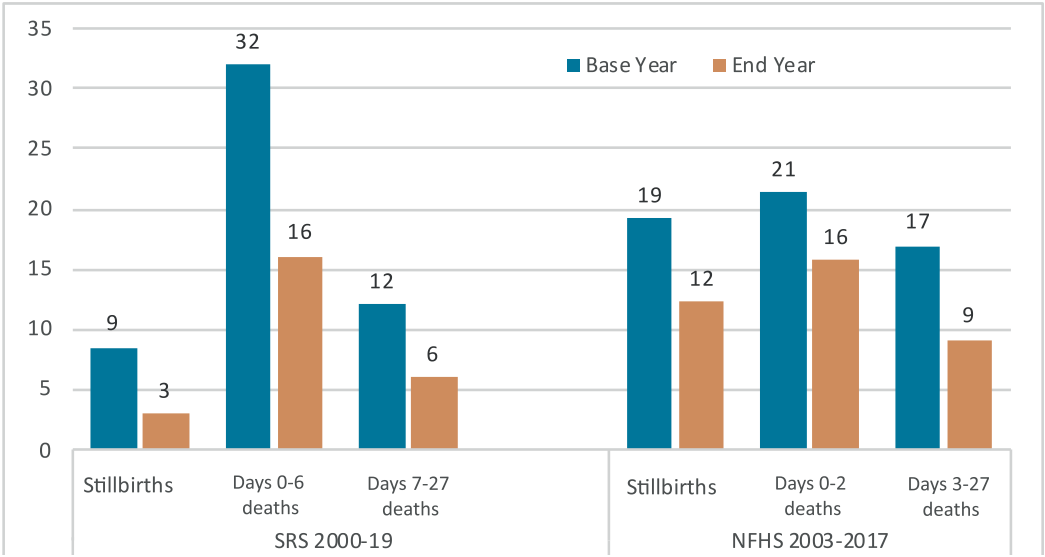
[xvii] According to the UN-IGME estimates, the proportion of global under-five deaths that were neonatal was estimated to have increased from 41% to 47%, between 2000 to 2019.
[xix] The district level NMR estimates from IHME were based on multiple data sources including the SRS, vital registration system, censuses, as well as complete birth history data from household surveys such as the NFHS, DLHS and AHS. District-level neonatal mortality rates were estimated by fitting an indirect, discrete-time, generalized additive hazard model with covariates at 5 x 5 km grids (GBDS, 2017).

Age and Cause-Specific Mortality

According to SRS, stillbirth rates declined at an average of 5.5% per year (Figure 2.4). Stillbirth rates have to be interpreted carefully, as underreporting is common which also appears to be the case for India (Annex C).[XX] For instance, the UN estimate for 2017 showed a stillbirth rate of 15 per 1,000 births for India. The SRS estimates reveal a similar pace of decline for both early and late NMR (AARC of -3.6%).

The NFHS data shows a slower decline compared to SRS data in stillbirth rates (3.2% per year), as well as likely underreporting. The slowest decline occurred on days 0-2, which resulted in an increase in the proportion of deaths occurring on days 0-2 from 56% to 63% of all neonatal deaths (Figure 2.5). Around 42% of the NMR decline between 2003 and 2017 was due to the decline in 0-2 days mortality. NFHS data by state cluster show that improvement in India's mortality in the first three days of life was slow because of a lack of decline in the higher mortality states, while the lower mortality states declined with an AARC of -4.4%. Research studies also observed declines in stillbirth and early neonatal mortality rates in both the RCH II/NRHM (2005-12) and NHM (2012-17) periods.[70,71,xxi]

Figure 2.4: Stillbirth and age-specific neonatal mortality trends (SRS 2000-2019, and NFHS 2003 and 2017)



Mapping the main causes of neonatal death to the age-specific mortality trends may help explain the drivers of the mortality decline. Based on the age-specific mortality trends, we expect slower declines for asphyxia/birth trauma and prematurity/low birth weight than for infections/sepsis.

A summary of India's national cause-specific NMR data from the MDS, WHO/MCEE, and GBD studies from 2000 and 2015-19 is shown in Figure 2.6. Major reductions occurred for infections and asphyxia/birth trauma (intrapartum-related causes) since 2000, but less so for prematurity/low birthweight, most notably in the MDS. Across studies, tetanus-related deaths declined to zero, and diarrhoea-related deaths slightly declined, while congenital anomalies-related deaths remained fairly constant or went up slightly.

[xix] The district level NMR estimates from IHME were based on multiple data sources including the SRS, vital registration system, censuses, as well as complete birth history data from household surveys such as the NFHS, DLHS and AHS. District-level neonatal mortality rates were estimated by fitting an indirect, discrete-time, generalized additive hazard model with covariates at 5 x 5 km grids (GBDS, 2017).
[xx] The UN estimates of stillbirth rates based on all available data sources and a global model suggest that stillbirth rates in India have declined from 29.6 (uncertainty interval 21.9-40.2) in 2000 to 15.1 in 2017, corresponding with an AARC of -3.9%.
[xxi] According to the recent UN-IGME estimates, India accounted for 30% of global stillbirths in 2000 and 17% in 2019 (IGME SBR report 2020; https://childmortality.org/data/). IGME estimated that India's SBR halved from 29 to 14 per 1000 births, or 4% average annual reduction. India's rate of reduction in stillbirths was greater than in Southern Asia overall, where the AARC was estimated at 3% between 2000-19.

Similar trends were observed in the higher and lower mortality state clusters, including a major decline in NMR due to infection and asphyxia in both clusters. The main exception was a less favourable trend in NMR due to preterm birth-related complications in the poorer than richer states, according to the MDS (2000-15) and estimates from the India GBD study (2000-2017).[73,74]

Figure 2.5: Stillbirth rates per 1,000 births and neonatal mortality per 1,000 live births at days 0-2 and 3-27, by state clusters (2005-06 and 2009-15)

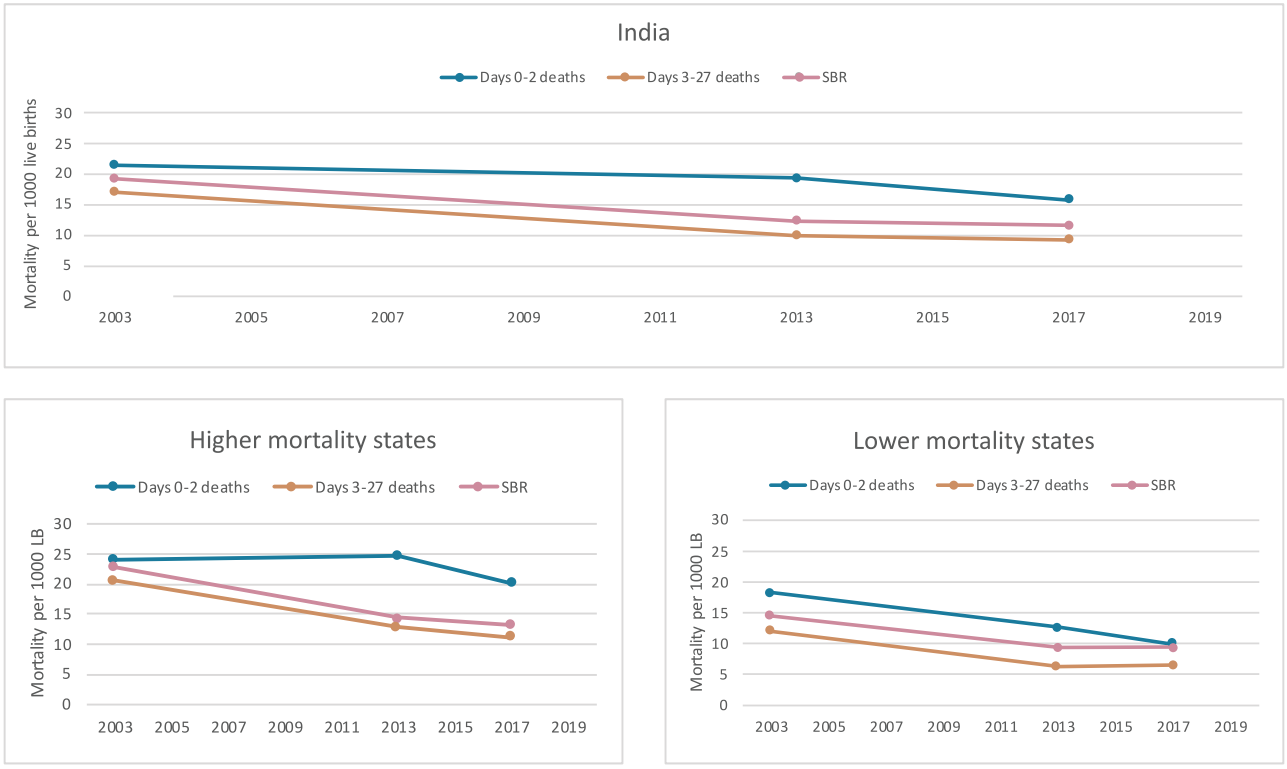
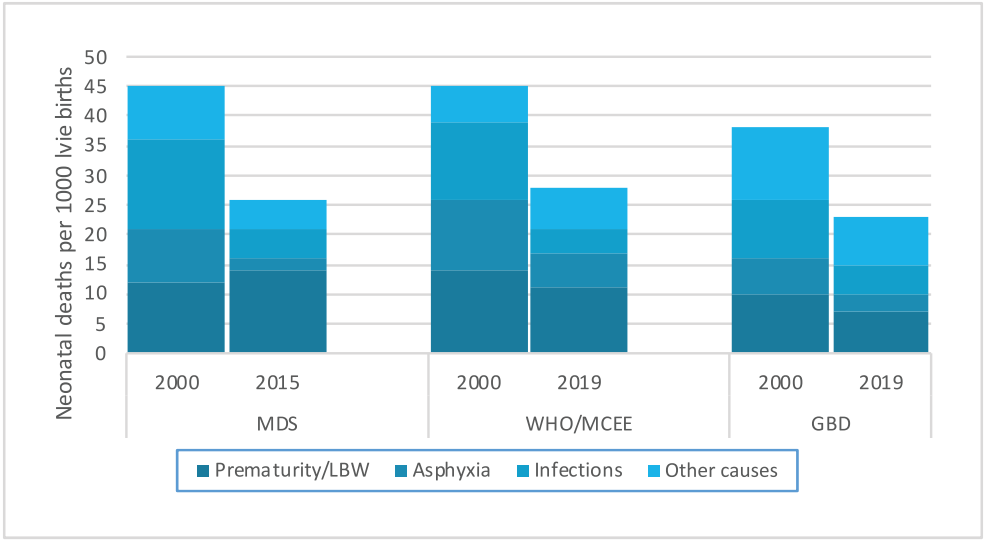


Figure 2.6: Neonatal mortality per 1,000 live births by major cause of death (2000- 2019)



Drivers of the Mortality Decline

Studying disaggregated trends in neonatal mortality has multiple purposes. First is to understand changes in levels of socio-economic inequalities, i.e. whether the relative risks of NMR have reduced, especially among the most disadvantaged populations. Second, the aim is to assess whether disparities have reduced between the subpopulations, which can only happen if there is faster progress among the most disadvantaged populations. The third purpose is to examine the relative contribution to national gains in NMR reduction of compositional changes in the population since 2000. Two compositional changes are particularly noticeable and of interest: increasing education among women and age-parity distributions of childbearing.

Sex preference

Sex preference towards male children is common in India. The low female to male sex ratio at birth (SRB) did not change in the past two decades (the female to male SRB was 894 per 1,000in 2000 and 904 per 1000 in 2017-19 in SRS), and therefore plays little role in explaining the mortality decline. Female sex has been associated with higher-than-expected mortality in infancy and childhood and in some studies, with reduced advantage in the neonatal period.[75,76,77,78,79] Overall, neonatal mortality among females declined faster than among males, resulting in a slight increase in the male to female NMR ratio from 1.1 to 1.2 (Table C.8 in Annex C). This may be associated with greater improvements in perinatal care for females. The sex differentials in NMR in the two state clusters follow the national pattern. State-specific analyses may provide further insight into sex-specific fertility and mortality trends.

Urban-rural residence

India has been experiencing rapid urbanization, but the majority of India's births are still rural (73% in 2019-21, 75% in 2005-06). The surveys show that there was a faster NMR decline in the urban areas (AARC of -3.2%) than the rural areas (AARC of -3.0%). A similar finding was observed in the SRS data for the period 2000-2017.

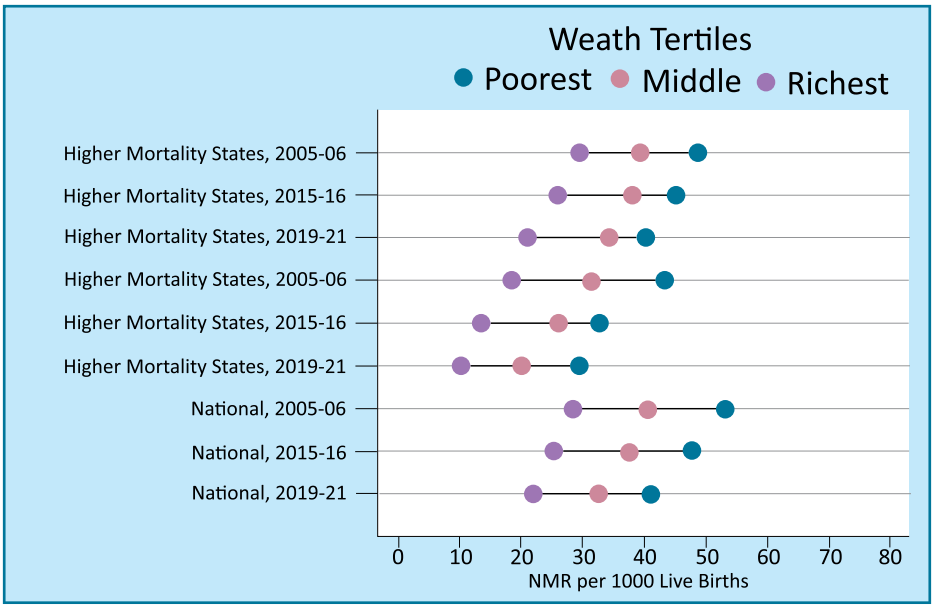
In the surveys, the rural disadvantage was larger in the lower mortality states even though the rural-urban gap reduced considerably between 2005-06 and 2019-21 (relative risk from 1.7 to 1.3), while the gap was smaller but increased in the higher mortality states (relative risk from 1.2 to 1.3) (Annexure C, Tables C.9 and C.10).

Socio-economic position

NMR declined for women in all socioeconomic groups at a similar pace (including no versus some education, Scheduled Caste and Scheduled Tribe (SC/ST) versus other caste groups, and Hindu religion versus non-Hindu including Muslim, Christian, and other religions), and the relative risks of mortality did not change (Table C.8). For instance, the NMR among women with no education compared to those with some education reduced by 2.0% and 2.5% per year, respectively, and the relative risk increased marginally from1.4 in 2005-06 to 1.5 in 2019-21. There was, however, an important shift in the composition of births by education, as the percent of women with some education increased from 50% to 79%, contributing about 24% to the overall NMR decline (the other 76% due to mortality decline in all categories), based on a univariate decomposition analysis. Such shifts did not occur for SC/ST groups and by religion. In the higher mortality states, the mortality gaps by education, SC/ST groups, and Hindu/non-Hindu religion all decreased between the surveys. No such decline was observed in the lower mortality states. The increase in the level of education was large in both state clusters but greatest in the lower mortality states.

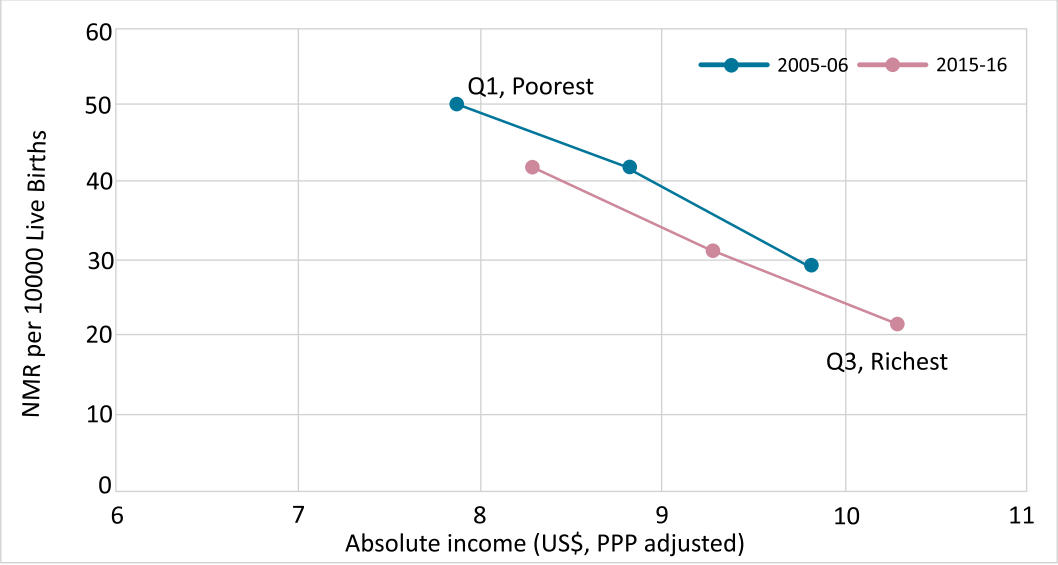
By household wealth, the NMR was greatest among poorest households in both survey rounds. The NMR declined faster among the richest households than among the poorest wealth tertile (AARC of -2.8% and -1.3%, respectively), widening the relative gap between poorest and richest households (Figure 2.7).

Figure 2.7: NMR by wealth tertile, India and state clusters (2005-06, 2015-16 and 2019-21)



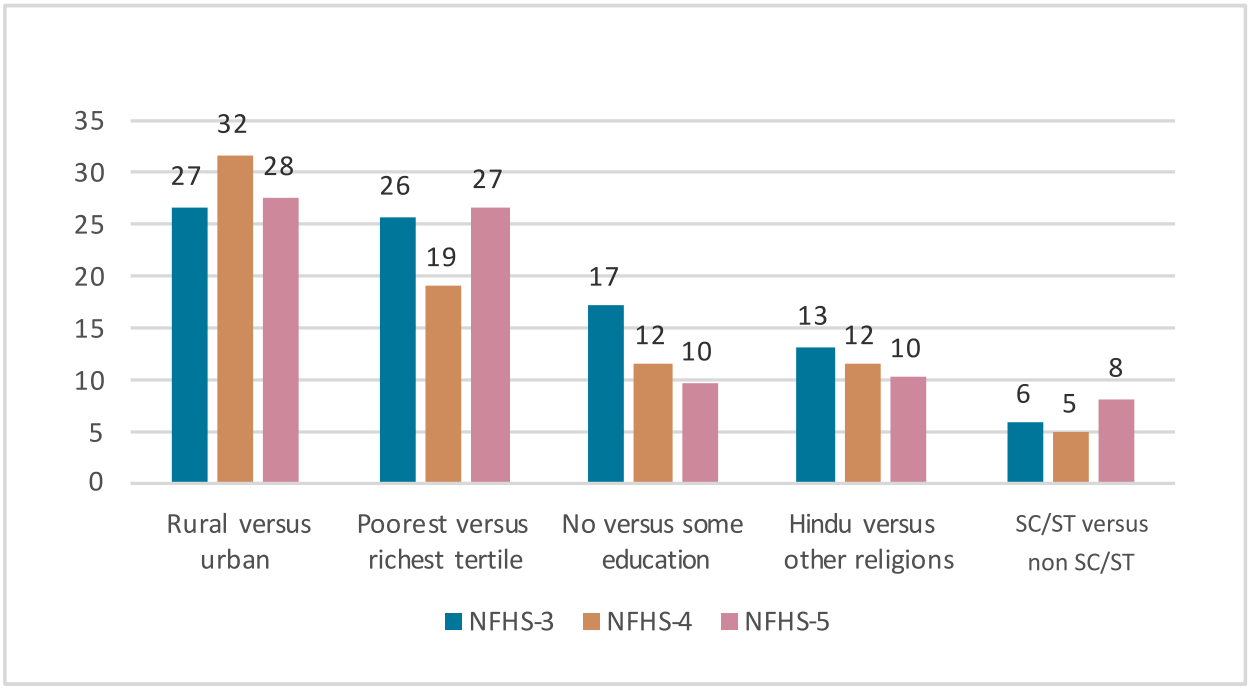
The wealth tertiles do not capture to substantial improvements in household income between two surveys. Using economic data on per capita income and income distribution, the average income was estimated for each wealth tertile to show the impact of economic growth (Figure 2.8).[80] The average annual rate of income growth ranged from 4% among the poorest to 5% among the wealthiest tertile, indicative of increasing economic inequality (data not shown). In NFHS-4, much lower NMR levels were reached at similar income levels a decade earlier: for the poorer tertile the difference was as much as 9 per 1,000 live births. The middle wealth quintile in NFHS-3, with an average income of $6,000, had NMR similar to the poorest quintile in NFHS-4, with an average income of $2,600. This suggests a large effect of non-economic drivers on NMR reductions.

Figure 2.8: Neonatal mortality by absolute income in each wealth tertile, India (NFHS, 2005-06 and 2015-16)



The population attributable fraction (PAF) is the proportion of neonatal mortality that can be attributed to a specific risk factor among the entire population. It captures both relative risk and composition. Figure 2.9 shows that most progress has been made in relation to wealth (due to narrowing the neonatal mortality gap between the poor and the rich) and by education (due to increases in education), whereas the rural PAF increased (because of a slower rural mortality decline). Details are found in Annex C (Tables C.8-C.9), which also shows that changes in the PAF by wealth and education in both the higher and lower mortality state clusters are similar to the national picture but that there is some variation by residence and religion.

Figure 2.9: Population attributable fraction (%) for neonatal mortality by selected socioeconomic characteristics, India (2005-06 and 2019-21)

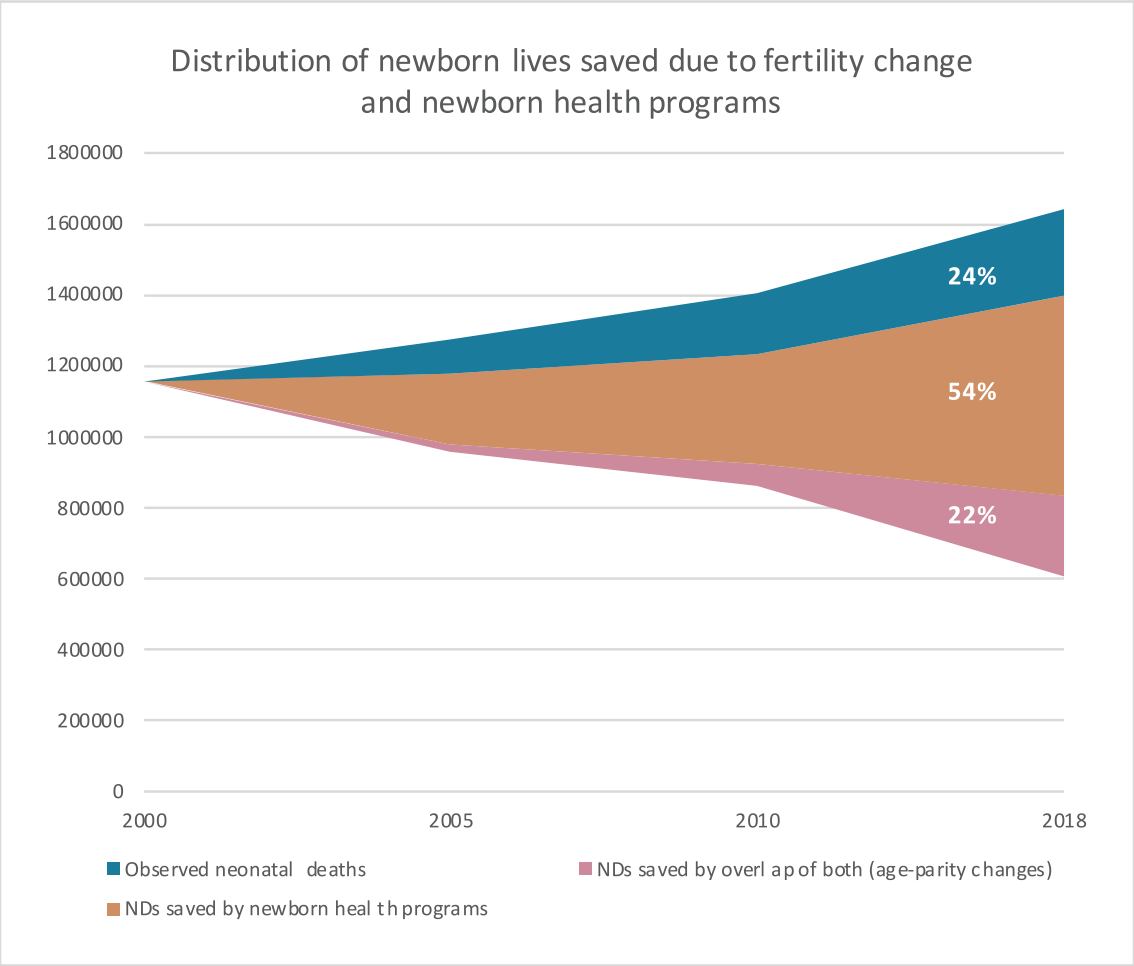


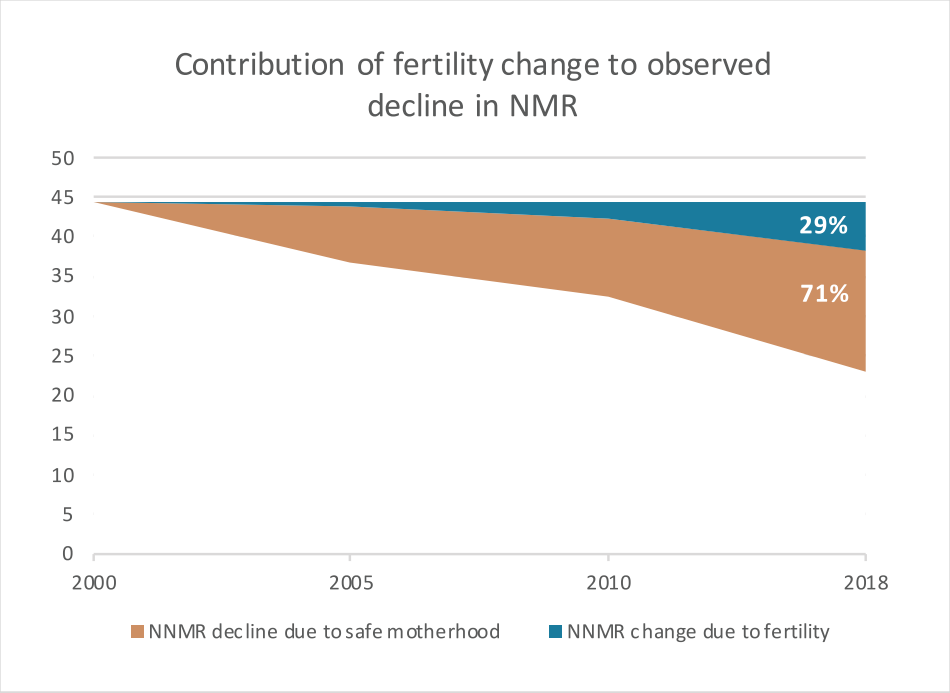
Fertility

Total fertility rate (TFR) in India declined from 2.8 children per woman in NFHS-2 (1998-9) to 2.7 in NFHS-3 (2005-06) and below replacement level of 2.0 in NFHS-5 (2019-21). Such changes result in fewer births and shift in the age-parity distribution of births. The decrease in births occurring to adolescents under 20 years (from 21% to 13% of all live births in NFHS-3 and NFHS-5, respectively) and to births of order 3 and above (from 43% to 27%), while births to mothers 35 years and older remained uncommon (4%). The decline in NMR was fastest among the women younger than 20 years (and first births). A univariate decomposition of the changes over time suggests that about 14% of the NMR decline between the two surveys was due to the changes in the distribution of births by age and birth order (Annex Table C.8).

Using the Jain method of decomposition,[81] we estimated the contribution of the fertility decline to the reduction in the NMR at 29% (Figure 2.10). The remaining 71% would be due to improvements in the utilization and quality of maternal/neonatal health and health services. The contribution of the fertility declines to the number of newborn lives saved between 2000 and 2018 was 46% including 24% due to fewer births and 22% due to shifts to an age-parity distribution with lower risks of mortality. Fertility decline had similar contribution to MMR reduction (29%). We also analyzed the contribution of fertility in the higher and lower mortality states and found no major differences with the national trend (data not shown). The proportion of the reduction in neonatal mortality risks due to fertility change was slightly greater in the lower than the higher mortality state clusters. Our results are corroborated by multiple analyses based on the same or other data sets.[82,83,84,85,86]

Figure 2.10: Contribution of changes in fertility in neonatal deaths (ND) saved and neonatal mortality rate (NMR) reduction in India, 2000-2018





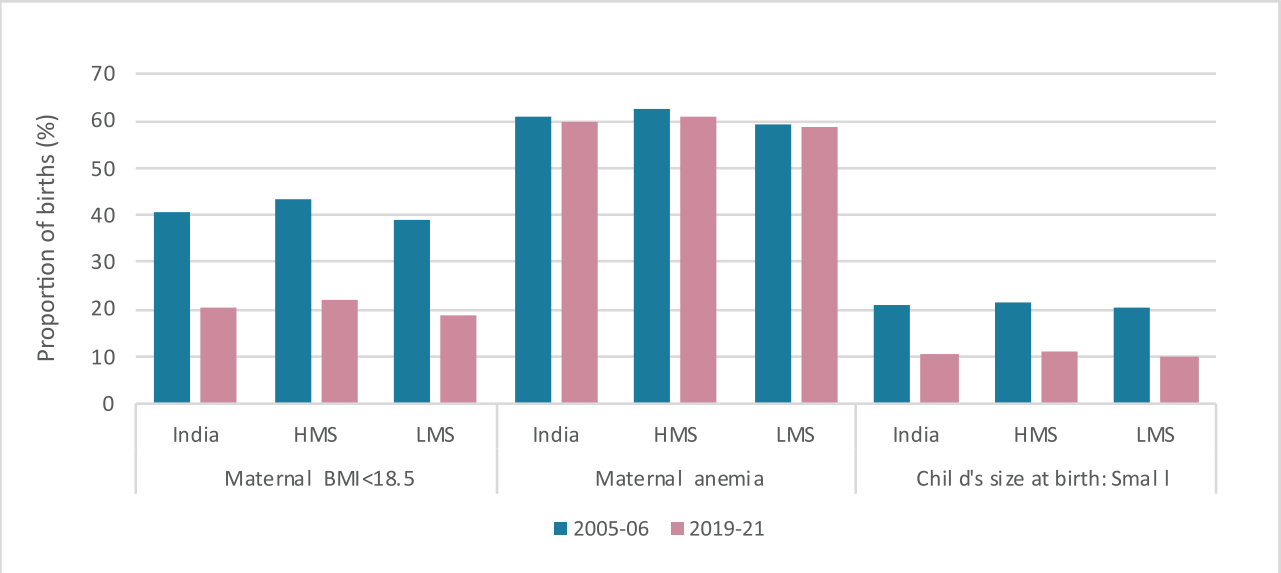
Maternal and Newborn Nutritional Status

India experienced a dramatic improvement in maternal nutrition status during 2005-2021. The proportion of births to women with a BMI of 18.5 or less decreased from 41% to 20% between NFHS-3 and NFHS-5 (Figure 2.11). The impact on neonatal mortality was however small because the relative mortality risk associated with undernourished mothers was small. We estimated that the population attributable fraction of maternal nutritional status halved 8% in NFHS-3 to 4% in NFHS-5 (Annexure Table C8). The population attributable fraction of women's anemia, on the other hand, increased slightly from 4% to 6%, although the proportion of anemic women was similar between the two surveys. The NFHS asked for subjective size at birth for all newborns as well as numerical birthweight.

Based on estimates using the combined information[87,xxii]
The proportion of low birthweight babies in India declined
31% → 28%
2005-06 2019-21

Most population subgroups that had higher prevalence of low birthweight babies in 2005-06 (higher mortality states, rural, those with no maternal education, poorest households) experienced relatively faster declines in 2015-16 (Annexure Table C.6). The neonatal mortality rate associated with being reported as small or very small were high (55 per 1,000 live births in NFHS-3), and declined in NFHS-5 to 48.The neonatal mortality among babies reported as average or higher declined at a greater speed from 32% to 20% (Annexure Table C.8). The contribution of the reduction in self-reported small size at birth to the neonatal mortality decline was 21% during 2005-2019, according to a univariate decomposition analysis (Annexure Table C.8).

Figure 2.11: Trends in maternal nutrition, maternal anaemia and reported child's size at birth in India and state clusters (2005-06 and 2019-21)



[xxii] Half of infants reported as weighing exactly 2500 grams were counted as having low birth weight. A previous study counted one-quarter of infants reported as weighing exactly 2500 grams as having low birth weight (Blanc AK and Wardlaw T. Monitoring low birth weight: an evaluation of international estimates and an updated estimation procedure. Bulletin of the World Health Organization. March 2005, 83(3)).

3

UNDERSTANDING THE MAJOR INCREASES IN INTERVENTION COVERAGE

UNDERSTANDING THE MAJOR INCREASES IN INTERVENTION COVERAGE

Highlights

Coverage of key interventions such as antenatal care and institutional delivery increased since 1990, with a major acceleration during RCH II/NRHM (2005-2012), especially from 2008.

The increases in coverage of institutional deliveries, reaching 90% nationally in 2020, was largest in higher mortality states and in public facilities, and prominent among rural and the poorest populations, suggesting major effect of cash transfer programs during NRHM.

C-section rates overall increased to 24% in 2019, due to high rates in the private sector (47%) but also increases in institutional deliveries especially in the higher mortality states.

Family planning coverage in terms of demand satisfied by modern methods was already high in the 1990s but increased further to 84% in the recent survey, but gaps between higher and lower mortality states remained.

Quality of care in health facilities seemed to have improved, as indicated by improvements in the contents of ANC and reduced neonatal mortality rates among public and private facility births, while the volume of deliveries in health facilities doubled.

Overview

This chapter presents the coverage of interventions across the continuum of care. Coverage of interventions – promotive, preventive, curative – is directly associated with maternal and newborn survival. Coverage includes levels of contact and, where feasible, quality-adjusted coverage, and the degree that these are equitable between socio-economic groups and geographical regions. This was investigated using existing research studies, and our analyses of data from five rounds of NFHS and three rounds of District Level Household Surveys (DLHS) were pooled and a sample of over a million births during 1989-2020.[xxiii]

Trends in Intervention Coverage

Antenatal and Delivery Care: Major Coverage Increases, Especially During NRHM and in Higher Mortality States

Trends in any ANC, antenatal care with contents and intensity-related components (referred to as ANCq, which has a 13-point scale)[xxiv] and institutional delivery are shown in Figure 3.1 and Table 3.1.

The fastest increase in any ANC coverage was during RCH-I in the late nineties, followed by stagnation at around 74% during 2000-2005. After 2005, a more gradual increase occurred resulting in 94% coverage in 2018. India's institutional delivery rates increased since the early nineties and the increase accelerated from 43% in 2005 to 90% in 2018. The total number of births in health facilities increased from 11 million in 2005 to 24 million in 2018 (out of around 26 million births each).

There was a large gap between any ANC and ANCq (shown as at least 9 points out of 13) but during RCH II/NRHM this gap narrowed, indicating more ANC visits, earlier initiation and better contents of care. [88,xxv]

[xxiii] The five rounds of National Family Health Survey (NFHS) conducted during 1992-93 (NFHS-1), 1998-99 (NFHS-2), 2005-06 (NFHS-3), 2015-16 (NFHS-4), and 2019-21 (NFHS-5) included information on antenatal and delivery care indicators for the births during 1989-1992, 1996-98, 2001-2005, 2011-2015, and 2015-2018. The three rounds of District Level Household Survey (DLHS) conducted in India during 1998-99 (DLHS-1), 2002-03 (DLHS-2), and 2007-8 (DLHS-3) included information on antenatal and delivery care indicators for the births during 1995-99, 1999-2004, and 2004-2008, respectively. As the name suggests, these surveys were designed to get program coverage estimates at the district level, and all the districts in India were covered.

[xxiv] ANCq is a composite indicator, consisting of number of ANC visits, timing of ANC, at least one ANC by skilled provider, blood pressure checked, weight measured, abdomen examined, blood sample collected, urine sample collected, and the number of tetanus toxoid. ANCq developed and first used by Arroyave et al., was adapted to the Indian context.

[xxv] Trends in specific components of ANC quality were also examined. All components of quality improved during the RCH-II/NRHM period, except TT which had the highest coverage across time periods.

Figure 3.1: Trends in any ANC, ANCq and institutional delivery (%) in India and by state cluster (NFHS and DLHS pooled data, 1989-2018)

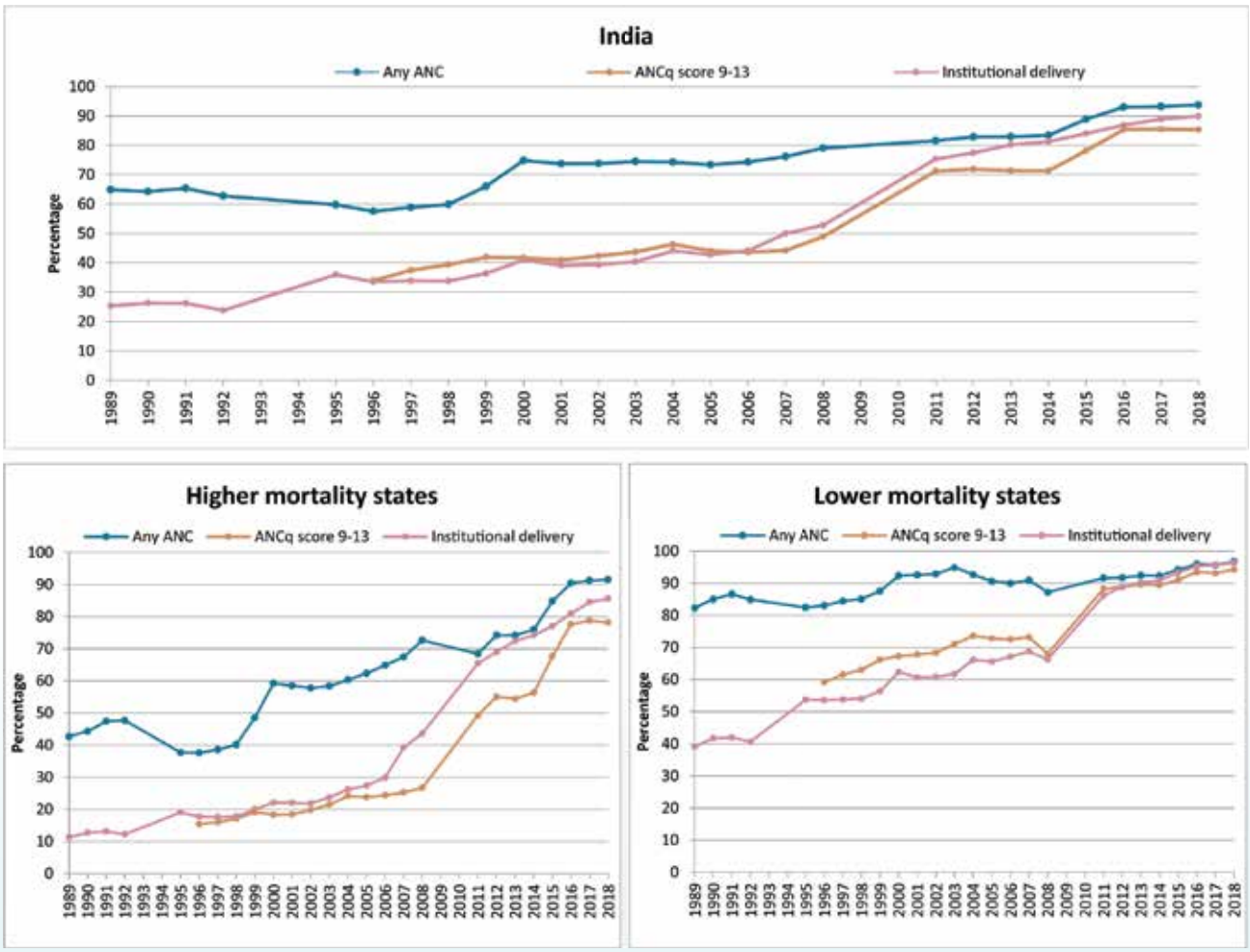


Table 3.1: Average annual rates of change (AARC) in any ANC, ANCq score of 9+ and institutional delivery in different policy periods in India (NFHS and DLHS pooled data, 1989-2018)

Policy period	Any ANC	ANCq 9+	Institutional delivery
1992-97 (CSSM)	-1.3	NA	7.0
1997-2005 (RCH-I)	2.8	2.0	2.9
2005-12 (RCH-II/NRHM)	1.7	7.0	8.5
2012-18 (NHM/RMNCH+A)	2.1	2.9	2.5

Intervention coverage improved in both state clusters for all three intervention indicators throughout the study period (Figure 3.1). In the lower mortality states, the increase was gradual from a higher baseline in 2000, with all three coverage indicators reaching about 90% by 2013. The most impressive finding however is the prolonged, steep increase in the higher mortality state cluster from low rates in the early 2000s, reaching 78-92% by 2018. Another study also found that by 2015 there was an increase in ANC 3+ and contents particularly in EAG states, where rates were lower, though the gap remained.[89]

Looking at institutional delivery in more depth by state cluster, the changes over time in the lower mortality state cluster included a steady, almost linear, increase in institutional births from 39% to 96% during 1989-2018 with a modest acceleration during 2008-2011. The higher mortality states showed a different pattern in institutional deliveries, increasing steadily at a high pace (AARC 5.5%) from 11% in 1989 to 27% in 2005, and then a major acceleration during NRHM to 65% in 2011 (AARC 14.5%) with continued increases to 87% in 2018.

Public Facilities Account for the Major Increase in Institutional Deliveries Overall and in Higher Mortality States

Public facility deliveries increased fastest during 2005-12, corresponding to RCH-II/NRHM period (Figure 3.2), as shown in other studies.

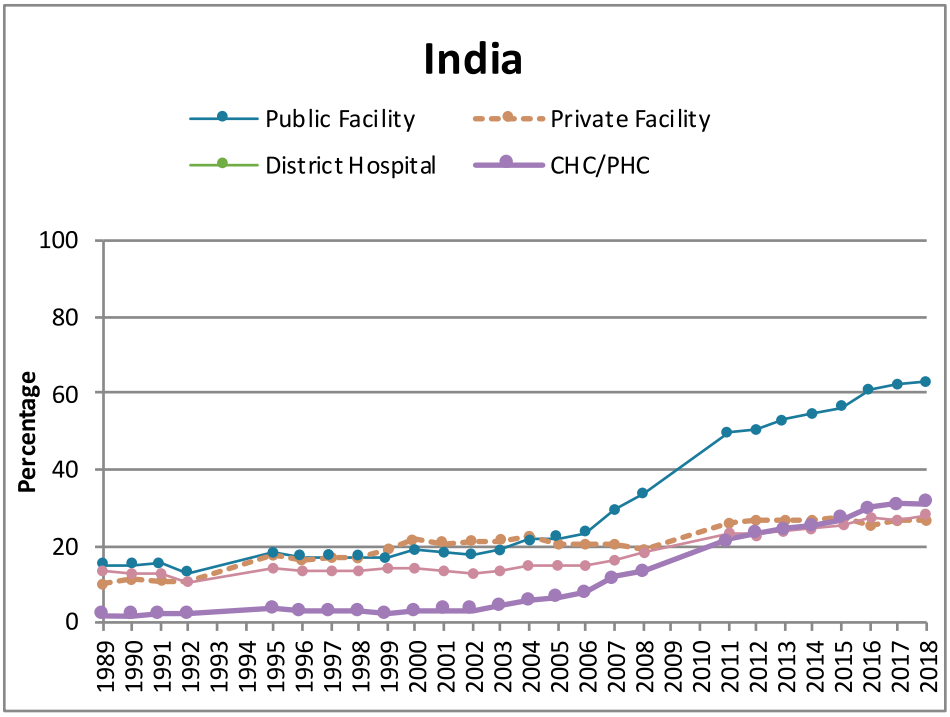
The share of deliveries among all institutional deliveries that occurred in public facilities increased from

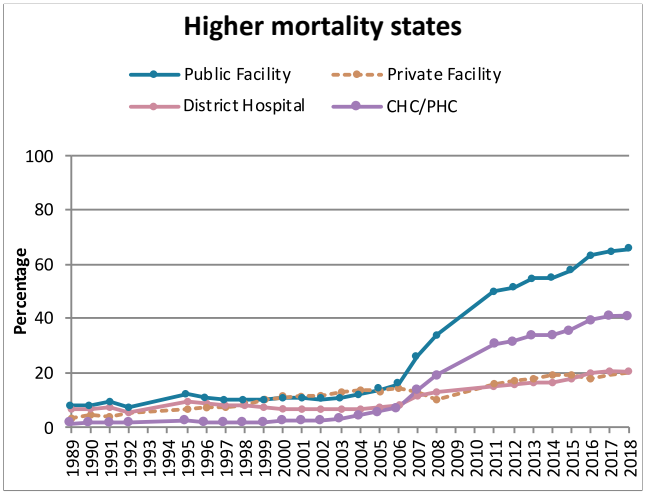
47% (2000) → 70% (2018)

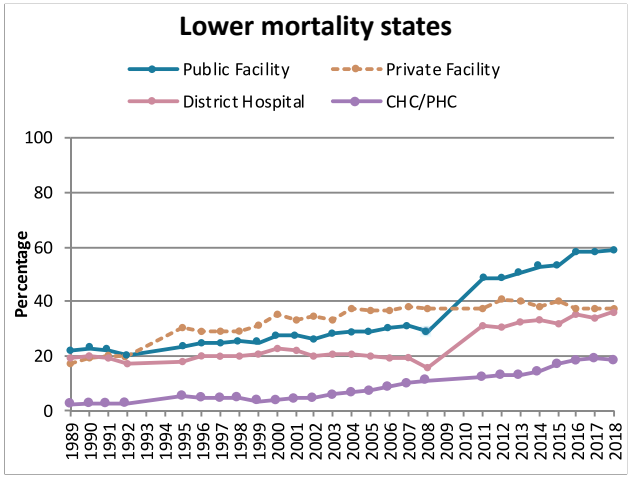
District public hospital deliveries experienced a gradual increase over time from handling 15% to 28% of all deliveries during 2000-2018, but deliveries in CHC/PHC increased more dramatically, from just 3% in 2000 to 14% in 2008 and then to 31% in 2018. Private facility deliveries gradually covered a larger proportion of India's births, increasing from 10% in 1989 to 22% in 2000 and 27% in 2018. As a share of all institutional deliveries, private facilities decreased from a little over half of all live births in 2000 to less than a third in 2018.

Looking at state clusters, it is apparent from Figure 3.2 that the steady increase in institutional delivery rates in lower mortality states was driven first by a steady increase in private sector and then from 2008 by a more concentrated increase in public sector deliveries. By 2011, public facilities emerged as a leading player in conducting more deliveries than the private facilities. In 2018, public facilities conducted three-fifths of all institutional deliveries, mainly in district hospitals. In the higher mortality states, the public sector played a major role in the rapid increases in institutional delivery rates, and the increase was especially notable in CHC/PHC.

Figure 3.2: Trends in institutional delivery by health facility type, India and state clusters (NFHS and DLHS pooled data, 1989-2018)







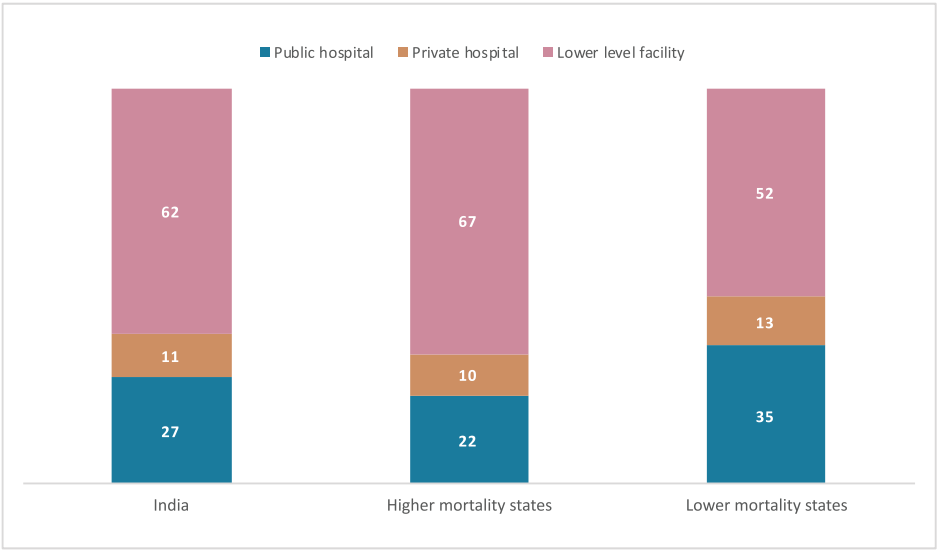
In absolute terms, 88% of the increase in institutional deliveries in India occurred in the public sector between 2005-06 and 2019-21; slightly more in the higher mortality states than in the lower mortality states (Figure 3.3). The private sector share of all deliveries increased from 21% to 27%, and played a far greater role in the lower mortality compared to higher mortality state clusters (38% and 20% of all deliveries in 2019-21, respectively).

Figure 3.3: Trends in institutional delivery in public and private health facility, India and state clusters (2005-2021)

The Increase was driven by Lower-Level Health Facilities in the Higher Mortality States and by all Facilities in the Lower Mortality States

For India, the largest contribution to the institutional delivery increase came from lower level health facilities (including CHCs, PHCs, HSCs, and private non-hospitals), followed by public hospitals and then private hospitals (Figure 3.4). In the higher mortality states, 67% of the increase in institutional deliveries came from lower-level health facilities which accounted for 45% of births by 2019-21. In the lower mortality states, about half (48%) of the increase came from hospital births, which accounted for nearly three-quarters of births by 2019-21.

Figure 3.4: Percentage contribution of deliveries at lower level facilities and hospitals to the increases in institutional deliveries during 2005-21, India and state clusters (2005-06 and 2019-21)



Caesarean Sections Increased to 24% of Live Births, Driven by Both Private and Public Sectors

The caesarean section (or c-section) rate among all live births increased from just 2% in 1990 to 8% by 2000, then 16% in 2011 and 22% in 2018, paralleling the massive increase in facility deliveries (Figure 3.5).

The c-section rates after 2010 exceeded the WHO indicative threshold of 10-15% of deliveries, though the national figure obscures over-use in some states/populations and under-use in others.[92,93,94] The main increase occurred during the nineties, followed by the NRHM period (AARC 2005-2012 8.6%). In India overall, around 4-5% of all live births in the private sector were C-sections between 1996 to 2008, but this increased to 13% by 2018.

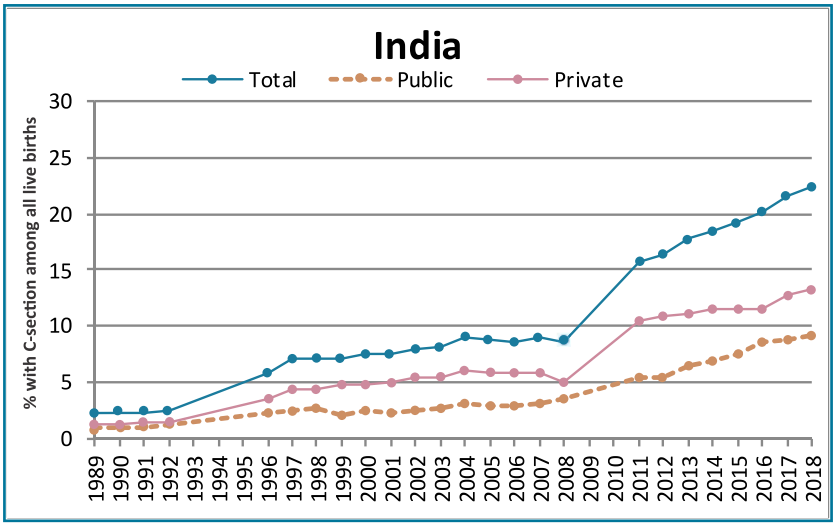
Most c-sections took place in the private sector and this proportion changed marginally over time: from 65% in 2000 to 59% in 2018.

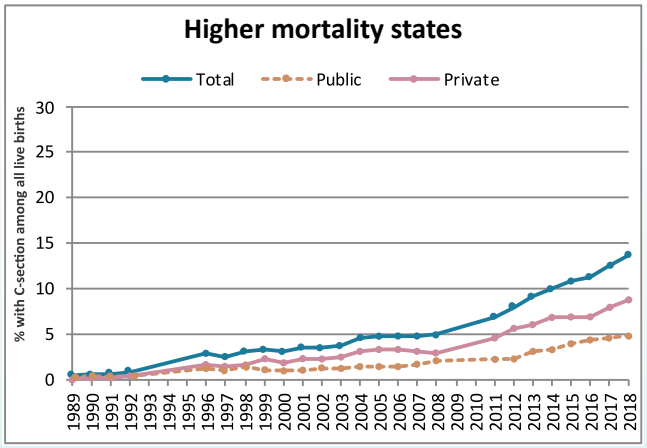
The public sector conducted more c-sections over time: 2.5% in 2000, 3.6% in 2008 and 9.2% of all live births in 2018. The main increase occurred during the NRHM period.

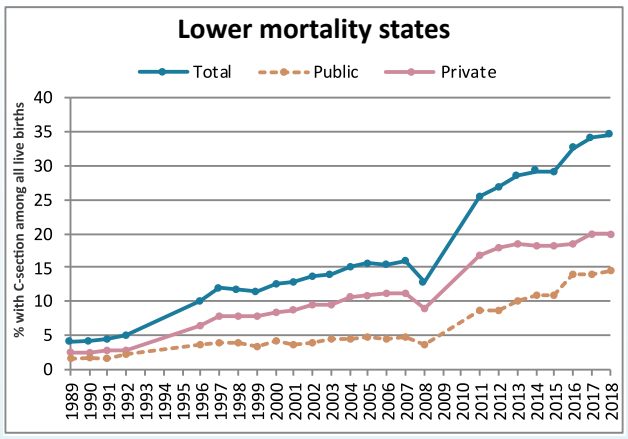
In the lower mortality states cluster, c-section rates increased during the nineties, and again rose rapidly from 2008-2011 from 13% to 25%, driven by increases in both private and public sectors (Figure 3.5). The former accounted for more than half of all C-sections.

C-section rates increased in the higher mortality states as well, following the increases in institutional birth rates with a few years' time lag, from 5% in 2008 to 14% in 2018. The increase was initially driven by a private sector increase but more recently also by the public sector increase. Nearly two-thirds of c-sections took place in the private sector with little change over time.

Figure 3.5: Trends in c-section rates among all live births by facility type (public and private), India and by state cluster (NFHS and DLHS pooled data, 1989-2018)







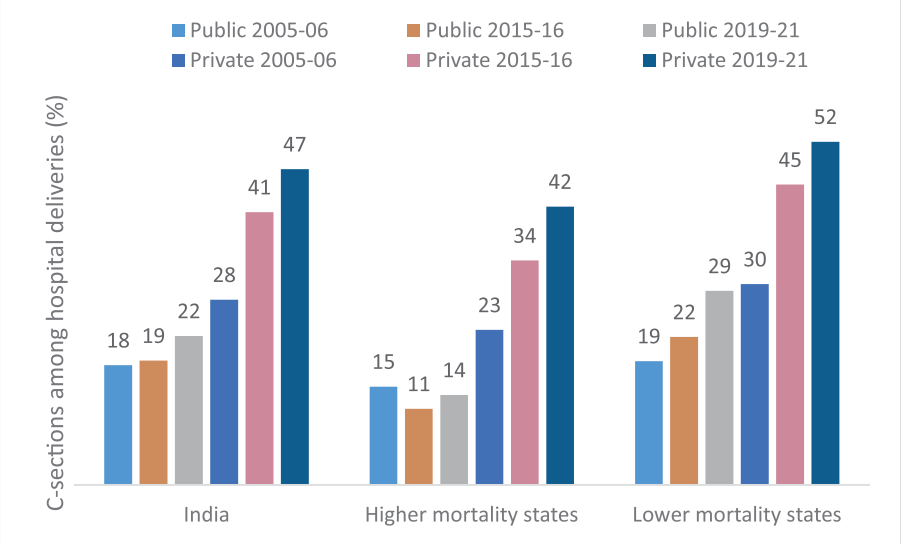
Institutional C-Section Rates among Hospital Births has Increased in the Recent Periods for Public And Private Hospitals but Major Increase in Private Hospitals

For public hospitals, institutional c-section rates increased marginally (from around 19% during 2005-15 to 22% in 2019-21), but there was a major increase (from 28% to 47%) in private hospitals (Figure 3.6). The c-section rate in public hospitals remained almost similar at 14-15% in higher mortality states. It may be recalled here that the volume of deliveries in public hospitals in higher mortality states remained more or less constant at 20% during this period (Figure 3.2). In contrast, the c-section rate in public hospitals in lower mortality states increased from 19% to 29% during the same period, where the public hospital deliveries had more than doubled. The major increase in c-section rates in private hospitals occurred in both the state clusters.

The institutional c-section rate - the percentage among live births - gives an idea of the extent to which facilities were able to cope with increased numbers of deliveries. Among women delivering in a private institution, the c-section rate was 47% in 2019-21, up from 28% in 2005-06. This may be due to increasing use of non-medically indicated c-section, especially among wealthier women, but could also be due to more out-referrals for c-section from public to private sector.

The institutional c-section rate in the public sector was 22% in 2019-21 and changed only marginally during the past two decades. This suggests that public facilities were generally able to cope with the massive increase in deliveries by stepping up the numbers of c-sections proportionally.

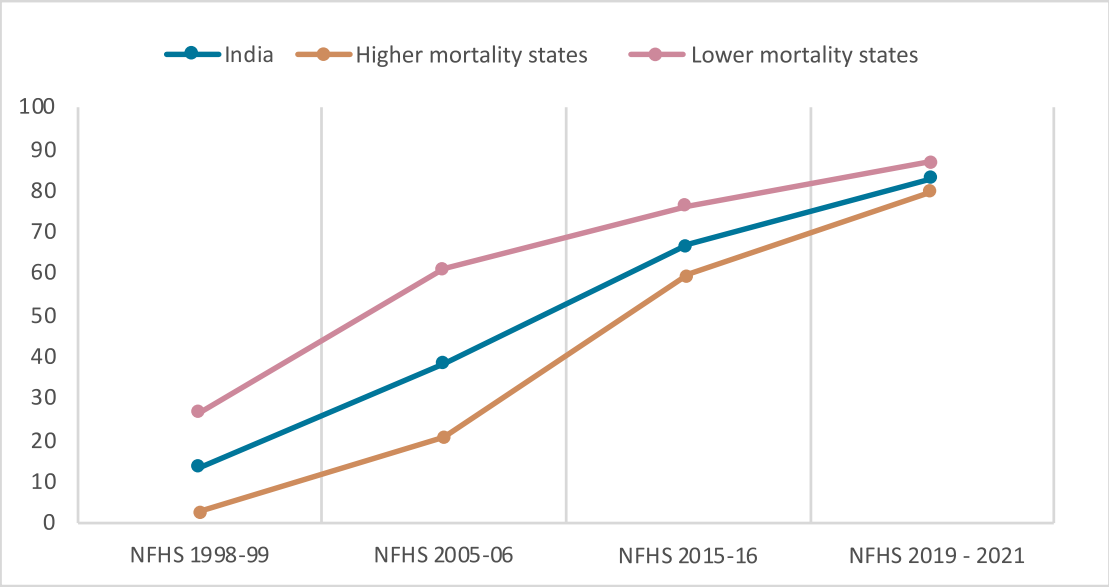
Figure 3.6: Institutional c-section rates by facility type, India and state clusters (2005-06, 2015-16, 2019-21)



Postnatal Care and Essential Newborn Care Improvements Including Early Initiation of Breastfeeding

Figure 3.7 presents the percentage of mothers/newborns who had a postnatal check-up during 0-2 days after delivery, either in the facility or at home by either a trained professional such as a nurse, ANM or a doctor or a community health worker. Coverage of any postnatal care (PNC) check-up increased five-folds from 13% for births during 1998-99 to 83% for births during 2019-21. The PNC coverage was better in lower mortality states compared to the higher mortality states in all time periods. However, the increase was steeper in higher mortality states.

Figure 3.7: PNC coverage for either the mother or the child within 0-2 days after delivery, India and state clusters (1998-2021)



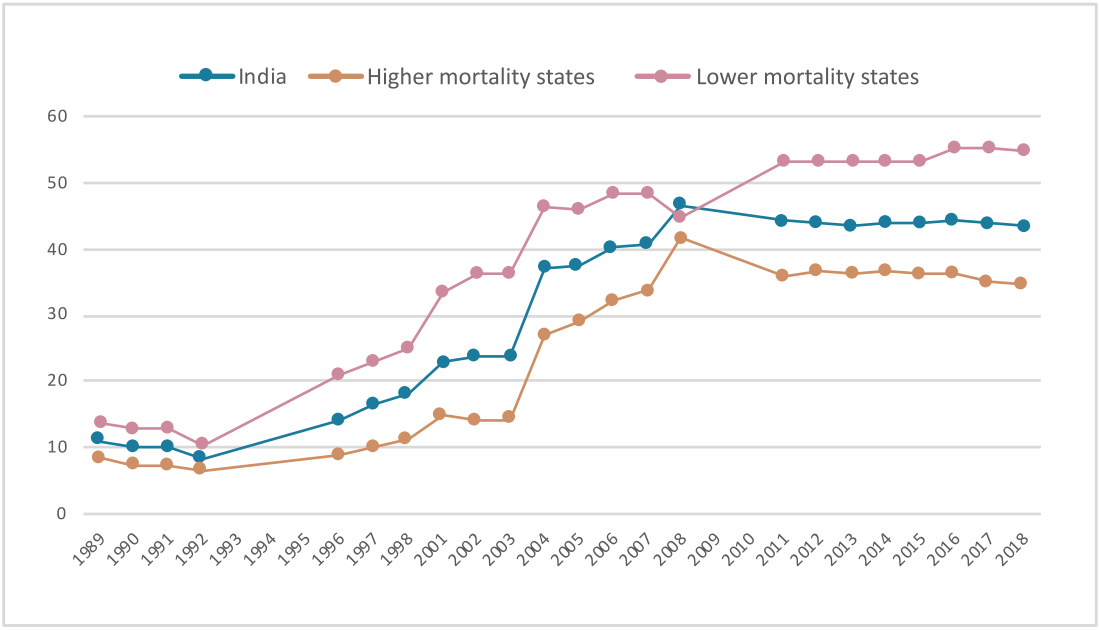
While the majority of neonates who received routine PNC received it through the public sector (whether in the government facility following delivery or in the home by outreach workers), the majority of newborns who required healthcare due to illness received it through the private sector.[95] Other research showed that PNC coverage was consistently higher among those who received any ANC and institutional delivery.[96] PNC visit coverage was also higher among those with a hospital stay of at least 48 hours.

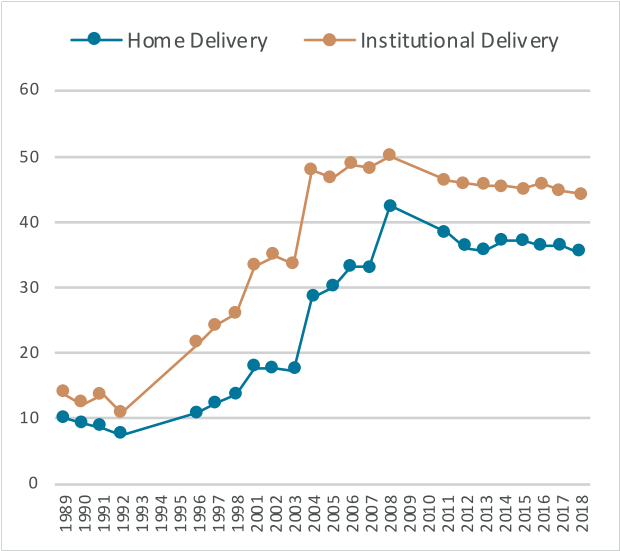
Among vaginal deliveries, staying at least 48 hours was a bit higher in public than private facilities (25% vs. 19% respectively in NFHS-4).[97]

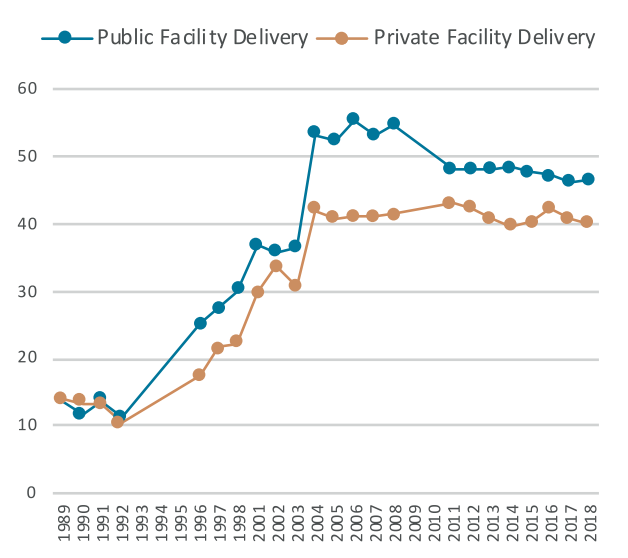
Early essential newborn care includes basic interventions that protect newborns against infection-related mortality, hypothermia and stimulate breathing such as drying, skin-to-skin contact, delayed cord clamping, breastfeeding initiation, and delayed bathing. In NFHS 2005-06 and 2015-16: clean cord care was already high (93 to 96%) but immediate drying of the newborn rose from 40 to 81%.[98] Early initiation of breastfeeding and avoidance of pre-lacteal feeding increased by 20 and 30 percentage points, respectively between 2005-06 and 2015-16, while exclusive breastfeeding remained at 45% between 1995 to 2009, then also rose by 10 points by 2015-16.[99] Clean cord care and kangaroo mother care were also higher among those with ANC and institutional delivery, and therefore increased with the increase in institutional deliveries.[100]

Although early initiation of breastfeeding (within the first hour after birth) doubled (from 23% to 47%) during 2001-2008, although it remained at around 40%-44% since 2011 (Figure 3.8). The positive trends were observed in both higher and lower mortality state clusters, with stagnation in both clusters post-2010. Institutional births consistently had higher rates of early breastfeeding compared to home births, but early breastfeeding also increased among home births. Public and private facility births showed major increases in early initiation of breastfeeding prior to 2005, but not later. The high rate of c-section in private facilities may have led to lower early breastfeeding, since initiation can be delayed by anaesthesia. Other studies have also shown an increase among those with ANC, institutional delivery, and PNC within 48 hours, but lower among c-sections.[101,102,103]

Figure 3.8: Trends in early initiation of breast feeding for India and state clusters; for India by place of delivery; and for India by public and private facility deliveries (NFHS and DLHS pooled data, 1989-2018)



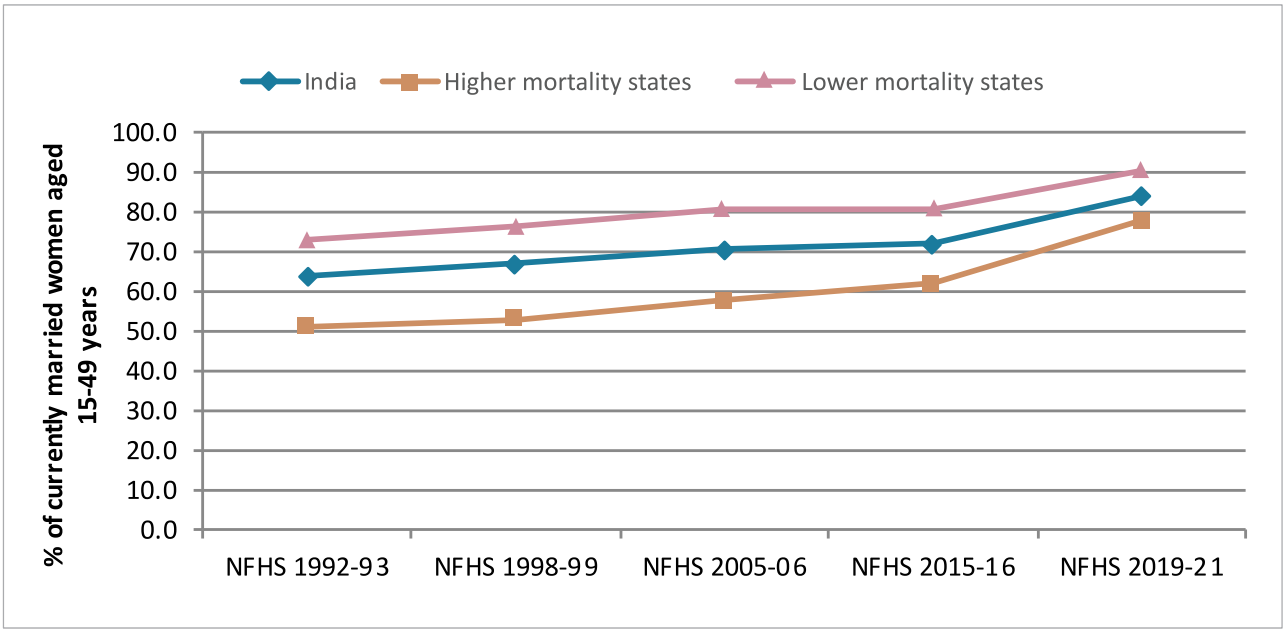




Modest Increase in Family Planning Coverage which was already High in The Nineties

Trends in family planning coverage were analyzed in terms of the contraceptive prevalence rate (CPR) using five rounds of NFHS data (Figure 3.9). Based on demand satisfied with modern contraceptive methods, CPR among currently married women changed only marginally between 1992 to 2016, however, it showed a major increase from 72% in 2015-16 to 84% in 2019-21 nationally.

Figure 3.9: Trends in demand satisfied for modern methods of family planning, India, higher and lower mortality clusters (1993-2021)



The gap between both higher and lower mortality state clusters show a steady decrease over time, although the gap is still as wide as 12 percentage points (78% and 90%, respectively) in 2019-21. In terms of specific methods, previous research on family planning in India showed that use of spacing methods and delaying first pregnancy was uncommon in the 1990s.[104] The proportion of families using temporary modern contraceptives has increased in many regions according to the four rounds of NFHS, but the majority still used permanent methods and mainly female sterilization in 2015/16.[105,106,107,108]

In the 1990s to early 2000s, studies showed that induced abortion rates were low (around 30 per 1000 women aged 15-49 years).[109,110] By 2015, the abortion rate had risen to an estimated 47 per 1000 women, of which 10.1 per 1000 was facility-based (6.5 surgical, 3.6 medication), while 34.4 per 1000 were medication abortions outside facilities.[111] According to studies in both 2001-3 (in 13 states) and in 2015/16 (NFHS-4 and Health Facilities Survey), 50 to 75% of surgical abortions occurred in private clinics.[112,113,114] The proportion of facility-based abortions in public hospitals reduced from 37% to 20% between 2001 and 2015, and much fewer in PHCs or CHCs than district hospitals. Multiple studies reported that by 2015-16, a much larger proportion occurred outside facilities through medication.[115,116,117,118,119,120,121,122,123]

Inequalities in Intervention Coverage

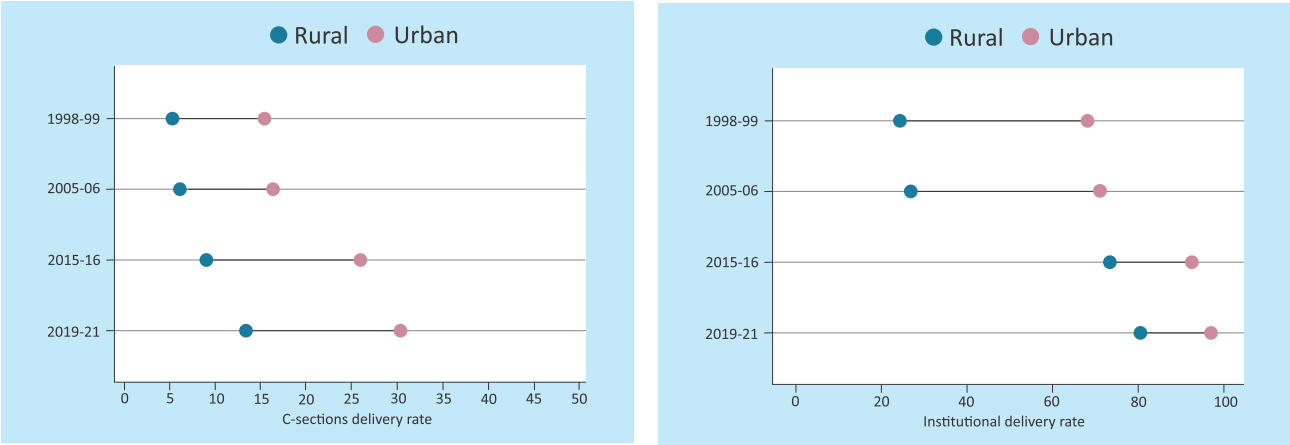
Inequalities decreased due to Greater Progress among Rural and other Disadvantaged Populations

Trends in inequalities in coverage by rural/urban residence, maternal education, household wealth (only from the NFHS), caste/tribe and religion were examined for any ANC, ANC with content, institutional delivery and c-section. In general, patterns were similar across indicators and stratifiers (more versus less disadvantaged). Several studies have documented positive changes in socioeconomic inequalities in the key coverage indicators.[124,125,126,127] This also applied to family planning. Higher use of modern contraceptives has been associated with higher levels of education, urban residence and wealth, but inequalities reduced substantially by 2015-16.[128,129,130,131] Wealth inequalities in use of modern contraceptives reduced for those who accessed contraceptives in both the public and private sectors but particularly in the public sector between NFHS 1-4. [132]

We focus on delivery coverage trends by urban-rural residence. Rural institutional delivery rates have increased from 25% in 1998-99 to 87% in 2019-21 (Figure 3.10). The major acceleration occurred during the NRHM period from 29% (2005-06) to 75% (2015-16). In urban areas, two-thirds of live births took place in health facilities as early as 1998-99 (a level reached by rural births between 2005 and 2015) and urban rates increased further to 94% in 2019-2021. During NRHM, the increase in urban areas was less dramatic, from 68% (2005-06) to 89% (2015-16).

The c-section rates followed a similar pattern of increase, but the urban/rural gap remained two-fold and worsened in absolute terms. Rural coverage however reached 18% by 2019-21, up from 5% in 1998-99, and in theory, sufficient to meet the need for c-section of all women.

Figure 3.10: C-section and institutional delivery rate by rural/urban residence in India (1998-21)



Spectacular Progress for the Poorest During NRHM Cash Transfer Programs

Inequalities in institutional births and c-sections were most pronounced by wealth tertile compared to place of residence (urban-rural) (Figure 3.11) or any other characteristic. By 2005-06, institutional delivery and c-section coverage among the poorest were still as low as 19% and 3%, respectively. The corresponding figures in the richest tertile were 81% and 25%.

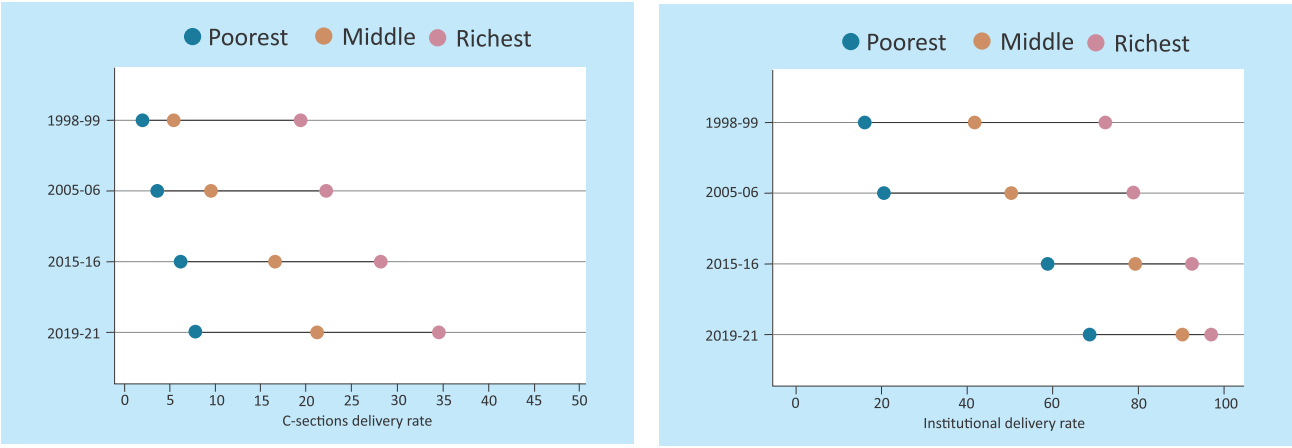
Over the course of NRHM, the situation changed dramatically and further improved during NHM/RMNCH+A,

Institutional delivery rates among the poorest
79%

Near Universal coverage among the richest
96% during 2019-21.

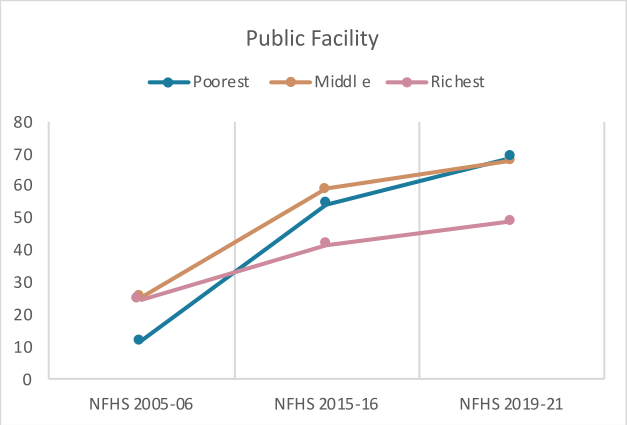
The c-section rates also increased in both groups but still tell a story of extraordinary inequality: 9% among the poorest – still indicative of inadequate access – and no less than 35% among the richest – indicative of heavy overuse for non-medical reasons.

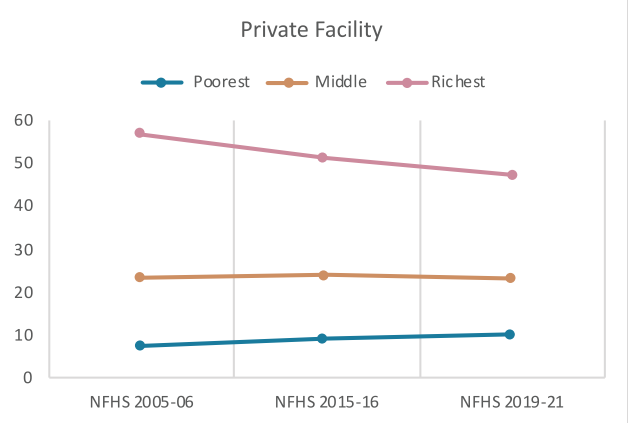
Figure 3.11: Institutional and c-section deliveries by household wealth tertile (NFHS, 1998-2021)



We further analysed institutional delivery coverage by asset ownership and public/private facility in the more recent three rounds of NFHS (Figure 3.12). The public facility births increased tremendously in all wealth tertiles except the richest where the increase was modest. For private facility births, coverage hardly increased in any wealth tertile and a massive gap between the poorest and richest persisted (10% and 47%) during 2019-21. These patterns were observed in both state clusters.

Figure 3.12:Coverage of institutional births among all live births for public hand private health facilities by wealth tertile, India (2005-21)





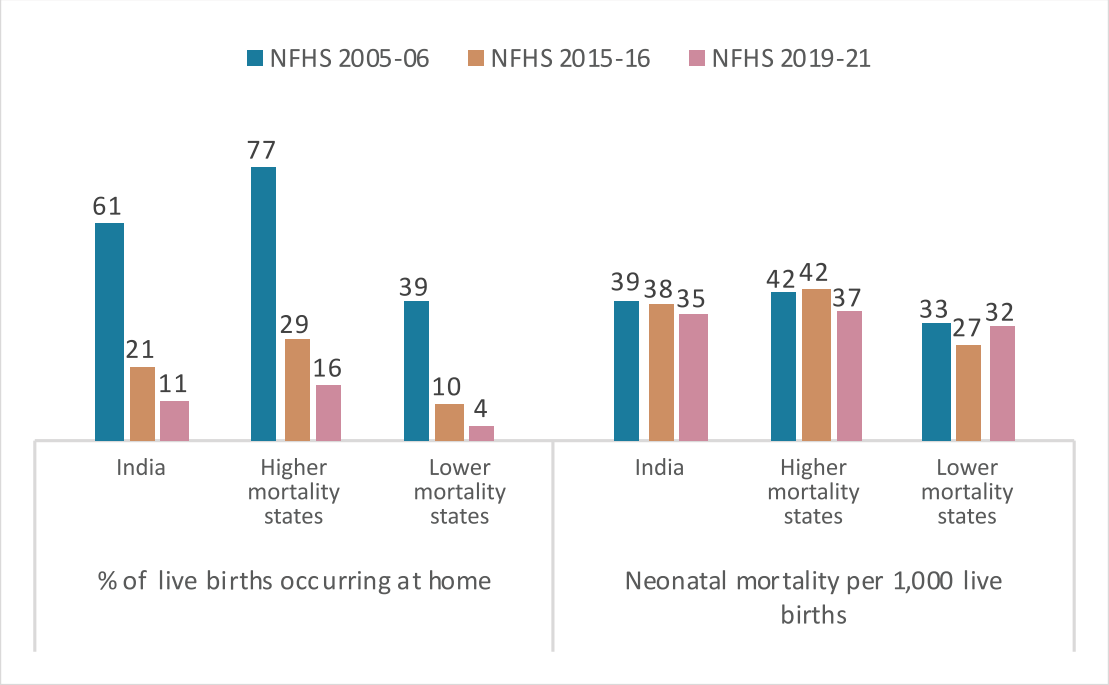
Differences in Neonatal Mortality by Intervention Coverage

Several studies have reported on the association between antenatal and delivery-related intervention coverage and NMR. The most critical lifesaving interventions for women and neonates are delivered at the time of birth. Therefore, we focus here on the changes in the association between institutional delivery coverage and NMR. We conducted similar analyses for the ANC indicators (any ANC and ANCq).

Neonatal mortality among home births declined marginally during 2005-19, but did not contribute to India's mortality decline, except a small positive effect in the higher mortality states

Over the past one and a half decades, home births in India decreased from 61% to 11% (Figure 3.13). Neonatal mortality among home births declined only marginally from 39 per 1000 live births in 2005-06 to 35 in 2019-21, mainly coming from higher mortality state cluster.

Figure 3.13: Percentage of home births and neonatal mortality among home births, India and state clusters (2005-21)

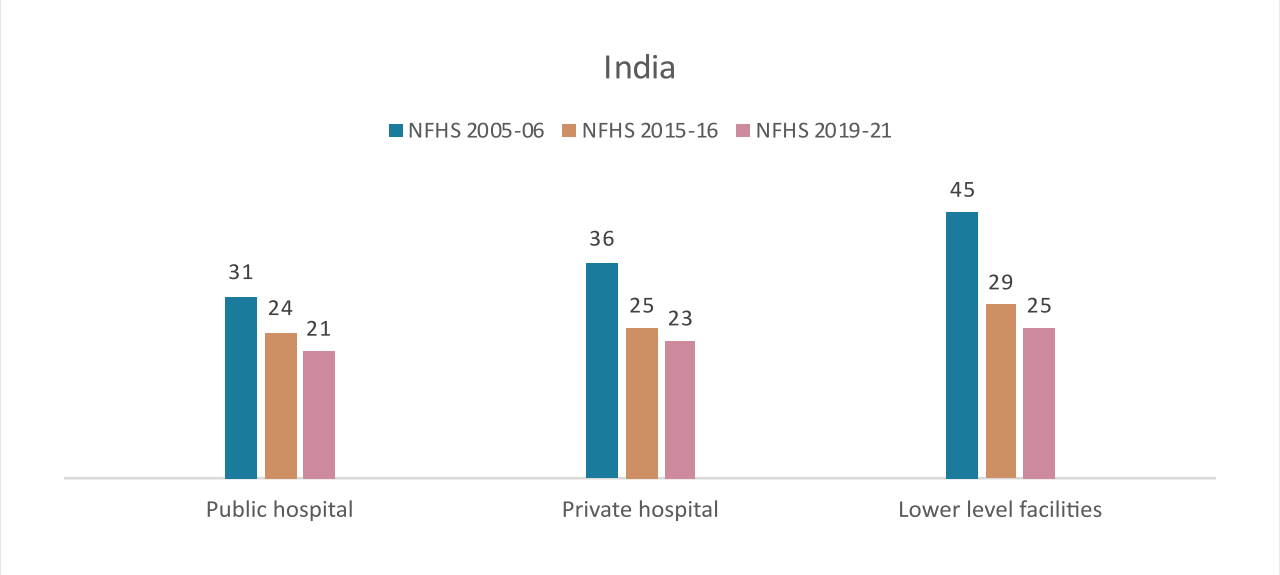


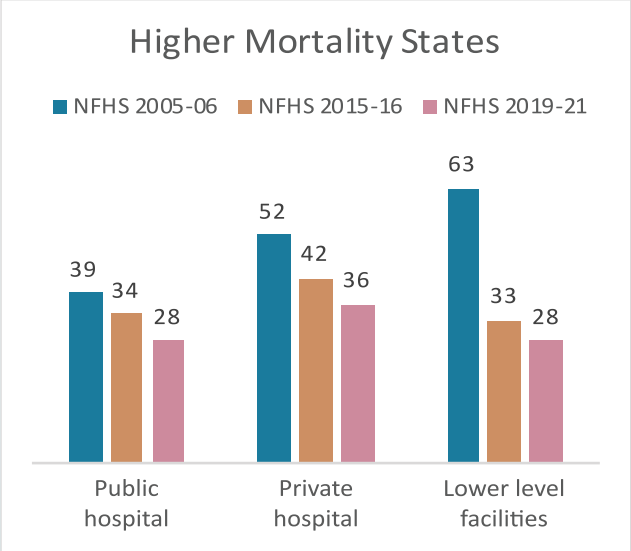
Major Mortality Reductions among Facility Births While Number of Deliveries Increased Rapidly

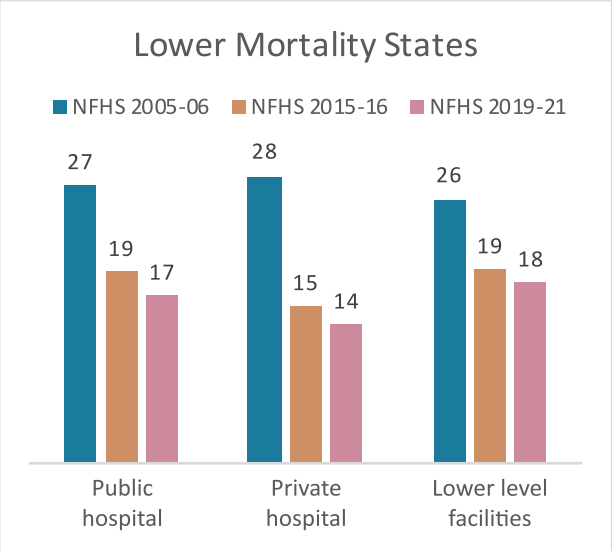
The neonatal mortality among babies delivered in health facilities, both public and private, experienced major declines to nearly 22 per 1,000 live births (Figure 3.14). Since health facility deliveries more than doubled during 2005-2019, especially in public facilities, this shift into lower mortality risk settings had a major impact on overall NMR. Mortality in the lower mortality state cluster showed a steeper decline, especially for private sector births, and a modest decline in home deliveries. The higher mortality state cluster initially had higher mortality among facility births than among home births, presumably due to a selection bias of facility deliveries in low coverage settings. The major decline in NMR among public facility deliveries, likely due to a major increase in lower-risk births in facilities and improvements in the quality of care, radically changed this situation against a backdrop of major increases in coverage. Private sector NMR also declined but much less so, which is possibly due to increased movement of high-risk deliveries from public to private sector facilities.

The contribution of the shift from home to facility deliveries to NMR reductions is large in higher mortality states (37% of the decline), compared to 41% in lower mortality states and 47% for India overall (Annex Tables C.8, C.9 and C.10). The remaining proportion of the decline is associated with the changes in the mortality rates in facility and home deliveries.

Figure 3.14: Neonatal mortality per 1,000 live births by place of delivery, India and by state cluster(2005-06, 2015-16, and 2019-21)







Neonatal Mortality Dropped Rapidly as Institutional Delivery Coverage Increased and is Strongly Associated with Increases in Hospital and C-Section Deliveries

The relative reduction in NMR compared to the corresponding increase in institutional delivery coverage was much greater in the lower mortality states than in the higher mortality states (slopes: HMS -0.22, LMS -0.40) (Figure 3.15). The lower and higher mortality states difference in mortality gains associated with delivery coverage is much smaller if only hospital delivery coverage is considered (slopes: HMS: -0.67, LMS -0.84) (Figure 3.16).

Figure 3.15: NMR by institutional delivery coverage, by India state and cluster (2005-2020)

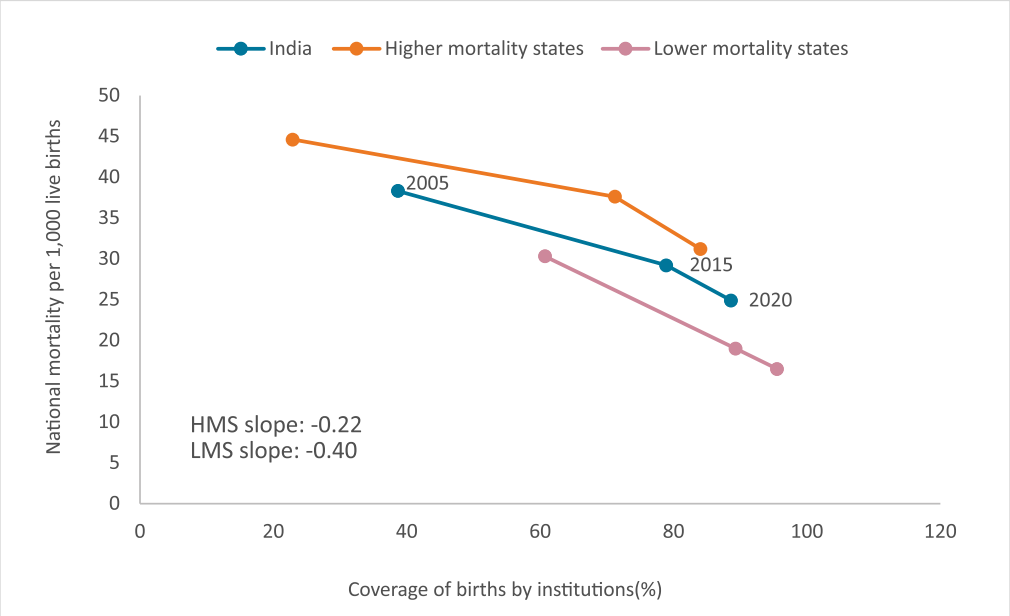
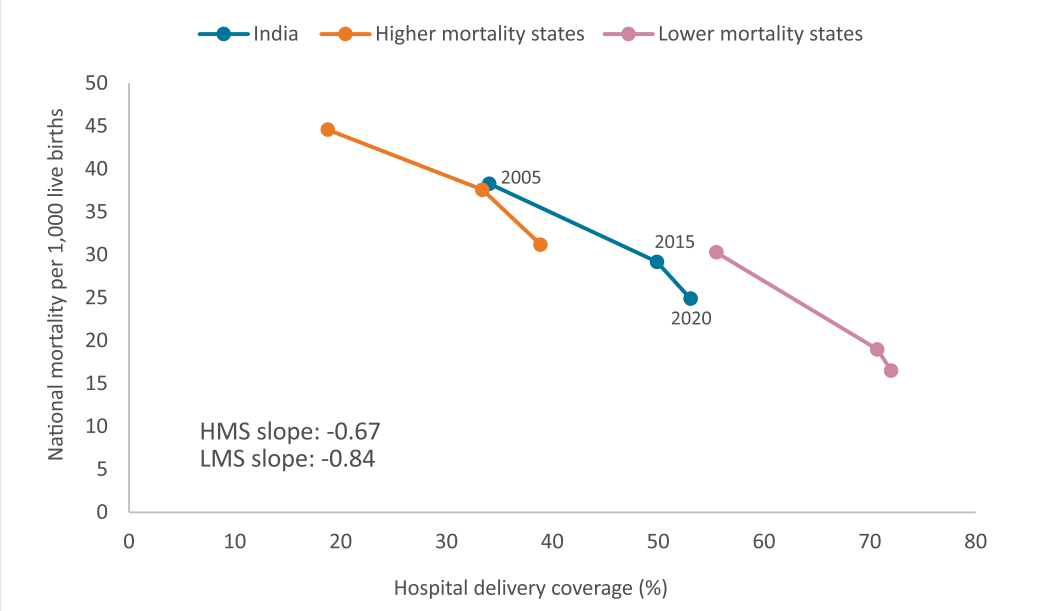
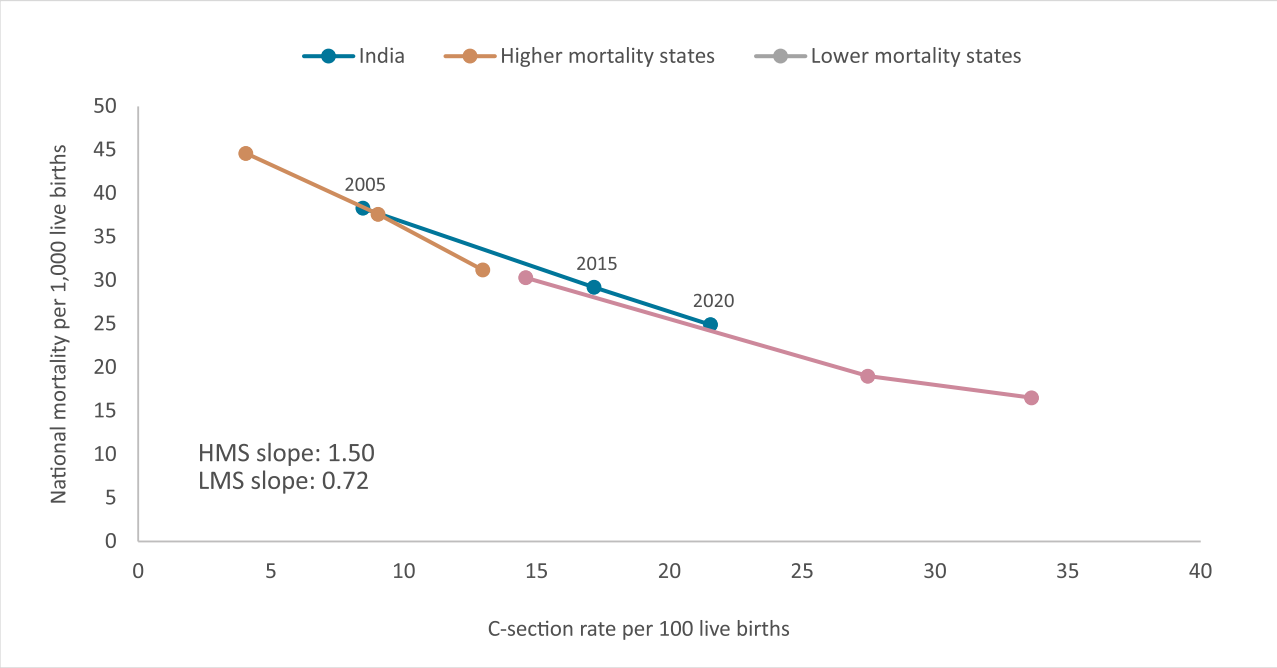


Figure 3.16: NMR by hospital delivery coverage, by India state cluster (2005-06 to 2019-21)



The increase in c-section rate at national and state cluster levels is associated with NMR declines (Figure 3.17). Also, in the lower mortality states, the increase in c-section rate from 15% in 2005-06 to 27% in 2015 was associated with major NMR reductions, but beyond that there was no substantial decline in NMR.

Figure 3.17: NMR by c-section rate, by state cluster(2005-20)



We also examined the changes in NMR over time by public and private facilities and wealth tertile. There is a clear gradation in NMR among private facility deliveries by wealth tertile in both the NFHS-3 and NFHS-5 (data not shown). The large gap between the poorest and richest in NMR among private sector deliveries persisted in both survey rounds, likely linked to the wide range in quality and cost across private facilities and the different case mixes among the poor and rich delivering in private facilities. This is predominantly the pattern in the higher mortality state cluster, where there was a very large wealth gap in NMR in private facilities. The NMR differences by wealth in private facilities were smaller in the lower mortality cluster, and more notably, there was no difference between public and private facilities.

Maternal and Newborn Lives Saved (LiST) by Specific Interventions

The results of a LiST modelled analysis of the additional maternal and newborn lives saved in India, associated with the scale up of interventions in 2018 in comparison with year 2000 are presented in Table 3.2. The model inputs are empirical data from sample registration, surveys and research studies, combined with default values of effectiveness of these interventions in reducing mortality.

For maternal lives saved, parenteral administration of uterotonics emerged as the most important intervention (30% of all lives saved in 2018 compared to 2000), contributing to a major reduction in hemorrhage, the leading cause of maternal death. Parenteral administration of antibiotics, contraceptive use, and clean birth environment each accounted for more than 10% of lives saved. C-sections followed with 7% of lives saved. BEmONC interventions saved the majority of lives (about 73%) and CEmONC (blood transfusion and C-sections) added another 10%.

The LiST model for neonatal mortality suggests that the greatest number of neonatal lives were saved by case management of sepsis/pneumonia (21%), followed by c-sections (15%) and thermal protection (11%). Some interventions appear in both listings with at least 5% of lives saved, notably c-section and clean birth environment.

Table 3.2: Percent distribution of maternal and neonatal lives saved in 2018 compared to 2000, based on the scale-up of interventions, LiST model

Maternal lives saved	%	N	Neonatal lives saved	%	N
Parenteral administration of uterotonics	29.6	12772	Case management neonatal sepsis/pneumonia	21	107058
Parenteral administration of antibiotics	14.3	6174	C-section	14.5	74228
Contraceptive use	13.8	5961	Thermal protection	10.8	55146
Clean birth environment	11.2	4845	Case management premature babies	9.6	48813
C-section	7.4	3219	Clean cord care	9.2	47104
MgSo4 for eclampsia	5.6	2425	Neonatal resuscitation	8.5	43185
Antibiotics for preterm or prolonged rupture of membranes (PROM)	4.7	2037	Immediate drying and environmental stimulation	7.5	38305
Manual removal placenta	3.8	1630	Clean birth environment	6.5	33153
Removal retained placental products of conception	3.3	1437	TT vaccination	3.6	18355
Blood transfusion	2.7	1161	Assisted vaginal delivery	3.5	18037
Safe abortion care	2.4	1043	Antibiotics for preterm or PROM	2.7	13544
Hypertensive case management	0.7	305	Parenteral administration of antibiotics	2.7	13544
Malaria control	0.3	141			
Tetanus toxoid	0.2	65			
	100	43215		100	510472

4

HEALTH SERVICE AND PROGRAM LEVERS

HEALTH SERVICE AND PROGRAM LEVERS

Highlights

Availability of rural public community health centres (CHCs), but not primary health centres (PHCs) or district hospitals, expanded markedly in India and in both state clusters since the late 1990s.

The density of nurses/midwives expanded greatly since 2007 in rural public health facilities.

The density of doctors in rural public health facilities did not increase nationally or in higher mortality states, but did somewhat in lower mortality states. A large proportion of doctors still worked in urban areas and private facilities by 2016.

Community platforms and outreach were scaled-up under the NRHM, including frontline workers and localized provision of MNH healthcare services.

Out of pocket expenditure for delivery services reduced over time and became more equitable in public facilities, while the opposite occurred in private facilities. Relatedly, an increasing proportion of women received Janani Suraksha Yojana (JSY) incentives for public but not private facility deliveries, particularly in the higher mortality states where incentives were higher and available for all deliveries regardless of socio-economic status.

While challenges remained in augmenting quality of public MNH services, particularly in higher mortality states, some evidence showed that more public facilities had the supplies, essential drugs and equipment to provide BEmONC and to a lesser extent CEmONC signal functions, i.e. the life-saving interventions to address major causes of mortality (at community health centres and especially district or municipal hospitals), and the required beds and neonatologists in special newborn care units (SNCUs) (provided at the tertiary level).

Integration of services was streamlined through the national 108 ambulance programme since 2008, which was estimated to have been used in a quarter of pregnancies, and more in rural and lower socio-economic groups by 2013/14. Inter-facility transfers for obstetric emergencies were less common or equitable.

Overview

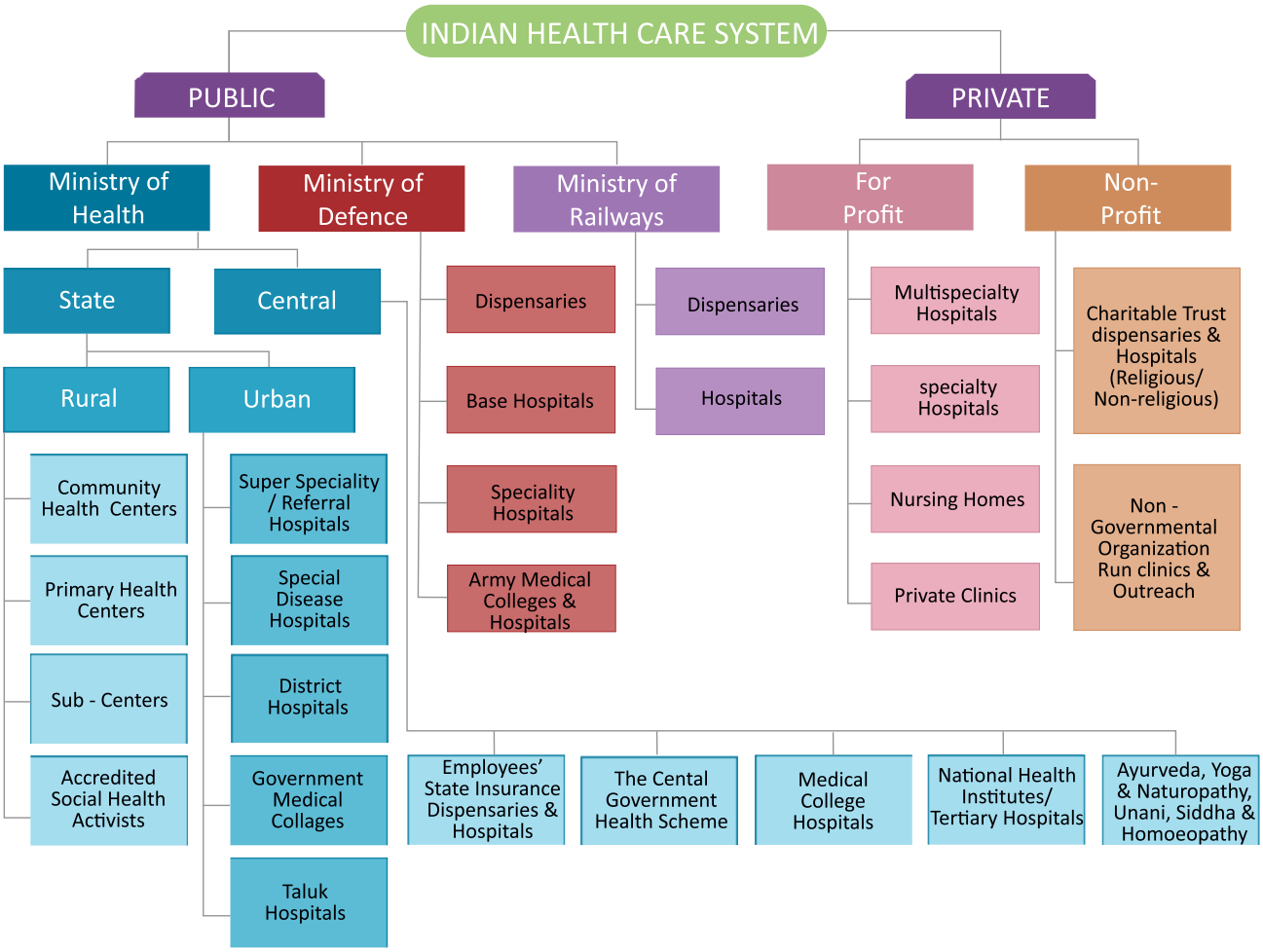
In this chapter, we examine the trends in availability, accessibility, quality and readiness of services across the continuum, and integration of services in terms of ambulance services. To assess the trends in such health service outputs, we analyzed available data on health resource outputs including health infrastructure and human resources derived from the Rural Health Statistics, an annual publication of Government of India. We also draw from key informant interviews and other sources of information on quality, readiness and integration of services providing key RMNCH interventions covered in the previous chapter. The detailed report on key informant interviews is presented in Annex D. We consider differences between the high and low mortality state clusters, public and private sectors, residence and socio-economic groups where possible in each section.

The Indian Health System

Public health services provided under the National Health Mission (previously NRHM) are primarily organized under the Ministry of Health and Family Welfare. As shown in Figure 4.1, the health services for routine and emergency delivery and postnatal care (including special neonatal units) are provided at the district hospital in each district headquarter (average population served about 2 million), as well as some government medical colleges and speciality or referral hospitals in urban areas. Within districts, a community health centre (population served, 120,000; CHC) is available at the sub-district (block or Taluka) headquarter to provide antenatal, delivery and postnatal care, as well as primary health centres (PHCs, population 30,000) and health sub-centres(HSC) (population 5,000) either at the sub-block and/or village levels that provide ANC and in some regions, delivery and postnatal care.[144,145] Below the District Hospital level, some states have Taluka Hospitals, located in Taluka headquarters. Overall, PHCs and HSCs played a minor role in intrapartum care over time compared to CHCs. Of all deliveries in India, PHCs/HSCs accounted just 8% in 2015-16, whereas CHC deliveries accounted for over 25%, according to NFHS-5). A sub-set of CHCs are strengthened to become first referral units (FRUs), which means they are to provide 24/7 CEmONC services (C-sections and blood transfusion).

Within villages, there are monthly Village Health and Nutrition Days (VHND) wherein the outreach auxiliary nurse midwife (ANM) visits and provides antenatal care, immunization, and health education with the support of the community's Accredited Social Health Activists (ASHAs) and anganwadi workers (AWWs).[146,147] ASHAs provide outreach community health services and AWWs run nutrition supplementation and preschool education centres. In the private sector, there are for-profit facilities including multi-speciality or specialty hospitals, nursing homes and private clinics, and non-profit facilities like charitable trust dispensaries or hospitals, and non-governmental organization-led clinics or outreach, as shown in the figure, below.[148] It may be noted here that the facility designations and structure may slightly vary across states.

Figure 4.1: India's health care system in the public and private sector



NB: District hospitals are located in district headquarters (urban) but also serve the surrounding rural population.

The cadres of health workers providing facility-based MNH services include allopathic doctors (physicians and surgeons) working at secondary and tertiary levels, who complete a Bachelor of Medicine and Bachelor of Surgery (MBBS), and specialists completing a postgraduate specialist diploma and registered by the Medical Council of India. In addition, nurses working at all levels are accredited by the Indian Nursing Council after completing a Diploma in General Nursing and Midwifery, a bachelor's degree or a postgraduate degree. ANMs working at the primary level complete a 2-year diploma.[150]

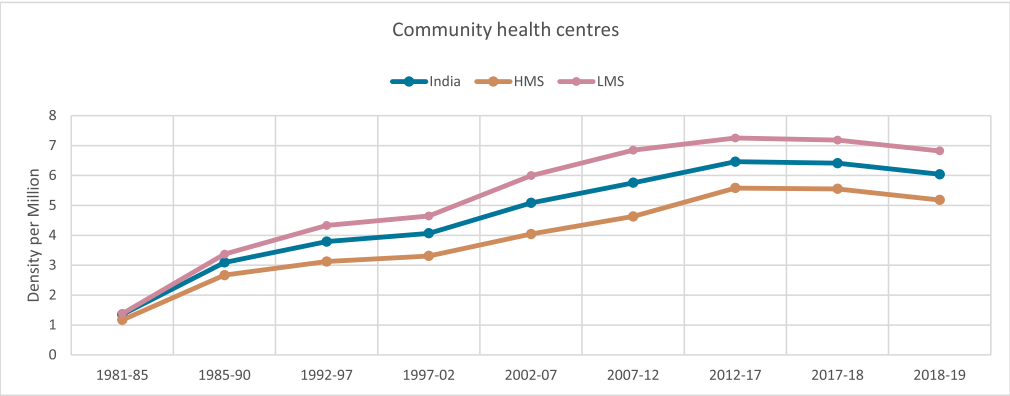
There is evidence that as family planning, ANC, institutional deliveries, and PNC have gone up in all regions of India, the levels of coverage have been linked to the availability of facilities, the presence of skilled health workers, and having essential equipment and laboratory services for maternal and newborn care.[151,152]

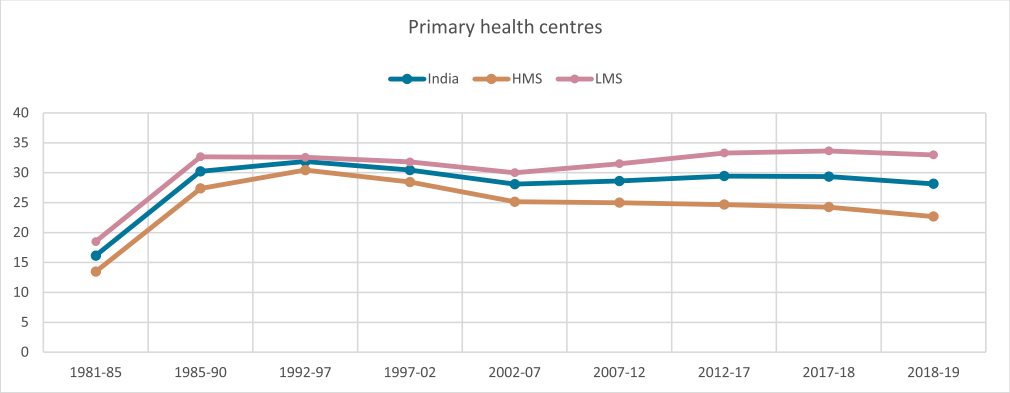
Trends in Availability of Services

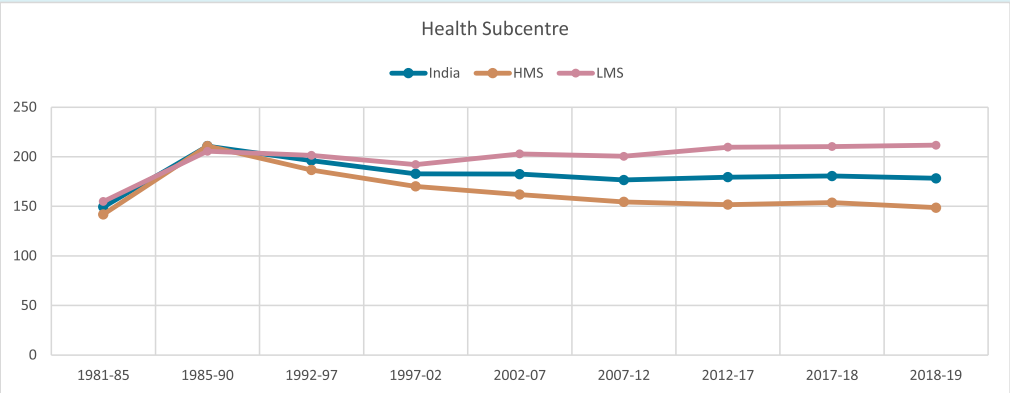
Health Infrastructure: More Community Health Centres

The trends in rural health infrastructure is presented in terms of density per million population during each of the Five-Year Plan periods starting with the 6th Five Year plan of 1981-85. The availability of CHCs increased particularly since the late 1990s and early 2000s (Figure 4.2), which coincides with a sharp increase in deliveries in CHCs shown in Chapter 3. The density of PHCs and HSCs generally remained unchanged nationally. However, the availability of PHCs and HSCs has increased in LMS. The gap between LHS and HMS has widened for PHCs and HSCs. The availability of all three facility types has been greater in lower mortality states, though the gap in the density of CHCs reduced in the most recent time period.

Figure 4.2: Trends in the density of community health centres, primary health centres and health sub-centres per million population in India, higher, and lower mortality state clusters (Rural Health Statistics 1985-2019)







Note: The health facility density is calculated based on population estimated from the RGI projection using the annual exponential growth rate.

Human Resources for Health: More Nurses and Midwives in Lower Mortality States

Trends in the health workforce in India are difficult to ascertain. The main data sources are the population census 2001, NSSO surveys of unemployment and employment in 2004-05 (61st round), 2011-12 (68th round) and 2017-18 (75th round), and Ministry of Health statistics including the recent national health workforce account (Table 4.1). Each source has its strength and limitations. A key issue in the surveys and censuses is that a large proportion of respondents defined themselves as employed health workers but lacked the necessary qualifications, especially in the rural areas. Also, the extent to which ANMs are included in survey data is often not clear.

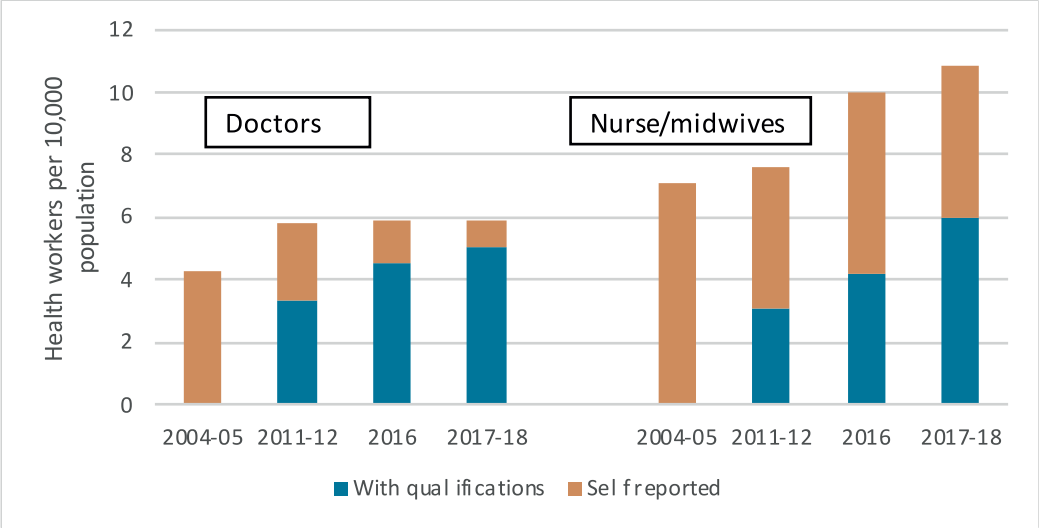
The number of core health professionals increased from 11 to 17 per 10,000 population during 2004-05 to 2017-18.

The surveys provide the best trend information on public and private sector combined. Focusing on core health professionals, which include allopathic doctors and nurses/midwives, the density increased over time for both doctors and nurses (Figure 4.3). The density of core health professionals with adequate qualifications nearly doubled during 2011-12 to 2017-18. This remains below the World Health Report 2006 recommended threshold of 23 core health professionals per 10,000 population, which was recently further increased the threshold to 44 per 10,000 population.[153]

Table 4.1: Health workforce data for allopathic doctors and nurse/midwives, by source

Source	Allopathic Physicians per 10,000	Nurse/ Midwives per 10,000	Data issues	Reference
Census 2001	**7.8**	**5.8**	Self reported employment status	Anand, 2010
Census 2001, sample	**6.1**	**7.4**	Self reported employment status	WHO, 2009
Census, 2001	**3.8**	**2.4**	Qualifications-adjusted	Rao et al. 2011
NSSO survey, 2004/5	**4.3**	**7.1**	Self-reported employment status only	WHO, 2009
MoHFW statistics, 2005	**5.9**	**12.8**	Nursing and medical council data	WHO, 2009
MoHFW statistics, 2009	**6.4**	**9.5**	If ANM are included: 14.4 per 10k	Hazarika, 2013
NSSO 2011/12	**5.8**	**7.6**	Self-reported	Rao 2016
NSSO 2011/12	**3.3**	**3.1**	Qualified	Rao 2016
NSSO 2016	**5.9**	**10.0**	Total active, unclear if includes ANMs	Karan 2019
	4.5	**4.2**	Qualification adjusted	
NHWA 2018	**8.8**	**17.7**	Stock, includes inactive health workers	Karan 2021
NSSO 2017/18	**6.1**	**10.6**	Total active, unclear if includes ANMs	Karan 2021
	5.0	**6.0**	Qualifications adjusted	

Figure 4.3: Trends in Allopathic doctors and nurse/midwives per 10,000 population, India (NSSO employment and unemployment surveys 2004 - 05 to 2017 - 18)



The nurse/midwife to physician ratio, while lower than the international standard (2-3 nurse/midwives per doctor), increased from 0.9 in 2011-12 to 1.2 in 2017-18 for those with adequate qualifications (and from 1.3 to 1.6 for all self-reports). However, there were very large differences between states.[154,155] Analysis of data from 2017-18 (NSSO 75th round) found that the density of health workers was lower in higher mortality states than lower mortality states.[156]

In terms of health worker distribution in the rural public facilities, the Rural Health Statistics showed that there was a major increase in the number of nurse/midwives since 2007. This increase was due largely to major increases in the lower mortality states. Overall the availability of PHC doctors remained the same, except in lower mortality states cluster (data not shown). In NSSO 2016 data, one third of allopathic doctors, and 45% of nurses and midwives worked in the public sector, though they may simultaneously work in the private and public sector and many were self-employed (overlap not captured in the data). Around 36% of this workforce was in rural areas, despite consisting of 71% of the population.[157]

The qualitative policy analysis and key informant interviews shed light on reasons for this uneven success of expanding human resources for health in different regions. Key informants described policy efforts to recruit and retain human resources for health in public sector health facilities, particularly in rural areas, and noted that the success of these efforts varied dramatically by state.

> Health is very much human resource intensive. It cannot be any other way. [It's not] only doctors, nurses: a whole gamut of allied professionals need to be in place. So, I think this filling the gap of the human resource is a critical factor and whichever states have managed to do that effectively have also been able to deliver and we're seeing the outcomes. (KI_11, government technical and academic)

Key informants noted that additional health worker posts have been sanctioned at health facilities under each successive health policy period. Efforts to fill these posts intensified under the NRHM, with the introduction of contract hiring (which simplified recruitment and offered more competitive salaries), and encouragement to states to develop innovative recruitment strategies, such as remote area allowances and financial incentives, bonded rural service and "you quote-we pay" models wherein specialists could be hired based on their quoted salary. Nonetheless, several key informants reflected that success was limited to a sub-set of states and primarily to increasing the availability of nurses and ANMs. Doctors, and specialist doctors in particular, were less willing to join rural public service due to a range of reasons including poor infrastructure and a lack of educational opportunities for their children. More detail on the policy and systems levers contributing to these changes are discussed in Chapter 6.

Community Platforms and Outreach: Introduction of the ASHA Program, Village Health and Nutrition Days, and Village Health Committees

Three key community-level platforms to promote maternal and child health and healthcare access were introduced as part of the National Rural Health Mission's 'communitisation' efforts:

- The Accredited Social Health Activist (ASHA) program
- Renewed Village Health and Nutrition Days (VHNDs)
- Village Health, Sanitation, and Nutrition Committees (VHSNCs)

ASHAs are female community health workers, selected from within the community that they serve at a ratio of approximately one ASHA per 1000 people, though this ranges from below 1000 to 2000 in practice.[158] The program was initially introduced in rural areas of 18 high-focus states[xxvi] but by 2009 was expanded to the rest of the country,[ibid] and in 2014 to underserved urban areas.[159] Core ASHA roles include identifying and tracking pregnant women, children under five, and married couples in order to encourage them to access health services and to counsel them on health, nutrition, immunization, and family planning. ASHAs are also to provide community-level curative care for minor illnesses[160] and home-based newborn care, which was emphasized through updated training in modules 6-7.[161]

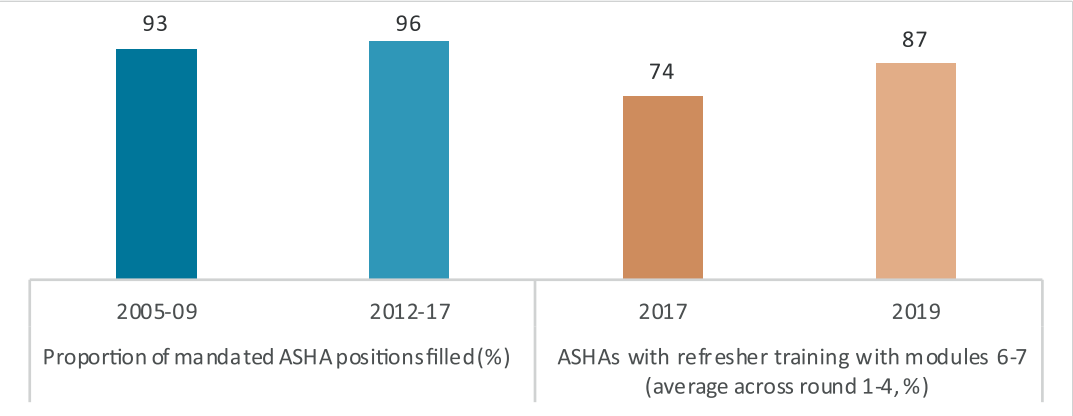
ASHA

The number of ASHAs trained in modules 1-5 and actively working increased from 697,000 to 890,000 between 2005-9 and 2009-14, according to NRHM reviews.[162,163]

Positions were nearly all filled within the early NRHM period, while the proportion trained in modules 6-7 expanded in the NHM period from 2017 onwards (Figure 4.4).

[xxvi] Composed of the 10 high-focus states (Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Himachal Pradesh, Jammu and Kashmir, Uttar Pradesh, Uttaranchal, Odisha, and Rajasthan) and the 8 northeastern high-focus states (Arunachal Pradesh, Manipur, Assam, Nagaland, Meghlaya, Tripura, Mizoram, and Sikkim).

Figure 4.4: Percentage of ASHAs in mandated positions between 2005-9 and 2012-17, and with refresher training modules 6-7 in 2017 and 2019, from annual Updates on ASHA Programme.[164]



The proportion of women contacted by a frontline worker, particularly ASHAs, increased over time and was higher among poorer and SC/ST women.[165,166] Between NFHS-3 (2005-06) and NFHS-4 (2015-16), contact with a frontline health worker (such as an auxiliary nurse midwife or ASHA) during the third trimester increased from 34% in both low and high mortality states to 55% in low and 47% in high mortality states. Analysis of data from the Indian Human Development Surveys (IHDS) from 2004-5 and 2011-12 found that 30% of rural and 10% of urban women who had a live birth since 2005 received ASHA services, with substantial variation by state[167] including higher exposure in high mortality states. The poorest women, and women belonging to scheduled castes and other backward castes, had the highest odds of receiving ASHA services among all women living in communities with an ASHA.[ibid] The ASHA programme evaluation in 2010-11 showed that around two-thirds of women had received home visits from ASHAs in sampled districts of eight states across India, and most of them had been visited at least three times.[168]

ASHAs have been found to be a vital link between government health services and communities, with a large number of women having been supported by an ASHA for ANC attendance, birth planning and institutional delivery.[169,170] Emphasis on ASHAs' roles in making postnatal home visits and especially home-based newborn care (HBNC) grew over time since the revision of the HBNC guidelines in 2014.[171] In one study comparing 2004-5 to 2011-12, exposure to an ASHA during pregnancy was associated with a 17% increase in having at least one antenatal care visit, a 5% increase in having four or more antenatal care visits, a 26% increase in skilled birth attendance, and a 28% increase in giving birth in a health facility.[172] Research among women who had recently given birth in Uttar Pradesh found that 84% were visited by an ASHA at least once during pregnancy and 70% received at least one visit the week following birth.[173] ASHA visits during pregnancy were positively associated with receiving ANC, institutional delivery and delayed bathing of the newborn and ASHA visits after delivery were associated with higher rates of clean cord care and exclusive breastfeeding.[ibid]

Another study in Uttar Pradesh found that third trimester home visits by an ASHA were associated with higher institutional delivery rates, particularly among less educated women.[174] Further, any third trimester home visits versus no home visit at all was associated with reduced perinatal mortality.[ibid] In western UP, a smaller cross-sectional study in the NHM period found that 80% or more pregnant women were escorted by an ASHA for ANC at least 3 or more times (44% 4+ ANC). About 72% who had an institutional delivery said they were advised to go by an ASHA, 92% were accompanied by an ASHA, 61% said ASHAs stayed with them at the facility, and 72% were told about the JSY incentive by an ASHA. In the newborn period, 55% said they received a home visit within 3 days of delivery.[175]

VHNDs were identified as an important platform for "first-contact primary health care" at the periphery of the health system during the NRHM period, to bring about convergence of immunization, antenatal and nutrition services at primary level.[176] VHNDs are monthly outreach events, usually on Wednesdays, wherein an ANM from the local sub-centre or PHC visits the village and conducts health check-ups, particularly ANC and immunization, and provides health education.[177] ASHAs support the VHND by encouraging women and children to attend and helping the ANM throughout. The AWWs, who provide preschool and nutrition services, also supports the event and VHNDs generally take place in the village's anganwadi centre. Local elected leaders (sarpanch, ward members) within the Panchayati Raj Institution (PRI) system of local democratic governance ensure that VHNDs take place and that the location provides appropriate infrastructure.

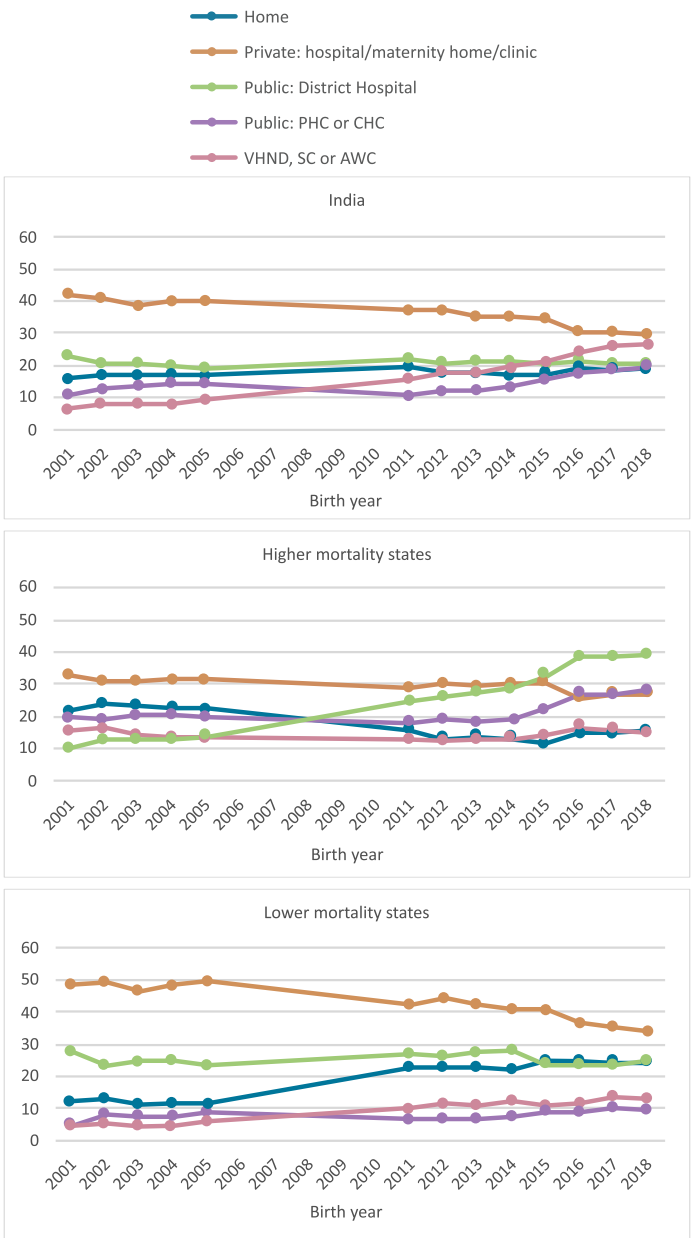
The proportion of women receiving their ANC at a VHND or other village-level centre increased steadily after 2005 (by year of birth), as shown in Figure 4.5.

7% → 27%

2001 2018

This was particularly driven by increases in the higher mortality state cluster (10% in 2001, to 39% in 2018), where those reporting receipt of ANC in public or private hospitals was relatively lower than in the lower mortality states. There would have been some overlap among these locations where women received their ANC. Recent studies found that while attendance and satisfaction at VHNDs increased, service quality or contents were not always consistent.[178,179,180,181,182]

Figure 4.5: Proportion of women that received their ANC at the community-level (VHND, Sub-centre or Anganwadi centre), or external facility (private facility, public district hospital, community health centre or primary health centre) according to birth year, in India and state clusters (NFHS, 2005-06, 2015-16 and 2019-21)



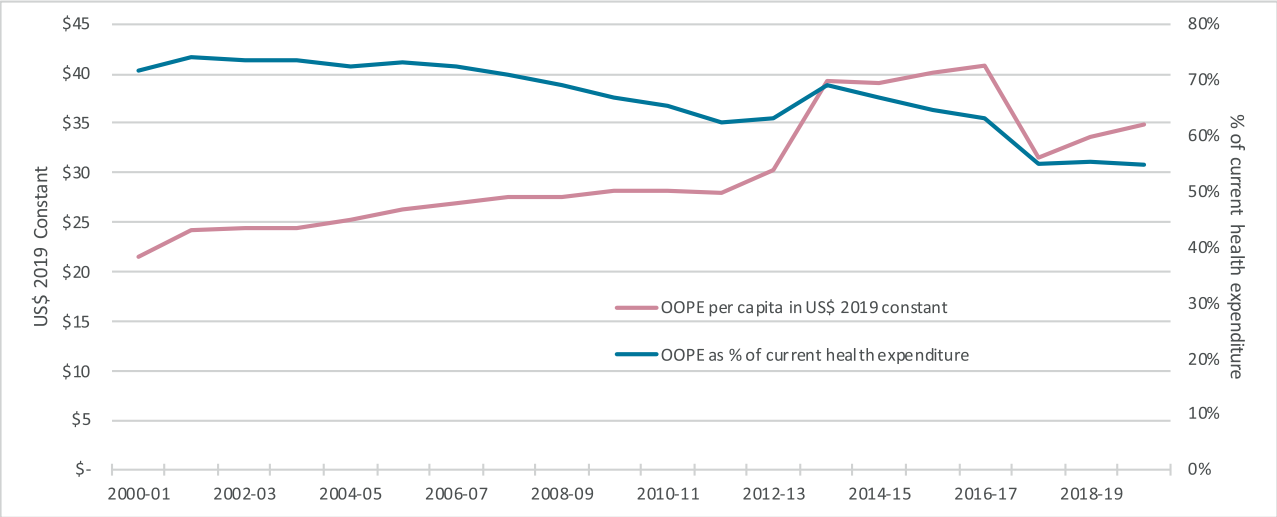
VHSNCs are another component of the NRHM's community primary healthcare platform, but have so far been less active than the ASHA program and the VHNDs overall. These committees are to meet on a monthly basis, convened by the ASHA, and bring together local stakeholders for direct health action (such as cleaning the village or encouraging healthy behaviors) and health system accountability functions (such as seeking improved WASH infrastructure or overseeing the quality of care provided by government health and nutrition workers). [183] They are to receive Rs. 10,000 (USD $130)[xxvii] in untied funds to spend on community health activities as they see fit. Over 500,000 VHSNCs have been formed since their inception, though the density of VHSNCs varies greatly by state.[ibid] To date, research has found that VHSNCs are often inactive, with members having limited knowledge about their roles and responsibilities, little training and guidance on monitoring and preparing village health plans, and insufficient support from higher level health system functionaries.[184,185] Nonetheless, some are monitoring local health functionaries[186] and engaging with the PRI on health issues.[187]

[xxvii] 2022 conversion of US$1 to Rs. 76

Out of Pocket Expenditure

Financial access to services for MNH was assessed in terms of the levels of out of pocket expenditure (OOPE), and the extent to which they were reduced through conditional cash transfers, over time. OOPE went up in absolute terms, from $21 per capita in 2000-1 to $35 in 2019-20. However, it served as a decreasing portion of overall health expenditure from almost 75% of current health expenditure prior to 2005 to 55% by 2017-18 (Figure 4.6)[188]. These trends reflect the overall increase in per capita healthcare spending, but a decreasing reliance on OOPE as government spending increased (also see Chapter 6 on financing).

Figure 4.6: Out-of-pocket expenditure trends per capita (US$ 2019 constant) and as % of current health expenditure (World Bank data, 2000-2019)

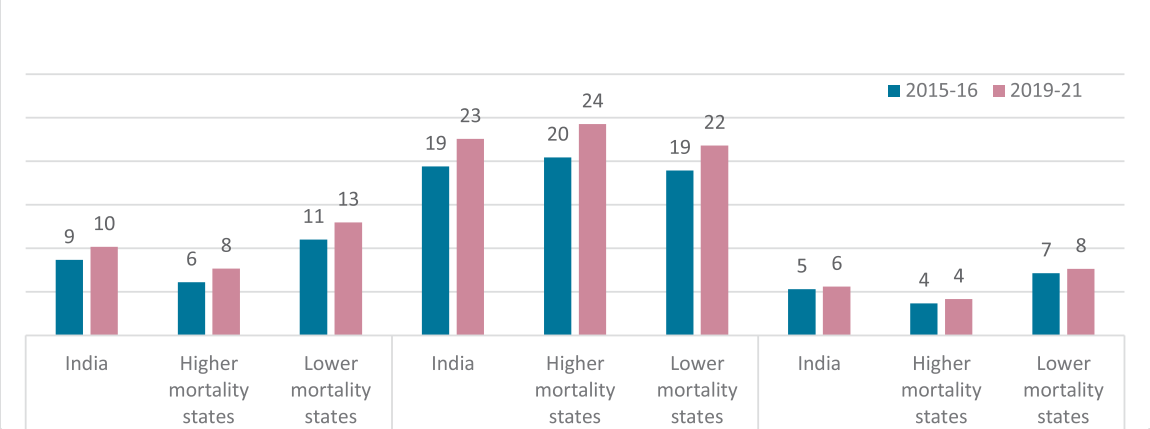


Public services are free but there are indirect costs for medications, diagnostic tests and other services that are often paid out of pocket. Private facilities charge varying levels of fees that tend to be much higher. Overall, OOPE for public services improved and became more equitable, even while some expenses were still incurred. Private OOPE increased over time and did not improve equitably. Between 2004 and 2017-18 (NSSO data), the OOPE for antenatal, delivery and postnatal services in public health centres remained steady. In contrast, OOPE for private services was consistently higher and had increased relative to those for public services.[189,190,191,192] Studies in 2014 (NSSO) and 2015-16 (NFHS 4) also showed that OOPE for routine and emergency delivery services was much higher among those availing private than public health services across India, and higher for secondary compared to primary public facilities. OOPE was somewhat higher in higher mortality states compared to lower mortality states.[193,194,195,196,197,198]

Inequities in OOPE also reduced among public but not private delivery services. In 2004 (NSSO data), expenditure for delivery care was more equitable in public than private facilities.[199] Ten years later (NFHS-4 2015-16 and NSSO 2014 data), OOPE were significantly lower among less educated, lower caste and poorer women, even when using the private sector.[200,201,202,203,204,205,206,207,208] Costs of the public sector was much lower than the private across all wealth quintiles.[209]

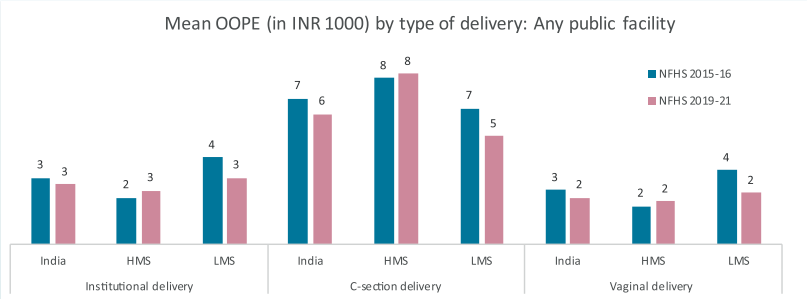
Using NFHS data, we found a 20% increase in the average out-of-pocket cost paid for delivery (including the OOPE for transport, hospital stay, drugs, diagnostics, and other), from Rs. 7935 in 2015-16 to Rs. 9543 in 2019-21 (Figure 4.7). In lower mortality states cluster, the out-of-pocket costs were almost twice as much as in higher mortality states in 2019-21, and the increase from 2015-16 was slightly higher in higher mortality states than the lower mortality states (26% and 22%, respectively). The average out-of-pocket costs paid for c-section deliveries was five times higher than that for a vaginal delivery, and while the average cost for vaginal delivery did not change, the c-section costs increased by 20% during 2015-16 and 2019-21.

Figure 4.7: Trends in average out-of-pocket cost (in INR 1000) paid for by type of delivery, India and state cluster (2015-16 and 2019-21)



The average out-of-pocket cost paid for delivery was greater in private than public health facility, both for vaginal and c-section delivery (Figure 4.8). While the OOPE in public health facilities, both for vaginal and c-section deliveries reduced over time, it increased for private facilities during 2015-16 and 2019-21.

Figure 4.8: Trends in average out-of-pocket cost (in INR 1000) paid for delivery, by delivery type, India and facility type (2015-16 and 2019-21)



The average out-of-pocket cost paid for delivery was the lowest for the poorest and remained more or less unchanged, both for vaginal and c-section delivery (Figure 4.9). In fact, the OOPE for the poorest reduced in public health facilities, both for vaginal and c-section deliveries, but it increased for deliveries in private facilities (Figure 4.10).

Figure 4.9: Trends in average out-of-pocket cost (in INR 1000) paid for delivery, by wealth tertile and delivery type, India (2015-16 and 2019-21)

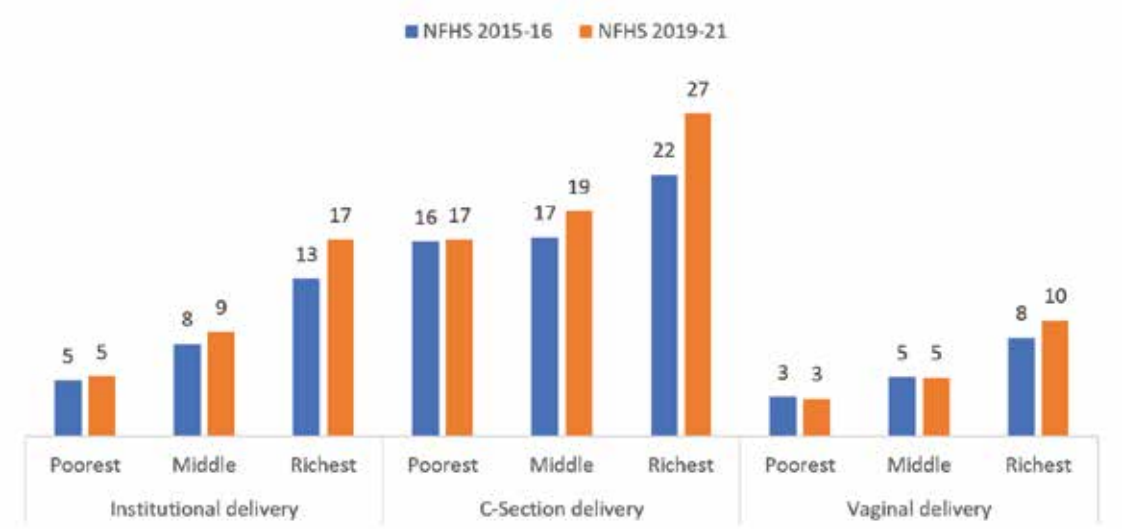
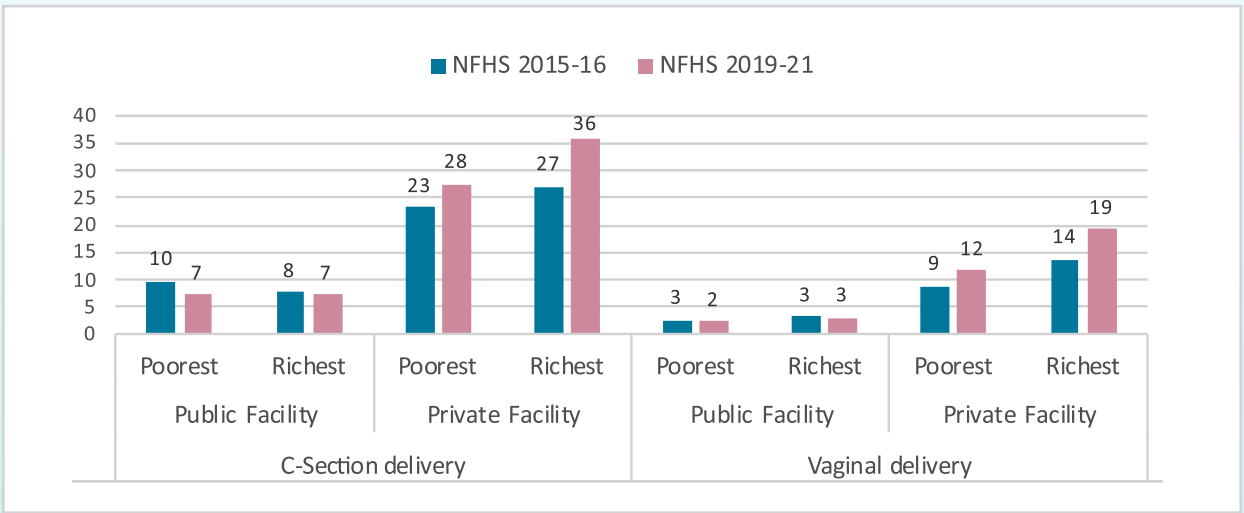


Figure 4.10: Trends in average out-of-pocket cost (in INR 1000) paid for delivery, by the poorest and the richest according to delivery type and facility type, India (2015-16 and 2019-21)



Conditional Cash Transfers

One of the flagship initiatives under the NRHM was the Janani Suraksha Yojana (JSY) scheme since 2005. It was initially meant to provide pregnant women with Rs. 700 for giving birth in a public facility or accredited private facility in all states. While all women in 'low performing states' (higher mortality state cluster) were eligible to receive JSY payments, only women of below poverty line and SC/ST groups in the 'high-performing states' (low mortality state cluster) were eligible. The incentives were increased in 2013 to Rs. 1400 in rural areas and Rs.1000 in urban areas of low performing states to further increase the financial benefit. ASHA workers were also given incentives for promoting and supporting pregnant woman to have a public facility delivery, including Rs.600 per delivery in low performing states, and Rs. 200 and later Rs. 600 in high performing states.[210] Key informants echoed the importance of JSY as the major driver of the shift from home birth to facility birth. One respondent noted:

> JSY was a really kind of flagship programme because at that point in time it was really, really important to increase the coverage of essential maternal health services. And a primary way to do that was to get women to come to hospitals. Because I think in 2005 institutional deliveries were around, I don't know, 20-25%, I mean, there were a lot of home births. So I think this trend of getting women to point-of-care started with JSY. (KI_03, civil society)

The number of JSY beneficiaries grew from 2005-06 in the year of inception from 7.4 lakh to 31.6 lakh in 2006-07, and hit a maximum of between 105 to 110 lakh between 2011-12 to 2017-18, though there has been some decline since 2018-19according to MoHFW records.[211,212]

The majority of beneficiaries availed public services, as contracting private providers to implement JSY was found to be less common due to low provider payments and lack of motivation to meet the accreditation criteria.[213] The proportion of JSY beneficiaries among those delivering in an institution increased most in higher mortality states (low performing states), from 21% to almost 90% between 2006-07 to 2012 respectively, compared to 11 to 27% in lower mortality states.[214] This likely reflects the higher designated amount and universal eligibility of the JSY in the low performing states. This was the same period when the gap in institutional delivery narrowed considerably between state clusters; evidence suggests that increasing coverage of JSY incentives (with the higher promised incentives and universal eligibility) in higher mortality states was effective in increasing institutional delivery rates.[215,216] Qualitative studies in select higher mortality states found that features of the JSY scheme had affected the extent to which it led to institutional delivery, including whether women had bank accounts to receive them, timely reimbursement, or if there were other costs beyond the incentive amounts such as transport costs when families decided to hire a private vehicle (related to the section on integration below).[217,218]

In 2007-08 (DLHS 2), receipt of JSY was higher among lower socio-economic groups for normal deliveries in public but not private facilities, and for c-sections in both private and public facilities.[219] Another study found that in high focus states (largely the same as higher mortality states), lower wealth groups were more likely to receive JSY benefits but not in India overall.[220] By 2015-16 (NFHS 4), the distribution of public subsidies for institutional delivery was found to be pro-poor in public facilities (particularly in primary compared to secondary facilities, where OOPE was lower), whereas the opposite was true in private facilities. This is a reversal from two decades before when public centres also were pro-rich.[221] It was also found that utilization and gross benefits of delivery services in the public sector were pro-poor nationally, though this varied by state.[222] Studies consistently showed that receipt of JSY incentives was associated with higher institutional delivery, more so in public facilities and in particular PHCs and CHCs.[223,224,225,226] There was evidence that this was higher among poorer, less educated women in some studies.[227,228,229]

Relative to the JSY, coverage of insurance in India was relatively low, estimated at around 15% in 2015 to 20% in 2017-18 NSSO data and therefore probably did not have a population impact on OOPE for maternity care.[230,231]

Trends in Quality and Readiness of Services

India's health programme under RCH I and II put an increasing focus on improving quality of care for MNH services. This included the establishment of standards (Indian Public Health Standard, IPHS), accreditation of hospitals and health care providers (National Board for Accreditation of Hospitals and Healthcare Providers), certification for quality management systems (Bureau of Indian Standards), and bodies to support and build capacity for quality improvements (National Institute of Health and Family Welfare and National Health Systems Resource Centre). Local bodies were also mandated to improve quality of health services locally, including facility committees (Rogi Kalyan Samitis) and Patient Welfare Committees at facility level, VHSNCs in villages, as well as public hearings for public grievance redressal.[232]

Key informants noted how Indian Public Health Standards (IPHS) for facilities and guidelines for HBNC were developed and periodically updated beginning in the 2000s, which signaled greater attention to standards and quality as well.

> Bringing IPHS helped the States in getting a vision, that you have to achieve up to these standards. The standards helped, and the various guidelines also helped the states in achieving the standards and the quality. (KI_01, government technical)

They also discussed the notable shift in the 2010s from focusing on access to seeking to improve quality as an important driver of sustained progress on maternal and neonatal survival in India.

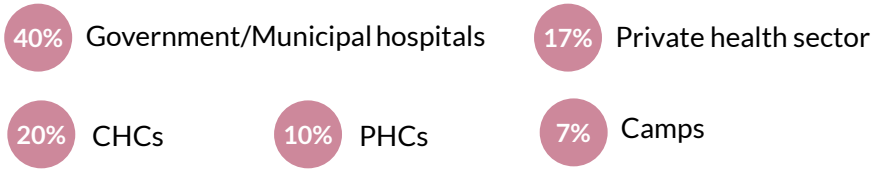
> From the years 2010-12 onwards until now where there has been this intended intentional, transition from being focused or even just monitoring access […] to get into quality of services. Both at facilities and outreach […] So, so that shift from numbers to quality of care approach or paradigm. (KI_07, development partners)

Abortion and Family Planning

A survey among a representative sample of public and private facilities providing abortion services in six Indian states (Assam, Bihar, Gujarat, Madhya Pradesh, Uttar Pradesh and Tamil Nadu) in 2015 found that readiness for manual vacuum aspiration was around 75%, but the differences between public and private sectors differed between higher and lower mortality clusters (private better in HMS and public better in LMS). Around 40 to 45% of facilities used medication for abortion in most of the states. Among women who had a facility-based abortion, the proportion who had received surgical methods of abortion (dilation and curettage or evacuation) varied from 25 to 37% among the states, among whom only 4 to 13% were conducted in the second trimester as recommended (suggesting overuse during the first trimester). These surgical methods were also used to address post-abortion complications in over half of the women experiencing them.[233]

For family planning, a review of literature on the Indian Family Welfare Programme found that in the late 1980s there was an increase in sterilization under the target-driven programme. After the 1994 International Conference on Population and Development in Cairo, Indian policy shifted towards a focus on quality of care and increased contraceptive method choice, and removed sterilization targets.[234]

Sources of sterilization services (NFHS-4 data, 2015-16)



A majority of women reported that services had acceptable quality, but quality was found to be relatively lower among more disadvantaged groups, lower mortality states, and those receiving services at CHCs, PHCs or SCs compared to District Hospitals and camps.[235,236]

Antenatal Care

Chapter 3 shows progress in antenatal care with contents in the NFHS-3 and NFHS-4. Women's receipt of quality components of ANC in 1998-99 (blood pressure measurement, weight, blood, urine, abdomen exams) was found to be much higher in the South than other regions, and less inequitable between socio-economic groups in that region.[237] The India Health Development Survey in 2006 also showed that women having higher education or wealth was associated with receiving better quality antenatal care nationally.[238] By 2015-16 (NFHS-4), while 82% of women had any ANC, 24% had received adequate ANC (skilled personnel, first visit in first trimester, four or more visits, and appropriate contents), and this remained higher in lower than higher mortality states.[239]

Routine and Emergency Obstetric Care

There is lack of nationally-representative data on readiness and quality for routine and EmONC services in India. However, with a limited number of studies in different regions or time periods, it appears that the proportion of PHCs and CHCs that were activated as 24x7 delivery points with sufficient labour rooms increased over time by 2014 onward. In the early 2000s, studies found that provision of some of the essential drugs such as antibiotics, oxytocin and anticonvulsants and neonatal resuscitation were available more at public facilities compared to other signal functions. With expansion of FRUs among CHCs and district hospitals, capacity seemed to be increasing for all BEmONC functions in both state clusters, as well as CEmONC (c-sections and blood transfusion) in low mortality states, particularly in the NHM period.

In the mid-1990s, the capacity for c-sections, quality of EmOC and timely referrals were found to be relatively low in district hospitals in ten districts of ten states.[240] In terms of BEmONC, the majority of facilities had necessary drugs (antibiotics, oxytocin, anticonvulsants), as well as capacity for assisted vaginal deliveries, while fewer provided manual removal of placenta or retained products of conception. The ability to provide CEmONC (c-sections and blood transfusion) among hospitals was more variable according to a study in Maharashtra and Rajasthan.[241]

By the early NRHM period, another study of public hospitals in higher mortality states found that most facilities had parenteral administration of antibiotics and oxytocin, and neonatal resuscitation, but fewer had parenteral anticonvulsants, manual removal of placenta or retained products and assisted vaginal delivery (though higher among CEmOC than BEmOC facilities). Around two-thirds of surveyed CEmOC facilities indeed provided c-sections and blood transfusions.[242] Among PHCs in the DLHS 3 (2007-08), around half were functional for 24 hours and two-thirds had obstetric drugs and sufficient beds, but few had obstetric and newborn equipment or sufficient HR trained in SBA and BEmOC. Around 31% of PHCs had trained staff for BEmOC or SBA, only 1.5% had a doctor.[243]

By 2012-14 in the NHM period (DLHS 4), a study of routine and emergency delivery care in PHCs and CHCs (included as 'lower level facilities' in Chapter 3) within 30 states showed that 70% of PHCs and 95% of CHCs provided childbirth care, and 86% of PHCs and 98% of CHCs offered 24-hour care; this was similar in rural and urban areas.[244] Capacity for intrapartum care was lower than the IPHS standards, more so for PHCs than CHCs, based on the self-reported facility data. A greater proportion had a functional labour room, supply of emergency drugs and supplies, newborn care equipment and supplies, parenteral oxytocin and antibiotics administration, newborn resuscitation and thermal protection. Fewer had adequate human resource training, assisted vaginal delivery, parenteral magnesium sulphate administration, and postpartum haemorrhage management. Though similar, these indicators differed a bit more between rural and urban areas for CHCs than PHCs. Facility capability was in the lowest third in a greater proportion of districts in higher than lower mortality states, suggesting quality of emergency delivery care had improved more widely in the latter.[245]

Consistent with trends in NMR by state cluster in Chapter 2 and also by delivery place in Chapter 3, key informants noted that in low mortality states, deliveries increasingly took place in facilities with specialists and CEmOC capabilities. Contrastingly, they reiterated that in high mortality states, expanding access to BEmOC through training ANMs, staff nurses and doctors in skilled birth attendance (SBA), was considered the central health system driver of reduced maternal mortality. AYUSH doctors were also given access to SBA training and served as additional BEmOC providers. Access to CEmOC and specialists (particularly pediatricians, obstetrician-gynecologists, and anesthesiologists) in high mortality states increased only gradually and thus was not considered to have been a major contributor.

> Not many people may talk about it or even understand the enormity of it, but I think under the SBA initiative when tasks were shifted and the government allowed and trained ANMs and staff nurses to do some of the skills, I think that was, that would have ended up in saving many, many lives. (KI_03, civil society)

> 70-80% of deaths could be avoided just by a judicious use of managing PPH, oxytocin, misoprostol, having proper antibiotic coverage to prevent sepsis, and giving mag-sulf for eclampsia, these were all the things nurses could do. […] These were low-hanging fruits, and unnecessarily women were dying, which could be prevented using these simple tools (KI_12, government technical and development partner)

Neonatal Care

Did India improve essential newborn health services as many more babies were born in health facilities during NRHM and beyond, especially in the high mortality states? How did the quality of services in lower mortality states manage to contribute to further reductions of neonatal mortality, for instance, through expansion of care for the small and sick newborns through neonatal intensive care units?

India's approach to newborn care encompasses both community and facility-based components. Early trials in 1980-90s showed that home-based newborn care (HBNC) could effectively reduce NMR. Notably, the Gadchiroli SEARCH trial in Maharashtra (1995-96 to 2001-03) trained community health workers in management of premature birth, asphyxia, infection, hypothermia and breastfeeding within communities, which effectively reduced neonatal and perinatal mortality, particularly due to the main causes of sepsis (reduced by 90%), asphyxia (53%) and prematurity (38%) through a combination of sepsis or asphyxia management, supportive care for low birth weight neonates, and to a lesser extent primary prevention.[246,247]

Since 2001, India's Integrated Management of Neonatal and Childhood Illness (IMNCI) programme brought neonatal health to the forefront with a package to involve health workers both in identifying and providing simple treatment within communities and referring sick newborns to facilities for further care.

With support from UNICEF/WHO, the Government of India initiated training in select districts for all cadres. As more people sought care in the private sector for sick newborns, there was a need to expand training to private providers as well.[248]

A study on the IMNCI programme in 2009 showed that it had been implemented in 36% of districts nationally. In select districts in seven states, 70% of health workers trained were AWWs and ASHAs, 15% ANMs, and 3% doctors and 15% others. Supplies were variable and performance was good for weighing, assessment of newborn and charting, but poorer for counselling and handwashing. 66% of newborns were visited at home within 24 hours, 63% were visited three times within the first ten days, and 18% of all newborns had been referred to a health facility. The proportion of children with acute respiratory infections for which care was sought was significantly higher than in control districts without IMNCI implementation.[249] Studies showed that the programme was not implemented widely enough to reduce NMR between 2001-06. Training expanded somewhat after that. Since 2012 only ANMs were trained in IMNCI, while focus also turned to HBNC program with the training focused on ASHAs. Some suggest that integration of these models may have augmented their impact.[250]

In addition to the IMNCI programme, India established an HBNC program in earnest. This was added to ASHAs' training in 2011, particularly to address NMR in areas with less access to facility-based neonatal care. This has been found to be implemented unevenly across the country. Studies indicate that ASHAs' counselling focused more on promoting ANC and delivery, and that families have continued to rely more on private services for neonatal illnesses despite the JSSK incentives.[251] Though not specific to the HBNC program, a couple of national studies between 2005 and 2015-16 have shown that improvements in early initiation of breastfeeding and PNC visits within 48 hours (which have somewhat increased) have been associated with lower NMR.[252,253]

Key informants emphasized that HBNC and IMNCI were major drivers of reduced NMR across India:

> "These community-based interventions played a big role in reducing the neonatal mortality and morbidity" (KI_01, government technical).

> "I think it was in India that the home-based newborn care originated. It demystified the newborn. They actually removed the medicalization and the infrastructure and the institutionalisation of newborn care, from a nursery, or an intensive care nursery, to the family home." (KI_10, government technical and development partner)

> "Low tech" and community-based interventions, including thermal care, early breastfeeding, antibiotics for sepsis, fetal heart monitoring devices and pulse oximeters for pneumonia, "have added up over time" (KI_02, government technical and development partner) to reduce newborn deaths from infection, hypothermia and asphyxia, which were major causes of death. As simple interventions brought NMR down, primarily through preventing later neonatal deaths due to infections, the cause of death shifted to low birth weight and preterm babies who require "intensive technology driven care" to save lives. (KI_11, government technical and academic).

The more medically complex interventions required to save them, including equipment, specially-trained medical staff, and ambulance services received policy attention but struggled with implementation beyond medical colleges and some district hospitals, particularly in the higher mortality states.

Regarding facility-based care for small and sick newborns, studies in the 1990s found that there was an expansion of tertiary hospitals with neonatal units as part of the CSSM, with increases in some supplies and equipment like incubators, vital sign monitors, ventilators, blood gas machines, parenteral nutrition; still there remained gaps in availability of nurses, training of specialists, and some equipment.[254] After a successful pilot project in West Bengal, SNCUs were scaled up in remote areas of many districts of that state, with UNICEF providing technical and financial support.[255] An assessment in 2006-09 among a sample of those units showed that there was an increase in admissions, and number of outborn newborns, in the SNCUs. There were less than the recommended ratio of nurses and doctors in some units, and while there was essential equipment, they were not regularly repaired when broken down. Still the case fatality rates reduced, particularly deaths due to LBW/prematurity and sepsis, but not asphyxia.[256]

By the mature NHM period, India expanded the number of trained neonatologists, available NICUs, and locally produced equipment to international standards through collaboration of doctors, engineers and entrepreneurs. Some suggest this contributed to reductions in NMR within district hospitals, medical college hospitals, and less often CHCs in the public sector.[257] A 2014 study of 70 SNCUs in India showed that most were now well-staffed by full-time consultants and led by neonatologists, though not all accredited by NNF. They also mostly had mechanical ventilation and other sophisticated equipment that were imported, while open care systems, incubators, X-ray, and other equipment were sometimes also indigenous. There was a lower proportion of invasive blood pressure monitoring, blood gas, human milk banks and parenteral nutrition, and there were some differences in private and public sector equipment and availability of transport.[258] By 2015, there were 575 SNCUs at district level, and 1810 NBSUs nationally, with many inputting data through a virtual monitoring system.[259]

There had been expansion of availability of SNCUs with the correct number of beds, doctors, and equipment in both state clusters.[260] Still, as reiterated by the key informants, the availability of SNCUs remained concentrated in more urban areas and, in most states, ambulances remained largely incapable of safely transporting premature and low birthweight infants. This was more difficult in the high priority districts of higher than lower mortality states.[261] Also, some areas struggled with retaining necessary HRH, purchasing and maintaining all necessary equipment, and standardizing quality of care,[262] as also mentioned by a key informant.

"Unfortunately, [it was at] the middle level that the newborn stabilising units didn't take off. We still know in most of India the middle level is really non-functional. Now largely every sick kid lands up being referred to the District Hospital, to the SNCUs, which are quite, quite oversubscribed" (KI_11, government technical and academic).

Some research has indicated that indigenization of the supplies and equipment contributed to the affordability of SNCUs in India, particularly since 2005, alongside increasing emphasis on neonatal care through the IMNCI program in RCH I, its inclusion in the NRHM, and later reiterated by the India Newborn Action Plan and Janani Shishu Suraksha Karyakaram (JSSK) scheme that also covered costs of referrals and treatment from 2012. In summary, the accelerating NMR reductions from 2008 to 2015-16 have been ascribed both to the community-based IMNCI and home-based newborn care programs, as well as expanding neonatal care units at least among district hospitals, since RCH I and especially during the NHM period since 2012.[263,264,265,266]

Trends in Integration of Services

Integration of MNH services was also pursued under the NRHM through improved ambulance services to provide free transport to facilities for delivery or neonatal illness, including inter-facility transfers. Though many schemes were developed across different states, the national programme ultimately adopted the 108 ambulances with GPS-fitted ambulances.

A systematic review of referrals between public sector institutions in India between 1994 and 2013[267]

25 to 52%

From a primary-level facility due to pregnancy complications

36%

From BEmONC centres for complications or emergencies

2 to 7%

From doctor-run BEmONC centres to specialist care in CEmONC facilities.

Data in 2013-14 from India's 108 ambulance call centres in five states (Andhra Pradesh, Telangana, Chhattisgarh, Gujarat, Himachal Pradesh) showed that about 20-25% of all institutional deliveries were transported using this service.[268] It was used more by women in rural areas and lower socio-economic groups. Only between 3 and 13% of obstetric emergencies were transported by 108 ambulances. The time to reach women was less than two hours for over 90% of the obstetric emergencies in most states.[269]

About 1 to 3% were inter-facility transfers, suggesting women used other transport that may have been more efficient for that. More women with than without obstetric emergencies were transferred between facilities, but this varied by state. Inter-facility transfers were more likely among women who were older or younger, from urban areas, not in high-priority districts, general caste groups, and above poverty line status. This suggests that there were inequities in inter-facility transports but not in overall use of 108 ambulances, possibly because referrals were made to more expensive facilities that were less accessible to more disadvantaged families.[270,271] Transporting small and sick newborns remained a great challenge, although Tamil Nadu was noted as a state that invested in excellent emergency transport for such neonates that included warming facilities, oxygen and a trained doctor or nurse to accompany the family.

5

CONTEXTUAL FACTORS ASSOCIATED WITH MORTALITY AND COVERAGE

CONTEXTUAL FACTORS ASSOCIATED WITH MORTALITY AND COVERAGE

Highlights

India's total fertility rate declined since 2000, in both state clusters, and more rapidly among rural, less educated and poorer women who had higher risks of mortality, due to improving education, economic status, cultural norms and related use of family planning methods to limit family size.

Women's nutritional status modestly improved, possibly through increasing education and economic opportunities, and some intentional programmes to provide supplementary food and nutrients for pregnant women over the past few decades.

Women's empowerment indicators have generally improved in India, based on a later median age at first marriage, greater educational attainment, employment, and roles in decision making on their healthcare, which have all been associated with higher utilization of MNH services and better pregnancy outcomes.

Incomes and household living conditions (including electrification, clean water source and cooking fuel, and to a lesser extent sanitation) have somewhat improved both through economic development and intentional public programmes, which seems to have improved financial access to MNH services as well as women's and newborn's health status and outcomes.

Overview

This chapter covers trends in major contextual factors that were found to contribute to reductions in maternal and neonatal mortality, directly or by influencing greater and more equitable intervention coverage. There is evidence that changes in India's demographic, socio-cultural and economic context have jointly contributed to the reductions in maternal and neonatal mortality rates in India. The analyses of contextual factors included literature and document review, key informant interviews, triangulated with quantitative trends from the SRS and NFHS where indicators were available for fertility, nutrition, socio-economic development and women's empowerment. Key informants were unanimous in recognizing the enormous contribution of "synergistic" (KI_04, government technical and civil society) contextual changes in reducing MMR and NMR: "I would put it [the contribution of broader changes] at 50% at least" (KI_10, government technical and development partner). These include the notable declines in fertility, particularly among lower socio-economic groups, improvements in nutritional status, and increasing women's access to education, improved social status, and wider employment opportunities.[272] Overall, families have also experienced improved wealth, electricity, better roads and communication infrastructure, and access to water and sanitary facilities, which are thought to have directly or indirectly contributed to reductions in mortality.

Declines in Fertility

There have been steady declines in India's fertility rate since the 1970s, from 5.3 to 3.8 in 1990, 3.2 in 2000, and 2.1 in 2019 according to SRS data (Figure 5.1). In the higher mortality state cluster, the TFR was higher but declined fairly consistently as well, from 5.8 in early 1970s to 4.7 in 1990, down to 4.2 in 2000 and 2.6 in 2019. In lower mortality states, fertility was already lower in 1970s and continuously declined to 3.0 in 1990, 2.4 in 2000 and under 1.6 in 2019. It is worth noting though that the gap narrowed over time between the higher and lower mortality states, from 1.8 units difference in 2000 to 1.0 unit in 2019.

As shown in Figure 5.2, the fertility rates were overall higher in rural areas in India, and in both state clusters. However, the gap narrowed as the fertility rates declined faster in the rural than urban areas particularly in lower but also in the higher mortality states.

Figure 5.1: Trends in total fertility rate in India overall, and in higher and lower mortality state clusters (SRS, 1970-2019)

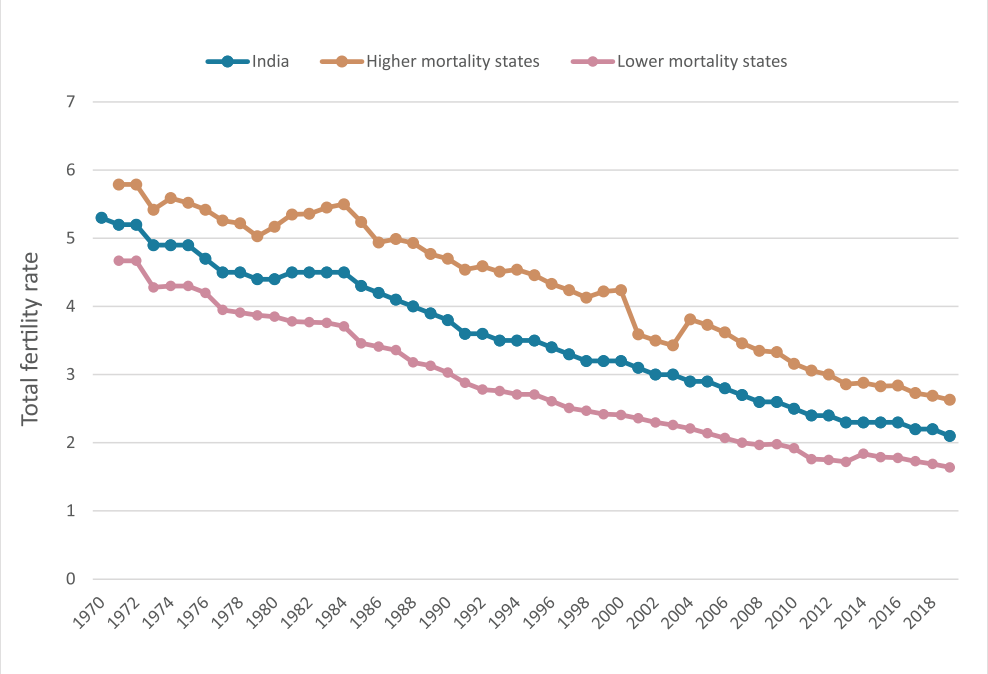
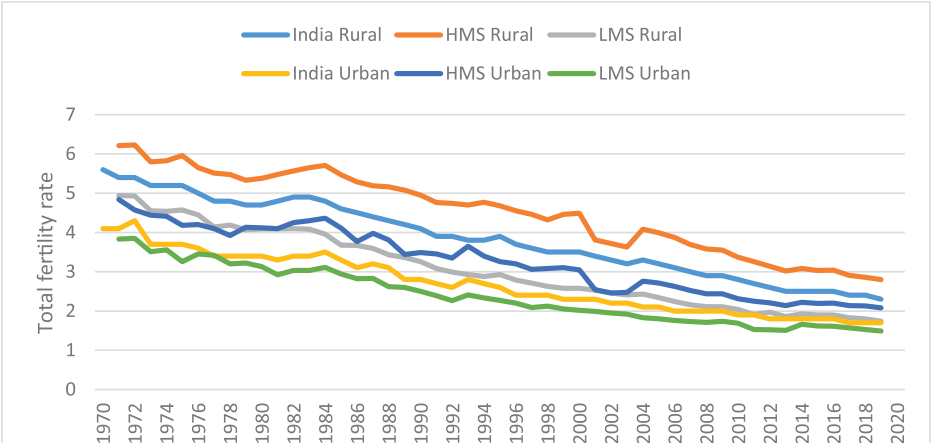
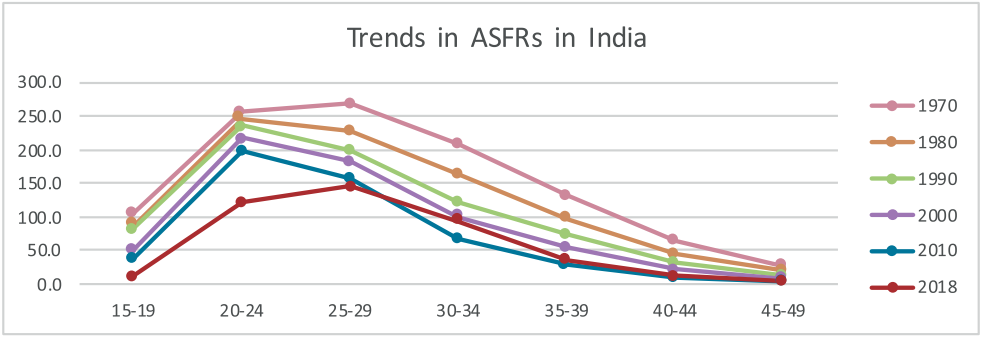


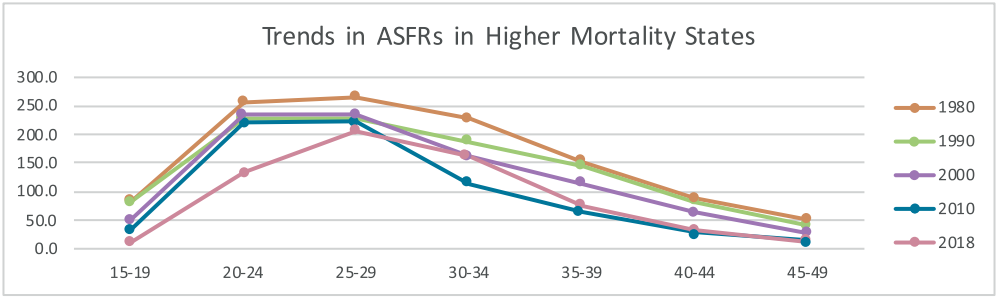
Figure 5.2: Trends in total fertility rate in India and the state clusters, by urban and rural areas (SRS, 1970-2019)



Age-specific fertility rates in India have also declined, particularly among women in the lower age groups between 15-29 years (Figure 5.3). In the higher mortality states, this decline was not as marked, especially among those between 25-29 and older. For the lower mortality states, fertility rates were already lower across age groups to start, but still declined particularly among women aged 20-29. The contribution of older women (age 30+) to total fertility has been reducing in both the clusters, with greater decline in lower mortality states cluster.

Figure 5.3: Trends in age-specific fertility rates in India and the state clusters (SRS, 1980-2018)





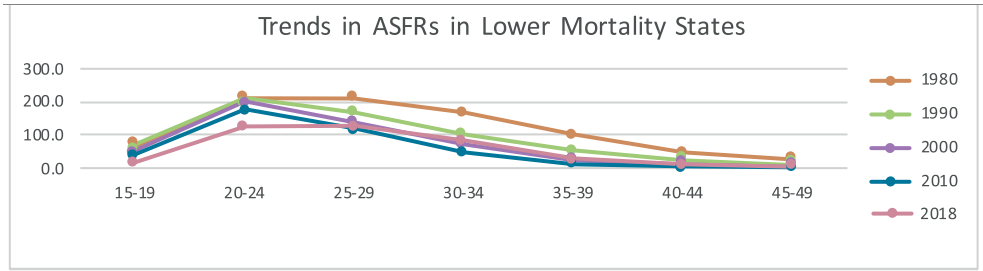
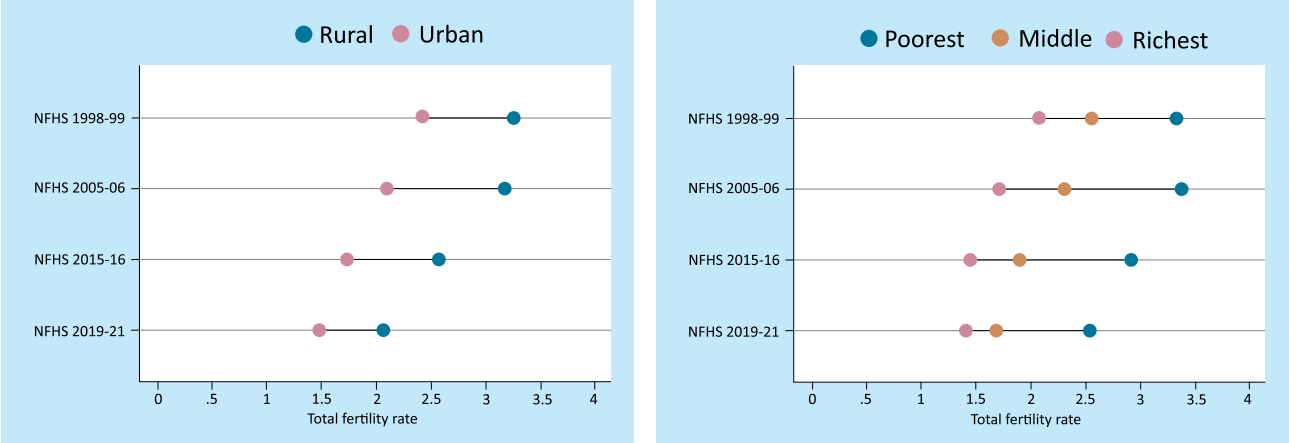


Figure 5.4: Inequality in TFR by place of residence and household wealth tertile for India (NFHS, 1998-99 to 2019-21)



As shown in Figure 5.4, the urban-rural and household wealth tertile inequalities in fertility reduction have decreased in India overall since 1998-99. However, the rates of decline in the rural and poorest tertiles were lower than the urban and the richest. Similar patterns were observed in the two state clusters (data not shown).

Between early 1990s and early 2000s when the fertility rate dropped noticeably in India, this occurred at a faster pace among rural, less educated and poorer groups who started with higher fertility rates.[273] Decreasing fertility rates in India have been associated with socio-economic and development improvements in the past two decades, building on the trends from as early as the 1970s. Increasing employment status and wealth has influenced fertility reduction, as women and men who were employed wanted fewer children than those without employment. Increasing education levels have been particularly associated with lower fertility, and this relationship is independent of other socio-economic factors.[274,275] There is also a social component to fertility choices, as research indicates that women's neighbourhood or religious peers had consistently similar preferred family sizes, and particularly for less than more educated women.[276]

Combined with these societal shifts, India has continuously put emphasis on fertility reduction in its policies and programmes in the past decades. In 2000, this was made explicit in the National Population Policy and the establishment of the National Commission on Population, and since then by integrating family welfare and reproductive health policies with other health goals across an expanding continuum of care for RMNCH+A under the RCH II and NHM.[277] Family planning rose more in the 1990s than in the past two decades, however more recently contraceptive use has increased relatively more among lower socio-economic groups who historically had higher fertility rates. Most notably, contraceptive prevalence rates have more rapidly increased among non-literate compared to more educated women in India, leading to greater fertility reductions for them. This has occurred in an expanding number of states, starting with the lower mortality states in the early 2000s followed by states in the higher mortality cluster in the decades since.[278]

Improvements in Nutritional Status

Women's nutritional status has improved in the past decades in some ways, with more women having higher BMI and diversified diets, but no reductions in anemia.[279] NFHS data showed that the proportion of births to women with a BMI lower than 18.5 (considered underweight) declined from over 41% to 20% between 2005-06 and 2019-21 (Figure 2.11). Anemia did not reduce as greatly in NFHS data in India overall between 2005-06 and 2019-21. The minimal decrease in anemia was a bit more in the higher mortality states (63% to 61%) than lower mortality states (remained same at 59%). Anemia has been found in other studies to be significantly lower among women with later age at marriage, fewer children, and higher education, which have all improved in India as shown elsewhere in this chapter.[280] At the same time, a large proportion of women still have anaemia, and adult protein and energy consumption has reduced in the past few decades.[281]

Child size at birth did improve more; the proportion of newborn's considered to be small for gestational age

22% → 14%
Hiigher moratality states

20% → 11%
Lower moratality states

Therefore, these small improvements in maternal nutrition, and to a greater extent newborn nutrition, may not have been as significant as other contextual factors to reducing mortality among mothers and newborns.

There have been public programs to improve food security and nutrition outside the health sector that have had varied success, including the Targeted Public Distribution System in 1997 to provide food rations for below poverty line families, and later the National Food Security Act in 2013 that provided women with a maternity benefit of 6000 Rupees per delivery.[282] Policies also sought to expand economic opportunities for poorer and rural families, notably the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in 2005, with some observed benefit for women's and family's income in some parts of India.[283,284,285]

Under the Ministry of Women and Child Development, the Integrated Child Development Services (ICDS) has trained AWWs to provide nutrition counselling and nutritious foods like pulses, grains, leafy vegetables for pregnant women at the village-level anganwadi centre since 1975. The anganwadi centre or other local centres are also the platform for the Village Health and Nutrition Days (VHNDs), where ASHAs and ANMs give pregnant women micronutrients including IFA tablets and Vitamin A under RCH II/NRHM. Education by ANMs and AWWs had been associated with utilization of nutrition services in the RCH I period.[286] Receipt of IFA, having the first ANC visit in the first trimester, and four or more ANC visits have been associated with improved maternal and newborn nutrition indicators: lower anaemia and low birth weight births in NFHS 2 and 3 respectively, as well as ICDS components including complementary food and nutrition counselling.[287,288,289,290,291]

Between 2005-06 and 2015-16, there was also an increase in coverage of ICDS services by AWWs for pregnant women (supplementary food, health and nutrition education, ANC check-ups), which became more equitable despite remaining gaps particularly in large states with the highest under. [292]

Women's Empowerment

Women's level of empowerment is multi-dimensional and has been examined through a range of indicators, including higher age at first marriage, proportion of women with education or employment, and decision-making roles. As noted above, many of these are interlinked with fertility, nutrition improvements and maternal and newborn health seeking. India included the broader human right to health into the 1993 Protection of Human Rights Act, established policies to support equal opportunities and political participation of women, and included gender-sensitive policies under the NRHM.[293]

Age at first cohabitation (after marriage) in India has increased from a median of 17 years to 19 years between 2005-06 and 2019-21 overall and in higher mortality states and from 18 to 19 years in lower mortality states (Table 5.1). This is also associated with increasing educational attainment of women, and lower fertility.[294] The proportion of women with some education has also improved in this time period, from 55% to 72% who were literate, and 45% to 66% for secondary education. The gaps also closed between state clusters in female literacy rates and the proportion with secondary education, which increased by over 21 points in HMS and 13 points in LMS between 2005-06 and 2019-21. India has put in place a string of policies and programmes to expand educational opportunities, from the National Literacy Mission in 1988, the District Primary Education Programme in 1993-04, then the Sarva Shiksha Abhiyan to pursue universal primary education since 2000-01. In 2008-09, the Saakshar Bharat for literacy aimed to build on the previous mission along with the Rashtriya Madhyamik Shiksha Abhiyan to expand secondary education, followed by the Right to Education Act in 2010. The National Education Mission in 2018 has now united all of the previous schemes.

In terms of decision-making roles

the proportion of women reporting that their husband solely decided on their healthcare reduced from 30% to 16%,

Women who jointly made decisions with their husbands about their health care increased markedly from 35% to 72% between 2005-06 and 2019-21

Despite these improvements, there are many areas of gender equity such as the sex ratio at birth and violence towards women that have not improved or worsened in some areas of India; there is unclear evidence to quantify how these may have countered India's progress in MMR and NMR reduction.[295,296,297,298]

The key informants emphasized women's empowerment and education as crucial, to the extent that one person asserted this was "actually the cornerstone of everything: gender, human rights, health decision-making, and so on" (KI_10, government technical and development partner). Educated women have more agency over their choices and "better decision-making" or "better absorption" of health message (KI_07, development partner), and greater ability to negotiate with their partners, the larger family, and health workers, including to demand higher quality, respectful maternity care.

Studies have also shown that women's membership in a self-help group providing microfinance (though not universally high), a greater sense of autonomy, education, working for cash, and having a role in decision making were associated with higher family planning, access to ANC, institutional delivery and PNC visits in 2007-08 (DLHS-3) and 2015-16 (NFHS-4).[299,300] Men's attendance at ANC and more equitable gender attitudes were also associated with institutional delivery in NFHS-3 and 4.[301,302]

Table 5.1: Women's empowerment indicators (NFHS, 2005-06 and 2019-21)

	India		Hiigher moratality states		Lower moratality states	
	NFHS 3 (2005-06)	NFHS 5 (2019-21)	NFHS 3 (2005-06)	NFHS 5 (2019-21)	NFHS 3 (2005-06)	NFHS 5 (2019-21)
Median age at first cohabitation, women aged 25-49 (years)	17.4	18.9	16.9	18.5	17.9	19.1
Women age 15-49 who are literate (%)	55.1	71.5	44.1	64.9	64.0	77.2
Women age 15-49 with secondary or more education (%)	44.7	65.8	33.7	59.1	53.58	71.8
Women age 15-49 currently employed (%)	36.3	-	32.1	-	40.5	-
Mainly husband decides on woman's health care (%)	30.1	16.4	29.6	15.7	30.7	18.3
Husband and wife jointly decided on woman's health care (%)	35.1	72.2	34.8	74.4	35.1	68.3

Expanding Socio-Economic Development and WaSH

India's economic gains have been uneven, as income levels increased more than income equality.[303] Living conditions have generally improved as well, which are associated with improved birth outcomes.[304,305] The proportion of households with electricity improved from 60% in 1998-99 to 97% by 2019-21 (Figure 5.5). Those with improved water[xxviii] and sanitation also increased. Safe drinking water reportedly increased from 85% in 1998-99 up to 88% in 2015-16, while access to improved sanitation increased to more than two-third of the households. Open defecation has decreased steeply from 64% in 1992-93 to 19% in 2019-21. Clean fuel for cooking also more than tripled to 59% by 2019-21 in that time. India has most recently put in place the Swachh Bharat Abhiyan (Clean India Mission) in 2014 to accelerate access to clean fuel, hygiene and water.

Households living in pucca houses nearly doubled

32% → 60%

1998-99 2019-21

Access to bank account, which is crucial for households to receive conditional cash transfers under various welfare schemes/programs, has sharply increased for households

40% → 96%

Access to telephone (either landline or mobile) had a sharp increase

7% → 93%

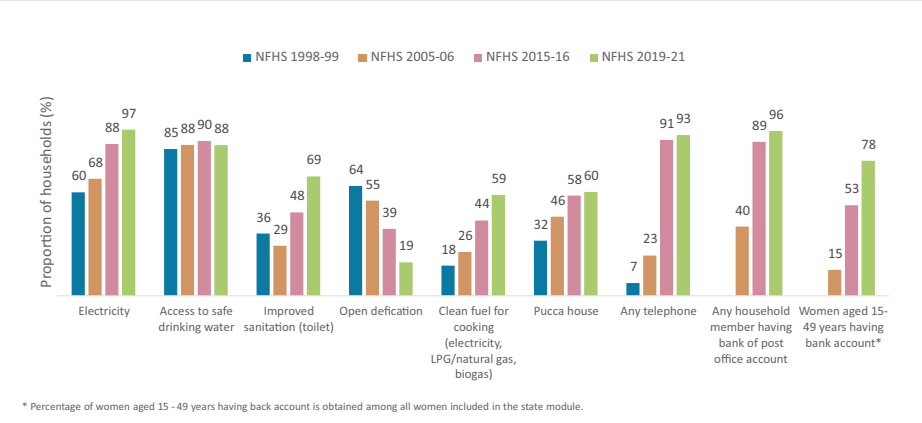
1998-99 2019-21

Increase was even sharper for women in the reproductive ages

15% → 78%

Greater proportions of households had electricity, access to improved sanitation, safe drinking wager, clean cooking fuel, telephone, and pucca houses in lower mortality clusters than in higher mortality states in all survey rounds (Figure 5.6). Improvements in most of these indicators started before 2000 in the lower mortality states according to NFHS 2 and 3. Meanwhile in the higher mortality states, most indicators improved noticeably faster during the 2005-06 to 2019-21period, even closing the gap with the lower mortality states (Figure 5.6). Open defecation was lower in the lower mortality states, and reduced at similar pace in both state clusters. Ownership of bank accounts by the household or women was similar in both the state clusters, and has risen sharply.

Figure 5.5: Community development indicators in India (NFHS, 1998-99 to 2019-21)



[xxviii] To maintain the definitional consistency with previous rounds, we have excluded bottled water and truck tanker/cart from the safe water source in NFHS 5.

Figure 5.6: Trends in community development indicators in the two state clusters (NFHS, 1998-99 to 2019-21)

In addition to poverty reduction, electricity, and WaSH, key informants highlighted the contribution of improved roads and expanded mobile communication infrastructure. They noted that roads and communication had both indirect benefits to health by supporting economic development, and also had direct immediate benefits to saving maternal and neonatal lives by enabling faster emergency referrals and facilitating communication about maternal and newborn health between health care facilities and between health workers and families.

> Roads are very, very important. You can transfer a patient from one place to another very quickly if you have a road. (KI_04, government technical and civil society).
>
> You know, just a simple thing, if from a PHC, a woman is being sent to the district hospital, somebody just gives a quick call that this woman is coming, get the operation theatre ready, you know! This is something, so we need to look at what has worked. (KI_12, government technical and development partner)

6

NATIONAL HEALTH POLICY AND SYSTEMS CHANGES IN INDIA

NATIONAL HEALTH POLICY AND SYSTEMS CHANGES IN INDIA

Highlights

India's health policy focus has expanded from a near-total focus on fertility reduction to increasingly broad programming for maternal and child health, with a focus on pro-poor programs and community outreach.

India's policy process has included geographic targeting wherein "socioeconomically backward" states and districts with particularly poor health indicators received additional financial and administrative support.

In the mid-2000s, India launched the National Rural Health Mission (NRHM) under the Reproductive and Child Health II (RCH II) program, which included major efforts to shift childbirth from homes and traditional birth attendants (TBAs) to facilities and skilled birth attendants (SBAs).

Two flagship components of the NRHM/RCH II -- the ASHA community health worker cadre and the conditional cash transfer program (Janani Suraksha Yojana) -- linked pregnant women to facility-based health services and incentivized institutional delivery.

Each subsequent national program has included efforts to improve the availability of government healthcare facilities in terms of increased density and operating hours, and to increase public-sector health worker availability through policy innovation to fill vacancies (such as contract hiring, allowances for remote postings, and paying private sector doctors for specific services) and sanctioning additional personnel.

Access to evidence-based life-saving technical services has expanded through skilled birth attendant training for auxiliary nurse midwives and staff nurses on elements of basic emergency obstetric and neonatal care (including on active management of third stage of labour) and through increasing the number of health facilities with blood banking, surgical wards, and physicians capable of offering caesarean delivery as well as basic or comprehensive neonatal care.

Spending on health increased from $31 per person in 2000 to $119 in 2018, of which the government's contribution increased from USD$4 per person in 2000 (13% of the total) to USD$20 in 2018 (17% of the total).

Administrative reforms and innovations gradually improved state-level capacity to shape their own locally responsive health plans, and to better "consume" or spend their allocated funding.

Overview

This chapter provides a synthesis of the national policies and programs related to maternal and neonatal survival in India over the past two decades. As noted in Chapter 1, India's national health policy landscape has been composed of four subsequent periods of MNH-related programming since the 1990s: the Child Survival and Safe Motherhood (CSSM) program from 1992 to 1997, the Reproductive and Child Health I (RCH I) program from 1997 to 2005, the Reproductive and Child Health II (RCH II) program and the National Rural Health Mission (NRHM) from 2005 to 2012; and the Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+A) program and National Health Mission (NHM) from 2012 to 2020.

India's national health policy in relation to maternal and neonatal health can be understood through six interrelated trajectories of change, which are each discussed in turn below:

(1) increasingly comprehensive healthcare with a pro-poor focus;

(2) community engagement and outreach;

(3) shifting childbirth from homes and traditional birth attendants (TBAs) to facilities and skilled birth attendants (SBAs);

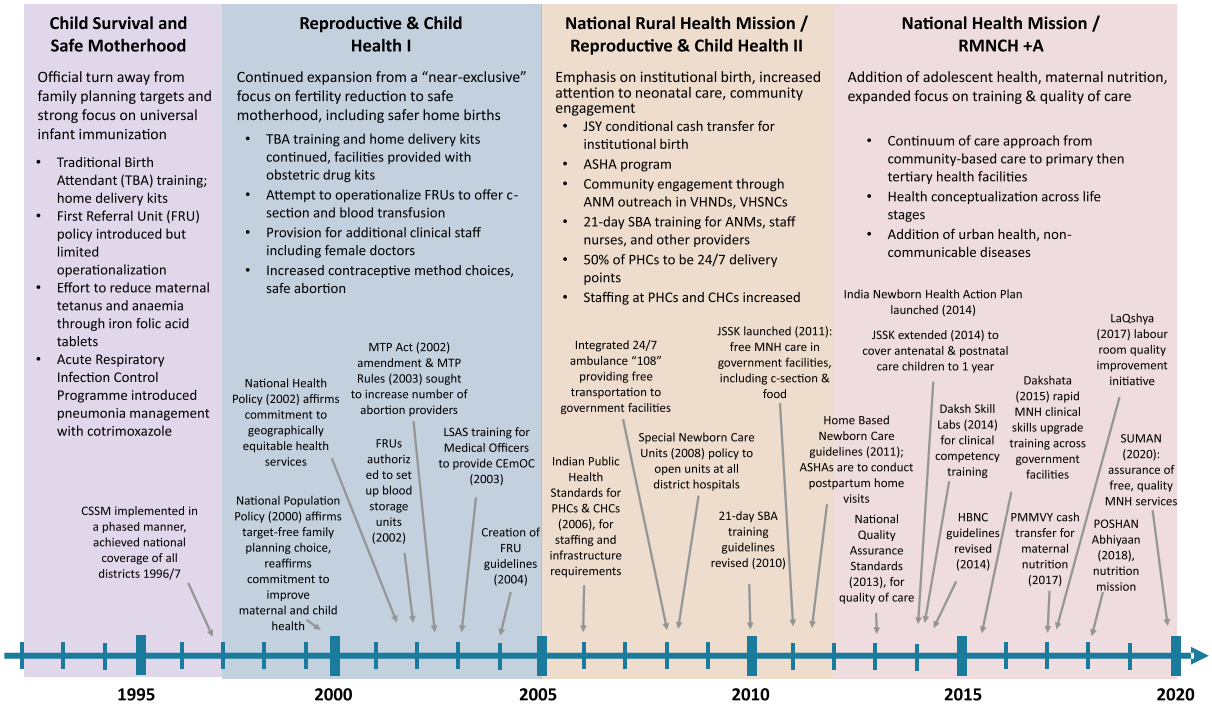
(4) improving the availability of healthcare facilities and health worker services;

(5) increasing access to evidence-based lifesaving technical services; and

(6) improving the quality of services.

These trajectories were underpinned by changes across all health policy and systems "levers" (policy, governance, resources/organizations/supply chain, payment, financing, regulation, information, and communication), with particular advancement in terms of increased financing and health sector reforms to strengthen financial management and planning, discussed in the second section of this chapter. Figure 6.1, below, presents a highlight of key policies and programs that are expanded upon below.

Figure 6.1: National-level policy changes seeking to improve maternal and neonatal health in India since 1992



Major Health Policy Trajectories for Improved Maternal & Neonatal Survival

Increasingly Comprehensive Healthcare with a Pro-Poor Focus

India's health policy focus has expanded from a "near-exclusive" focus on fertility reduction to increasingly broader programming for maternal and child health, with an explicitly pro-poor focus.[306] While CSSM brought efforts to reduce maternal tetanus and anaemia and create secondary-level maternity care facilities called "first referral units" (FRUs),[307] it was found to have had limited impact on maternal health.[308,309] The early 2000s consolidated political prioritization for maternal health due to some civil society action, global pressure (including India's rising leadership profile and the Millennium Development Goals) and the ruling political party's 2004 social equity-oriented promises.[310] RCH II/NRHM redoubled the government's healthcare focus on safe motherhood and expanded consideration to neonatal care. RMNCH+A/NHM expanded to a continuum of care model, offering a basket of essential services from the community to tertiary levels across five life stages of reproductive, maternal, newborn, child and adolescent health.

Each successive health policy sought to increase pro-poor benefit and reduce disparities between states, across districts, between the urban and rural populations, and between households. RCH I supported posting additional health personnel to remote facilities in a set of eight high priority states.[xxx] RCH II/NRHM channelled additional financing for Empowered Action Group (EAG) states.[xxxi] It also introduced the JSY conditional cash transfer scheme, which "focuses on the poor pregnant woman with special dispensation for states having low institutional delivery rates"[311] through higher cash transfers for women and community health workers in low performing states and rural areas, for women below the poverty line, and those from tribal groups or marginalized castes.[312] In 2011, just prior to the 2012 launch of RMNCH+A/NHM, Janani Shishu Suraksha Karyakaram (JSSK) was introduced, which entitled women and children to comprehensive maternity and newborn care at government hospitals at no cost.[313] Free emergency medical transportation under the NHM helped remove access barriers for rural people and the poor.[314]

[xxix] Acronyms in Figure 6.1: ASHA: accredited social health activist; CSSM: child survival and safe motherhood; EAG: empowered action group; FRU: first referral unit; HBNC: home based neonatal care; IPHS: Indian Public Health Standards; IMNCI: integrated management of neonatal and child illness; JSSK: Janani Shishu Suraksha Karyakaram; JSY: Janani Suraksha Yojana; LaQshya: labour room quality improvement initiative; LSAS: lifesaving anesthetic skill; MO: medical officer; NBSU: newborn stabilization unit; NSSK: Navjaat Shishu Suraksha Karyakram; NQAS: National Quality Assurance Standards; RCH: reproductive and child health; RMNCH+A: reproductive, maternal, neonatal and child health plus adolescent health; SBA: skilled birth attendant; SNCU: special newborn care unit; SUMAN: Surakshit Matritva Aashwasan; TBA: traditional birth attendant; VHNDs: village health and nutrition days

xxx Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Rajasthan, Haryana, Assam and Nagaland

xxxi Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Rajasthan, Chhattisgarh, Jharkhand and Uttaranchal

Community Engagement and Outreach

Prior to the NRHM, health care services and education were concentrated in health facilities, available only to those families that decided to seek care due to acute need or higher awareness. The NRHM introduced several interrelated strategies to empower communities around health and to provide outreach-based community level primary health care: the ASHA program, HBNC, VHNDs, and VHNSCs. Under the ASHA program a woman in every village was selected and trained with an initial 24 day training and then subsequent shorter update trainings to serve as a community health worker.[315] ASHAs were trained and incentivized to identify pregnant women, teach them about health during pregnancy and the benefits of institutional delivery, and link them to facilities for delivery.[316,317] In 2011, ASHAs also began being capacitated to provide HBNC, which brought essential lifesaving education on breastfeeding, hygiene, and cord and thermal care, and screening for pneumonia and sepsis into the home through a series of visits over the first six weeks of life.[318]

Under the NRHM, ANMs began providing monthly outreach visits, called VHNDs, where they offered antenatal care, immunization services, health check ups and health education services. ASHAs facilitated these outreach events by identifying community members in need of care, particularly pregnant women and mothers of young children, and encouraging them to attend VHNDs. The NRHM also encouraged community participation in health promotion, health planning and monitoring government services through mandating that every village form a VHSNC.[319]

Key informants reflected that the ASHA program, HBNC, and the ANM's outreach services have been major drivers of success in reducing neonatal and maternal mortality throughout the country. In contrast, village level planning and monitoring (through VHSNCs and the PRIs) has been an important contributor in some low mortality states but less so in high mortality states.

Shifting Childbirth from Homes and TBAs to Facilities and SBAs

While efforts to improve the obstetric capacity of health facilities began in CSSM (1992), it was not until RCH II/NRHM (2005) that the government launched a massive effort to shift childbirth from homes and trained TBAs to health facilities and SBAs. In the interim, during CSSM (1992-1997)[320] and RCH I (1997-2005)[321], the government trained and equipped TBAs for safer home deliveries. During RCH I, debate about the value of TBAs emerged.[322] Ultimately TBAs were phased out because they were shown unable to adequately identify and manage complications during pregnancy and child birth, and thus could not be classified as SBAs.[323] The launch of RCH II/NRHM brought a focus on midwifery training for ANMs and staff nurses to designate them as skilled birth attendants who could attend uncomplicated births and make appropriate referrals.[324] RCH II/NRHM introduced JSY, as mentioned above; these cash transfers strongly incentivised institutional childbirth for pregnant women and ASHAs.[325]

Improving the Availability of Healthcare Facilities and Health Workers

Each subsequent national program has intensified efforts to improve the availability of government healthcare facilities in terms of density and operating hours, and to increase public-sector health worker availability through filling vacancies and sanctioning additional personnel.

Facilities

CSSM sanctioned the creation of 1700 FRUs through upgrading existing community health centers (CHCs) or sub-district hospitals by adding staff, infrastructure, and equipment.[326] RCH I sanctioned the creation of 1243 new facilities, consisting of health sub centers, PHCs, CHCs and staff quarters, and the renovation of another 2500 buildings, including the addition of delivery rooms and operation theatres.[327] RCH II/ NRHM brought an additional round of facility upgrades and the goal that 50% of PHCs and CHCs were to be operational as 24 hour delivery facilities,[328] with bonus payment to healthcare workers to ensure that at least one medical officer, a nurse and a cleaner were available throughout the day.[329] All FRUs were to be operationalized for surgical care, including blood banks, and funding was again allocated to upgrade operation theatres and labour rooms.[330]

Health Workers

Increasing the availability of human resources for health in government service was a major government policy focus. CSSM sanctioned the addition of obstetrician-gynecologists, pediatricians, and anesthetists to all facilities newly designated as FRUs, although actually filling these positions remained a major challenge.[331]

- RCH I sanctioned a number of investments in health workers, including additional ANMs in some remote sub-health centres and additional nurses in some remote PHCs in high priority states, "safe motherhood consultants" (i.e., doctors trained in medical termination of pregnancy (MTP) techniques) contracted on a per day basis, and private anesthetists contracted on a per case basis to support CEmOC.[332]

- RCH II/NRHM sanctioned a second ANM in every health sub-centre[333] and established the ASHA program,[334] mentioned above. RCH II / NRHM also sanctioned a second medical officer (MO) and two more staff nurses at PHCs[335] and four MOs, seven staff nurses, one ANM and one LHV at upgraded 24/7 CHCs.[336]

- Under RMNCH+A/NHM health sub-centres (HSCs) and Urban PHCs were to be provided with additional human resources and supplies in order to become the first access point for a full range of primary care services.[337]

The NRHM allowed contractual hiring, wherein states could hire additional health workers through a simplified contractual process. In addition, the NRHM provided states with the flexibility to develop innovative strategies to fill human resource vacancies. A variety of strategies emerged, including special allowances and higher pay for difficult or hard to reach areas, preferential selection for post-graduate seats for those who served in rural areas, and bonded rural service for new graduates.[338] In 2014, under RMNCH+A, the Government announced that AYUSH[xxxii] doctors could serve as skilled birth attendants and supervise labour rooms after receiving the 21 day SBA training (discussed further below, in "Increasing access to evidence-based lifesaving technical services: Basic emergency obstetric and newborn care") and seven days hands on practice.[339] The extent to which the states were successful in filling vacancies and regaining workers varied widely; administrative strategies to increase HRH availability are discussed further in "health system financing and reform," below.

[xxxii] AYUSH stands for Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy -- the six non-allopathic systems of medicine practiced in India

Increasing Access to Evidence-Based Lifesaving Technical Services

Over the last two decades, the Government of India has developed guidelines that seek to expand access to evidence-based lifesaving technical maternal and neonatal health care.

Antenatal Care

While ANMs and TBAs were trained in aspects of ANC under CSSM and RCH I, by RCH II/NRHM, antenatal care became primarily the ANM's responsibility.'[xxxiii] ANC also expanded from a focus on three core services -- tetanus injection, supplementary iron and folic acid (IFA) tablets for anaemia prophylaxis, and high risk pregnancy screening[340] -- to a more comprehensive package over four visits, defined in the 2005 guideline on antenatal care and skilled attendance at birth.[341] The 2010 update included the recommendation that women undergo their third ANC check up with a medical doctor at the [342]

In 2018, the MoHFW launched the Anaemia Mukt Bharat, which was a comprehensive anemia prevention and treatment program.[343] Under this program, all pregnant women are screened for anemia, those found to be anemic are listed by the ANM, provided treatment, and followed up to check progress. Iron sucrose IV treatment was also introduced for moderate and severe cases and mild cases that are identified late or do not improve after initial treatment.

Basic Emergency Obstetric and Newborn Care (BEmONC)

Under CSSM, TBAs were provided with pre-sterilized disposable delivery kits and trained in basic obstetric care, alongside ANMs.[344] Under RCH I, the provision of pre-sterilized delivery kits was expanded to include pregnant women themselves, in preparation for home delivery. However by RCH II/NRHM, the Ministry of Health and Family Welfare consolidated its focus on upskilling ANMs, LHVs and staff nurses.[345] Leading up to RCH II/NRHM, the Government of India expanded the legal scope of work for ANMs/LHVs and staff nurses to allow them to give some injections and provide interventions for the "basic management of complications which might develop while providing care during pregnancy and child birth", detailed below.[346] Accordingly, guidelines for ante-natal care and skilled attendance at birth by ANMs/LHVs and staff nurses were published in 2005 and revised in 2010.[347]

These guidelines were operationalized in RCH II/NRHM as a 21 day skilled birth attendant training for ANMs, LHVs and staff nurses, which included skill-building training in: the use of partographs to clearly support decision-making on referral,[348] active management of third stage of labour, including the use uterotonic drugs; the use of drugs in emergency situations to stabilise the patient prior to referral (including injectable Magnesium Sulphate for eclampsia), the provision of a first dose of antibiotics in cases of delayed post-partum hemorrhage or sepsis (gentamycin injection, ampicillin capsule or metronidazole tablet), vitamin K injection to newborns, and how to perform basic procedures in emergency situations (e.g., IV fluids, neonatal nose and mouth suction, and bag and mask equipment neonatal resuscitation).[349] India has also introduced updated protocols for the management and treatment of common obstetric complications, including non-pneumatic anti-shock garments to decrease maternal mortality from obstetric hemorrhage.[350]

RMNCH+A/NHM introduced "Daksh skills labs", a series of competency based certificate short courses for ANMs and staff nurses that include aspects of BEmONC,[351] and "Dakshata", a 3-day training on BEmONC institutional delivery skills for ANMs, staff nurses and medical officers.[352]

Notably, the SBA training, Daksh and Dakshata do not cover three components of BEmOC: assisted vaginal delivery, with vacuum extractor; manual removal of the placenta; and removal of retained products following miscarriage or abortion – these must be done through referral to a medical officer.

[xxxiii] In all cases, reference to ANMs includes lady health visitors (LHVs). LHVs are ANMs who have been promoted to oversee six sub-centers. To be eligible for this promotion, an ANM must have five years of work experience and complete a six-month training program

Comprehensive Emergency Obstetric Care(CEmOC)

The FRUs sanctioned under CSSM were to provide 24/7 secondary-level comprehensive emergency obstetric care (CEmOC) which includes all BEmOC functions plus c-section and blood transfusion.[353,354] RCH I and RCH II/NRHM both sought to operationalize FRUs, reflective of persistent infrastructure and specialist shortfalls.[355] Under CSSM and RCH I, FRUs struggled to access blood banks and were not authorized to bank blood.[356] An amendment to the Drugs and Cosmetics Rules in the early 2000s enabled FRUs to set up blood storage units,[357] and in 2004, FRU guidelines noted that 24/7 on-site blood storage facilities were a critical determinant of FRU functionality.[358] To help overcome specialist shortages, RCH II/NRHM introduced training for MBBS doctors in lifesaving anaesthetic skills and obstetric management.

Neonatal Health Care

India's neonatal survival policies have gradually intensified efforts to improve neonatal survival. CSSM introduced FRUs which were to include secondary-level neonatal care and began training frontline workers on neonatal resuscitation, and prevention of infection and hypothermia.[359] Although RCH I operationalized an essential newborn care package, Integrated Management of Newborn & Childhood Illnesses (IMNCI), [360] the program's neonatal health efforts were primarily facility-focused.[361] RCH II/NRHM shifted the emphasis to basic community-level essential neonatal health interventions for states with high IMR (drying and wrapping the newborn, kangaroo mother care, cord care, cotrimoxazole or amoxicillin treatment, exclusive breastfeeding).[362] Community-based neonatal care was set out in the 2005 NRHM policy documents to consist of health worker visits on days 1,2,7,14 and 28.[363] HBNC following IMNCI protocols was institutionalized in 2011, with ASHAs identified as its main providers. [364]

Facility-based comprehensive neonatal care was promoted during RCH II/NRHM through newborn care corners (NBCCs) to provide essential newborn care at birth at all delivery points, newborn stabilization units (NBSU) in CHCs and FRUs, and special newborn care units (SNCUs) in district hospitals and sub-district hospitals[365] in priority districts.[366] In 2009 the government introduced Navjaat Shishu Suraksha Karyakram (NSSK), a two-day training for doctors, nurses and ANMs in basic newborn care and resuscitation.[367] In 2014, the government introduced guidelines for ANMs, nurses and Medical Officers on how to use Antenatal Corticosteroids in instances of preterm labour, based on evidence that this intervention can improve preterm birth outcomes.[368] However, in 2015 research findings suggested that without precise estimation of gestational age and assessment of imminent preterm birth, and without adequate newborn care and postpartum maternal care, antenatal corticosteroid administration could do more harm than good.[369,370] Research within India has found that many government facilities were not equipped to ensure safe use of antenatal corticosteroids.[371,372]

[xxxiii] In all cases, reference to ANMs includes lady health visitors (LHVs). LHVs are ANMs who have been promoted to oversee six sub-centers. To be eligible for this promotion, an ANM must have five years of work experience and complete a six-month training program

Medical Termination of Pregnancy

Abortion has been legal in India since the 1970s and the past two decades of health policy, particularly the National Population Policy (2000) and RCH II/NRHM, has sought to increase access and availability to comprehensive abortion services. RCH I introduced "safe motherhood consultants" to visit PHCs and CHCs for scheduled termination and provided skill-based training to doctors in MTP techniques. In the lead-up to RCH II/NRHM the ministry released guidelines on manual vacuum aspiration for equip medical officers at the PHC level and above.[373]

The MTP Rules, 2003, authorized registered medical practitioners (RMPs) to prescribe Mifepristone and Misoprostol for medical abortion up to seven weeks.[374] The 2003 amendment to the 1971 MTP Act sought to increase the number of safe MTP service providers by decentralizing the power to approve health facilities as MTP centers.[375]

Emergency Transportation

Under CSSM, each FRU was to be provided with an ambulance.[376] RCH I piloted emergency transport programs and designated funding for Panchayats to manage local referral transportation,[377] however the pilots did not scale.[378] Under RCH II/NRHM PHCs were mandated to provide "round the clock referral transport support" either managed by the PHC or by an NGOs / CBOs.[379] During the RCH II/NRHM period, in 2008, the 108 ambulance service was launched across multiple states, introducing a GIS enabled, digitally tracked ambulance service.

Improving the Quality of Services

Health Worker Training

Efforts to increase the availability of lifesaving maternal and neonatal healthcare were intertwined with multiskilling, intensive trainings and refresher training for frontline health workers. Key health worker trainings (already mentioned above) under RCH II/NRHM were the 21 day skilled birth attendant training for ANMs/LHVs and staff nurses[380] and several programs for multiskilling medical officers, including lifesaving anesthetic skills training and CEmOC skills training for MBBS doctors to fill specialist gaps.[381,382] RCH II/NRHM introduced essential basic neonatal survival skills training for ASHAs focused on HBNC.[383] RMNCH+A/NHM brought Daksh and Dakshata skills training for ANMs, staff nurses and medical officers.[384,385]

Facility Standards

India has increasingly set and operationalized facility standards and treatment guidelines to create benchmarks and standardize high quality care. FRU guidelines were published in 2004.[386] RCH II/ NRHM saw the creation of Indian Public Health Standards for HSCs, PHCs, CHCs, sub-district health facilities, district hospitals in 2006.[387] These guidelines were updated in 2012.[388] Infection Management and Environment Plan guidelines were released during RCH II/NRHM. The Indian Public Health Standards introduced during the RCH II/NRHM[389] period included a requirement that government facilities adhere to a Charter of Patients' Rights, develop a grievance redressal mechanism and constitute management committees that include community members and PRI representatives. Each PHC and CHC is required to set up a Rogi Kalyan Samiti / Hospital Management Committee[390] and is entitled to an untied fund that supports facility infrastructure and maintenance.[391] RMNCH+A/NHM intensified attention on quality of care with the 2017 Labour Room Quality Assurance Initiative (LaQshya), which emphasized patient centred maternity care,[392] the National Quality Assurance Standards (NQAS) and Surakshit Matritva Aashwasan (SUMAN), which adds a maternal health rights perspective and community engagement.

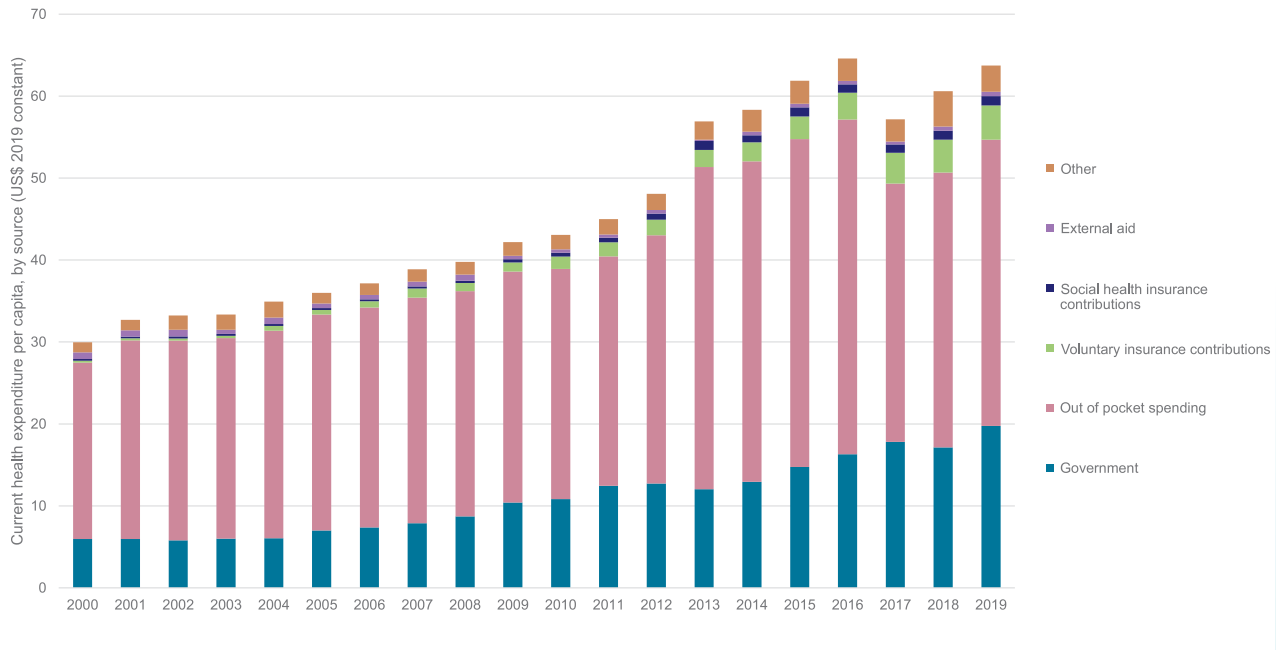
Health System Financing and Reform

Improvements in maternal and newborn healthcare were made possible by increased spending on health (private and public) and major health sector reforms over the last two decades.

Healthcare Spending

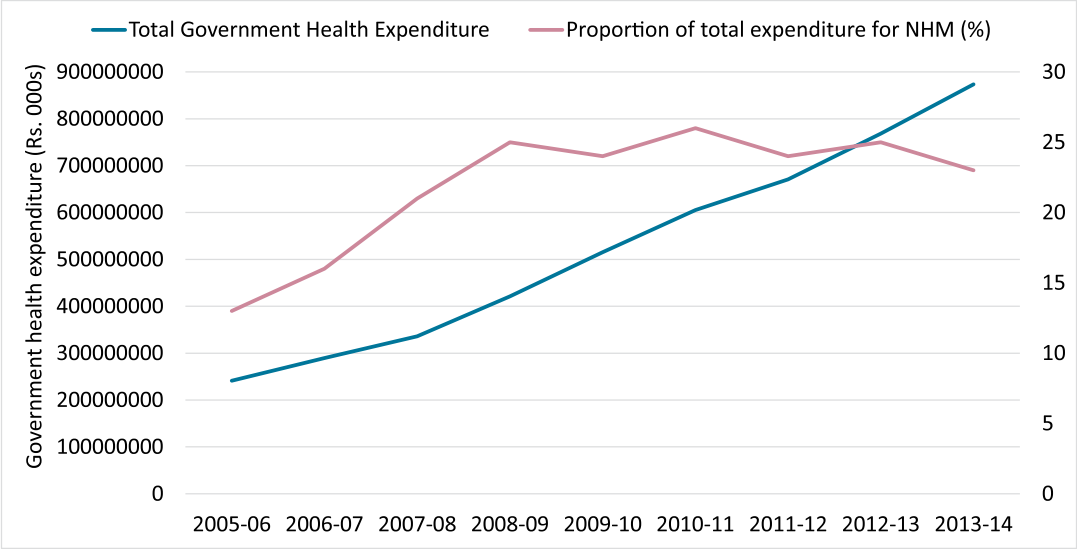
The total spent per person on healthcare more than doubled in India between 2000 and 2019, from $30 to $64 (in US$ 2019 constant). In that time, the government's contribution increased from US$ 6 per person (20% of the total) to US$ 20 (31% of the total) (Figure 6.2).[393] External aid and health insurance made small but slightly increasing contributions.

Figure 6.2: Health expenditure per capita (US$ 2019 constant), by source (National Health Accounts 2000-2019, GHEx database)



In raw numbers, government spending on health increased from around Rs. 24,122 Crore (USD$ 3.2 billion) in 2005-06 to Rs. 87,350 Crore (US$ 11.7 billion) in 2013-14 (Figure 6.3).[394] Despite absolute increases in government expenditure on health, the percent of gross domestic product (GDP) that the government has spent on health hovered around 1% throughout the past two decades.[395] The government also increased the portion of their expenditure channelled through the NRHM, from 13% at its launch in 2005-06 to a plateau around 25% from 2008-9 onward through to the NHM period (Figure 6.3).

Figure 6.3: Total government health expenditure and proportion spent through the NRHM/NHM (2005-06 to 2013-14)[396]



Government spending specifically on maternal and child health doubled from around Rs. 650 crores (US$ 87 million) to Rs. 1,242 crores (US$ 166 million) in the same four-year period and further increased to Rs. 2,069 crores (US$ 277 million) by 2015-16.[397]

Health System Reform

The Government of India introduced many interrelated governance and financing reforms that promoted responsiveness and improved states' "consumptive capacity" (ability to spend the amount budgeted). The reforms focused on (A) decentralization and associated administrative capacity building; (B) human resource policies to increase health worker availability and expand their legal scope of work; (C) increased financial flexibility; and (D) government program accountability through increased monitoring, discussed in turn below.

Key informants noted that these reforms were largely introduced through the NRHM, which was considered a "game changing moment" (KI_03, civil society), or a "tipping point" (KI_13, government administrative), in strengthening government maternal and neonatal healthcare provision. The NRHM's importance was attributed first to it being a "complete architectural correction" (KI_10, government technical and development partner) of the health system, meaning that it focused not only on strengthening technical services but also on improving administrative processes, human resources for clinical care as well as planning and management, community level maternal and neonatal linkages, governance, supply chain, data quality, equity, and demand side behavioural sciences. Second, as a mission "blessed" by the office of the Prime Minister (KI_10, government technical and development partner) and monitored through clear appraisals, the NRHM brought renewed urgency, decision-making power, and separate budgetary allocation. Third, the NRHM deepened domestic ownership of the maternal and child health agenda. Previously, reproductive and child health interventions were "by and large World Bank funded loan-based" programs (KI_10, government technical and development partner). The NRHM made these programs "government owned, government funded, taxpayer supported, with political will at the highest level possible" (KI_10, government technical and development partner). This domestic ownership extended into state-level ownership as states became increasingly skilled at developing project implementation plans (PIPs) to meet their needs.

Political will to undertake these reforms arose from a confluence of factors: "There were a lot of different kinds of events, data, coming together of people, which kind of helped bring in many elements in the National Rural Health Mission" (KI_03, civil society). The factors that culminated in the 2005 NRHM included: a newly elected United Progressive Alliance government, which was motivated to introduce a dramatic new health policy; data released in 2000 showing unexpectedly high MMR; a growing sense that being "at the bottom of the heap" (KI_03, civil society) in terms of maternal and child health indicators was at odds with the modern and progressive image India was seeking to project; "large international initiatives" (KI_07, development partner), particularly the Millennium Development Goal on maternal mortality; and growing domestic and international evidence on "what really works" (KI_03, civil society).

Important evidence cited by key informants included Society For Education, Action and Research in Community Health's (SEARCH) research in Gadchiroli showing that rural community health workers dramatically reduced NMR, followed up by research through the Indian Council of Medical Research (ICMR), evidence from Egypt and Sri Lanka presented at White Ribbon Alliance conferences on their rapid reductions in maternal mortality, Lancet series on maternal and neonatal death, and WHO and EU guidance around allowing auxiliary workers to provide Misoprostol, Oxytocin, and Magnesium Sulfate. The NRHM was celebrated for bringing together leaders from multiple stakeholder groups (academia, civil society, donors, and private sector clinicians) to collaborate on its design.

Decentralization and Associated Administrative Capacity Building

CSSM and RCH I took a "one size fits all" approach to health program planning, relying on standardized design with little state-level input.[398,399,400] Although RCH I introduced a "community needs assessment" as part of a broader "target free" decentralized approach, the implementation of these processes were assessed to be unsatisfactory.[401] It was RCH II/NRHM that brought an "architectural correction" to the government health care system,[402] in part through operationalizing novel financing and governance approaches.[403] NRHM focused on institutionalizing state project implementation plans (PIPs), which were to be developed by consolidating district health plans, which were in turn developed from the community and block levels. While many states initially lacked the capacity to prepare and cost their health plans, particularly at the district and lower levels, this "bottom up" planning approach was increasingly institutionalized.[404]

> … Prior to that [NRHM], you do not have a concept of even a state level plan with outcomes and so on. Starting from a base where the central government is looking for a plan where you [state governments] come back and commit to a certain level of MMR and so on. You never had that. So first getting to the state level and think in terms of outcomes itself was a big challenge (KI_05, government administrative & private sector)

State PIPs "galvanised the system" (KI_12, government technical and development partner) by pushing State governments to take a "systematic, structured approach to develop plans for each geography" (KI_12, government technical and development partner) and answering these plans with an infusion of funding from the NRHM (and later the NHM). It was through PIPs that the health system decentralised planning, built stronger management systems, and introduced innovations including the contractual hiring of health workers, setting up blood storage units and blood banks, and referral transport systems: "A lot of these innovative and interesting activities were undertaken through these PIPs" (KI_12, government technical and development partner).

A number of innovations gradually improved state capacity to implement their PIPs and "consume" or spend their allocated funding.[405] This was particularly true for Empowered Action Group (EAG) states, which initially underspent large portions of their budgets. The NRHM gradually strengthened institutional capacity for financial and program management, and removed some of the administrative burden from medical professionals, through appointing an additional officer to support the Joint Secretary at the center[406] and sanctioning public health managers to head all tiers of the health system,[407] including State Programme Managers, District Programme Managers, Finance Officers and Data Officers.[408]

The development of the National Health Systems Resource Centre (NHSRC) and State Health Resource Centres enabled program managers and technocrats at the state levels to become increasingly technically grounded in the principles of public health, issues around quality of care, and global perspectives on India's development (KI_07, development partner). The heightened capacity of governmental actors decreased India's reliance on external technical assistance. Administrative bodies were introduced in the forms of state and district health societies, a NRHM finance branch, planning and monitoring committees, and state, district, and block program management units. Additional administrative and technical consultants were hired on contract to rapidly address human resource shortages.

Human Resource Policies to Increase Health Worker Availability and Expand Their Legal Scope of Work

As discussed in "Major health policy trajectories for improved maternal and neonatal survival," above, the Indian government passed policies to sanction additional health worker postings in government facilities during each policy period over the last two decades. Key informants noted that actually implementing these policies has been inconsistent, particularly in terms of recruiting and retaining specialists in government facilities. While low mortality states have seen far more success, they felt that there were some high mortality states that continued to have extremely low BEmONC and almost no CEmONC capacity below the District Hospital level.

> … There were more than 80% shortfalls in CHCs of gynecologists, surgeons and anesthesiologists […] if the health workforce is not in station, the best policy cannot be implemented. And I am telling you that 90% of doctors in India are not in public hospitals. They work in the private sector. So no matter that you try to make your FRU well equipped with an OT [operating theatre] and all the equipment needed, if you do not have the human resources needed for a functional FRU, the buildings and the equipment and the budgets are not really going to lead to an effective outcome. […] You know, I'm not imputing that the policies were wrong. The policies were completely well intentioned. But they missed out the elephant in the room which is the fact that there is no skilled workforce. (KI_08, civil society)

Nonetheless, experts highlighted a number of administrative changes under the NRHM that played a role in increasing HRH availability. Under the NRHM, states were permitted to hire workers on contracts, which simplified the recruitment process and allowed more competitive salaries.

> States were given "complete flexibility to pay differential salaries for difficult areas and hard-to-reach-areas" (KI_13, government administrative).

> The logic of the market salaries was, you know, extended to even models like 'you quote-we pay'. So, you know, states were told that you give anything that it takes to get the human resources. So, states would come out with advertisements where they would ask the specialists to quote their salary. So, so, you know, for difficult areas, there they pay three hundred thousand, three and a half hundred thousand rupees per month to get specialists. So, I think that's the important part of HRH (KI_13, government administrative).

The NRHM also granted states the flexibility to develop context-specific incentives to recruit and retain personnel in underserved areas (KI_04, government technical and civil society), such as compulsory or incentivised rural service (KI_12, government technical and development partner)

> States came up with all kinds of options based on the local conditions. I think in 2009 or 2010, we made a list of all of possible innovations that different states were trying. But those innovations were at preliminary stages. But, I think we came up with something like a hundred of them. Different guys trying out different things. And although, not too many of them really got scaled up and some did like the special transport business, but nevertheless, I think it had a big impact on the human resource (KI_05, government administrative & private sector).

Several key informants noted that these changes were not able to overcome the root problems of recruitment and retention: insufficient pay for non-contract positions, overly complex recruitment processes, and the "massive sub-industry" (KI_08, civil society) of favours related to transfers, promotions and postings.

Legal changes in India's obstetric and neonatal guidelines and regulations encouraged health workers to expand the range of lifesaving care that they provided. One legal and regulatory change considered "a real game changer" (KI_01, government technical) was authorizing ANMs and nurses to undertake active management of third stage of labor (AMTSL) in emergency situations. Another was the 2014 update to home based newborn care guidelines that permitted ANM to provide a "pre-referral dose" of Gentamicin (injection) and Amoxicillin (oral syrup) for sepsis in young infants and to provide the complete 7-day course at home in cases where the family did not accept referral to a facility.

> It's been saying that okay she gives the first pre-referral dose. The idea is that we safeguard and say you're only giving the first dose. You refer the child. Or in the event let's say where the family refuses to accept to go and say "okay, you go ahead and treat my kid. And I take responsibility." Then she can [treat the child at home]... (KI_11, government technical and academic)

Generalist medical officers who received skills upgrade training in lifesaving anesthetic skills (LSAS) and CEmOC were given legal protection from liability if the emergency interventions were unable to save a maternal or newborn life.

Increased Financial Flexibility

Improvements were made over time in the ability to spend allocated finances, which occurred unevenly across states. Several key informants suggested that a lack of funds was not the main issue, but rather that available funds were not fully utilized.

> We stopped asking for an increase in the percentage of GDP, quite some time back. Because I think the problem was the utilisation rates. (KI_03, civil society)

One key informant challenged this perspective, explaining that insufficient expenditure remained the fundamental issue. They explained that the majority of public money spent on health in India went to tertiary facilities and special health care for government employees: "if 10,000 rupees per capita is spent on a central government health employee, its 600 for the ordinary citizen on the street" (KI_08, civil society). They also asserted that states struggled to spend all that was budgeted to them not because of poor financial management, but because their transfers came at the very end of the fiscal year, leaving no time to disperse the money.

A shift occurred as the NRHM intentionally sought to improve utilization by improving financial management and monitoring.

> I think what happened with NHM was that states had to kind of pull up their shoes [socks], and explain, why have I been to spend the money, or not being able to spend the money. So I think what happened, was, see, the push was never vertical. So there were HR initiatives, there were infrastructure initiatives, there were community initiatives, there was training of, you know, the set-up of the cadre, there were untied funds given to the sub-centres. Um, so I think, I think, what happened with this intense, kind of, reporting back, monitoring, etc. was that states started utilising the money better. (KI_03, civil society)

Prior to the NRHM, state expenditure was largely "straitjacketed" (KI_04, government technical and civil society) by strict financial accountability norms at the Centre. Under the NHRM, the Ministry developed RCH flexi pools to address this problem, wherein states could spend money, such as paying out JSY, and from a pool rather than a tight line item. This meant that if additional money was required beyond what had been budgeted, the outgoing payments could continue uninterrupted from the flexi pool, and the flexi pool could be replenished based on the state's financial reports. Financial flexibility extended to the facility level, wherein an untied fund was made available for each facility to use on purchases that prevented service disruption. This flexibility across the system had the tangible benefit of enabling continuous financial flows (to address the issue that "When there is a need of money [...] everything comes to standstill" (KI_05, government administrative & private sector) and supporting context-specific innovation. It also had the "intangible" benefit of boosting health worker morale and confidence.

Efforts were also made to ensure that the central government's transfer of funds to the states and movement of funds within the states were timelier: "The financial management group spent a lot of time making sure that the financial systems in terms of ensuring that states got money on time, also speeded it up" (KI_05, government administrative & private sector). These efforts included the use of electronic wire transfers and an online Public Financial Management System (KI_04, government technical and civil society): "nobody writes a cheque anymore but at that time [early 2000s], sending the money to the states was a big nightmare. So, I think they started doing this electronically" (KI_05, government administrative & private sector).

The government expanded the availability of financially literate staff at all levels of the system, inculcated a problem-solving approach to addressing financial bottlenecks, and clarified expenditure guidelines. Prior to the NRHM period, when a health facility could not produce a utilization certificate for the previous tranche of funds, the next disbursement would simply be blocked. However, the NRHM introduced a new approach wherein program managers were hired who took interest in understanding why the utilization certificates were not available and how these certificates could be accessed so that the bottleneck could be unblocked. This new approach was aided by the hiring of financial experts such as MBAs in finance and chartered accountants to shift the burden of financial management away from "ward boys and nurses" (national stakeholder meeting). Administrators were given clearer guidelines and supported in "proactive spending" because "people used to be afraid" to spend and later be accused of a criminal offence (KI_04, government technical and civil society).

The NRHM introduced State Health Societies, which were independent of the treasury, allowing NRHM financing to avoid the treasury's "archaic" bureaucratic checks and balances and instead institute financial processes and regulations that were responsive to implementation realities.[409]

For example, societies instituted a devolved system of accountability and decision-making wherein the power to spend money stayed with the "financial envelope"; this meant that, for example, money allocated to a district could be spent by the district according to their plan without requiring additional approval from the state. The decentralization of approval procedures increased state level responsibility for training plans, local capacity enhancement and the program implementation.[410]

Government Program Accountability through Increased Monitoring

Many key informants emphasized the value of "more rigorous reviews and monitoring" (KI_12, government technical and development partner) introduced during the NRHM period, which took a supportive, problem-solving rather than punitive approach. This improved monitoring extended from high level Missions down to supervision of staff at facilities. Annual Joint Review Missions and Common Review Missions, most of which focused on high mortality states, standardized data reporting and "made the system accountable" through visits to "check each and every thing" (KI_04, government technical and civil society). These review processes focused on recommendations and developing action plans for future improvement: "The more something is monitored and flagged, the impact does get better" (KI_12, government technical and development partner). The concept of supportive supervision was introduced to encourage solving, rather than hiding problems, although key informants did not comment on the extent to which organizational culture at the facility level shifted. The Health Management Information System was simultaneously developed during the NRHM period and supported this monitoring process.

> Monitoring also improved a lot and there was a big focus, but difference was that from the word monitoring came – supportive supervision. So, monitoring earlier was a sort of inspection. And, when it is inspection people they try to hide their fault and try to show you that everything is good. And then the scope of improvement is less. So instead of monitoring, we started calling it supportive supervision and there is a guideline RMNCH+A on the supportive supervision, where we've focused on the fact that you go there, not for the fault finding, you go there to support the staff. If you see and observe any gaps you don't start chiding them. You try to solve it. (KI_01, government technical)

7

STATE SYNTHESIS ON MNH DRIVERS

STATE SYNTHESIS ON MNH DRIVERS

Highlights

In LMS, MMR and NMR levels were similar, but NMR started higher and decreased more in Tamil Nadu than Maharashtra.

In HMS, MMR was higher and NMR lower in Uttar Pradesh and Rajasthan than Odisha and Madhya Pradesh, but all converged at lower levels over time.

NMR declines were mainly on days 3-27, except Maharashtra where day 0-2 deaths declined more.

Deaths due to all causes declined in LMS, and mainly in preterm birth and asphyxia, while in HMS more of the decline were in deaths due to infections and other causes.

States converged with higher coverage levels for all key interventions but four or more ANC visits, with faster increases in the NRHM to NHM periods except in Tamil Nadu which was earlier and in Uttar Pradesh which was mainly in the NHM period.

Institutional deliveries increased more in the public sector for all states, though not as substantially in Maharashtra and Uttar Pradesh as they also saw an increase in private sector deliveries.

The increases were greater in hospitals in the LMS, and at lower level facilities in the LMS.

Inequalities in institutional deliveries between urban-rural residence and household wealth tertiles substantially reduced, particularly after 2013, except for between urban-rural areas in Odisha, while wealth-based inequalities were lowest in Tamil Nadu and highest in Odisha.

C-section rates differed a lot between states, being highest in the LMS, as well as Odisha.

C-sections were lowest among the poorest, however those in Tamil Nadu reached well above the level of 10-15% needed C-sections, while in rural areas of HMS it remained around 15% .

Total fertility rates in the selected six states declined from about 4-6 children per woman in the 1970s to 1.5-3 in 2019; it remained higher in the HMS than LMS except Odisha.

Household access to basic amenities such as improved sanitation, clean fuel for cooking, telephone/ mobile and bank account has improved substantially in all the six selected states between 1992-93 and 2019-21, with LMS having higher levels than HMS over time.

LMS started with good availability of services and health workers, and so targeted efforts to improve access to disadvantaged groups, and quality of CEmONC facilities and SNCUs (mainly hospitals) generally through enhanced training and need-based deployment.

HMS started with less density of facilities and human resources for health, and thus focused on expanding health facilities and improving quality ANC, BEmONC, and later HBNC with in-service training, mentoring and upskilling of CHWs, nurses and general doctors, with recent focus on increasing specialists through training/need-based deployment.

At different time points, all states streamlined public procurement systems by establishing medical services corporation, engaged in regular review processes, enhanced quality and use of digital information systems, and established GIS-fitted emergency transport with integrated call centres.

The shifts from equitable access towards quality in public MNH services was underpinned by strong central and state political will, leadership, coordination, and partnerships across government, private organizations and civil society in the different exemplar states. This was buttressed by widespread NRHM/NHM's administrative reforms that allowed flexibility for localized planning, spending, innovation and implementation.

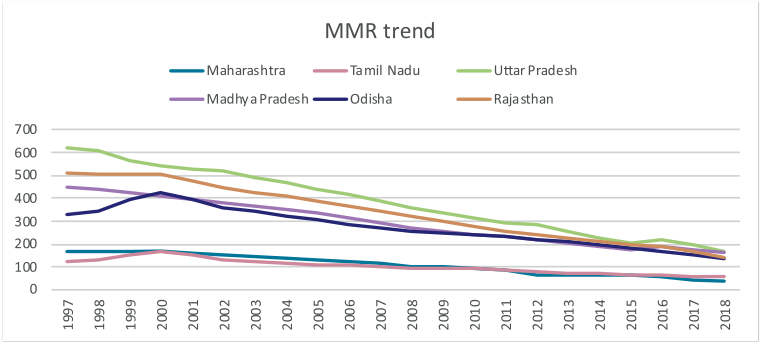
To help India further reduce NMR and MMR and reach the SDG targets, it would be valuable to focus on further support to disadvantaged groups and regions to access and afford high-quality MNH services, and especially CEmONC for those who need, complemented by efforts to continue socio-economic development and women's empowerment.

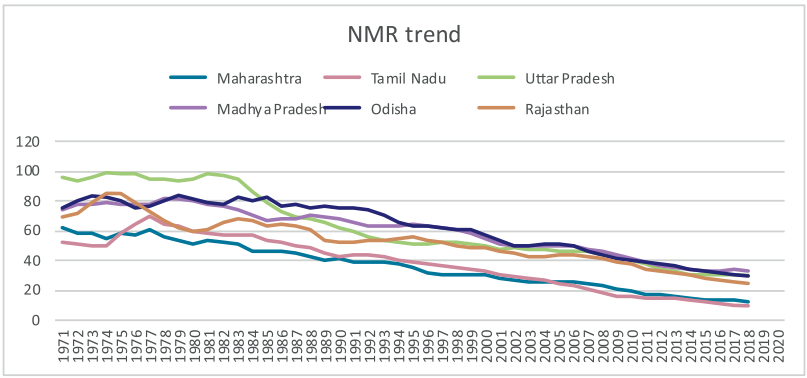
Maternal and Neonatal Mortality Trends

The MMR and NMR trends in the six selected states show distinct clustering in terms of mortality levels during the study period (Figure 7.1). Within the two "exemplary" low mortality states, Maharashtra and Tamil Nadu had similar MMR during the reference period. However, in case of NMR, Tamil Nadu had higher NMR than Maharashtra until 2006, and then a lower NMR than Maharashtra. Within the four "exemplary" high mortality states, Uttar Pradesh and Rajasthan had higher MMR but lower NMR compared to Madhya Pradesh and Odisha. However, all four states are converging at lower levels.

During 2000-2018, the MMR declined faster than the NMR in all exemplar states, except Tamil Nadu. During the same period, the MMR declined fastest in Maharashtra (an AARC of -8.3%) and NMR declined fastest in Tamil Nadu (an AARC of -7.1%). Among the HMS, the AARC was the highest for MMR in Rajasthan (-7.0%) and for NMR in Odisha (-3.8%).

Figure 7.1: Levels and trends in MMR (1997-2018) and NMR (1992-2018) in six selected states (SRS)





Age and Cause Specific Mortality

During 2005-19, mortality declined in both 0-2 days and 3-27 days periods in all exemplar states, except Uttar Pradesh, where the 0–2-day mortality stagnated (Figure 7.2). In all states, the neonatal mortality decline was largely due to the greater reductions in day 3-27 mortality. Those declines were faster than neonatal mortality in the first two days of life, except in Maharashtra where days 0-2 mortality declined faster than 3–27-day mortality (AARC of -5.1 compared with -2.6).

According to the Global Burden of Disease Study (GBDS), neonatal mortality due to all causes reduced in all the six states during 2000-2019 (Figure 7.3). Maharashtra and Tamil Nadu showed major reductions in NMR among neonates with preterm births and birth asphyxia, reflecting the pattern observed in LMS overall. In the four HMS states, the major reduction in NMR was due to fewer deaths due to infection and other causes such as congenital disorders and other neonatal disorders, like the pattern observed in that state cluster overall.

Figure 7.2: Age-specific neonatal mortality rates (per 1000 LBs) in six selected states (NFHS 2005-2019)

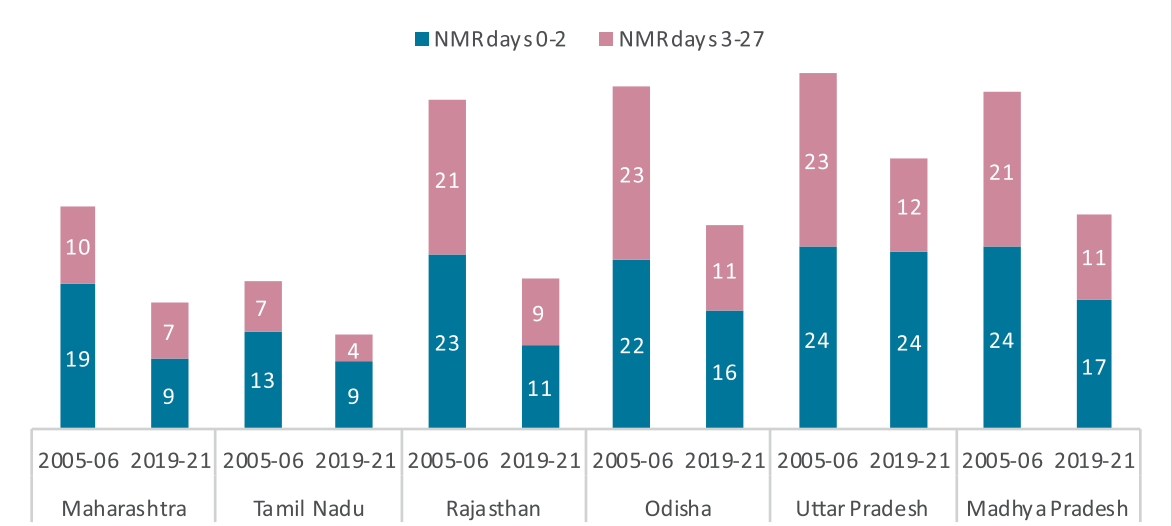
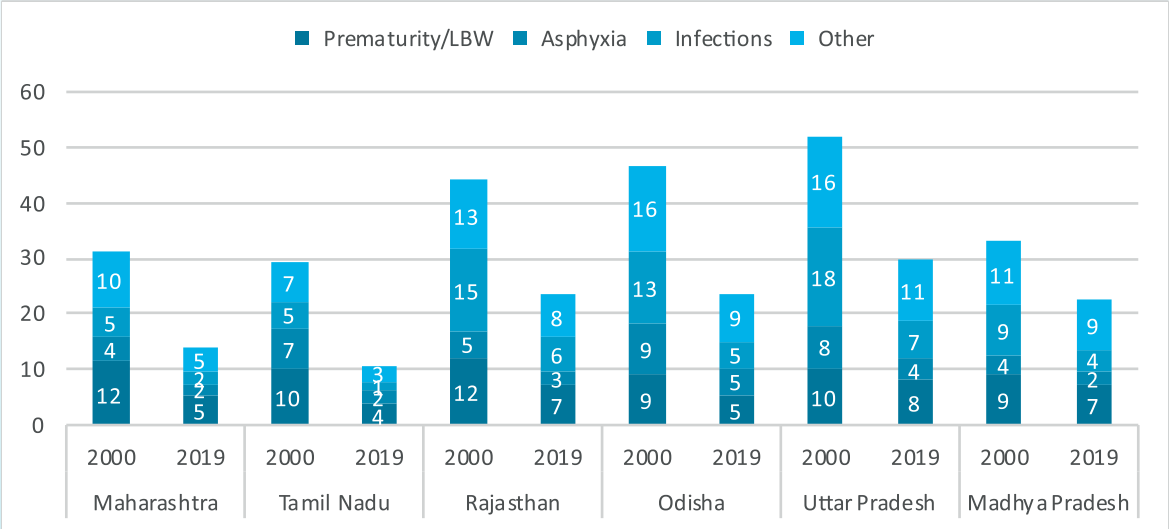


Figure 7.3: Cause-specific neonatal mortality rates (per 1000 LBs) in six selected states (GBDS 2000-2019)



Antenatal and Delivery Care

The coverage of key interventions has improved in all six states according to the pooled NFHS and DLHS data (Figure 7.4). All six states are converging at higher coverage levels, except for 4+ ANC, where considerable between state differences still exist. Among the six states across analysis/study period, Tamil Nadu always had relatively higher coverage, and Maharashtra (from the LMS) and Odisha (from the HMS) had greater success in approaching Tamil Nadu's coverage levels. The increases in coverage were fastest during the NRHM and NHM periods for exemplar states, except in Tamil Nadu, where coverage levels were increased faster during the CSSM and RCH-I periods. The coverage levels in Uttar Pradesh improved more slowly during the NRHM period compared to the other states but caught up with the other states with continued increases in the NHM/RMNCH period as well.

Increases in institutional deliveries were mainly driven by public facilities in all states. (Figure 7.5) Still, Maharashtra and Uttar Pradesh had relatively lower public facility deliveries than the other states. Private facility deliveries meanwhile increased in Maharashtra, Uttar Pradesh, and to some extent Rajasthan. Yet private facility deliveries reduced in Tamil Nadu, and remained constant in Odisha and Madhya Pradesh.

In Maharashtra and Tamil Nadu, recent increases in institutional delivery were largely due to increases in hospital deliveries including both public and private hospitals, which matches the pattern observed in LMS overall (Figure 7.6). Similarly, in the four HMS states, the recent increases in institutional delivery were due to increases in lower-level facility deliveries, like the pattern observed in that state cluster overall.

Major increases in institutional delivery in these six states were possible because more of the rural and the poorest women were reached, and disparities were reduced substantially (Figure 7.7). Absolute inequalities (measured by slope index of inequality, SII) in institutional deliveries between urban versus rural residence and household wealth tertiles declined in all six states, particularly after 2013. The exceptions to this were in Odisha and Rajasthan where inequalities between urban and rural residents increased in the most recent survey period. Inequalities in institutional deliveries were lower by urban-rural residence than by household wealth tertile in all states and survey periods.

The inequalities both by place of residence and household wealth were the lowest in Tamil Nadu and the highest in Odisha in the most recent survey period.

Figure 7.4: Trends in antenatal and delivery care coverage in six selected states (NFHS and DLHS pooled data, 1989-2020)

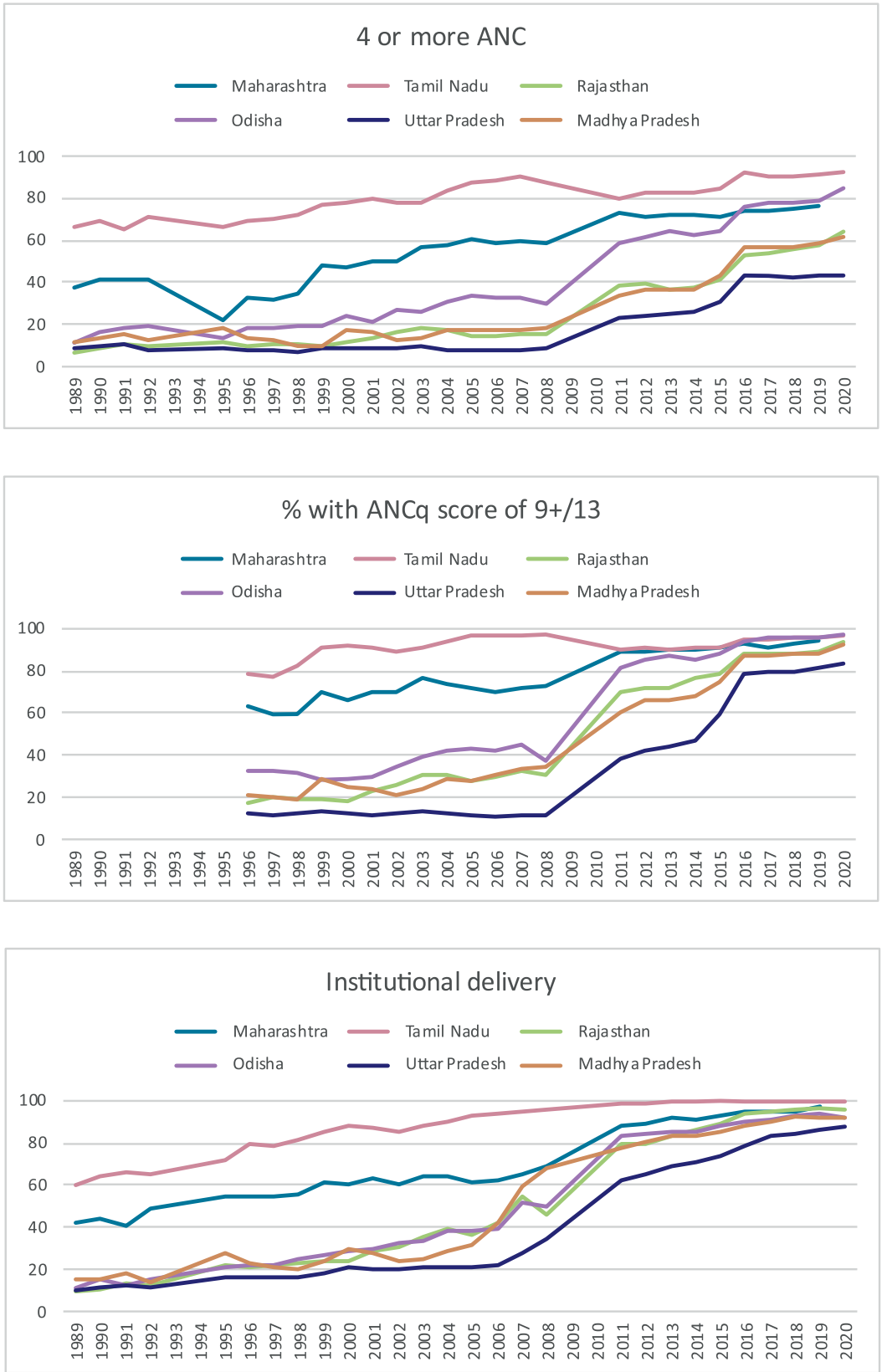
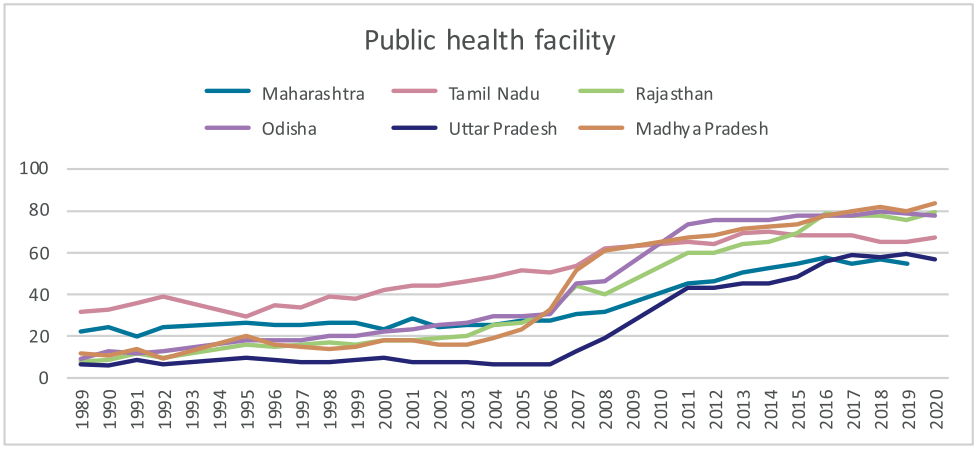


Figure 7.5: Trends in public and private facility deliveries in six selected states (NFHS and DLHS pooled data, 1989-2020)



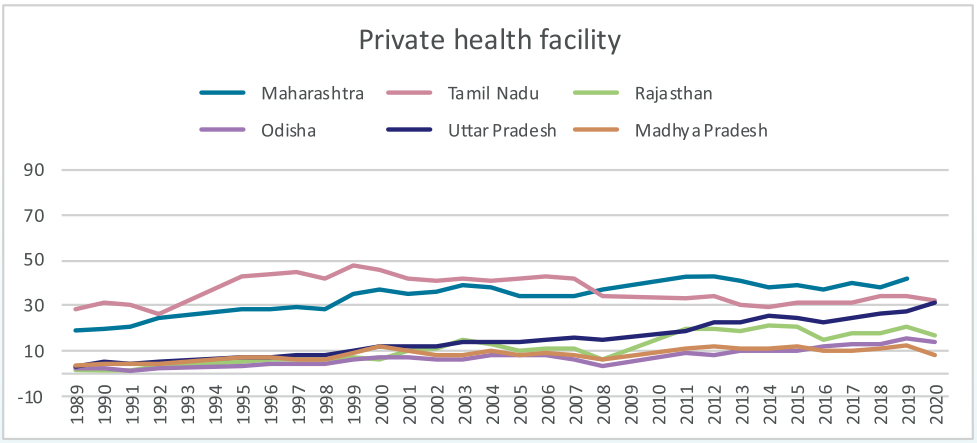


Figure 7.6: Trends in institutional deliveries by facility type in six selected states (NFHS and DLHS pooled data, 1992-2019

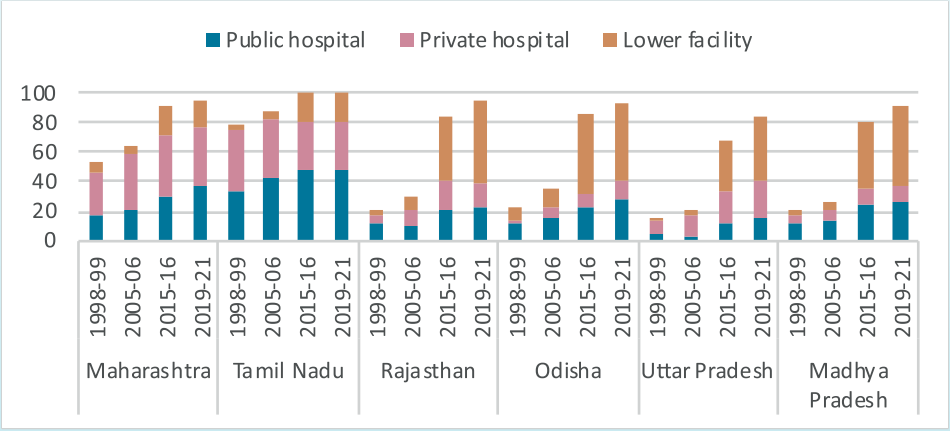
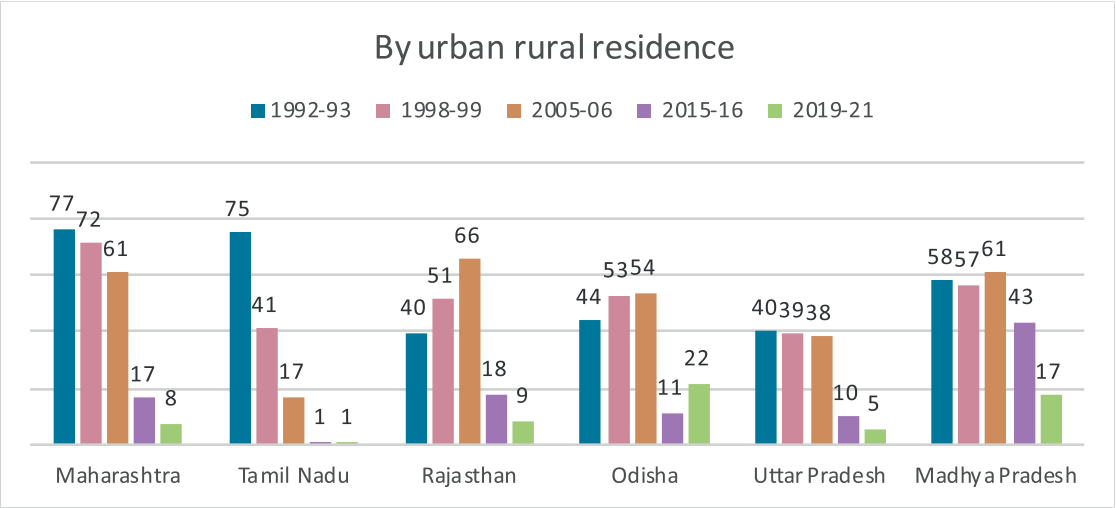
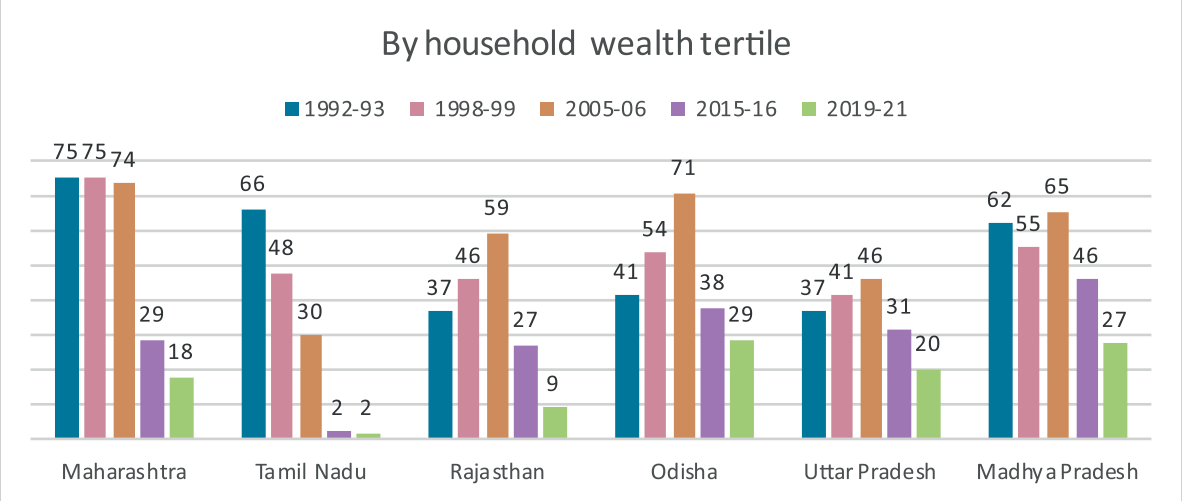


Figure 7.7: Trends in absolute inequalities (slope index of inequality, %) in institutional deliveries by urban-rural residence and household wealth tertile in six selected states (NFHS, 1992-2021)

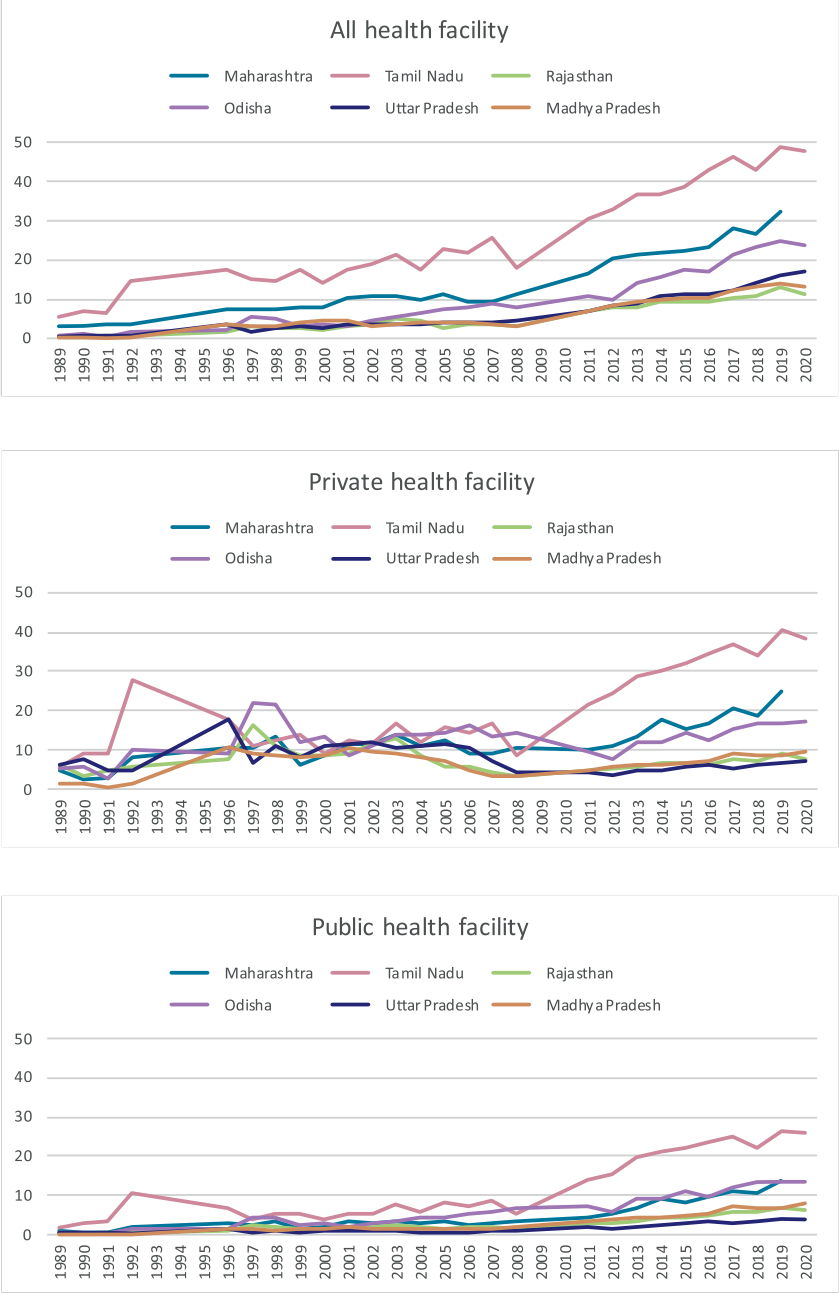




C-Sections

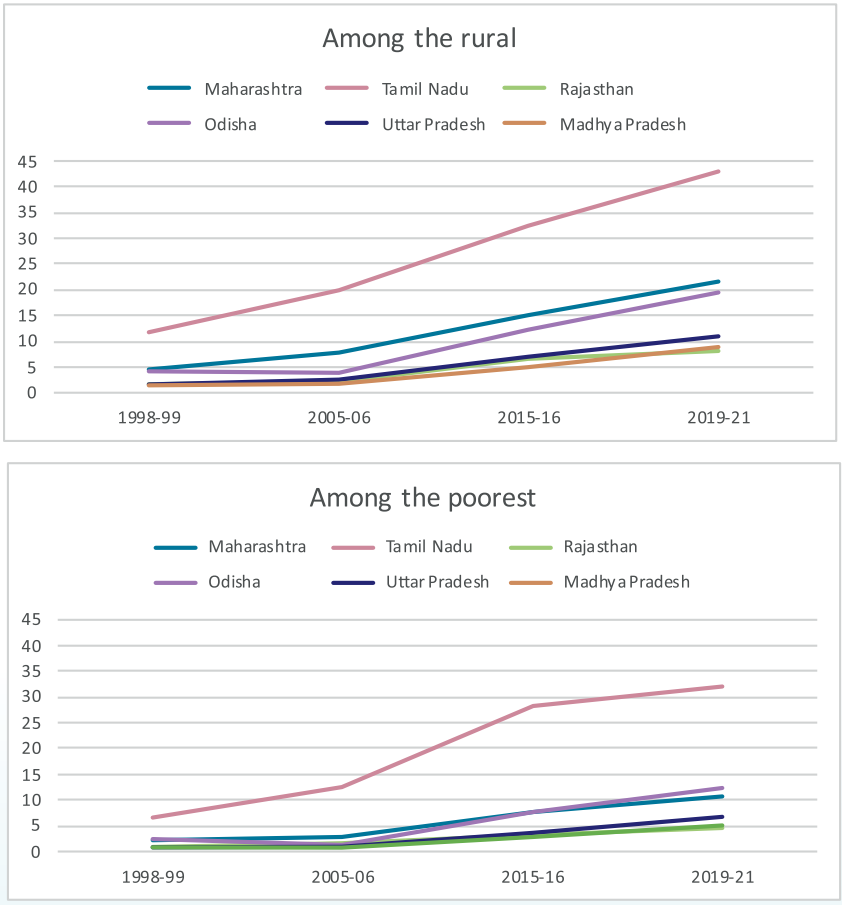
C-sections have increased in all six states, but the inter-state differences have widened (Figure 7.8). While the 2019 C-section rates are well above the acceptable range of 10-15% for medically indicated C-sections in Tamil Nadu (49%), Maharashtra (32%) and Odisha (24%), it was 17% or less in the remaining three states. While C-section delivery rates have increased among both the private and public sector deliveries, the increase was faster among private facilities in all states.

Figure 7.8: Trends in C-section rates by facility type in six selected states (NFHS and DLHS pooled data, 1989-2019)



The C-section rates among the poorest women were below the acceptable range of medically indicated C-sections in all states and time periods, except in Tamil Nadu which reached 28% by 2015/16 (Figure 7.9). This suggests enduring unmet need for this life saving intervention among the poor in most states. Among rural women, it was under 15% in Rajasthan, Madhya Pradesh, and Uttar Pradesh, suggesting that these states have not successfully met rural need for C-sections.

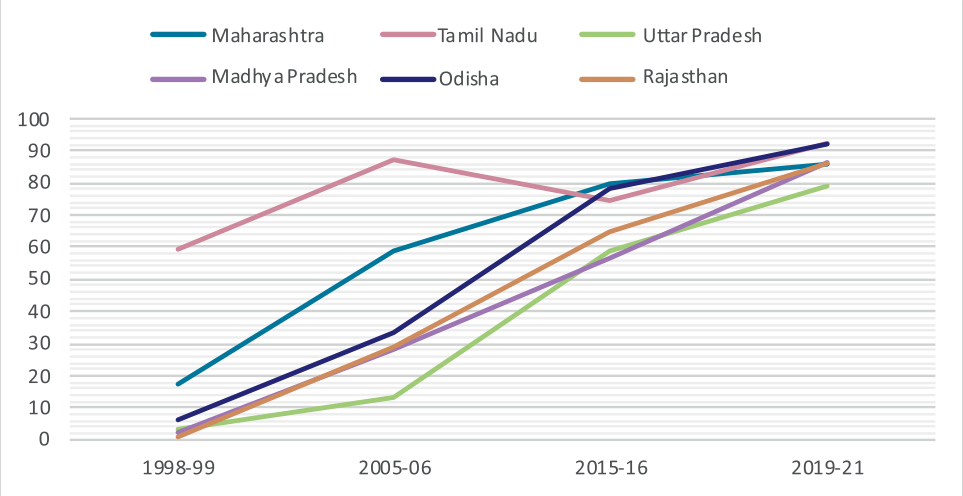
Figure 7.9: Trends in C-section delivery rates among the rural and the poorest (household wealth tertile) in six selected states (NFHS, 1998-99 to 2019-21)



Postnatal Care

Figure 7.10 presents the percentage of mothers or newborns in the six selected states who had a postnatal check-up during the 0-2 days after delivery, either in the facility or at home by either a trained professional such as a nurse, ANM, doctor or community health worker. Coverage of any postnatal check-up increased substantially in all states converging at higher levels (except in Tamil Nadu where the PNC coverage declined between 2005-06 and 2015-16 before reaching the 2005-06 levels again in 2019-21 survey period).

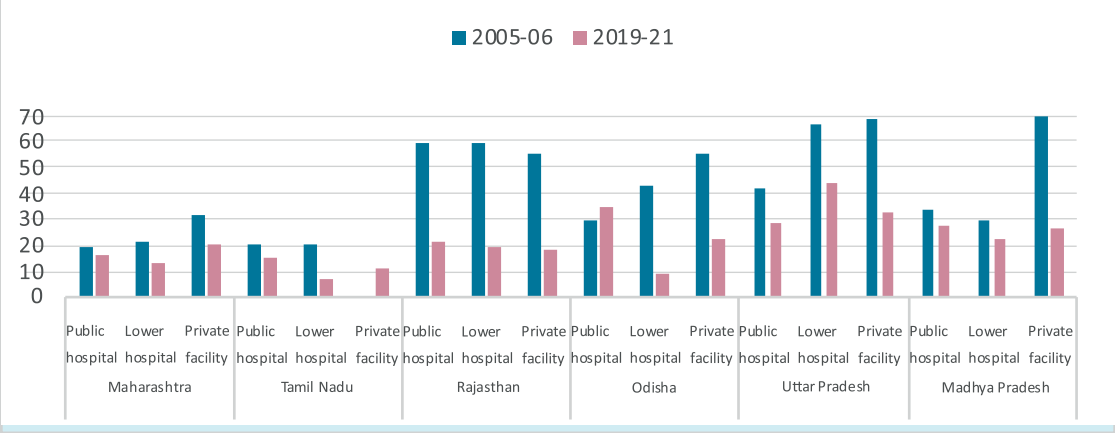
Figure 7.10: PNC coverage for either the mother or the child, within 0-2 days after delivery in six selected states (NFHS 1998-99 to 2019-21)



NMR by Place of Delivery

Between NFHS 2005-06 and 2019-21, NMR declined substantially in all facility types in all six states, except in public hospital deliveries in Odisha (Figure 7.11). Among private facility deliveries, the NMR decline was the fastest in Odisha (AARC of -11.4%). Among the public hospital deliveries and deliveries in lower-level health facilities, the fastest decline in NMR was in Rajasthan (AARC of -7.4% and -7.8%, respectively).

Figure 7.11: Trends in NMR by place of delivery in six selected states (NFHS 2005-06 and 2019-21)



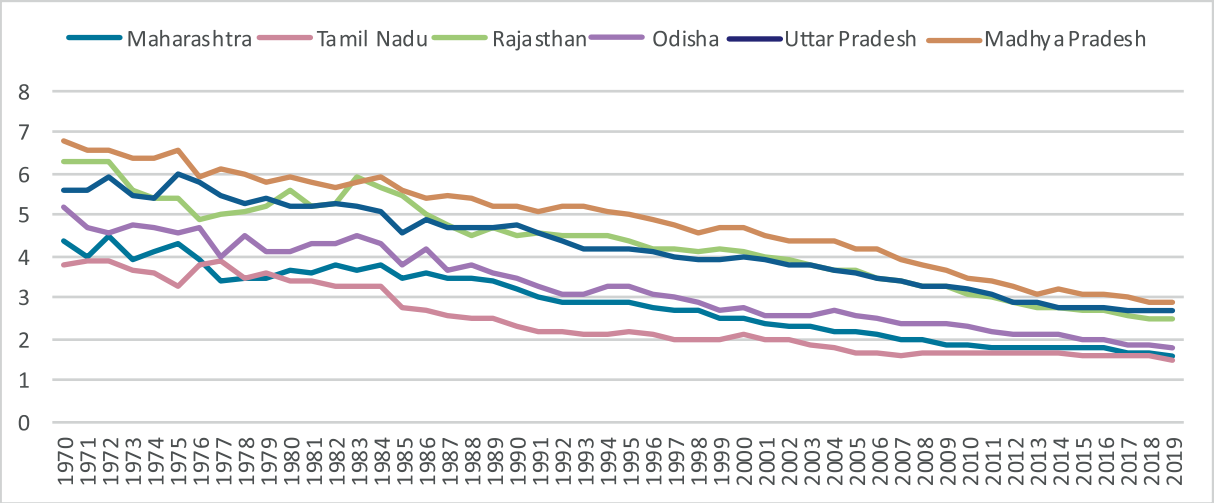
Note: No death was reported in 2005-06 among the 5% of deliveries that occurred in lower health facilities in Tamil Nadu.

Demographic and Socio-Economic Contextual Shifts

Fertility

Fertility in the selected six states has been declining, from a total fertility rate (TFR) of about 4-6 children per woman in the 1970s to 1.5-3 in 2019 (Figure 7.12). The differences between states also reduced considerably. In recent years, Odisha's TFR became more like the LMS states of Maharashtra and Tamil Nadu than the rest of the selected states in its HMS cluster.

Figure 7.12: Trends in total fertility rate in six selected states (SRS 1970-2019)



Community-Level Context

Household access to basic amenities such as improved sanitation, clean fuel for cooking, telephone/mobile and bank account has improved substantially in all the six selected states between 1992-93 and 2019-21 (Figure 7.13). The states have converged at higher levels of access except for cooking fuel where the LMS states of Maharashtra and Tamil Nadu have forged ahead much more than the four HMS states.

Figure 7.13: Trends in community development indicators in six selected states (NFHS 1992-93 to 2019-21)

Note: Data on telephone was not collected in 1992-93 survey and data on women's back account was not collected in 1992-93 and 1998-99 surveys.

Major Health Policy and Systems Drivers in the Six States

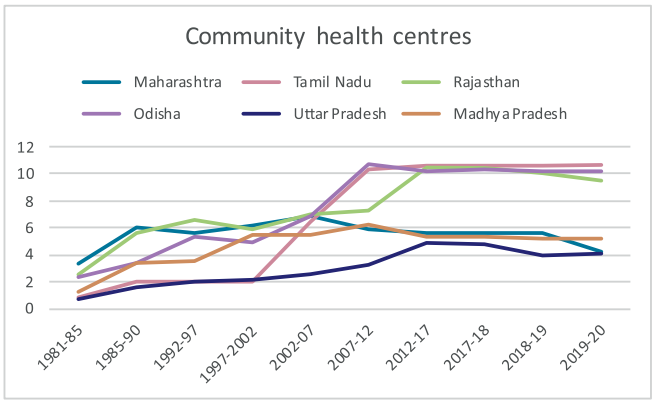
This section draws from policy review, literature and other data sources, to expand on comments made by experts on state implementation of and innovations on national policies/programmes. The results under major themes are presented for the states in the lower mortality cluster, then the higher mortality cluster, and finally common approaches between clusters.

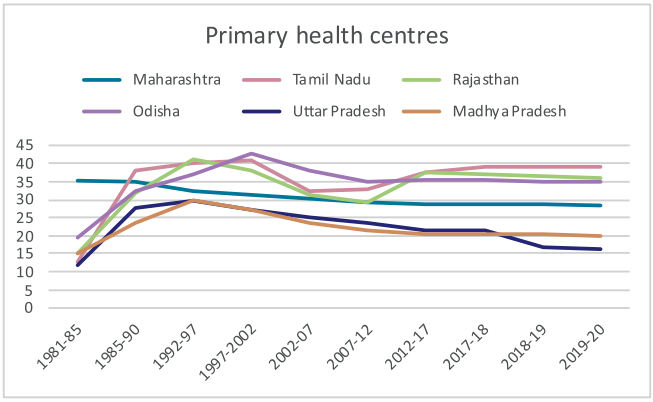
Transitions in MNH Service Availability and access to Quality

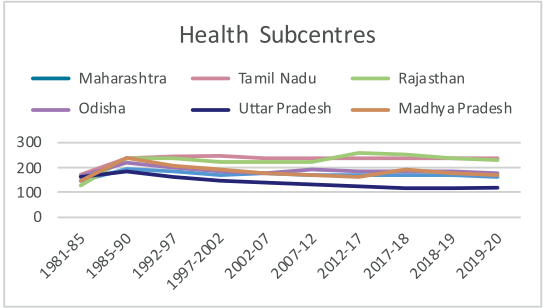
Expanding Service Availability, Access and Integration

The individual states differ substantially in the density of health facilities (Figure 7.14). In general, two of the six selected states – Tamil Nadu (from the LMS) and Rajasthan (from the HMS) have maintained relatively greater availability of all three facility types since 2007-12. Odisha had also increased its density of PHCs and CHCs since 2007-12, reaching the levels of Tamil Nadu and Rajasthan. Although Uttar Pradesh has increased the availability of CHCs in recent years, it has the lowest density of CHCs.

Figure 7.14: Trends in the density of community health centres, primary health centres and health sub-centres per million population in six selected states (Rural Health Statistics 1985-2020)







The LMS started with higher density of facilities since the late 1990s, and therefore focused on upgrading them and filling gaps in underserved areas mainly in the RCH I period. Then during RCH II/NRHM periods to date, they focused on expanding CHCs with CEmONC and BEmONC at all lower-level facilities (PHCs, SCs), and NICUs at all district hospitals. Tamil Nadu implemented the Dr. Muthulakshmi Reddy Maternity Benefit Scheme since the late 1980s to provide incentives for public health services, which also covered qualified private facilities later. Maharashtra brought in the Matrutva Anudan Yojana incentive program in 1997 to improve demand, which preceded the NRHM's JSY scheme.

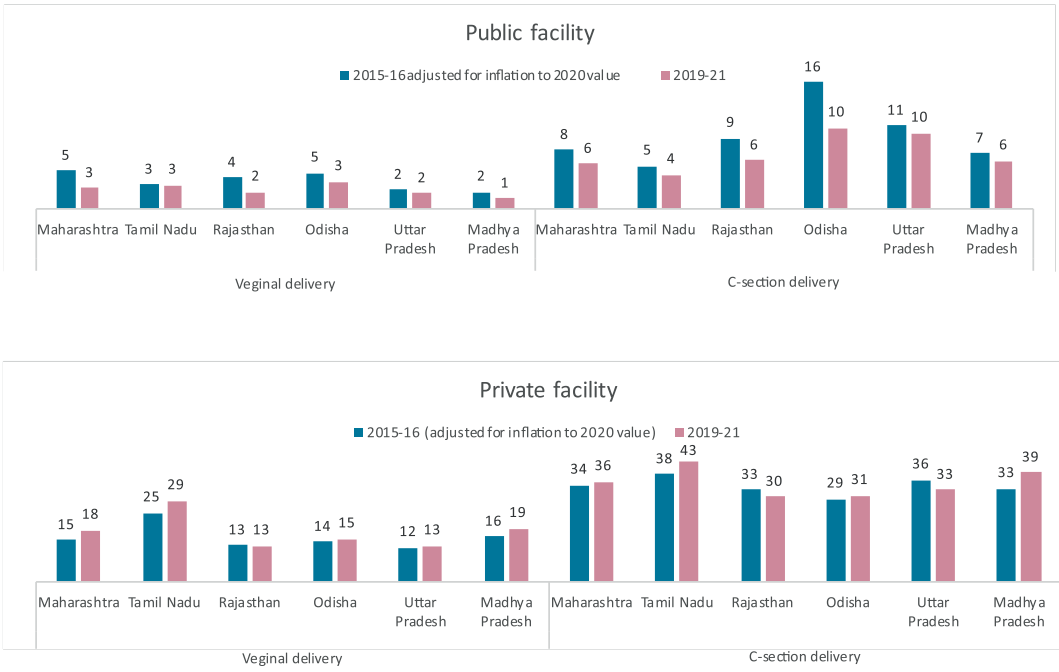
HMS expanded ANC to more local levels through the VHNDs, increased their density of CHCs to do routine deliveries in the NRHM period. Then to varying degrees, they upgraded more of the CHCs as FRUs over time as in the NHM policies (though data on this is scant). The experts discussed how HMS focused on expanding life-saving interventions under BEmONC (such as AMTSL, partograph, breastfeeding, kangaroo mother care or KMC, and temperature checks), and linkages between lower to higher facilities for more complicated deliveries (such as linkages to medical colleges when needed in Odisha). A couple states also engaged in explicit targeting including Madhya Pradesh in tribal areas, and Odisha in areas that are remote and with high home births. Odisha created maternity waiting homes called Maa Gruha to support women in remote areas. In later years, the states started to establish MCH wings and NICUs or SNCUs in all district hospitals, including the UNICEF-supported program in Rajasthan.

In both state clusters, integrated 108 (or similar) ambulance services and call centres were implemented, often through private-public partnerships, to provide maternity care and inter-facility transfers for women and newborns free of cost.

Figure 7.15 presents the average out-of-pocket expenditure (OOPE) for delivery (including the OOPE for transport, hospital stay, drugs, diagnostics, and other) in the six selected states in constant 2020 rupees (i.e., 2015-16 cost adjusted for inflation to the 2020 value). This is disaggregated by delivery type (vaginal or C-section) and by facility type (public or private), using the NFHS data. The OOPE for vaginal deliveries in public health facilities were the lowest, and declined or remained constant in all the six states, with little difference between states. Although the OOPE for C-section deliveries in public health facilities has also declined in all six states, it has been relatively greater in Odisha and Uttar Pradesh.

Compared to the public health facilities, the OOPE for both the vaginal and C-section deliveries in private health facilities in all six states were greater and has increased with few exceptions. The exceptions are Tamil Nadu where the OOPE for vaginal deliveries in private facilities remained constant, and Rajasthan and Uttar Pradesh where the OOPE for C-section deliveries in private facilities has increased.

Figure 7.15: Trends in average out-of-pocket cost (in INR 1000) paid for delivery in six selected states, by facility type and delivery type, NFHS 2015-16 and 2019-21



Human Resources for Health

LMS started with higher density of health workers, so focused on increasing numbers in underserved areas through targeted incentives, rural recruitment and retention programs in the public sector. For example, Maharashtra created the Navsanjeevani Yojana since 2003 to target efforts in 52 tribal blocks, which provided extra monitoring, volunteers and flying squads of health workers. They invested in medical colleges, trained, and certified many nurses and doctors, and mentored them. Tamil Nadu has had many merit-based public medical colleges, allowing production of quality, service-oriented doctors. Tamil Nadu's Directorate of Public Health also helped to integrate primary care and technical experts with medical health worker cadres. They have amended public doctor recruitment to attract medical officers to stay in public sector.

HMS put major focus on in-service training and mentorship of staff nurses and community health workers, including the SBA training, labour and delivery protocols and checklists, skill and IT labs. Medical officers were given SBA, BEmONC and LSAS training to address shortage of specialists. Madhya Pradesh added staff nurse positions and tightened retention bonds for medical officers. Rajasthan led digital services for the ASHA program using the novel ASHASoft application, to integrate their activities and timely payments through JSY. Odisha created a nursing directorate to systematically improve nursing education, was first to extend SBA training to AYUSH doctors, and expanded ANM responsibilities to deliver simple antibiotics. Uttar Pradesh implemented a nurse mentorship program to improve their capabilities from 2013, and changed policies to hire better ANMs and ASHAs. More recently, some states started addressing the shortages of specialists through wider training and changing distribution and retention rules. Uttar Pradesh created a new "specialist cadre" in 2018 and introducing a bidding model of remote posting, and a buddy-buddy model of paired posting for anaesthesiologists and gynaecologists to provide CEmONC where needed.

All states put incentives for health workers to work in remote and rural areas, as well as various in-service training, mentorship and task shifting to expand their capabilities.

[xxxv] We considered an average annual inflation rate of 5.09% from 2015 to 2020 (https://www.inflationtool.com/indian-rupee?amount=7124&year1=2015&year2=2020&frequency=yearly)

Clinical/Technical Innovations, Quality Assurance and Procurement

LMS started focusing on quality improvement earlier than national NHM policies put this emphasis. Tamil Nadu led the country in major clinical and quality improvement processes, including maternal death reviews (adding referral reviews and near miss audits over time), prenatal screening, IV anaemia care for pregnant women, birth companionship, neonatal screening, breast feeding support, and monitoring and birth planning for high-risk women. It also established the first Medical Service Corporation for procurement of free medicines, and revised the medical equipment maintenance systems to connect with engineers when equipment needed repairs. Maharashtra made serious efforts to implement the national IPHS at all levels and locations of government facilities, which was further catalyzed by LaQshya from 2017.

HMS put the largest focus in this period on ANC quality improvement, including more recently high-risk pregnancy identification and timely referrals, such as the Kushal Mangal Programme in Rajasthan and the Mahila Swasthya Divas program in Madhya Pradesh. BEmONC training was scaled up for postpartum hemorrhage management and partographs since NRHM, and in the NHM period, they worked on implementation of Dakshata training, NQAS and IPHS. Efforts were made to start ramping up tertiary care and NICUs, such as Madhya Pradesh's expansion of blood transfusion to all FRUs and Odisha's efforts to improve tertiary care for sick and small newborns. Rajasthan demonstrated technological leadership in its development of an integrated software system for monitoring the PC-PNDT Act (Pre-Conception and Pre-Natal Diagnostic Techniques), as well as its family planning logistic management information system. Uttar Pradesh's medical colleges and Technical Support Unit provided training/quality assurance. The state also established a 'quality division' of district level functionaries. All states eventually developed a Medical Services Corporation like that of Tamil Nadu to streamline drug and equipment procurement digitally. These states are working to further improve the quality of VHNDs, intrapartum care, and maternal death reviews.

Role and Regulation of Private Sector

In LMS, the states differed in their approach to the private sector based on its role in providing MNH services. Tamil Nadu's history of and investment in the public sector limited private sector expansion in MNH. The government supported improving quality of the private clinics, and expected their participation in maternal death reviews and digital risk-tracking of pregnancies and births. Private clinics of sufficient quality were also integrated within the Muthulakshmi Reddy Maternity Benefit Scheme to address cost barriers. Maharashtra's regulation of the private sector has been more challenging, given it provided a growing higher proportion of MNH care compared to Tamil Nadu where its share declined. Still, the government has had longstanding partnerships with FOGSI to develop training, and inspired NICU development, and private doctors have been recruited for short-term rural service to address shortages. The government also endorsed FOGSI's private maternity care facility accreditation program, called Manyata, to utilize the government's LaQshya quality standards, thereby creating the unique public-private LaQshya-Manyata initiative.

Experts in HMS did not emphasize involvement of the private sector, though partnerships with private medical training colleges helped in developing training curricula for public health workers. Also, FOGSI was a partner in most states, such as in developing and implementing quality of care guidelines or trainings. Rajasthan was the only state with a PC-PNDT Bureau of Investigation, which has shut down illegal (private) abortion providers in the state, which experts saw as reducing unsafe abortions and saving maternal lives.

Policy Implementation and Administrative Reforms

Political will and Leadership for MNH

LMS states demonstrated consistent political commitment to improving MNH, with strong governance structures already in place from village to state levels. In Tamil Nadu, a long-standing ethos around the welfare state's responsibility to provide quality services was said to have underpinned this commitment as MNH stayed a political issue. There was a collaborative approach across political parties, as well as continuity allowing for innovation, building on previous decades of action. Tamil Nadu's lasting political commitment and continuity resulted in enormous innovation; many policies and programs it developed were eventually adopted at the national level as best practice. Maharashtra also maintained continuous commitment to improving MNH care access and quality. It embraced geographic targeting, with intensive inputs and scrutiny given to tribal districts, and took data analysis seriously for planning and accountability, also learning from neighbouring states.

HMS also showed strong and sustained political will for MNH, and intentional collaboration between administration and technical bodies. Creating a proactive program implementation plans (PIP) process under the NRHM had a particularly important role in these states, as well as putting great efforts into CRM/JRM processes taking support from central government, more so than in LMS that were planning and financing more independently already. States like Madhya Pradesh and Odisha noted the importance of openness to new ideas emerging from frontline implementation experience.

Experts discussed the importance of openness to new ideas and collaboration between ministries and politicians.

Decentralized Planning, Financial Flexibility and Innovation

LMS put heavy emphasis on geographic targeting, and developing interventions to solve specific problems using data. Decentralized planning already existed in Tamil Nadu and Maharashtra, in different ways, as district level management had been important for managing primary health care. This district-level management infrastructure was used to further catalyze implementation of key MNH programs tailored to the context. NRHM brought additional financial resources and flexibility to continue to innovate, conduct robust district-level monitoring, and reach high levels of per capita spending, especially in Tamil Nadu.

HMS saw a shift from programs being "pushed" by the centre, with tight targets to programs being "pulled" by the state during NRHM to NHM periods. Rajasthan took implementation science approach to identify and adapt implementation of national programs. Odisha learned from others like Tamil Nadu or internationally, and mobilized additional state resources. Madhya Pradesh developed several special inputs for marginalized areas, including salary top ups for health workers, maternity waiting homes, and investments in more ASHAs (per hamlet, not 1000 people as in the central guidelines) and sub-health centres. Uttar Pradesh discussed the importance of tailored district health action plans and engagement of district collectors in implementation.

In all states, experts reported the increasing emphasis on working at all health system levels, as well as identifying need-based approaches to targeting and increasing spending over time through more flexibility through the NRHM mission mode.

Accountability, Progress Review and Data Systems

The LMS were early adopters and users of HMIS linked across facilities, and then Mother and Child Tracking System since late 2000s, enabling data-driven tracking for those at risk. Both states also discussed the role of having strong maternal death reviews, and Tamil Nadu had joint CEmONC review meetings as well. Tamil Nadu linked data in its HMIS across facility levels to track patient outcomes (including high risk pregnancies, babies in SNCU or those leaving facilities early using Whatsapp). Maharashtra used "escalation" based accountability wherein issues identified using data had to be addressed within a stipulated time period before being escalated to the next administrative level.

HMS strengthened accountability through more systematic and routine reviews of health data. Common Review Missions were conducted in low performing states/districts, wherein review teams identified gaps and suggested resolutions. In all states, the MCTS (replaced by the Ashish portal in Odisha) had helped systematically track pregnancies and newborns. In Rajasthan, these were said to be especially helpful in "empowering" and "encouraging" the field-level functionaries. Though not mentioned in other states, experts in Odisha noted growing emphasis on maternal death audits. Madhya Pradesh instituted a time-bound grievance redressal system with strict hierarchical accountability. Uttar Pradesh took a data-driven approach wherein data was collected through a number of digital programs including the ASHA app and MCTS. Its MCTS was later updated to RCH, and examined by decision-makers through dashboards through the state's TSU in the NHM period.

In all states, there was a shift through the NRHM's review processes from focusing on negative or punishment-based incentives, towards positive incentives of support, reward and empowerment. All states also enhanced the use of digital systems to monitor progress and identify gaps.

Community Participation and Demand Generation

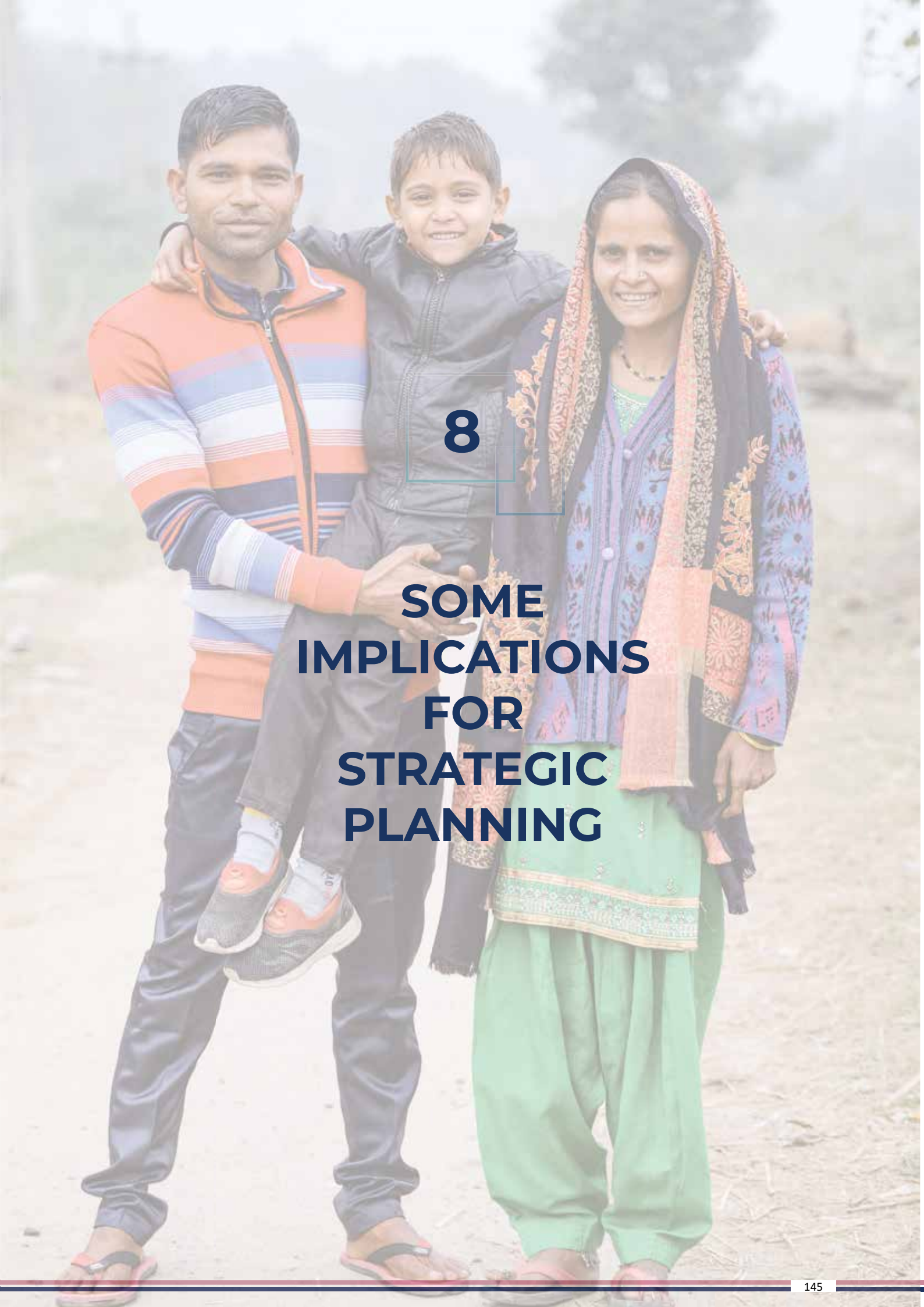
In LMS, Maharashtra had generally strong panchayat system and civil society, which helped in implementing and generating demand and accountability for quality MNH services. Tamil Nadu's emphasis on the role of the welfare state over multiple decades has helped, as citizens are very aware of their rights to public services and hold government to account. As a precursor to the CHW programs under NRHM, Tamil Nadu had a village health nurse placed in villages to generate demand from the community since the 1970s. Maharashtra also had robust community engagement in health through VHSNCs conducting local health action planning and community-based monitoring of government health services. They also have a long tradition of community demand generation and outreach services by CHWs, grounded in its programming experiences particularly in tribal areas since the 1970s.

HMS emphasized the strong role of the communitization features of the NRHM/NHM, including JSY, JSSK, and CHWs (ASHAs, ANMs, AWWs), and localized VHNDs in increasing birth planning and access to MNH services. They put more emphasis on training ASHAs and ANMs to provide HBNC in the NHM period too. In Madhya Pradesh, complaint grievance redressal systems have created pathways for women to demand access to their maternity benefits (distributed by the direct benefit transfer system) and to raise complaints about healthcare. Odisha worked with local folk media and self-help groups to support behaviour change communication, though uptake was not always even. The role of self-help groups or other collective approaches in other states was taken up more by the non-governmental sector and not yet implemented at scale.

Partnerships

LMS expressed the importance of collaboration across government branches. Multilateral organizations and other development partners gave them some funding to support rural hospitals and health worker training to improve quality of care, but were not as engaged in implementing programs more broadly. In Maharashtra, civil society activists and NGOs tested and modeled effective health care approaches and demanded accountability in part by engaging the media.

HMS engaged in active partnerships between state government departments, and guidance and resources by central government. More than in the LMS, they also worked with many development partners for improving availability and quality of facilities and health workers. Rajasthan has benefited from technical expertise and support from international development partners particularly UNICEF, UNFPA, NIPI, WHO and Jhpiego (with indication of coordinated efforts), particularly in improving quality of care. Madhya Pradesh managed multiple development partners (especially UNICEF, Jhpeigo, UNFPA, Ipas, and Wish Foundation) by assigning them districts. In Odisha, UNICEF and Liverpool School of Tropical Medicine supported health worker training and mentoring, UNFPA provided health system support, and Jhpiego helped in developing delivery points. Uttar Pradesh worked with the World Bank on a UP health system strengthening initiative earlier, SIFPSA on a capacity building initiative for family planning, and developed an embedded UP technical support unit (UP TSU) with funding from BMGF since 2013.



8

SOME IMPLICATIONS FOR STRATEGIC PLANNING

SOME IMPLICATIONS FOR STRATEGIC PLANNING

As part of the Exemplars study, we developed a five-stage integrated framework for a maternal, late fetal and neonatal mortality transition and assessed the associations of the transition stages with cause-of-death patterns, fertility, health service coverage and inequalities, in terms of changes between stages and within-stage country distributions. We used the transition framework as a tool to understand change, benchmark current situations, and inform strategy development, as well as improve data quality, nationally and globally.

Stage I in this model indicates the highest levels of maternal and peri-neonatal mortality, where access to services is limited, inequalities are large, infectious diseases are a common cause of death, and fertility is high. Populations move across Stage II, III, and IV as access to health services increases, quality improves, inequality patterns change from top to bottom inequality, infectious diseases and peri-partum conditions decrease in importance as causes of death, and fertility declines. Stage V is the lowest possible maternal and peri-neonatal mortality, wherein mothers and newborns have universal access to high quality care and (almost) all preventable deaths are eliminated.

This chapter provides some reflections on potential strategic and policy implications from the MNH exemplar study in India. Then, we focus on the strategic implications for the higher mortality states, and particularly use the data for lower mortality states to reflect on the path ahead. Finally, we describe the way forward for the lower mortality states towards the SDG targets and beyond, drawing from common patterns observed in countries that have advanced to the final stage of the mortality transition.

India Overall

Using the mortality transition framework, we summarized the national situation and consider what overall strategic implications can be drawn from our analysis. Figure 8.1 shows India's progress during 2000-2018 from Stage II in 2000 to Stage III in 2018, based on the SRS data on maternal and neonatal mortality.

Figure 8.1: Maternal and neonatal mortality transition, India 2000-2018, showing the five stages of transition based on SRS data and mortality estimates for 148 countries with population over 2 million in 2017

The 2017 mortality estimates for 148 countries with populations of at least 2 million by 2000 are also plotted. India's mortality progress was substantive since 2000 and greater for maternal mortality than for neonatal mortality. We did not consider stillbirths in this assessment as underreporting in both registration systems and surveys is considered high.

The key changes in selected statistics of mortality, cause-of-death pattern, fertility, coverage, inequalities, human resources for health and socioeconomic progress are summarized in Table 8.1. The right columns show the median value of countries who have reached stage IV (includes SDG targets) and V of the mortality transition.

Table 8.1: Summary of key indicators for India in 2000 and 2017/18 and considerations for further progress based on common characteristics of countries in stage IV and V of the mortality transition

What changed?				How to progress?		
Indicator	India		Interpretation	Median value		Strategy reflections
	2000	2017		Further stages		
Stage	II	III		IV	V	
Mortality						
Maternal mortality per 100,000 LB (SRS 2000-18)	327	103	Major mortality reduction, though not among home births (which declined)	43	9	Halving of maternal and neonatal mortality rates needed to reach next transition stage and SDG target
Neonatal mortality per 1,000 LB (SRS 2000-18)	44	23		9	3	
Neonatal mortality, home births (NFHS 3 & 5)	39	35		NA	NA	
Stillbirth rate per 1,000 births (UN-IGME)	30	16		9	3	
Cause pattern (neonatal) (MCEE 2000 & 2015)			Reduction for all causes, faster for infections and peripartum complications than health status such as prematurity			Continued reduction in infectious and peripartum causes, but increasing need to deal with mother's and baby's health issues
Infectious conditions (Group 1)	29	21		14	7	
Health status (Group 2)	38	54		70	78	
Peri-partum (Group 3)	33	25		17	14	
Fertility (SRS)			Major fertility decline, contributing one-third to mortality decline; low adolescent fertility			Further gains from fertility decline will be limited, but focus on poorest needed
Total fertility rate	3.2	2.2		2.2	1.6	
Adolescent fertility (per 1000)	51	13		44	13	
Coverage of interventions (NFHS+DLHS)			Large coverage increases in ANC and delivery care, increasing reliance on hospital deliveries and major increase in C-section rates			Continued increase in universal coverage of ANC and delivery care with increasing role for hospitals with comprehensive quality services
ANC 4 or more visits (%)	34	59		89	87	
Delivery in health facility (%)	41	89		95	99	
Delivery in hospital (%)	35	53		78	91	
C-sections (%)	8	22		26	25	
Inequalities			Large increases among the poorest and rural, reduction in poor-rich gaps for coverage, but not for neonatal mortality			Continued need for major coverage increases, and focus on reducing mortality among the most disadvantaged
C-section, poorest quintile (%) (NFHS 3 & 5)	2	7		17	23	
Delivery care, rural (%) (NFHS+DLHS)	28	87		91	99	
Delivery care, poor-rich gap (abs) (NFHS 3 & 5)	-71	-21		-12	-1	
Neonatal mortality, poor-rich gap (abs) (NFHS 3 & 5)	26	22		7	7	
Human resource for health			Increase in core health professional density, but considerably below the WHO's recently recommended threshold of 44 per 10,000			Major increase needed in the availability of core health professionals
Core health professional density, per 10,000	11	17		45.8	112.4	
Physician density, per 10,000	4	6		20.6	33.3	
Nurse-midwife density, per 10,000	7	11		26.5	70.9	
NMW to physician ratio	2	2		1.5	2.4	
Socioeconomic development			Mortality decline accompanied by socioeconomic development			Continued parallel and equitable socioeconomic development
GNI per capita (2017, US$)	440	1900		5503	27870	
Secondary enrollment, female (%)	45	66		94	100	

Note: The NFHS 3 was conducted during 2005-06 and NFHS 5 was conducted during 2019-21. NA: Not available

Based on the transition framework, we note several points relevant for India's overall strategy considerations. Here we build on observations made elsewhere in the report on the role of the private sector, other health system characteristics and the complex interactions between socioeconomic, cultural, and health sector drivers of change.

Need to address causes of death related to the health status of women (indirect causes, probably also anaemia) and babies (small and sick newborn), while further reducing peri-partum causes of death, and to a lesser extent infectious disease, which became less common already through quality obstetric and neonatal emergency care.

Mortality gains from further fertility declines will be limited, except among the most disadvantaged populations where high-risk births are still most common.

While lower-level health facilities (including CHCs, PHCs, HSCs and private non-hospitals) have been the main contributor to increases in coverage of institutional deliveries, further gains will need more emphasis on a greater role for hospitals that are able to provide comprehensive care including for the most disadvantaged.

Inequalities in coverage have greatly reduced and continued emphasis on reaching the poorest is needed to sustain this trend; the persistent and large inequalities in neonatal survival will need special attention.

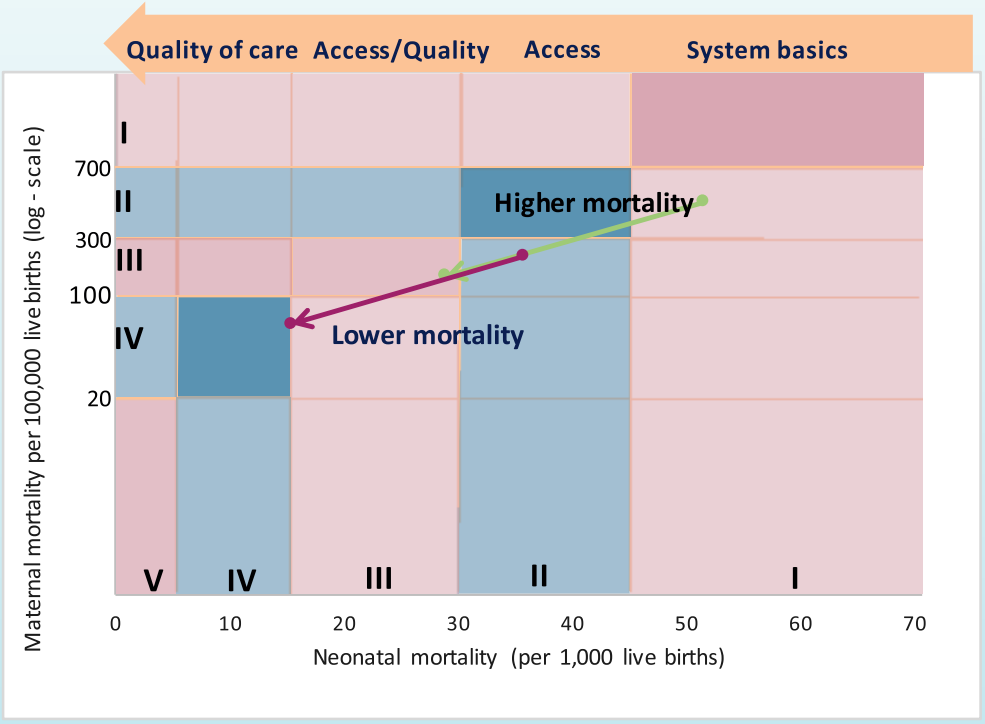
A major increase in health workforce to provide quality obstetric and newborn care is a necessity, based on comparable workforce statistics from countries that have reached the SDGs and beyond.

Higher Mortality States

The progress made by the higher mortality / lower socioeconomic status cluster of states between 2000 and 2017/18 has been remarkable for mortality rates (Figure 8.2) and its related components of the mortality transition framework (Table 8.2). By 2018, this cluster of states is approaching the middle of mortality transition stage III, which is where the lower mortality state cluster was 10-15 years earlier. Therefore, it appears that strategy development for the higher mortality states can draw upon some of the lessons learned in the lower mortality states during the past 15 years. The most important points relevant to the overall strategic planning in the higher mortality states, emanating from this approach, are:

- If the higher mortality states cluster manages the same pace of mortality decline as the lower mortality states cluster in the past 15 years, the higher mortality states will be in early mortality stage IV by 2035 and approach the SDG targets.
- Fertility declines in the higher mortality states are still possible, especially among the poorest, but the gains in terms of mortality reductions are likely to be modest, as the prevalence of most high-risk births has been reduced substantially.
- With neonatal mortality among home births stagnant at about 35 per 1,000 live births, further gains can only be made by ensuring near-universal coverage of facility deliveries.
- Further increase in health facility deliveries are needed, especially among the poorest, and major emphasis needs to be put on hospital births, rather than lower-level facility births, and much improved access to C-section and other life-saving interventions in the higher mortality states.
- Substantial increases in antenatal care coverage and contents (quality) should accompany the increase in deliveries in facilities that can provide comprehensive obstetric and neonatal care.
- A continued and expanded focus on intervention coverage among the poorest and rural populations is needed to reach the high levels of coverage and quality of the advanced stages in the mortality transition.

Figure 8.2: Mortality transition in India's higher and lower mortality state clusters (SRS, 2000 and 2018)



[xxxvi] Assam, Bihar, Madhya Pradesh, Odisha, Uttar Pradesh (using 2000 boundaries)

Table 8.2: Summary of key indicators in 2000 and 2017/18 for higher and lower mortality states clusters, India, and common characteristics of countries in stage IV and V of the mortality transition

	What changed?				Future challenges	
Indicator	High mortality states		Lower mortality states		Median value	
	2000	2017	2000	2017	Further stages	
Stage	I	III	II	IV	IV	V
Mortality						
Maternal mortality per 100,000 LB (SRS 2000 & 2018)	461	145	198	69	43	9
Neonatal mortality per 1,000 LB (SRS 2000 & 2018)	52	29	36	15	9	3
Neonatal mortality, home births (NFHS 3 & 5)	42	37	33	32	NA	NA
Stillbirth rate per 1,000 births (SRS)	7	5	16	5	9	3
Cause pattern (neonatal) (MCEE 2000 & 2015)						
Infectious conditions (Group 1)	30	21	26	20	14	7
Health status (Group 2)	36	55	42	53	70	78
Peri-partum (Group 3)	34	24	32	27	17	14
Fertility (SRS)						
Total fertility rate	4.2	2.7	2.4	1.7	2.2	1.6
Adolescent fertility (per 1000)	56	13	53	14	44	13
Coverage of interventions (NFHS+DLHS)						
ANC 4 or more visits (%)	13	45	57	75	89	87
Delivery in health facility (%)	22	84	62	96	95	99
Delivery in hospital (%)	17	39	56	71	78	91
C-sections (%)	3	13	13	34	26	25
Inequalities						
C-section, poorest quintile (%) (NFHS 3 & 5)	1	5	4	15	17	23
Delivery care, rural (%) (NFHS+DLHS)	16	83	47	95	91	99
Delivery care, poor-rich (quintile) gap (abs) (NFHS 3 & 5)	-64	-21	-65	-12	-12	-1
Neonatal mortality, poor-rich (quintile) gap (abs) (NFHS 3 & 5)	22	18	20	16	7	7

Note: The NFHS 3 was conducted during 2005-06 and NFHS 5 was conducted during 2019-21.
NA: Not available

Lower Mortality States

The progress of the lower mortality / higher socioeconomic status cluster of states between 2000 and 2017/18 has been remarkable for mortality (Figure 8.2) and its components of the mortality transition framework (Table 8.2). The LMS cluster of states has entered stage IV and is close to the SDG targets of 12 per 1,000 live births for neonatal mortality (and 12 per 1,000 births for stillbirths, according to the ENAP target). For maternal mortality there is only a global target (70 per 100,000 live births) but the global program (EPMM) has set a target of two-thirds or more reduction from 2010 baseline. Here also the lower mortality states are close (to about 50 per 100,000 live births).

The comparison of the most recent values for key indicators in the lower mortality state cluster (2017) with the common values obtained from countries in stage IV or V of the mortality transition may give some strategic insights for future planning:

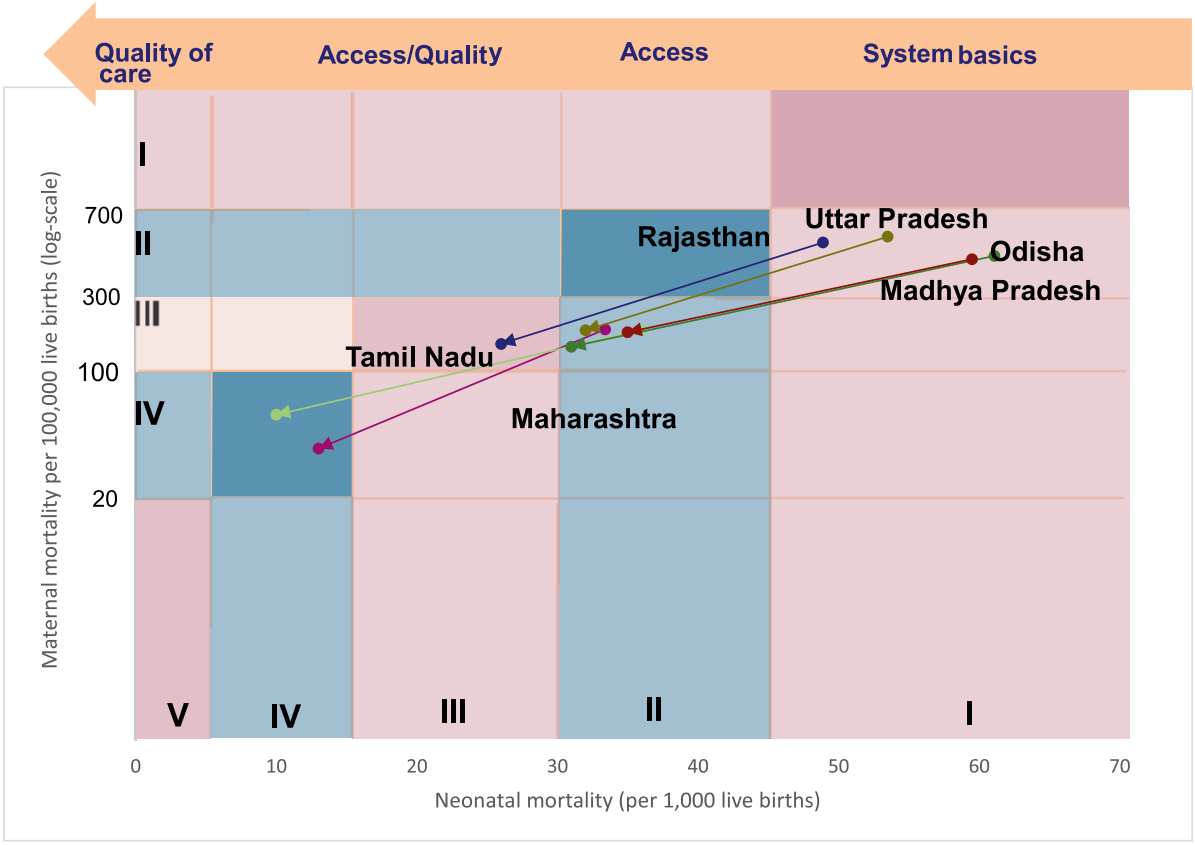
- Further declines in the relative importance of infectious diseases and peri-partum conditions such as birth asphyxia will lead to even greater importance of health status related causes of death for neonates (small and sick newborn, congenital anomalies) and women (indirect causes).
- No further gains from fertility declines can be expected (as further declines of fertility are unlikely and higher risk birth have been all but eliminated); the lower mortality states already have Stage V fertility levels.
- As delivery care in health facilities is nearly universal already, achieving the remaining 4 percentage points or so will remain critical in some areas, while the bigger shift will be in the type of facility conducting deliveries: currently 71% deliver in hospitals yet the typical level in stage V is 91% coverage in hospitals.
- Further increases in antenatal care intensity, timeliness, and quality (from 75% in 2017) are needed to approach universal coverage, which implies a strong focus on left-behind populations such as the poorest.
- With 15% coverage of C-sections in the poorest wealth quintile, one can assume that nearly all women who need a C-section are getting the life-saving intervention, though specific attention for smaller underserved population remains necessary. Overuse of C-sections, based on non-medical indications, is common in this cluster, and this pattern is observed in all countries in stage IV and V: slowing further increases in overuse will need to be considered.
- Despite major reductions in inequalities in coverage, the poor-rich gap in neonatal mortality remained surprisingly large (18 per 1,000). Reducing this gap remains critical through a comprehensive pro-poor focus, as is typical for countries in advanced stages of the transition (7 per 1,000).

Individual States

In 2000, all four states selected from the HMS cluster were in stage I, and all had shifted to stage III by 2018 (Figure 8.3). The two states from the LMS cluster moved from stage III to stage IV during the same period. Tamil Nadu's shift was driven more by the decline in stillbirths+neonatal mortality, compared to the other five states where the shifts were driven more by declines in MMR.

A comparison of the key indicators in the selected six states in 2000 and 2017/18 are presented in Table 8.3. The country median values at Stage V are included after the two LMS as a benchmark for further progress moving to the next transition stage. The 2017 values for the LMS and the country medians for Stage IV are provided after the four HMS as internal and external benchmarks respectively, for further progress in these states to move to the next transition stage. None of the high mortality case study states had notable variation in cause of death patterns for neonatal deaths compared to the LMS 2017 average values. Adolescent fertility was also not a major issue in these states (except Madhya Pradesh).

Figure 8.3: Mortality transition in the selected six states (SRS, 2000 and 2018)



Several state-specific policy considerations emerge based on the transition framework, which are summarized below.

[xxxvii] Andhra Pradesh, Haryana, Gujarat, Karnataka, Kerala, Maharashtra, Punjab, Tamil Nadu, West Bengal (using 2000 boundaries)

Table 8.3: Summary of key indicators in 2000 and 2017 for the six selected states, and common characteristics of countries in stage V and in LMS in 2017

	Lower mortality states				Next stage	Higher mortality states								Next stage	
Indicator	Maharashtra		Tamil Nadu		Median stage V values	Rajasthan		Odisha		Uttar Pradesh		Madhya Pradesh		LMS 2017 stage IV values	Median stage IV values
Year	2000	2017	2000	2017		2000	2017	2000	2017	2000	2017	2000	2017		
Stage	II	IV	II	IV		I	III	I	III	I	III	I	III		
Mortality															
Maternal mortality per 100,000 LB (SRS 2000-18)	169	38	167	58	9	501	141	424	136	539	167	407	163	73	43
Neonatal mortality per 1,000 LB (SRS 2000-18)	33	13	36	10	3	49	26	61	31	54	32	60	35	16	9
Neonatal mortality, home births (NFHS 3 & 5)	42	32	26	NC	NA	37	23	45	53	43	39	45	45	33	NA
Stillbirth rate per 1,000 births (SRS)	7	5	15	3	3	6	8	15	12	7	3	8	6	5	9
Cause pattern (neonatal) (MCEE 2000 & 2015)															
Infections (Group 1)	25	17	25	18	7	29	19	32	22	31	22	31	18	21	14
Health status (Group 2)	44	57	44	55	78	41	63	34	53	35	53	37	61	57	70
Peri-partum (Group 3)	31	25	30	26	14	30	18	34	25	34	26	31	21	22	17
Fertility (SRS)															
Total fertility rate	2.5	1.7	2.1	1.6	1.6	4.1	2.6	2.8	1.9	4.7	3	4	2.7	1.7	2.2
Adolescent fertility (per 1000)	50	9	33	11	13	65	15	39	10	41	8	75	18	15	44
Coverage of interventions (NFHS+DLHS)															
ANC four or more visits (%)	47	74	78	91	87	12	54	24	78	9	43	18	57	75	89
Delivery in health facility (%)	61	95	88	100	99	24	95	29	91	21	84	30	90	96	95
Delivery in hospital (%)	51	77	80	77	91	12	39	18	39	16	40	25	38	71	78
C-sections (%)	8	28	14	47	25	2	10	4	21	3	12	4	12	34	26
Inequalities															
Neonatal mortality poor-rich gap (abs) (NFHS 3 & 5)	40	22	NC	NC	7	15	15	1	16	29	16	4	16	18	7
Delivery care, rural (%) (NFHS+DLHS)	42	94	78	99	99	17	94	23	90	16	83	17	88	95	91
Delivery care, poor-rich gap (abs) (NFHS 3 & 5)	-73	-19	-30	-4	-1	-63	-7	-71	-15	-54	-18	-75	-15	-12	-12
C-section, poorest quintile (%) (NFHS 3 & 5)	1	7	10	32	23	1	4	1	9	1	5	1	4	15	17

MAHARASHTRA

Comparing Maharashtra's indicators at stage IV (2017) against the mean values for countries in stage V highlights the following key policy considerations:

- Moving into stage V requires drastic reduction in MMR, from **38 to 9 deaths per 100,000 live births, and NMR, from 13 to 3 deaths per 1000 live births**
- Reducing neonatal deaths further will require a focus on infection control and treatment during the neonatal period and peri-partum causes; **infection-related causes of deaths (17%) and peri-partum causes of deaths (25%)** currently contribute a far higher percentage than the average in **stage V countries (7% and 14% respectively)**
- Fertility has already **fallen to stage V levels**, so further contributions to mortality decline are unlikely
- In terms of intervention coverage, Maharashtra may focus on increasing access to **ANC from 74% receiving 4 ANC visits in 2017 to the stage V average of 87%**
- Maharashtra has already **achieved high rates of delivery in health facilities (95%)** but can ensure the final 5% of deliveries currently outside any facility are shifted into facilities
- Maharashtra may also ensure women in the poorest quintile can better access C-sections, given that only **7% of deliveries among women in the poorest quintile currently have C-sections**, far below the **WHO recommendation of 10-15% and the Stage V average of 23%**
- Maharashtra may plan to ensure **all deliveries take place in hospital-level facilities**
- The poor-rich gap in **delivery care (-19 percentage points) and neonatal mortality (22 deaths per 1000)** in Maharashtra is quite high compared to the **Stage V average (-1 and 7 units respectively)**; improving access for the poor is where the greatest gains in survival can be achieved

TAMIL NADU

Examining Tamil Nadu's indicators at stage IV (2017) against the mean values for countries in stage V, it highlights the following key policy considerations:

- With a **2018 MMR of 58 deaths per 100,000 live births**, reaching the average MMR for stage V countries **(9 deaths per 100,000 live births)** requires that Tamil Nadu reduce its MMR even further than Maharashtra
- Tamil Nadu's NMR of **10 deaths per 1000 live births** is closer to the stage V average (3 deaths)
- Like Maharashtra, Tamil Nadu needs to focus on infection control and treatment during the neonatal period and peri-partum causes; **infection-related causes of deaths (18%) and peri-partum causes of deaths (26%)** currently contribute a far higher proportion than the average in stage **V countries (7% and 14% respectively)**
- Fertility has already **fallen to stage V levels**, so further contributions to mortality decline are unlikely
- In terms of intervention coverage, Tamil Nadu has already achieved stage **V levels of 4+ ANC visit coverage** and delivery in health facilities, but can reduce mortality by ensuring all deliveries take place in hospital-level facilities **(currently 77% of deliveries are in hospital level facilities, compared to a stage V average of 91%)**
- In Tamil Nadu, women in the poorest quintile have already **achieved sufficient access to C-sections; rural women** are also very well served by delivery care
- Thus, Tamil Nadu's progress should be closely tied to ensuring **quality of care for the poor and addressing wider determinants of health for the poor**

RAJASTHAN

Examining Rajasthan's indicators at stage III (2017) against the mean values for India's low mortality states in 2017 highlights the following key policy considerations:

- Moving towards India's LMS average requires steady reductions in MMR, from **141 to 73 deaths per 100,000 live births, and in NMR, from 26 to 16 deaths per 1000 live births**
- The total fertility rate in Rajasthan remains substantially higher than the LMS average **(2.6 versus 1.7)**, suggesting that substantial gains in survival could be achieved through continued reductions in fertility including family planning and shifts in family sizes
- In terms of intervention coverage, Rajasthan has already achieved LMS levels of **coverage for health facility deliveries (95% versus the LMS average of 96%)** but can now focus on shifting deliveries to hospital-level facilities from **low levels in 2017 (39%), compared to the LMS average of 71%**
- Major gains can be made through improving access to C-sections, which remained **low overall (10% compared to the LMS average of 34%)**, and particularly **for the poor (4% compared to the LMS average of 15%)**
- Except for C-section access, Rajasthan is a high-achiever in reducing inequalities: the state has already achieved **high rural access to delivery care (94%) on par with LMS 2017 values (95%)** and has less inequality than the **LMS in delivery care (-7 vs -12 points of absolute inequality)** and **neonatal mortality (a difference of 16 vs. 18 deaths) between the rich and poor**
- However, the state has a long way to achieve the **median rich-poor difference of 7 deaths per 1000 among the countries at Stage IV** of the transition

ODISHA

Examining Odisha's indicators at stage III (2017) against the mean values for India's low mortality states in 2017 highlights the following key policy considerations:

- Moving towards India's LMS average requires halving MMR, from **136 to 73 deaths per 100,000 live births, and NMR, from 31 to 16 deaths per 1000 live births**
- The total fertility rate in Odisha was slightly higher than the **LMS average (1.9 versus 1.7)**, suggesting that small gains in survival could be achieved through continued reductions in fertility including family planning
- In terms of intervention coverage, Odisha had already achieved LMS levels of **ANC 4+ (78% versus 75% LMS average)** and is near the LMS average for health facility coverage for deliveries **(91% versus the LMS average of 96%)** but can now focus on shifting deliveries to hospital-level facilities from **only 39% in 2017 (as in Rajasthan), to pursue the LMS average of 71%**
- Access to **C-sections in Odisha is already 21%;** although this is lower than the LMS **average of 34%,** survival gains related to C-section access will be found by **increasing access among the poor (currently 9%) rather than increasing overall access**
- Inequality in neonatal mortality requires major attention in Odisha, with an **absolute poor-rich gap of 16,** which is lower than the **LMS average of 18** but higher than the median values for countries in Stage IV (7)

UTTAR PRADESH

Examining Uttar Pradesh's indicators at stage III (2017) against the mean values for India's low mortality states in 2017 highlights the following key policy considerations:

- Moving towards India's LMS average requires steady reduction in MMR, from **167 to 73 deaths per 100,000 live births, and NMR, from 32 to 16 deaths per 1000 live births**
- The total fertility rate in Uttar Pradesh remains substantially higher than the **LMS average (3 versus 1.7**), suggesting that substantial gains in survival could be achieved through continued fertility reduction including family planning
- Uttar Pradesh needs to substantially expand access to **ANC 4+ visits (43% versus 75% LMS average), delivery in a health facility (84% versus 96% LMS), delivery in a hospital (40% versus 71% LMS) and C-section access (12% versus 34%) to hit the LMS 2017 averages.**
- In addition to increasing overall intervention coverage, Uttar Pradesh needs to focus on addressing **major inequalities in coverage and NMR by wealth and rural-urban residence** to approach LMS averages
- Delivery care in rural vareas was **83% compared to 95% in the LMS**, and **18 percentage points lower for the poor than the rich (compared to 12 percentage points in LMS**), while **C-section access among the poorest quintile was only 5% in 2017 in Uttar Pradesh (compared with 15% in the LMS)**
- There were **16 more neonatal deaths per 1000 live births** among the poor than **the rich (compared to 18 in LMS, and 7 in the countries that have reached Stage IV in the transition)**

MADHYA PRADESH

Examining Madhya Pradesh's indicators at stage III (2017) against the mean values for India's low mortality states in 2017 highlights the following key policy considerations:

- Moving towards India's LMS average requires substantial reduction in MMR, from **163 to 73 deaths per 100,000 live births, and NMR, from 35 to 16 deaths per 1000 live births**
- The total fertility rate in Madhya Pradesh remains substantially higher than the **LMS average (2.7 versus 1.7)**, suggesting that substantial gains in survival could be achieved through continued fertility reduction including family planning.
- Madhya Pradesh will make gains in maternal and neonatal survival through addressing coverage gaps particularly in **ANC 4+ visits (57% versus 75% LMS average), delivery in a hospital (38% versus 71% LMS average) and C-section access (12% versus 34% LMS average)**
- Inequalities in access require further attention: rural delivery care was **88% compared to 95% in the LMS,** and delivery care was 1**5 percentage points lower for the poor than the rich (compared to 12 percentage points in LMS)**, while **C-section access among the poorest quintile was particularly low, at only 4% in 2017 (compared with 15% in the LMS)**
- Despite these inequalities, NMR wealth differences were very similar to the LMS average: there were **16 more neonatal deaths per 1000 live births** among the **poorest than richest (compared to 18 in LMS)**, but this still must much further to reach **the median of 7 in Stage IV countries**

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NATIONAL REPORT: ANNEXURES

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ANNEX A:
STUDY OBJECTIVES, DATA & METHODS

Study Objectives

The primary study objective is to systematically investigate, document and compare the contribution of health policies and systems, programs and services, as well as changes in coverage, quality and equity of reproductive, maternal, newborn and child health (RMNCH) interventions and contextual factors, to the reduction in maternal and neonatal mortality in India over the past two decades nationally and sub-nationally.

The mixed methods study in India includes the following components:

National macro-level analysis: Develop an understanding of India's levels and trends in maternal and neonatal mortality, and how these coincided with changes in health policies and systems, health programs and services, contextual factors, and MNH intervention coverage and equity, and identify clusters of states with varied contexts contributing most to India's national progress;

State-level in-depth analysis: Gain an in-depth understanding in six states of the pathways by which key drivers may have led to reductions in the states' neonatal mortality rate (NMR) and maternal mortality ratio (MMR);

Synthesis: Develop an analytical synthesis across the national and state-level research findings on the success factors contributing most to the reduction of maternal and neonatal mortality in India.

Methodology: Research Activities

1) National Macro-Level Analysis

The implementing team is led by the National Health System Resource Centre (NHSRC), the International Institute of Population Sciences (IIPS), University of Manitoba (UM), and India Health Action Trust (IHAT). A steering committee, chaired by the Additional Secretary (RCH), Ministry of Health and Family Welfare, Government of India has been established and includes representatives from the key departments of the Ministry as well as representation from NHSRC, IIPS, Bill and Melinda Gates Foundation (BMGF) and the University of Manitoba. A technical working group (WG) was set up to give input on the overall design and results, with leading scientists and government directors from India, representatives of the global Exemplars team, Countdown to 2030 for women's, children's and adolescents health, and others.

The steering committee, working group and implementing team finalized the main research activities, advised on the selection of six focus states, and identified the key stakeholders and intended users of the study outputs. Representatives from the state governments are also joining the Steering Committee in that phase of the study.

An in-depth literature review has been conducted to identify and synthesize information on trends in NMR and MMR, and the key interventions that aimed to reduce them in India and develop hypotheses on pathways of impact.

Quantitative data analyses have been conducted using data from the Sample Registration System (SRS), household surveys (primarily five rounds of National Family Health Surveys) and other available data to assess levels and trends of NMR and MMR over time, intervention coverage, as well as programs and services, policy and systems drivers, and contextual factors for which other data is available, to develop hypotheses on the pathways of impact. This was followed by analyzing the contributions of these drivers (for which robust quantitative data is available) to changes in coverage and mortality using univariate decomposition using STATA, population attributable fraction, and the Lived Saved Tool.

To better understand the national drivers and take advantage of the wide array of experiences in India at the state level, we have also examined state-wise trends in mortality during 2000 to 2017-19 in two distinct clusters of states according to their levels of mortality levels and economic development (measured by per capita income). MMR and NMR dropped dramatically in both state clusters and the higher mortality states are at the same level in 2017-19 as the lower mortality states 15 years earlier. The homogeneity of the trends over time is striking: the states with higher maternal mortality and lower economic development have reduced the gap in MMR but not in income. NMR shows a similar pattern.

Qualitative document review was undertaken to understand changes in health system inputs, service outputs and contextual changes that are hypothesized to relate to the reductions in NMR and MMR in the past couple decades. The initial results of the national-level analyses were shared in a national stakeholder meeting, with representatives of the steering committee, the implementing team leads, and key stakeholders (MNH policy makers, planning boards, other public health institutions) who were interested to inform and use the learnings from the study. Then a small set of key actors and decision makers were identified at the national level and invited for qualitative in-depth key informant interviews to understand their perspectives on how key drivers contributed to NMR and MMR reduction in India.

2) State-Level In-Depth Analysis

Six states with exemplary progress and major contributions to India's progress were identified for in-depth analyses. The research team held one workshop in each state with key stakeholders to present the main findings from the national-level analyses and gain input and interpretations on the key pathways of impact for deeper exploration. It also involved discussions on data sources and documentation in each state, and the methods and tools for interviews with key informants. The mixed methods conducted in each state involved the following:

Quantitative analyses of NFHS, SRS, and state-specific surveys and databases to describe changes in and examine associations between MMR and NMR and coverage of key interventions over time. The teams also considered intra-state heterogeneity (district level) where data are available, and multilevel or decomposition analyses to understand which drivers contributed most to improved intervention coverage, equity and mortality reduction.

In-depth literature and document reviews of policy plans, program reviews and available reports to understand the health system and policy drivers that may have influenced coverage and equity of key interventions to improve NMR and MMR. Qualitative expert roundtable discussions with a diverse set of actors and decision-makers were held to explore their understandings of the processes and pathways by which key contextual, health system, policy or program drivers may have positively influenced NMR and MMR in their state. Further in-depth qualitative and quantitative analyses were conducted to explain how the major drivers identified in preliminary analyses influenced the outcomes in each state.

3) Synthesis

A national synthesis meeting involving the implementing team, steering committee and state stakeholders will compare the pathways by which drivers were found to significantly influence progress in NMR and MMR nationally and in the six states.

Cross-cutting conclusions are being developed to determine the most salient pathways by which success in NMR and MMR reduction was achieved. Working with the steering committee, working group and implementing team, a process for using the results to inform future policies and planning will be developed, with the identification of key planning processes and events for disseminating relevant findings. Insights derived from the study will be identified and developed for wider dissemination by the Government of India and India-based partners and organizations, through global meetings and platforms, peer-reviewed publications and other knowledge products.

Mixed Methods Integration

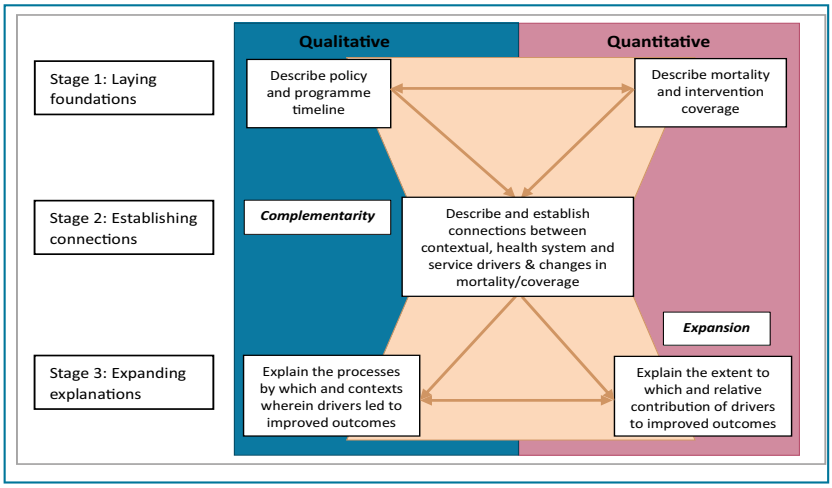
The study used a concurrent, multistage mixed methods design, which integrates interpretive understandings from documentary sources and key informant interviews with quantitative data analyses to develop deeper explanations on the drivers of NMR and MMR reduction.[1,2,3] It adopted a pragmatic approach that employs different qualitative and quantitative methods with both inductive and deductive analyses to comprehensively address the research problem1. For the national and then subnational level, the quantitative and qualitative methods were conducted concurrently in three stages to build up the evidence to fulfil the objectives of describing, comparing and exploring the contribution of key drivers to the declines in NMR and MMR, as follows (also summarized in Figure A.1 below):

1. The first stage laid the foundations by developing a timeline of policies, programs and implementation plans related to MNH (qualitative document and literature review). Separately, we analyzed the trends in NMR and MMR, and coverage of RMNCAH interventions put in place according to the policy and programme timeline (quantitative descriptive analyses).

2. In the second stage, the mixed methods analyses were used complementarily to look at similar phenomena from different angles[2]. Quantitatively, the analyses statistically described changes in the context, and actual health service outputs and health system inputs (stemming from the intended policies and programs in the timeline) that were hypothesized to lead to the observed improvements in intervention coverage/equity and mortality reductions in stage 1. This was followed by multivariate and LiST analyses to identify significant associations between the outcomes, and individual and socio-demographic, epidemiological, macro-economic and/or health system indicators. It also included qualitative review of databases with contextual information and documents of the actual inputs and outputs of the intended policies and programmes related to RMNCAH mapped in the first stage. We also gathered information on factors that were not quantifiable or best understood through qualitative inquiry, such as the role of governance, accountability and other software of the health system.

3. In the third stage, we used mixed methods as a means of expansion to explain different aspects of the research problem[2], namely the relative importance (quantitative) and nature (qualitative) of the key drivers' contributions to improved MNH outcomes over time given available data. The quantitative component at this stage involved further disaggregation, and hierarchical decomposition analyses on the contribution of the different drivers identified in stage 2 to the changes in MNH outcomes. Qualitative in-depth key informant interview tools and samples explored the processes by which and contexts wherein observed changes in key drivers have led to improvements in the MNH outcomes. The implementation team then compared and contrasted the results from different methods and locations, and developed explanations for how and where progress was best achieved in light of related academic and grey literature.[3]

Figure A.1: Stages of mixed methods analyses & integration



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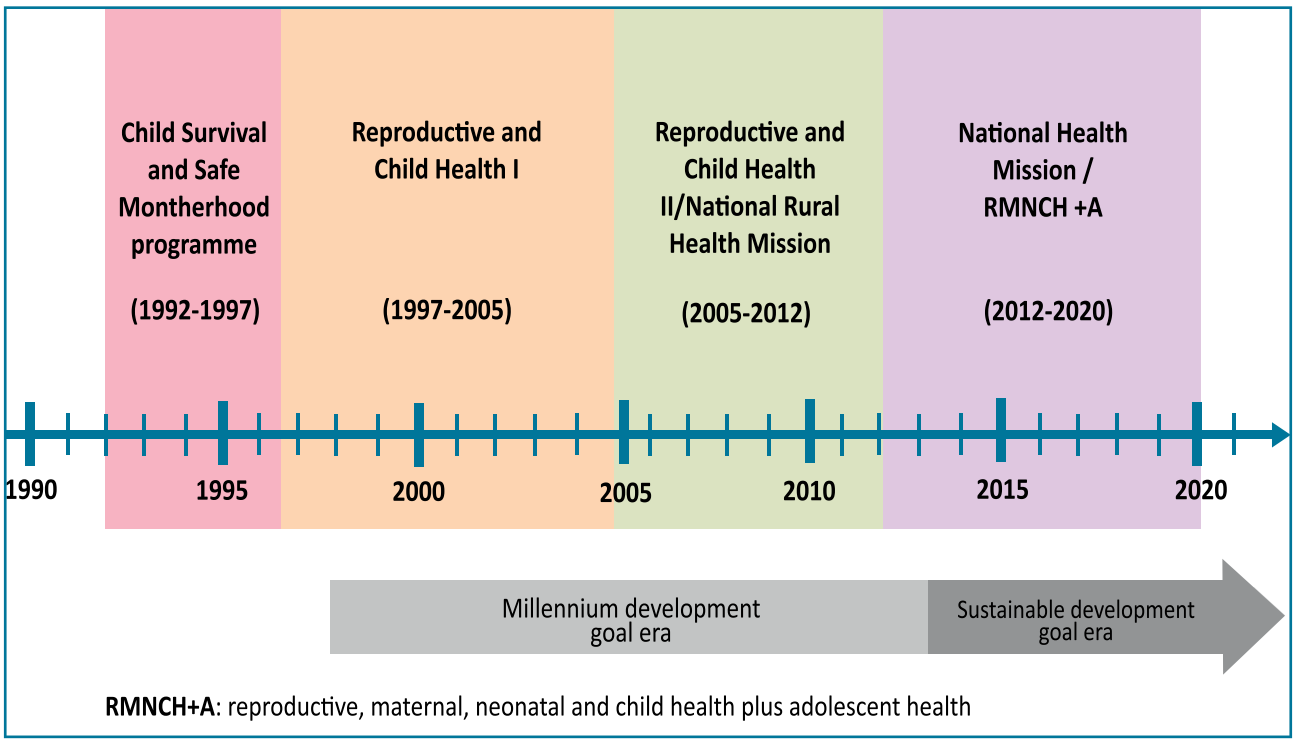
Identifying Critical Periods of Policy Change to Guide Analysis

The time period of primary interest is 2000 to 2020, or the year the latest data was collected. Levels and trends prior to 2000 are also relevant to understanding whether there were changes in pace of decline post-2000. To assess the possible impact of major policy and program changes implemented through the National Health Mission (NHM) to deliver services across the RMNCAH+N continuum of care across India, we divided the time period into four intervals to guide our mixed-methods analyses: the Child Survival and Safe Motherhood (CSSM) program from 1992 to 1997, the Reproductive and Child Health I (RCH I) program from 1997 to 2005, the Reproductive and Child Health II (RCH II) program and the National Rural Health Mission (NRHM) from 2005 to 2012; and the Reproductive, Maternal, Neonatal, Child and Adolescent Health (RMNCH+A) program and NHM from 2012 to 2020 (Figure A.2). In addition, we assessed all annual or five-year time trends (depending on the indicator) for inflection points: periods of acceleration or deceleration of the decline in the relevant indicator (using the average annual rate of change).

Figure A.2 India's health policy periods



RMNCH+A: reproductive, maternal, neonatal and child health plus adolescent health

Selection of Six States for In-depth Analyses

Many states in India experienced impressive declines in both maternal and neonatal mortality during 2000-2017, and so it is valuable to comprehensively study how different states achieved success. To come up with a study design that suits the scope and time frame of the study, six states were selected for in-depth research on the drivers of the MNH decline. The India MNH Exemplar Working Group advised that the states should be selected based on objective transparent criteria. This note provides more details about the selection criteria for six exemplar states. First, it uses the average annual pace of the decline in both maternal and newborn mortality during 2000-2017 to select the six best performing states, to reflect the two main outcomes of the study. We also considered population size, and different dimensions of equity (available for the neonatal mortality outcome). However, the results provide variable conclusions on the six states with most progress, and there is more uncertainty because of larger sampling errors for disaggregated data. Hence, considering the key objective of selecting states that have achieved fastest declines in MMR and NMR since 2000, the strongest indicator is the sum of a state's NMR and MMR average annual rates of change (AARCs).

State Selection Based on Mortality Decline

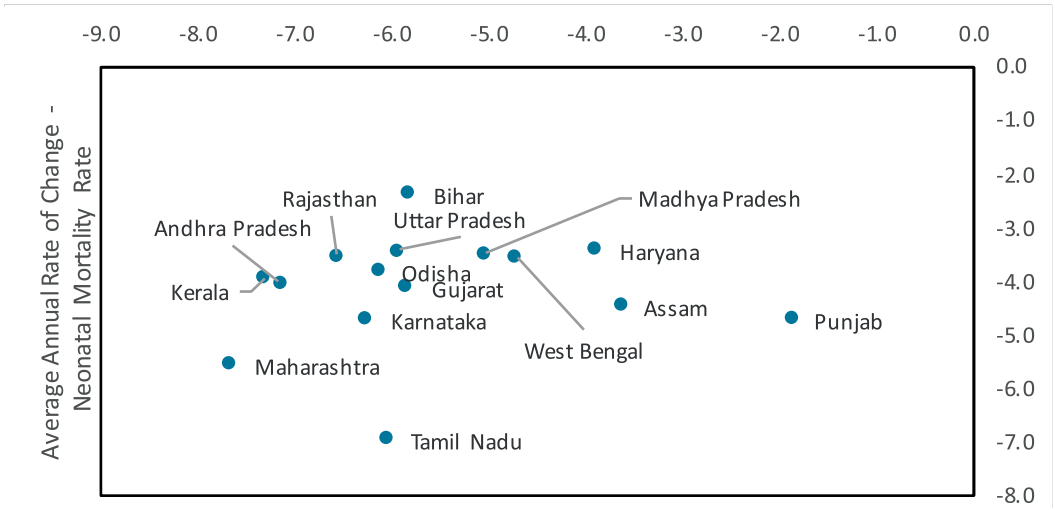
All major (large population) states in the selection process were considered, although we recognize that administrative reorganizations during the study period may be a challenge for the study in some states. The AARCs in maternal and neonatal mortality during 2000-2017 were used as the main statistics for selection.

The selection is based on SRS data, with its high consistency over time and availability for both indicators. The NFHS also provides trend data on neonatal mortality. The NFHS mortality data are more limited as they are only available for neonatal mortality, and there are more data quality-related and sample size-related issues that affect state-level trends.

To study national trends, the MNH exemplar study is using a binary grouping of states, including states with (i) higher mortality / lower economic status and (ii) lower mortality / higher economic status. The consistency of the patterns between the two clusters of states is striking and turns out to be instrumental in understanding India's overall decline (Figure 1.1 and 1.2 in main report). The contribution of the cluster of higher mortality states to the India's progress was over 70% for maternal mortality and over 60% for neonatal mortality. Therefore, four of the six states selected for in-depth analysis will be from the higher mortality cluster, and two from the lower mortality cluster of states. Conducting in-depth analysis in diverse states also provides scope for analyzing the drivers of success within different health systems, socio-economic and demographic contexts over time.

The AARCs for maternal and for neonatal mortality are measures of common unit and scale. Therefore, we added the two rates to obtain an overall score for ranking the states. Figure A.3 presents the scatter plot of the AARC by state for maternal and neonatal mortality, showing the high rates of decline in all major states but with variability by individual indicator.

Figure A.3: Scatter plot of average annual rate of change for maternal and neonatal mortality, by state, (SRS, 2000-2017)



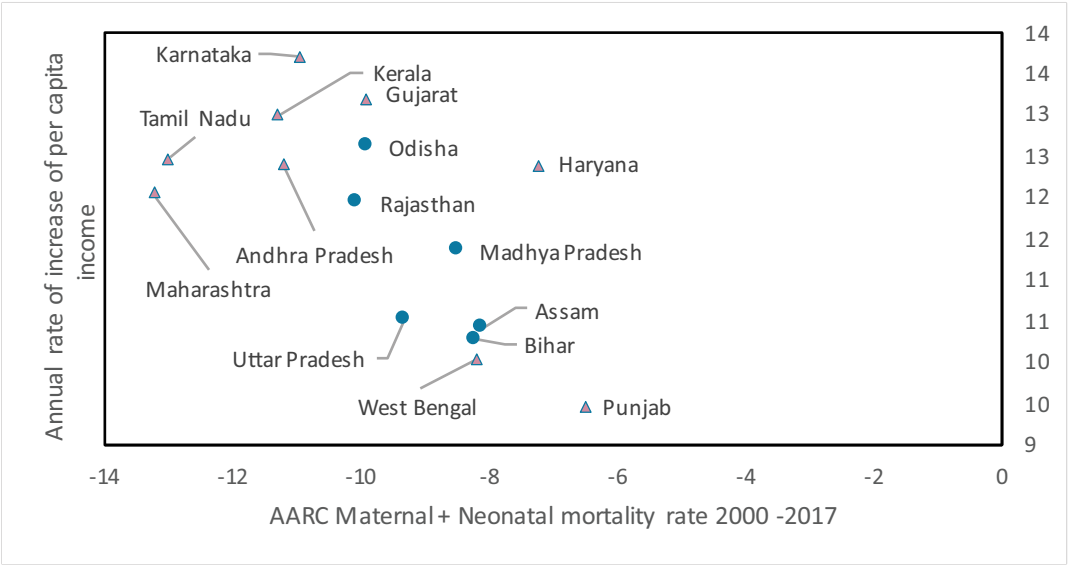
The sum of the maternal mortality and neonatal mortality AARCs is shown in Table A.1 below. Based on the sum of the two AARCs, the top-ranking four states overall among the high mortality state cluster are Rajasthan (-10.1%), Odisha (-9.9%), Uttar Pradesh (-9.3%) and Madhya Pradesh (-8.5%), followed by Bihar and Assam. In the lower mortality state cluster, the top states overall are Maharashtra (-13.2%) and Tamil Nadu (13.0%), with Kerala and Andhra Pradesh slightly below (both around -11%).

Table A.1: Average annual rate of change (AARC) for maternal mortality and neonatal mortality, India by state, (SRS, 2000-2017) (states ranked within state cluster by total AARC)

	MMR			NMR			Sum of AARCs	Rank
State	1999-01	2016-18	AARC	2000	2017	AARC		
Higher mortality states								
Rajasthan	501	164	-6.6	48.9	27.0	-3.5	-10.1	1 (selected)
Odisha	424	150	-6.1	61.1	32.0	-3.8	-9.9	2 (selected)
Uttar Pradesh	539	197	-5.9	53.5	30.0	-3.4	-9.3	3 (selected)
Madhya Pradesh	407	173	-5.0	59.5	33.0	-3.5	-8.5	4 (selected)
Assam	398	215	-3.6	47.2	22.0	-2.4	-8.2	5
Bihar	400	149	-5.8	42.1	28.0	-4.5	-8.1	6
Lower mortality states								
Maharashtra	169	46	-7.7	33.4	13.0	-5.5	-13.2	1 (selected)
Tamil Nadu	167	60	-6.0	35.9	11.0	-7.0	-13.0	2 (selected)
Kerala	149	43	-7.3	9.8	5.0	-3.9	-11.3	3
Andhra Pradesh	220	65	-7.2	45.4	23.0	-4.0	-11.2	4
Karnataka	266	92	-6.2	40.2	18.0	-4.7	-11.0	5
Gujarat	202	75	-5.8	42.4	21.0	-4.1	-10.0	6
West Bengal	218	98	-4.7	31.1	17.0	-3.6	-8.3	7
Haryana	176	91	-3.9	37.5	21.0	-3.4	-7.3	8
Punjab	177	129	-1.9	29.0	13.0	-4.7	-6.6	9

The sum of the AARCs for maternal and neonatal mortality was plotted against the AARC for per capita income to single out states that were performing better than others (Figure A.4). There are differences between the states, though most are relatively modest. The position of the states did not change within the respective clusters and the six states highlighted in Table A.1 were selected for in-depth analysis.

Figure A.4: Total AARC in per capita income and AARC in mortality (maternal and neonatal combined), by state, (2000-2017)



Quantitative Methods

Maternal Mortality Trends

The main data source for maternal mortality trends is the Sample Registration System (SRS), which provides state-level estimates of MMR by combining data for three-year periods. The reported trends in maternal mortality are affected by changes in the sampling design from 2015 to provide estimates for states that had been split into two. Details of how this may affect MMR trends are described below. The SRS does not provide MMR estimates disaggregated by any socioeconomic characteristics including rural/urban residence.

National household surveys such as the National Family Health Survey (NFHS), District Level Household Surveys (DLHS), and the Annual Health Surveys (AHS) collected data on maternal deaths in the sampled households. The NFHS (except NFHS-3) used the two years preceding the surveys as the reference period. In the 4 rounds of DLHS, the reference period was 1 to 3 years preceding the surveys, and for the 3 rounds of AHS, the reference period was 1-5 years preceding the survey. An earlier comparison of MMR estimates from SRS, NFHS 1-2 and DLHS 2-3 (Hogan, 2010) indicated that the survey estimates were highly inconsistent. There are two global estimates of the MMR trend in India: The Maternal Mortality Estimation Inter-Agency Group (MMEIG) estimates and the Global Burden of Disease Study (GBDS) modeling estimates. The MMEIG estimates are much closer to the observed trends than the GBDS. These modeling estimates tend to underestimate the changes over time.

For the higher mortality states, we used the published SRS pooled estimates for EAG states and Assam. The estimates for the lower mortality state cluster is computed by pooling the individual state estimates based on the estimated number of live births (using annual population estimates/projections and the SRS crude birth rates). The focus is on the post 2000 trends.

Causes of Maternal Death

Information of causes of death in India are available in death registration data, based on verbal autopsy systems and facility records, such as the SRS data (2001-3)[4], and the Million Death Study (MDS) for 2005-6[5]. Also, national medically-certified public and private facility-based data is available from the Registrar of India's Medical Certification of Causes of Death (MCCD), though it represents variable reporting between states, and generally more from urban than rural hospitals[6]. Modelling estimates combining available national data were produced by the GBDS for 1990 to 2013[7]. There is also health facility data at the national level, including the Health Management Information System (HMIS) for select years[8], the FOGSI study[9], and the facility module of the DLHS-4 in non-EAG and UTs[10]. There are also some regional studies using facility-based case records, from one or multiple hospitals. A range of regional state or district level studies were conducted using community-based surveys, mostly cross-sectional and fewer longitudinal, many of which involved maternal death review with verbal autopsy to ascertain the causes of death in accordance with national guidelines and ICD-9 or 10 codes.

[4] Registrar General, India. Maternal Mortality in India: 1997-2003: trends, causes and risk factors. Registrar General, India and Centre for Global Health Research, University of Toronto. New Delhi: 2006.

[5] Montgomery AL, Ram U, Kumar R, Jha P, Million Death Study Collaboration. Maternal mortality in India: causes and healthcare service use based on a nationally representative survey. PloS one. 2014;9(1):e83331. Available from: doi:https://dx.doi.org/10.1371/journal.pone.0083331.

[6] Census of India Website: Office of the Registrar General and Census Commissioner, India. https://www.censusindia.gov.in/2011-common/mccd.html.

[7] Kassebaum NJ, Barber RM, Dandona L, Hay SI, Larson HJ, Lim SS, et al. Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. The Lancet. 2016;388(10053):1775-812. Available from: doi:10.1016/S0140-6736(16)31470-2.

[8] Causes of Death, National Health Systems Resource Centre, MoHFW, Government of India. http://nhsrcindia.org/hmis-details/causes-of-death/NjY1.

[9] Konar H, Chakraborty AB. Maternal Mortality: A FOGSI Study (Based on Institutional Data). Journal of obstetrics and gynaecology of India. 2013;63(2):88-95. Available from: doi:https://dx.doi.org/10.1007/s13224-012-0258-1.

[10] Tripathy JP, Mishra S. Causes and Predictors of Neonatal, Post-neonatal and Maternal Deaths in India: Analysis of a Nationwide District-Level Household Survey-4 (DLHS-4), 2012-13. Journal of tropical pediatrics. 2017;63(6):431-9. Available from: doi:https://dx.doi.org/10.1093/tropej/fmx009.

Neonatal Mortality Trends

The main data sources for the national and state cluster neonatal mortality are the Sample Registration System (SRS) and a series of four surveys of the National Family Health Surveys. The SRS provides annual estimates of neonatal mortality and stillbirth rates and has provided annual NMR estimates for India since 1971.[11] The most recent year with published data was 2019. The data are based on the dual reporting system of continuous enumeration and half-yearly retrospective survey of births and deaths in representative units spread across the country. The SRS provides age disaggregated estimates of under-five mortality, infant mortality, neonatal mortality, early neonatal mortality and perinatal mortality rates. The completeness of neonatal deaths has been assessed in two in-depth studies and found to be good.[12]

Five national population-based surveys, the National Family Health Surveys (NFHS), have been conducted: NFHS-1 (1992-93), NFHS-2 (1998-99), NFHS-3 (2005-06), NFHS-4 (2015-16) and NFHS-5 (2019-21).[13] The sample sizes increased over time. While the first three NFHS rounds were designed to provide most estimates at the state level, the NFHS 4 (2015-16) was designed to provide district level program coverage indicators for all the 640 districts of India (as per the Census, 2011), and NFHS-5 provided district level coverage indicators for 707 districts (as on March 2017). Selected details of these surveys are provided in Annexure A.

The neonatal mortality data in the National Family Health Surveys are derived from the birth histories of women 15-49 years of age and were analyzed to obtain estimates for 2-year intervals, going back as much as 15 years before each survey. Data are available in days at death.[14] Because the use of the codes day 0 and day 1 is often inconsistent, the two are combined to assess early neonatal mortality (corresponding with on average the first 36 hours). The stillbirth data through additional questions on stillbirths and abortions (reproductive history) were only available from the NFHS-3, NFHS-4, and NFHS-5.

While the SRS data provides annual state-level trends in NMR and MMR for the past 30 years or longer, it does not provide mortality trends for any population subgroups below state level, except for urban and rural areas. It also does not provide data on intervention coverage. Furthermore, primary data were not available for this study. On the other hand, the NFHS primary data is publicly available, and was used to study disaggregated mortality trends and intervention coverage.

Can We Use Stillbirth and Age-Specific Neonatal Mortality Data?

Even though the focus is on neonatal mortality decline, including stillbirths would be useful for the trend analysis, particularly since intrapartum stillbirths have a similar etiology as early neonatal (1st week) deaths. However, there is evidence of major underreporting of stillbirths in the SRS and to a lesser extent in the NFHS, based on the ratio of stillbirth to early neonatal or neonatal deaths. Accurate registration and reporting of stillbirths have been challenging in many contexts, due to various reasons such as late pregnancy registration or imprecise tracking, cultural norms around concealing pregnancy and stillbirths, disincentives for reporting due to lack of social supports or services, or lack of ability, tools or willingness of birth attendants to identify them. [15]As a general indication, we expect a ratio of at least 1 or more stillbirths to early neonatal deaths based on historical data.[16,17] Five longitudinal studies in India showed a ratio ranging from 0.84-1.57 with a median value of 1.14.[18,19,20]

In the SRS, stillbirth rates were as low as 8.5 and 4.0 per 1,000 births in 2000 and 2015, respectively. This corresponds with a stillbirth to early neonatal death ratio of 0.2 – 0.3 during most of 2000-15 suggesting major underreporting of stillbirths (Figure A.5). The declining trend however is similar to the neonatal mortality trend.

[11] SRS historical data, http://censusindia.gov.in/vital_statistics/Compendium/Srs_data.html

[12] Bhat PNM. Completeness of India's Sample Registration System: An Assessment Using the General Growth Balance Method. Pop Stud 2002, 56 (2): 119-134 and Saikia N, Jasilionis D, Ram F, Shkolnikov VM. Trends and geographic differentials in mortality under age 60 in India. Pop Stud 2011, 65 (1): 73-89. The comparison with NHFS-3 2005/06 showed higher infant mortality in SRS especially in rural populations. Global estimations such as UN-IGME also use SRS data as the main driver of the estimates using all data sources.

[13] A more detailed description of these surveys is available in: Dandona R, Pandey A and Dandona L. A review of national health surveys in India, Bulletin of World Health Organization, 2016; 94: 286-296A. doi: http://dx.doi.org/10.2471/BLT.15.158493.

[14] Age at death was recorded in days for children who died within a month, in months who died between first and 11 months and in years thereafter.

[15] Frøen, J. F., et al. (2009). "Making stillbirths count, making numbers talk - Issues in data collection for stillbirths." BMC Pregnancy and Childbirth 9(1): 58.

[16] Woods R. Late-Fetal Mortality: Historical Perspectives on Continuing Problems of Estimation and Interpretation. Population 2008, 63 (4): 591-614.

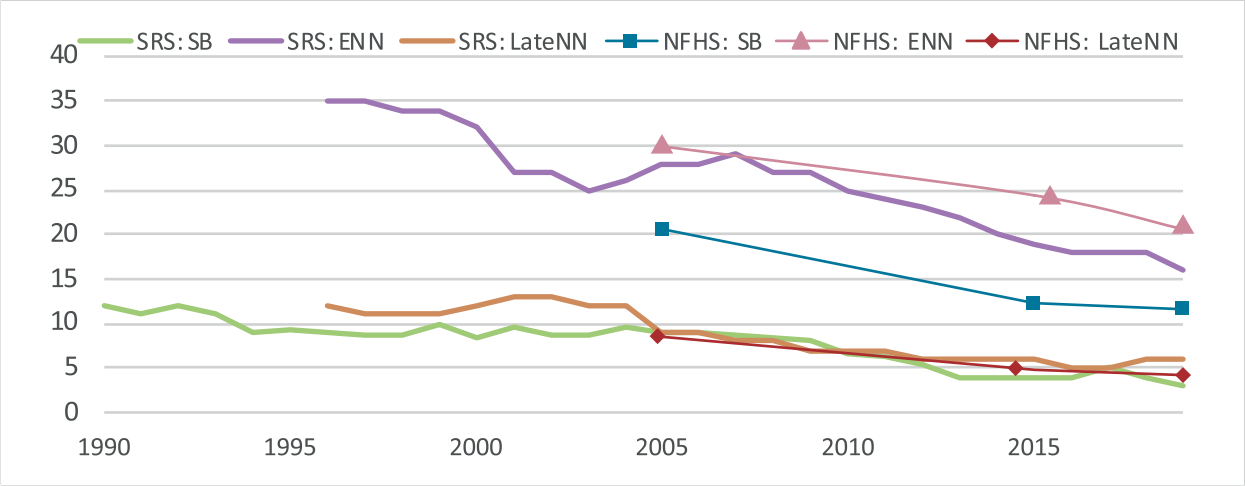
[17] World Health Organization. Neonatal and perinatal mortality: country, region and global estimates. Geneva. 2006.

[18] Alliance for Maternal and Newborn Health Improvement (AMANHI) mortality study group. Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study. Lancet Glob Health. 2018 Dec;6(12):e1297-e1308. doi: 10.1016/S2214-109X(18)30385-1. Epub 2018 Oct 22 PMID: 30361107; PMCID: PMC6227247.

[19] Saleem S, McClure EM, Goudar SS, et al. Global Network Maternal Newborn Health Registry Study Investigators. A prospective study of maternal, fetal and neonatal deaths in low- and middle-income countries. Bull World Health Organ. 2014 Aug 1;92(8):605-12. doi: 10.2471/BLT.13.127464. Epub 2014 Jun 5

[20] Bapat U, Alcock G, More NS, Das S, Joshi W, Osrin D. Stillbirths and newborn deaths in slum settlements in Mumbai, India: a prospective verbal autopsy study. BMC Pregnancy Childbirth 2012; 12: 39.

Figure A.5: Stillbirth rates per 1,000 births and early/late neonatal mortality per 1,000 live births, India, (SRS, 1990-2019 and NFHS, 2005-06, 2015-16 and 2019-21)



The underreporting of stillbirths in the NFHS is less severe, with a ratio of stillbirths to first week deaths of 0.7 in NFHS-3 for 2002-06 to 0.5 in NFHS-4 for 2012-16 and 0.6 in NFHS-5 for 2015-19. Still more than one-third of stillbirths may not have been reported in NFHS-5. The trend in stillbirths is similar to that of overall neonatal mortality, which appears mostly driven by a decline in late neonatal mortality according to the survey (Figure A.5). There are also large declines in stillbirth rates in both data sources. Early neonatal (first week) mortality declined in SRS, but not in NFHS-4. However, there was a large decline in later neonatal mortality (weeks 2-4) in both data sources (SRS more than NFHS).

The consistency between early and late neonatal mortality rates, as well as the ratio early to late neonatal mortality (which is expected to be about plus or minus two standard deviations from 2.4, based on longitudinal studies), suggest that the data are not of sufficient quality to analyze mortality trends within the neonatal period.[21] Further disaggregation to obtain an idea of very early neonatal mortality (day 0-1) is also considered possible. A reference value based on longitudinal studies for the ratio day 0-1 to day 2-6 is 3.

The UN estimates of stillbirth rates based on all available data sources and a global model suggest that stillbirth rates in India have declined from 29.6 (uncertainty interval 21.9-40.2) in 2000 to 17.0 (14.9-19.3) in 2015 and 13.9 (11.4 – 17.0) per 1,000 births in 2019.[22]

[21] Data from 4 longitudinal studies in India (2 AMANHI and 2 Global Network Study, see earlier references) result in ratios from 1.5-3.3 with a median of 2.45.

[22] CME Info - Child Mortality Estimates

Causes of Neonatal Death and Still Births

India has multiple sources of data on the causes of neonatal death in the population: the national population-based Million Death Study (MDS), the national facility-based MCCD (with more representation of urban health facilities), and 15 published community studies that provide data on levels of neonatal mortality and cause distributions. Multi-site studies included the AMANHI study (Haryana and UP)[23], a Save the Children project's baseline study in 2012 in two districts each in Rajasthan, Bihar and Odisha, [24]and the Global Network for Women's and Children's Health Research (Belagavi, Karnataka, and Nagpur, Maharashtra)[25]. Some of the community studies have two data points, as part of an intervention study. In addition, IHME and WHO- Maternal Child Epidemiology Estimation (MCEE) have estimated cause specific mortality trends in the neonatal period.[26,27]

Causes of death are ascertained most often using verbal autopsy methods. This is also done in combination with or solely using computer algorithms of hierarchical causes using basic routine data. Verbal Autopsy methods involve interviews of families or other informants (at home or hospital) on the circumstances of the death, by health workers or researchers, and physicians independently use these to assign causes. The MDS determined causes of death based on physician-verified verbal autopsies of deaths in the SRS, using an WHO modified checklist. Others, including the WHO and GBD, model causes of death based on available empirical data.

For this analysis we used broad cause groupings, including birth asphyxia/trauma, prematurity/low birth weight, neonatal infections (pneumonia, sepsis, diarrheal disease and tetanus), and congenital anomalies. We combined the categories as other or ill-defined that were not consistent across studies.

Qualitative Methods

Literature and Document Review

The literature review strategy adapted the components in the Exemplars in MNH conceptual framework to the national RMNCAH+N strategic plans and frameworks developed in India between 2000 and 2020 during the Reproductive and Child Health I and II (RCH-I and II), the National Rural Health Mission (NRHM) and subsequently the National Health Mission (NHM) policy periods. A published literature search was conducted to identify published, peer-reviewed articles of various methods that cover terms related to a) NMR, MMR and stillbirths, their causes, and b) the continuum of RMNCAH interventions. Due to the high volume of studies retrieved using those search terms, we then looked among them to identify any that primarily analyzed how these changes in mortality and/or coverage were impacted by c) health policy & system changes, as well as the role of the d) household, community or societal context between over the past two decades in India and in the focus states. We focused the search and review of literature on the following four topic areas:

We used databases for peer-reviewed literature that contained both biomedical as well as social science literature, including MEDLINE, Scopus, and Web of Science. Standard search terms for all steps have been developed by the wider EGH study team. Search terms for relevant components were adapted and added as applicable to India, including both MeSH and free terms where relevant.

[23] Baqui, A. H., R. Khanam, D. K. Mitra et al. (2018). "Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study." Lancet Global Health 6(12): E1297-E1308.

[24] Dogra, V., et al. (2015). "Neonatal mortality in India's rural poor: Findings of a household survey and verbal autopsy study in Rajasthan, Bihar and Odisha." Journal of Tropical Pediatrics 61(3): 210-214.

[25] Goudar, S. S., N. Goco, M. S. Somannavar, S. S. Vernekar, A. A. Mallapur, J. L. Moore, D. D. Wallace, N. L. Sloan, A. Patel, P. L. Hibberd, M. Koso-Thomas, E. M. McClure and R. L. Goldenberg (2015). "Institutional deliveries and perinatal and neonatal mortality in Southern and Central India." Reproductive health 12 Suppl 2: S13.

[26] Dandona, R., G. A. Kumar, N. J. Henry, et al. (2020). "Subnational mapping of under-5 and neonatal mortality trends in India: the Global Burden of Disease Study 2000-17." Lancet 395(10237): 1640-1658.

[27] Liu, L., Y. Chu, S. Oza, D. Hogan, J. Perin, D. G. Bassani, U. Ram, S. A. Fadel, A. Pandey, N. Dhingra, D. Sahu, P. Kumar, R. Cibulskis, B. Wahl, A. Shet, C. Mathers, J. Lawn, P. Jha, R. Kumar, R. E. Black and S. Cousens (2019). "National, regional, and state-level all-cause and cause-specific under-5 mortality in India in 2000-15: a systematic analysis with implications for the Sustainable Development Goals." The Lancet. Global health 7(6): e721-e734.

All retrieved articles were imported into Endnote X9, and screened for inclusion and review. Duplicates were then removed across the results from each database search, and combined into one folder for screening. To screen the retrieved literature and documents, we used a set of questions to determine if a source was relevant for inclusion. Peer-reviewed articles' titles and abstracts (and full texts where needed) were screened in Endnote, and included if they fit the selection criteria.

- Was the study conducted in India?
- Does the study provide data or information relevant to neonatal/maternal mortality or both?
- Does the study use an epidemiological design with representative population-level sample and/or a other credible data source derived from rigorous methods?
- Does the study use data that was collected later than 1990?
- Is the full text available?

The published literature searches retrieved a total of 8248 articles, after removing duplicates. After title and abstract screening, the number of included articles were as follows for each topic and at national/state levels.

Table A.2. Literature review search results: number of studies identified by subject area

Topic	National or multi-state studies	State-level studie
MMR and/or NMR	149	200
Intervention coverage & equity		
Antenatal, delivery and postnatal	149	248
Reproductive and adolescent health	50	117
Health services	84	246
Health policy & systems	242	50
Contextual factors	123	113
Review articles (covering a mix of the above)	135	
Hand search	47 (hand search)	
Total	1953	

For the health policy and systems document review, online or archival sources (e.g. government, WHO, WB websites) were searched. All relevant grey literature from the RCH I, II and NHRM/NHM periods were retrieved and reviewed to aid in describing the policies, strategies and health systems changes that were intended to reduce MMR and NMR in India. In addition, documents containing evaluations or reports were retrieved to analyze how key policies and programmes were implemented effectively to reduce NMR and MMR, and/or increase intervention coverage over these time periods. The grey literature search initially included 69 documents at the national level, which was supplemented by hand search to develop the policy timeline and overview of health system strategies and implementation processes.

To extract the literature results for analysis, summary tables were developed for each topic to compare results across studies with pertinent results to our research questions. Results were synthesized by comparing and organizing results within each of the topic areas related to the framework (either within one source based on longitudinal analyses, or across sources at different time points). Next, comparisons of results across those topics were made to synthesize information on the drivers of changes in NMR and MMR and intervention coverage over time.

Articles that covered topics hypothesized to be important during quantitative analyses, document review and stakeholder consultations were analyzed in more depth to inform the conclusions. The literature review was also the primary source of information on topics that received less attention in the primary data collection due to logistical constraints, such as causes of death, processes and perspectives on policy prioritization and development at national or state levels, or community or health service provider perspectives at district, block and village levels.

Primary Data Collection – Key Informant Interviews

Interviews were conducted by members of the core research team between July and November 2021. A list of 30 potential respondents were identified by the Exemplars India research team as experts active in maternal and neonatal health policy and implementation in the national government (administrative and technical roles), donor organizations, and the civil society and academic spheres. We invited twenty respondents to participate and sought to balance representation from across affiliation spheres. Of these, 12 agreed to participate and were interviewed. The others declined due to their busy schedules or could not be reached. After completing the 12 interviews, we added one more respondent to ensure representation from the Indian Administrative Services, the central civil service of India, making the total number of key informants 13.

Interviews averaged 1.5 hours and were conducted remotely on Zoom. The interviews began with a formal introduction to the Exemplars in Maternal and Newborn Health India study and a brief synthesis of major national maternal and neonatal health policies since the 1990s. The interview then covered four topics: overarching drivers of progress, differences between high and low mortality state clusters, the role of the private sector, and contextual drivers. Further details on the interview guide are provided in annexure 1. All respondents provided informed written consent.

Interview Topic Guide

The first discussion topic invited respondents to reflect on the overall question:

- From your professional experience and scientific knowledge, how do you think India was able to reduce maternal and neonatal mortality over the last 20 years?

During this initial discussion, respondents were asked to discuss important policies, strategies, and programs and the underlying factors that enabled these policies, strategies, and programs. We provided a wide range of potential probes to expand the discussion on topics relevant to the respondent's area of expertise. For instance, some respondents had more experience on clinical/technical changes (such as treatment protocols and health worker skills) and others on administrative changes (such as management, financing, retention, and recruitment or evaluation); some were maternal health experts, so discussed specific aspects of maternal survival and others focused on neonatology.The total fertility rate in Uttar Pradesh remains substantially higher than the LMS average (3 versus 1.7), suggesting that substantial gains in survival could be achieved through continued fertility reduction including family planning

The second discussion topic asked respondents to consider differences in high mortality states versus low mortality states. Trigger questions for this topic were:

- What did the low mortality states do to maintain ongoing reductions in maternal mortality? In neonatal mortality?

The third topic focused on the private sector, asking:

- What role has the private sector played in improving maternal and neonatal survival in India? What is the private sector doing well?
- Over the past 20 years, what has shaped the private sector in terms of its role in providing maternal and neonatal healthcare and the quality of care it provides?
- How has the maternal and neonatal lifesaving capacity of the private sector differed in high versus low mortality clusters?

Fourth, we asked about broader contextual changes, using the discussion question:

- In the past 20-30 years, what are some broader contextual movements, trends, events, or forces that have affected maternal and newborn mortality?
- Finally, we invited closing reflections, including on whether there were any other drivers of success that had not yet been discussed and lessons for other countries.

Analysis of Key Informant Interviews

We audio-recorded the interviews and transcribed them later. The transcriptions were uploaded into the qualitative management software Dedoose and coded using a codebook developed based on our a priori areas of exploration. We expanded our codes after coding the first two transcripts into eight "parent codes": administrative, technical, private sector, contextual, future directions, high/low mortality state clusters, respondent personal and career, and problems, mistakes, and reasons for slower progress. We created "child" codes under many parent codes and further sub-divided "child" into "grandchild" codes. For example, the technical code on positive changes in technical aspects of maternal and neonatal care had three child codes: lifesaving technical interventions and interventions, changes in health facility use and capacity, and changes in emergency transportation. Grandchild codes were added under lifesaving technical interventions and interventions for antenatal care, intrapartum care, neonatal care and family planning.

The coded excerpts were read and synthesized into a 27,000-word long-form analytic summary document, which summarized the various points made by respondents, grouped by parent code, and sub-grouped by emerging themes. The analytical summary included direct quotations from many interviews. The analytic summary was then developed into the "National level key informant interviews, detailed report" by synthesizing respondent views and adjusting the headings to a final set of emergent themes. The report was shared with the key informants, whose input was also used to finalize the report. This can be found in Annex D.

Maternal Mortality Trends in Other Studies

Other studies that estimated MMR in India found similar results. During the pre-NRHM period, India's MMR declined from 580 to 440 per 100,000 live births between 1984 and 1994, or and AARC of 2.8% reduction.[28,29]During the pre-NRHM period, the UN MMEIG estimated that India's MMR declined from 370 to 286 between 2000 and 2005 (AARC: -2.6%). Post-NRHM, it showed the MMR decreased faster between 2005 to 2017 from 286 to 145, or an AARC of 6.6%.[30,31,32] The GBDS estimates showed less drastic reductions, from 482 (441-527) to 245 (214-300) between 1990 to 2015, or -2.7% per annum. The average rate of reduction was again faster (-3.5% per annum) between 2000 and 2015.

Comparing MMR by residence, one study estimated that there was a more drastic fall in MMR between 1984 and 1994 in rural areas (638 to 498), than in urban areas (389 to 321)[34,35]The MDS study calculated weighted regional MMR using the SRS estimates from 2004-6 and UNPD estimates of live births and deaths in India in 2005. [36]It showed that MMR was highest in rural areas of poorer states (EAG and Assam) at 397 per 100,000 live births, a bit higher than the overall estimate for the higher mortality state cluster above. The lowest MMR was found for urban areas of richer states (115 per 100,000 live births.

Heterogeneity in Maternal Mortality

Heterogeneity in mortality between individual states narrowed down considerably (Figures B.1 and B.2). According to two measures of inequality (interquartile range and mean distance from the mean), the gap between states decreased gradually in India as whole, especially post-2005, and between higher and lower mortality states (Table B.1). The gaps remained considerable due to differences in risk and in fertility.

Table B.1: State inequality in maternal mortality ratio, according to state cluster and policy periods, (SRS, 1997-2018)

Year	Inter-quartile range			Absolute mean difference from overall mean		
	India	Higher mortality states	Lower mortality states	India	Higher mortality states	Lower mortality states
1997	359	154	113	188.6	73.0	81.8
2005	194	128	56	109.2	59.7	30.8
2012	130	64	48	70.3	30.3	25.2
2018	83	33	40	40.9	30.1	23.2

[28] Bhat PNM, Navaneetham K, Rajan SI. Maternal mortality in India: estimates from a regression model. Studies in family planning. 1995;26(4):217-32.

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[32] https://www.who.int/gho/maternal_health/countries/ind.pdf

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[34] Bhat PNM, Navaneetham K, Rajan SI. Maternal mortality in India: estimates from a regression model. Studies in family planning. 1995;26(4):217-32.

[35] Bhat PNM. Maternal mortality in India: an update. Studies in family planning. 2002;33(3):227-36.

[36] Montgomery AL, Ram U, Kumar R, Jha P, Million Death Study Collaboration. Maternal mortality in India: causes and healthcare service use based on a nationally representative survey. PloS one. 2014;9(1):e83331. Available from: doi:https://dx.doi.org/10.1371/journal.pone.0083331.

Figure B.1: State heterogeneity in MMR in different policy periods, India, (SRS, 1997-2018)

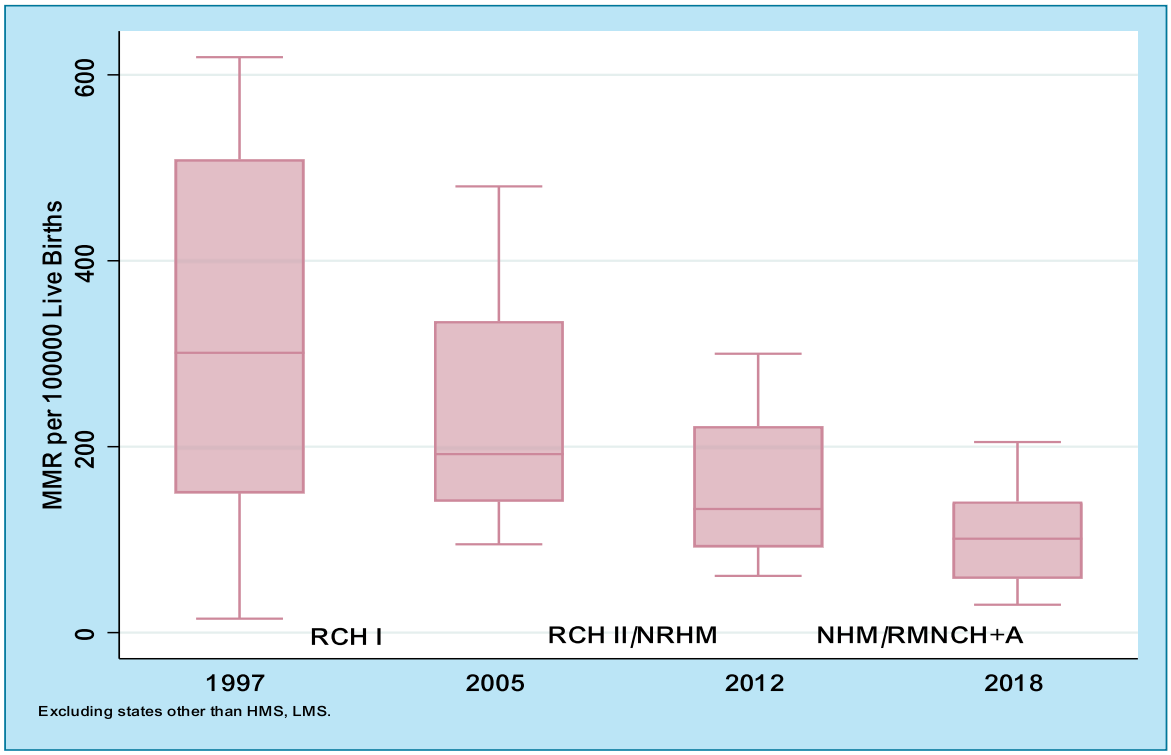

Figure B.2: State heterogeneity in MMR by state cluster in different policy periods, India, (SRS, 1997-2018)

Causes and Timing of Maternal Deaths

First, we consider the timing of maternal deaths in the antepartum, intrapartum and postpartum periods, and the distribution of associated causes in existing research. In regional community-based studies, between 20-30% maternal deaths occurred in the antepartum period.[37,38,39,40,41,42] Most studies showed around 15-30% of deaths occurred during the intrapartum period (labour and up to 24 or 48 hours after delivery). Yet two found that nearly 50% were intrapartum deaths.[43,44] Between 30 to 50% occurred in the postpartum period (up to 42 days after giving birth). A few studies reported a fairly even distribution of postpartum maternal deaths each week up to six weeks after birth.[45,46,47]

Patterns in causes by time of maternal death were apparent in a few studies. [48,49,50] Malaria and hypertensive disorders, followed by antepartum haemorrhage and septic abortion, were reported as the main causes in the antepartum period (ibid). The main direct and indirect causes across all periods were haemorrhage and anaemia respectively; postpartum haemorrhage was the predominant cause in the intrapartum period. Intrapartum deaths were often also attributable to obstructed labour, hypertensive disorders and sepsis. Puerperal sepsis was a more important cause of postpartum death. The timing of deaths by major causes did not seem to change greatly between time or region of the studies, though few had looked at this (ibid).

According to national and regional population based, and facility-based studies, overall, the leading causes of maternal deaths is haemorrhage (antepartum and postpartum), pregnancy-related infection (puerperal sepsis), hypertensive disorders (including preeclampsia and eclampsia), abortion-related complications, obstructed labour or other complications of labour and delivery, and indirect causes (anaemia, HIV, TB, malaria, jaundice, heart disease, meningitis, hepatitis, other or unknown) (Table B.2, Figure B.3, B.4 and B.5).

[37] Montgomery AL, Ram U, Kumar R, Jha P, Million Death Study Collaboration. Maternal mortality in India: causes and healthcare service use based on a nationally representative survey. PloS one. 2014;9(1):e83331. Available from: doi:https://dx.doi.org/10.1371/journal.pone.0083331.

[38] Baqui AH, Khanam R, Mitra DK, Begum N, Rahman MH, Moin MI, et al. Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study. Lancet Global Health. 2018;6(12):E1297-E308. Available from: doi:10.1016/s2214-109x(18)30385-1.

[39] Khan N, Pradhan MR. Identifying factors associated with maternal deaths in Jharkhand, India: a verbal autopsy study. Journal of health, population, and nutrition. 2013;31(2):262-71.

[40] Singh S, Murthy GVS, Thippaiah A, Upadhyaya S, Krishna M, Shukla R, Srikrishna SR. Community based maternal death review: lessons learned from ten districts in Andhra Pradesh, India. Maternal and child health journal. 2015;19(7):1447-54. Available from: doi:https://dx.doi.org/10.1007/s10995-015-1678-1.

[41] Vousden N, Holmes E, Seed PT, Gidiri MF, Goudar S, Sandall J, Chinkoyo S, Kumsa LY, Brown A, Charantimath U, Bellad M, Nakimuli A, Vwalika B, Chappell LC, Shennan AH, CRADLE Trial Collaborative Group. Incidence and characteristics of pregnancy-related death across ten low- and middle-income geographical regions: secondary analysis of a cluster randomised controlled trial. BJOG: an international journal of obstetrics and gynaecology. 2020. Available from: doi:https://dx.doi.org/10.1111/1471-0528.16309.

[42] Toppo M, Pal DK, Gour D, Melwani V, Khan A, Sethia S. Addressing Maternal Mortality in Selected Districts of Madhya Pradesh, India - A Human Rights-based Approach. Indian J. 2019;44(2):138-41. Available from: doi:10.4103/ijcm.IJCM_315_18.

[43] Barnett S, Nair N, Tripathy P, Borghi J, Rath S, Costello A. A prospective key informant surveillance system to measure maternal mortality - findings from indigenous populations in Jharkhand and Orissa, India. BMC pregnancy and childbirth. 2008;8:6. Available from: doi:https://dx.doi.org/10.1186/1471-2393-8-6.

[44] Baqui AH, Khanam R, Mitra DK, Begum N, Rahman MH, Moin MI, et al. Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study. Lancet Global Health. 2018;6(12):E1297-E308. Available from: doi:10.1016/s2214-109x(18)30385-1.

[45] Baqui AH, Khanam R, Mitra DK, et al. Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study. Lancet Global Health. 2018;6(12):E1297-E308. Available from: doi:10.1016/s2214-109x(18)30385-1.

46. Barnett S, Nair N, Tripathy P, Borghi J, Rath S, Costello A. A prospective key informant surveillance system to measure maternal mortality - findings from indigenous populations in Jharkhand and Orissa, India. BMC pregnancy and childbirth. 2008;8:6. Available from: doi:https://dx.doi.org/10.1186/1471-2393-8-6.

47. Vousden N, Holmes E, Seed PT, et al. Incidence and characteristics of pregnancy-related death across ten low- and middle-income geographical regions: secondary analysis of a cluster randomised controlled trial. BJOG: an international journal of obstetrics and gynaecology. 2020. Available from: doi:https://dx.doi.org/10.1111/1471-0528.16309.

48. Toppo M, Pal DK, Gour D, Melwani V, Khan A, Sethia S. Addressing Maternal Mortality in Selected Districts of Madhya Pradesh, India - A Human Rights-based Approach. Indian J. 2019;44(2):138-41. Available from: doi:10.4103/ijcm.IJCM_315_18.

[49] Barnett S, Nair N, Tripathy P, Borghi J, Rath S, Costello A. A prospective key informant surveillance system to measure maternal mortality - findings from indigenous populations in Jharkhand and Orissa, India. BMC pregnancy and childbirth. 2008;8:6. Available from: doi:https://dx.doi.org/10.1186/1471-2393-8-6.

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Comparing cause group classifications has some limitations to note. Pregnancy-related infection was mainly indicated to be puerperal sepsis, but the MCCD included puerperal sepsis within 'complications predominantly related to puerperium'. Obstructed labour was usually classified as a distinct cause group or as part of 'complications of labour and delivery', which also included pulmonary embolism, malpresentation, preterm or prolonged labour and so on. However, the MDS categorized obstructed labour as an 'other direct cause'. The MCCD included antepartum and postpartum haemorrhage in the category for complications of pregnancy, labour and delivery. Indirect causes included a range of conditions, including anaemia, heart disease, jaundice, infections unrelated but affecting pregnancy, other medical conditions, as well as unknown causes (causing the numbers to vary more than other categories). Some studies identified deaths specifically due to anaemia, but severe anaemia was also noted as an important underlying cause of deaths due to leading direct causes like haemorrhage and obstructed labour.

Figure B.3: Distribution of maternal deaths by cause (%), India, (National and regional population-based studies, 2001-2017)

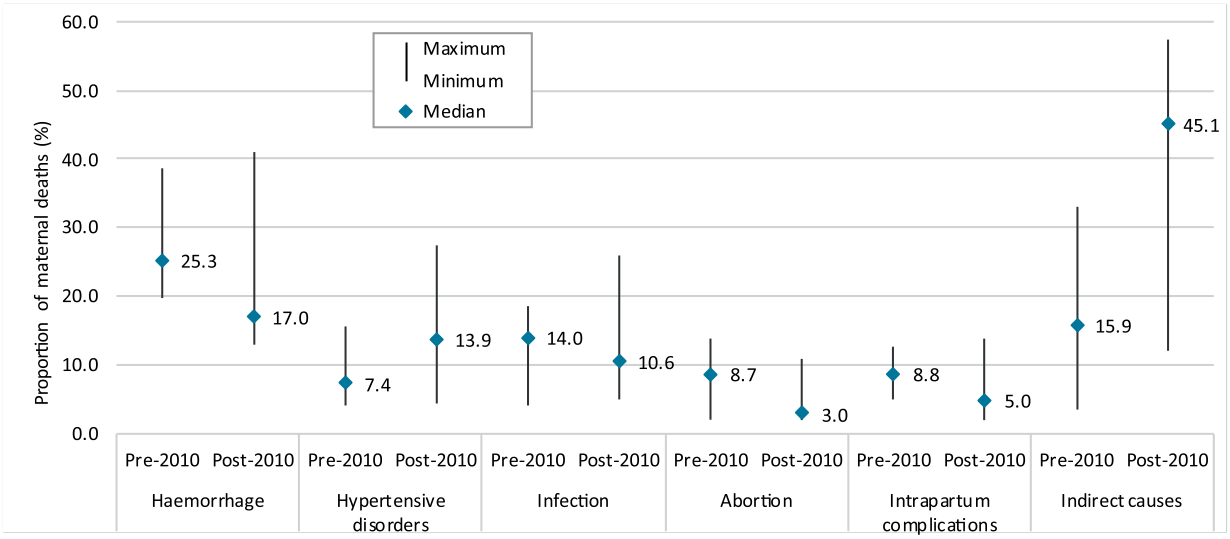
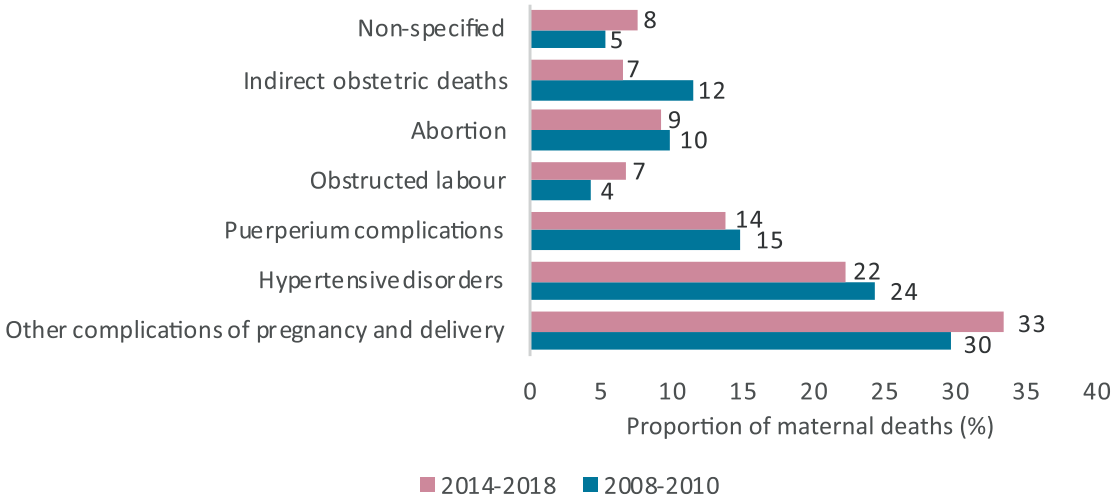


Figure B.4: Proportion of maternal deaths by cause (%), India, (MCCD, 2008-10 and 2014-18)



NB: 'Puerperium complications' includes puerperal sepsis or other infections, venous complications, embolism, complications related to anaesthesia etc.; 'other complications of pregnancy and delivery' includes antepartum or postpartum haemorrhage, malpresentation, preterm labour, prolonged labour etc.

Table B.2: Causes of maternal death, India, (National and regional studies, 1986-2017)

Proportion of maternal deaths (%)	National population and facility studies (2001-16)		Regional population-based studies (2003-17)		Regional facility-based studies (1986-2012)	
	Range (min - max)	Median	Range (min - max)	Median	Range (min - max)	Median
DIRECT CAUSES	34 - 81	73.4	43 - 84	67.6	34 - 67	59.9
Haemorrhage	13 - 38	18.8	15 - 41	25.3	7 - 28	27.1
Hypertensive disorders	5 - 9	8.6	4 - 27	14.7	5 - 28	9.2
Pregnancy-related infection	3 - 17	10.4	4 – 26	12.9	5 - 22	9.0
Abortion-related complications	2 - 11	8.7	2 – 14	3.0	3 - 11	8.5
Obstructed labour and related intra-partum complications	4 - 9	5.5	2 - 14	9.8	5 - 15	12.0
Other direct causes	17-65 (17-34 without HMIS)	28.5 (20.3 without HMIS)	NS	NS	NS	NS
INDIRECT CAUSES (anaemia, jaundice, heart disease, meningitis, TB, malaria, hepatitis, unknown)	12 - 66	15.9	4 - 57	33.5	33.5	27.3
Severe anaemia	NS	NS	NS	18.6	10 - 14	12.7
MMR (per 100,000)	122 - 482	249.5	122 - 482	275.0	209 - 798	388.8

Note: NS indicates 'Not Specified' in the study

Among direct causes, haemorrhage was consistently the cause of the largest proportion of maternal deaths. This proportion appeared to decline somewhat over time in national and regional community-based studies, from a median of 25% to 17% in studies before compared to after 2010. However, the relative proportion of haemorrhage-related maternal deaths remained consistently higher among facility-based studies even more recently. The studies that distinguished between types of haemorrhage found that most of the deaths were postpartum rather than antepartum.

Next, hypertensive disorders (pre-eclampsia or eclampsia) made up about 9-15% of maternal deaths, though this ranged between 4 to 30%. There appeared to be a slight increase in community but the reverse across facility-based studies, including the MCCD between 2008-10 and 2014-18. Pregnancy-related infections was another leading cause in India, though its contribution seemed to decline slightly across both population and facility-based data, from around 14% in pre-2010 to 10% after 2010. Next, deaths that were ascribed to abortion-related complications made up between 2-11% across studies. This appeared to decline as a relative proportion in both population and facility-based data from the pre- and post-NRHM period compared to the NHM/RMNCH+A period in 2012-17.

Some studies enumerated deaths related to obstructed labour and related intrapartum complications and found contribution of around 4-15% of deaths. This did not vary greatly over time nationally, but its contribution seemed to decline in regional studies. However, the MCCD indicated that the relative proportion of deaths due to obstructed labour had increased slightly from 4% to 7% between 2008-10 and 2014-18. Other direct causes were defined in some national studies, but not regional. Overall, the estimates ranged between 17 and 65% of maternal deaths, and a median of 29% before 2010 and 42% after 2010. However, without the national facility data (FOGSI and HMIS), the medians were much lower and declining, from 23% pre-2010 to 18% post-2010.

Indirect causes also accounted for a notable proportion of maternal deaths, but estimates ranged widely from around 7 to 57%. It seemed increase as a relative proportion of deaths in national and regional population-based studies, from a median of 20% to 42% before and after 2010 respectively. At the same time, it represented a declining proportion across facility-based studies (from around 12% to 7% in the MCCD in 2008-10 vs. 2014-18, and a median of 33% to 17% in regional studies before and after 2007). Also, the proportion of indirect deaths attributed to severe anaemia (when examined as a distinct cause) was found to increase somewhat in both facility and community-based regional studies.

Comparing Major Causes by State Cluster

The SRS was analyzed to show the causes of maternal deaths between 2001-3 in EAG and Assam (higher mortality cluster) compared to states in the South (all in the lower mortality cluster). A relatively higher proportion were due to haemorrhage, abortion-related complications and other conditions among the EAG and Assam states than the South. The opposite was observed for sepsis, hypertensive disorders and obstructed labour, which made up a relatively higher proportion of deaths among the southern states than the EAG states and Assam. The MDS data for 2005-6 looked at causes between state clusters, and the only notable difference was that the proportion of deaths due to indirect causes was lower in poorer than richer states (15.3 versus 19.1%).[51] The FOGSI study's facility-based retrospective observational study in 19 states between 2005-7 looked at how the distribution of deaths due to various causes by region and did not find systematic differences. [52]

While the mortality levels varied over time across states, the regional studies in higher mortality states generally showed higher proportion of deaths attributed to haemorrhage and obstructed labour, and a lower proportion ascribed to hypertensive disorders, than among studies in lower mortality settings. This may correspond with the observation above that these leading intrapartum causes declined most nationally, relative to other direct causes, as the MMR declined faster in the higher mortality states in India. The proportion of sepsis-related deaths seemed to decline over time in studies within both state clusters as MMR declined.

Maternal Deaths Related to Three Delays and Place of Delivery

Some studies looked at how maternal deaths related to delays in seeking and receiving care between 2012 to 2016, mainly using community-based surveys and one with facility records.[53,54,55,56]Two indicated substantial overlap between the three types of delays.[57,58] Type one delays, or delays in seeking care, were found for up to 60% in all but one study, both in states with higher and lower mortality. Between 20-40% were attributed to type two delays (not reaching the facility in time, or having no transport or finances for transport or treatment). Studies showed that between 13 and 50% were linked to type three delays, due to not receiving appropriate treatment if they had reached the facility (such as unavailability of equipment, drugs or blood bank).

The type of delay was somewhat aligned with the timing of certain causes of death. A study in Kolkata, West Bengal, in a hospital that received many of the complicated deliveries from surrounding areas, found that the majority of deaths due to eclampsia and postpartum haemorrhage were attributed to type 3 delays, closely followed by type 1 and 2 delays in 2013-15. A surveillance study in a district in Assam found that the first type of delay was linked to more deaths attributed to anaemia and antepartum haemorrhage in 2015-16. Postpartum haemorrhage-related deaths occurred most among women facing type three delays, but also those facing the first two delays. Sepsis-related deaths occurred among women that faced each of the delays. [60,61,62]

[51] Montgomery AL, Ram U, Kumar R, Jha P, Million Death Study Collaboration. Maternal mortality in India: causes and healthcare service use based on a nationally representative survey. PloS one. 2014;9(1):e83331. Available from: doi:https://dx.doi.org/10.1371/journal.pone.0083331.

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[53] Sk MIK, Paswan B, Anand A, Mondal NA. Praying until death: revisiting three delays model to contextualize the socio-cultural factors associated with maternal deaths in a region with high prevalence of eclampsia in India. BMC pregnancy and childbirth. 2019;19(1):314. Available from: doi:https://dx.doi.org/10.1186/s12884-019-2458-5.

[54] Singh S, Murthy GVS, Thippaiah A, Upadhyaya S, Krishna M, Shukla R, Srikrishna SR. Community based maternal death review: lessons learned from ten districts in Andhra Pradesh, India. Maternal and child health journal. 2015;19(7):1447-54. Available from: doi:https://dx.doi.org/10.1007/s10995-015-1678-1.

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[56] Kakoty SD, Das P. Surveillance of maternal deaths in Barpeta district of Assam. The National medical journal of India. 2018;31(4):206-10. Available from: doi:https://dx.doi.org/10.4103/0970-258X.258218.

[57] Singh S, Murthy GVS, Thippaiah A, Upadhyaya S, Krishna M, Shukla R, Srikrishna SR. Community based maternal death review: lessons learned from ten districts in Andhra Pradesh, India. Maternal and child health journal. 2015;19(7):1447-54. Available from: doi:https://dx.doi.org/10.1007/s10995-015-1678-1.

[58] Kumari K, Srivastava RK, Srivastava M, Punvar N. Maternal Mortality in Rural Varanasi: Delays, Causes, and Contributing Factors. Indian J. 2019;44(1):26-30. Available from: doi:10.4103/ijcm.IJCM_170_18.

[59] Sk MIK, Paswan B, Anand A, Mondal NA. Praying until death: revisiting three delays model to contextualize the socio-cultural factors associated with maternal deaths in a region with high prevalence of eclampsia in India. BMC pregnancy and childbirth. 2019;19(1):314. Available from: doi:https://dx.doi.org/10.1186/s12884-019-2458-5.

[60] Sk MIK, Paswan B, Anand A, Mondal NA. Praying until death: revisiting three delays model to contextualize the socio-cultural factors associated with maternal deaths in a region with high prevalence of eclampsia in India. BMC pregnancy and childbirth. 2019;19(1):314. Available from: doi:https://dx.doi.org/10.1186/s12884-019-2458-5.

[61] Singh S, Murthy GVS, Thippaiah A, Upadhyaya S, Krishna M, Shukla R, Srikrishna SR. Community based maternal death review: lessons learned from ten districts in Andhra Pradesh, India. Maternal and child health journal. 2015;19(7):1447-54. Available from: doi:https://dx.doi.org/10.1007/s10995-015-1678-1.

[62] Kakoty SD, Das P. Surveillance of maternal deaths in Barpeta district of Assam. The National medical journal of India. 2018;31(4):206-10. Available from: doi:https://dx.doi.org/10.4103/0970-258X.258218.

Studies on the place of maternal death indicated that around 35-50% occurred in a tertiary facility, either public or private. [63,64,65,66,67,68] An exception was a cross-sectional study collected in 2003-4 in five districts of Jharkhand, in which 81% of women died at home.[69] Among them, 47% had had an institutional delivery and 13% had been attended by a trained doctor or midwife. A study in Assam found that almost two thirds of women who died had been taken to more than one facility, often referred from primary to tertiary facilities.[70] Two separate studies in Andhra Pradesh in 1984 and 2012 respectively showed that the proportion at home declined from 40% to 15%.[71,72] The studies found that 7-15% occurred on the way to facilities, though one in UP reported this to be 30%.

Interrelated Risk of Maternal and Fetal or Neonatal Mortality

Regional studies in India indicated that stillbirths, early and late neonatal deaths were significantly more common among cases of maternal death, or those experiencing obstetric complications generally, or obstructed and prolonged labour, and failure to progress specifically.[73,74,75,76,77] The AMANHI study in Haryana and Uttar Pradesh between 2012-16 found that most antepartum stillbirths were attributed to hypertensive disorders, infections, or other maternal medical conditions, as well as antepartum haemorrhage. Only 20% or less were due to specific fetal disorders or congenital abnormalities. For intrapartum stillbirths, almost 50% were assigned to complications of labour and delivery. Between 5-20% were due to congenital malformations or other fetal causes, and around 5-10% was attributed each to antepartum haemorrhage, hypertensive disorders, infection, or other maternal medical conditions. A couple studies specifically looked at the associations of severe maternal anaemia and the risk of poor fetal outcomes, including low birth weight or premature infants, stillbirths, early and late neonatal death. [79, 80]

63. ibid.

64. Bhatia JC. Levels and Causes of Maternal Mortality in Southern India. Studies in Family Planning. 1993;24(5):310-8. Available from: doi:10.2307/2939224.

65. Singh S, Murthy GVS, Thippaiah A, Upadhyaya S, Krishna M, Shukla R, Srikrishna SR. Community based maternal death review: lessons learned from ten districts in Andhra Pradesh, India. Maternal and child health journal. 2015;19(7):1447-54. Available from: doi:https://dx.doi.org/10.1007/s10995-015-1678-1.

66. McCord C, Premkumar R, Arole S, Arole R. Efficient and effective emergency obstetric care in a rural Indian community where most deliveries are at home. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2001;75(3):297-9.

67. Khan N, Pradhan MR. Identifying factors associated with maternal deaths in Jharkhand, India: a verbal autopsy study. Journal of health, population, and nutrition. 2013;31(2):262-71.

68. Raj SS, Maine D, Sahoo PK, Manthri S, Chauhan K. Meeting the community halfway to reduce maternal deaths? Evidence from a community-based maternal death review in Uttar Pradesh, India. Global Health Science and Practice. 2013;1(1):84-96. Available from: doi:10.9745/GHSP-D-12-00049.

69. Khan N, Pradhan MR. Identifying factors associated with maternal deaths in Jharkhand, India: a verbal autopsy study. Journal of health, population, and nutrition. 2013;31(2):262-71.

70. Kakoty SD, Das P. Surveillance of maternal deaths in Barpeta district of Assam. The National medical journal of India. 2018;31(4):206-10. Available from: doi:https://dx.doi.org/10.4103/0970-258X.258218.

71. Bhatia JC. Levels and Causes of Maternal Mortality in Southern India. Studies in Family Planning. 1993;24(5):310-8. Available from: doi:10.2307/2939224.

72. Singh S, Murthy GVS, Thippaiah A, Upadhyaya S, Krishna M, Shukla R, Srikrishna SR. Community based maternal death review: lessons learned from ten districts in Andhra Pradesh, India. Maternal and child health journal. 2015;19(7):1447-54. Available from: doi:https://dx.doi.org/10.1007/s10995-015-1678-1.

73. McCord C, Premkumar R, Arole S, Arole R. Efficient and effective emergency obstetric care in a rural Indian community where most deliveries are at home. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2001;75(3):297-9.

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75. Singh D, Goli S, Parsuraman S. Association between obstetric complications & previous pregnancy outcomes with current pregnancy outcomes in Uttar Pradesh, India. The Indian journal of medical research. 2014;139(1):83-90.

76. Iyengar K, Yadav R, Sen S. Consequences of maternal complications in women's lives in the first postpartum year: a prospective cohort study. Journal of health, population, and nutrition. 2012;30(2):226-40.

77.Harrison MS, Ali S, Pasha O, Saleem S, Althabe F, Berrueta M, et al. A prospective population-based study of maternal, fetal, and neonatal outcomes in the setting of prolonged labor, obstructed labor and failure to progress in low- and middle-income countries. Reproductive health. 2015;12 Suppl 2:S9. Available from: doi:https://dx.doi.org/10.1186/1742-4755-12-S2-S9.

78. Baqui AH, Khanam R, Mitra DK, Begum N, Rahman MH, Moin MI, et al. Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study. Lancet Global Health. 2018;6(12):E1297-E308. Available from: doi:10.1016/s2214-109x(18)30385-1.

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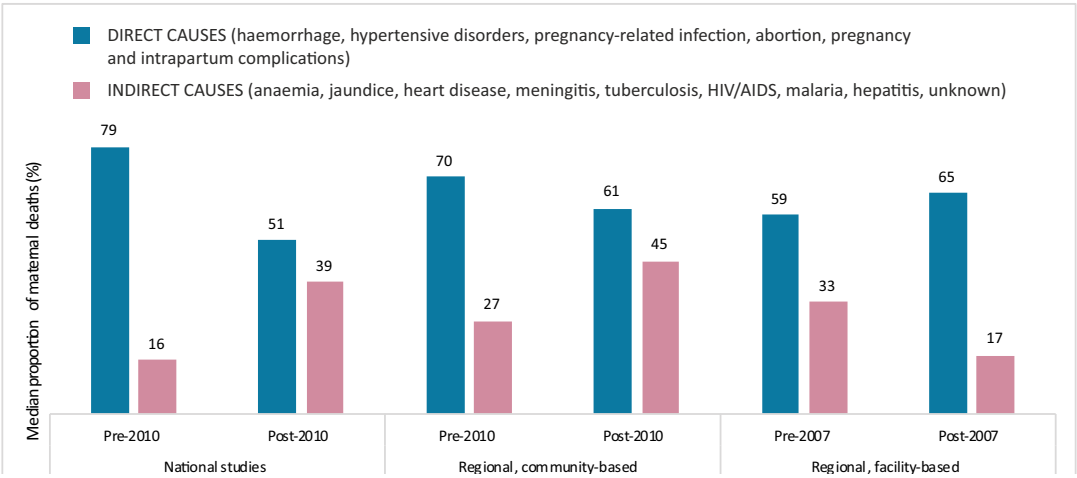
Summary of Cause of Death Analysis

Direct causes of maternal death accounted for the majority of deaths in India (Figure B.5). Yet there was evidence of this declining relative to indirect causes across population-based studies, with a median of 79% to 51% in national studies, and 70% to 61% in regional studies, before and after 2010. This may reflect the reducing proportion of deaths due to haemorrhage, infections, abortion and intrapartum-related complications. Conversely, facility-based studies seemed to show a small increase in deaths attributed to direct causes (59% to 65%), and a notable drop in those due to indirect causes (33% to 17%), though this should be interpreted cautiously given the variability in categorization of indirect causes. Around 10-20% of these were attributed specifically to severe anaemia, while many due to direct intrapartum causes may have also been linked to anaemia among women who had not survived.

Figure B.5: Changes in the proportion of maternal deaths due to direct and indirect causes (median %), among population- and facility-based studies, India, (1987-2017)



Overall, all three types of delays had contributed to maternal deaths in regional studies. For those who reached the hospitals (a proportion that has increased over time), these delays often overlapped. The proportion of maternal deaths occurring in facilities rather than home seemed to have increased. There was a consistent link between maternal deaths, or intrapartum complications that can lead to death, and significantly higher risk of having a stillbirth or neonatal death. One study showed that antepartum stillbirths were largely caused by the leading maternal causes like hypertension, infections, antepartum haemorrhage and other maternal conditions, while half of intrapartum stillbirths were caused by labour and delivery complications. Less than 20% of these stillbirths were related to congenital and fetal causes, indicating that the risks for mothers and their babies are consistently intertwined. Yet for this reason, reductions in mortality among women would have reduced the risk of stillbirth and neonatal mortality as well.

Differences by Socio-Economic and Fertility-Related Factors

Comparing socio-economic groups, MMR was found to be higher among women in SC/ST vs. non-SC/ST and Hindu versus non-Hindu groups, not literate compared to primary and especially secondary education (woman and husband), those who are employed (woman and husband), and having higher wealth or income (and clean fuel or sanitation).[81,82,83] Districts or states with higher economic growth or income also had consistently lower rates of MMR, though one study found that this was not independently associated with lower MMR.[84,85] Measures of women's empowerment were examined in a few studies, in which MMR was associated with women's limited role in decision-making, which they posited could negatively affect the timeliness of seeking care for emergencies[86], and any previous exposure to spousal violence.[87]

MMR was associated with younger maternal age[88], lower BMI, and higher parity (and population TFR)[89]. Increasing women's age at first marriage and pregnancy (associated with higher risk of experiencing complications, miscarriage and stillbirths)[90], and relatedly, declining total fertility rates over time have been independently linked to the MMR reductions in India. [91,92,93] Using SRS data, Jain applied a decomposition approach to analyze the contribution of fertility decline to the reductions in MMR in India.[94] Accordingly, about 35% of the estimated number of maternal lives saved between 1990 and 2008 could be attributed to fertility decline. Applying the same method, we estimated this proportion to be 37% for the period 2000-2018. The contribution of fertility declines to the maternal lives saved between 2000 and 2017 was higher in lower mortality states than in higher mortality states (40% versus 37%).

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[91] Jain AK, Measuring the effect of fertility decline on maternal mortality ratio, Studies in Family Planning, Volume 42, Number 4, December 2011.

[92] Saha UC, Saha KB. A trend in women's health in India--what has been achieved and what can be done. Rural and remote health. 2010;10(2):1260.

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[94] Jain AK, Measuring the effect of fertility decline on maternal mortality ratio, Studies in Family Planning, Volume 42, Number 4, December 2011.

Differences by Intervention Coverage

Though there is less information to look at the associations between intervention coverage and MMR, some studies have drawn on available data collected during the early NRHM period (MDS, NFHS-3, AHS). These found that MMR has been generally associated with higher contraceptive prevalence rates, and improved coverage of ANC, institutional delivery, skilled attendance and postnatal check-ups that can ensure more timely and safe delivery care.[95,96,97] Lower risk of maternal death was found to be correlated with 3+ ANC visits, skilled birth attendance, and PNC within 48 hours in some national studies during the early NRHM period.[98,99,100] Trial studies in Jharkhand on community women's group found that MMR halved when 30% or more of women attended in Jharkhand, as ANC and clean delivery practices improved.[101]

The MDS looked at maternal deaths by place of delivery and access to routine or emergency services in 2005.[102] They found that maternal deaths were more likely among women that sought consultation in the community, while in richer states they were more likely among those who transported or seeking routine care at a health facility. Admission for routine and emergency facility care was also significantly lower in poorer than richer states (27.5% vs. 50.4%). 26% of women in the sample had no healthcare contact, 37% sought no healthcare when a complication arose, while 12% received routine care and 21% sought community consultation. 29% sought emergency admission while in a critical medical condition. There was lower skilled birth attendance, planned health facility delivery, emergency transport and health facility admission in rural than urban areas of poorer states, while being only slightly lower in rural than urban areas in richer states.

[95] ibid

[96] Montgomery AL, Ram U, Kumar R, Jha P, Million Death Study Collaboration. Maternal mortality in India: causes and healthcare service use based on a nationally representative survey. PloS one. 2014;9(1):e83331. Available from: doi:https://dx.doi.org/10.1371/journal.pone.0083331.

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[98] Ibid.

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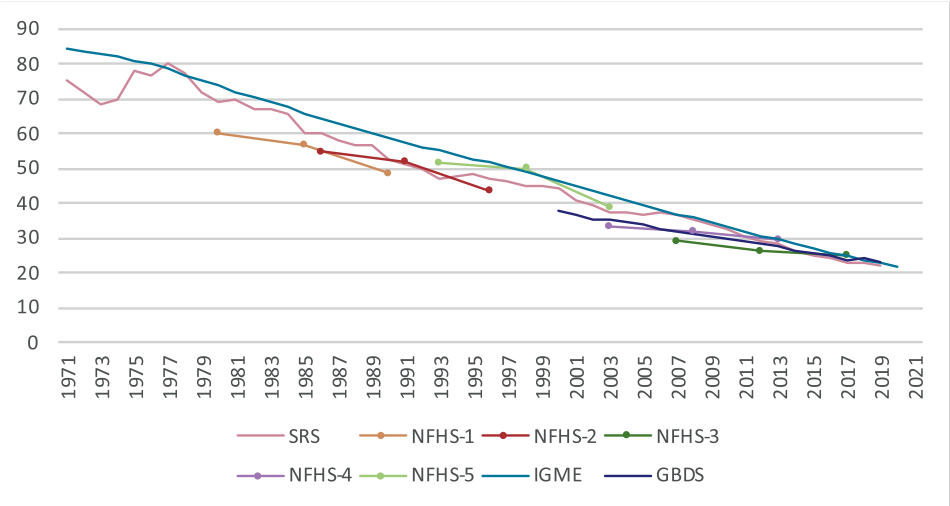
Comparing Trends By Different Data Sources And Estimates

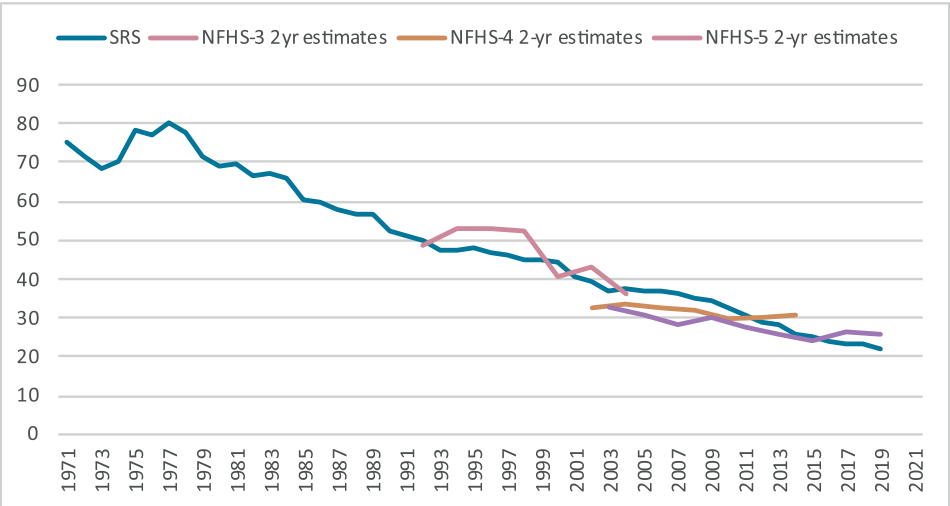
We compared the NMR trends in two main data sources with the global estimates: the annual SRS estimates and the five rounds of the NFHS with estimates for the 0-4, 5-9 and 10-14 years preceding the survey, the modeled estimates from the United Nations Inter Agency Group for Child Mortality Estimation (UN-IGME)[103] for the period 1969-2020, and the Institute for Health Metrics and Evaluation (IHME) Global Burden of Disease Study (GBDS) 2000-19.[104] All data sets indicate that there has been a large decline in NMR since 1971 (Figure C.1). From 2000 onwards, this decline in NMR has accelerated and there appear to be sub-periods between 2000 and 2019 of even more rapid acceleration. The IHME-GBD decline is smaller and the estimates for the early 2000s are well below SRS during the same period.

Figure C.1: Neonatal mortality rate, India (SRS, surveys, IGME and IHME estimates, 1971-2020)



Several important points emerge. First, the NFHS 2015-16 and 2019-21 results differ from the SRS. The most recent data point from both rounds of rounds of NFHS (0-4 years before the survey) is close to the SRS data points for the same period. Yet, the more distant data points (5-9 and 10-14 years before the survey) are considerably lower than SRS. Furthermore, the NFHS-4 and -5 estimates for 10-14 years before the survey were considerably lower than the NFHS-3 and -4 estimate respectively for the same period (0-4 years before that survey), suggesting large recall errors in both survey rounds. While the SRS trend line suggests a substantial decline during 2010-13, the trend line in the 5-year estimates from NFHS 4 is more or less flat. The problem persists even with the 2-year estimates from NFHS-3, 4 and 5 (Figure C.2). We tried to address this issue by pooling the data from NFHS-3 and NFHS-4 for the overlapping period and compute the 2-year estimates (Figure C.3). However, pooling too does not seem to adequately address the issue of recall errors in NFHS-4 and 5.

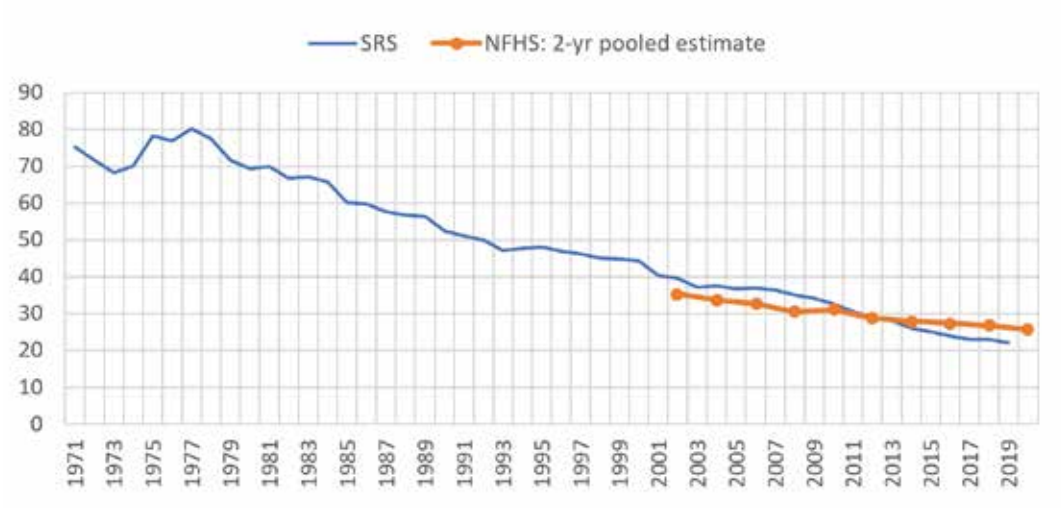
Figure C.2: Neonatal mortality rate, India (SRS, NFHS, 1971-2020)



103. https://childmortality.org/

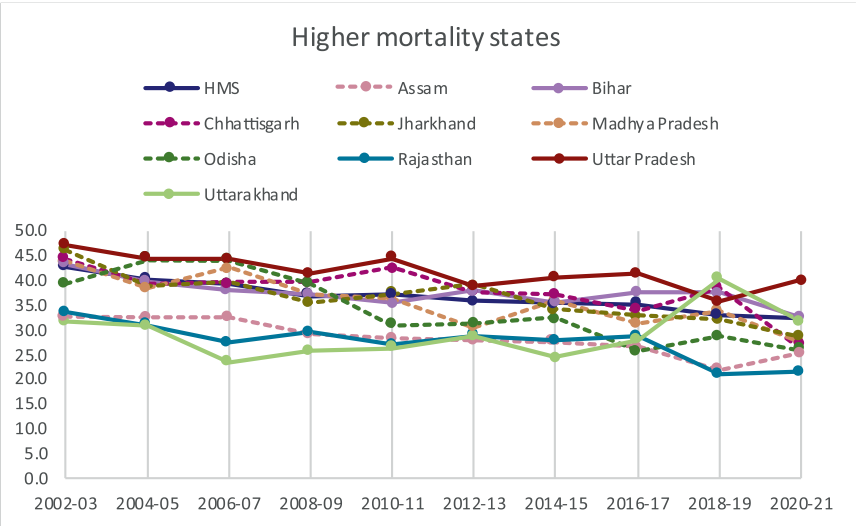
104. https://doi.org/10.1016/S0140-6736(20)30471-2

Figure C.3: Neonatal mortality rate, India (SRS, NFHS, 1971-2020)



There are some data quality issues around the NFHS-4 estimates in higher mortality states for the two most recent periods. Though to a lesser extent, NMR increases are seen in Uttar Pradesh, Bihar, Rajasthan and Uttarakhand which is contradicting the SRS results (Figure C.4). Such data quality issues in NFHS would affect the study of drivers (household and individual level socioeconomic and fertility characteristics) of neonatal mortality decline, since the SRS does not have disaggregated trends by relevant household and individual characteristics.

Figure C.4: State-specific NMR trends among higher mortality states, (NFHS, 2002-03 to 2020-21)



The second point concerns the IGME and IHME estimates. Both are model-based and have been smoothed, as can be observed in Figure C.2. These estimates are less useful to determine periods of accelerations/decelerations in NMR related to policy or program changes, and we therefore rely more on the SRS and NFHS data on NMR trends.

Trend Analyses

Based on data quality considerations, we used the SRS data to study trends in NMR. Assessments of SRS data quality have generally been very good and also neonatal mortality data have been used almost at face value by global estimation groups. To reduce annual fluctuations, we used three-year moving averages. From the surveys, we used only the estimates for 0-4 years preceding NFHS-3, 4 and 5 primarily to capture disaggregated trends over time in India as a whole and in the two state clusters, according to selected household and individual women's socioeconomic and fertility characteristics.

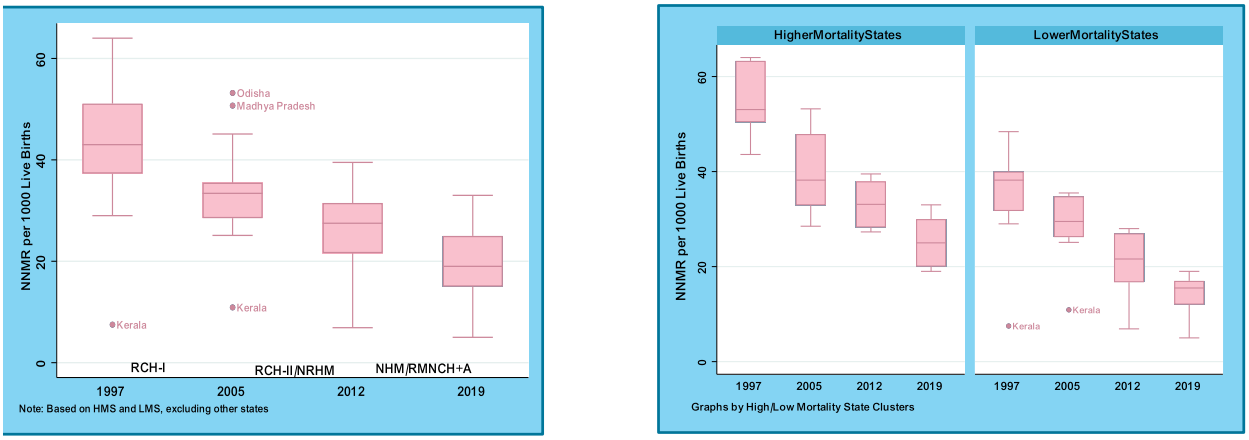
To compare the levels and trends, we use different measures: absolute differences, average annual rates of change (AARC), and a time gap which was defined as the lag (number of years) between the higher and lower mortality clusters at a specific level of mortality.

State and District Heterogeneity

Given the diversity of India, geographical comparisons of NMR trends in India between and within states (between districts) are important to understand the drivers of NMR reductions at the sub-national levels. Although health in India is concurrently funded and managed by both the central and state governments, the implementation is largely led by the state and district administrations. State and district prioritizations have been at the center of India's strategies to accelerate the decline in maternal and newborn mortalities. Reductions in state and district heterogeneity are expected with the reductions in neonatal mortality.

We examined the inter-quartile range as well as absolute mean difference from overall mean as measures of inter-state heterogeneity, using the SRS for state heterogeneity (for 22 major states) for the period 2000-19. The heterogeneity in NMR between states reduced since 2000, as indicated by both the inter-quartile range and absolute mean difference from overall mean (Figure C.5). The between-state differences in NMR have been reducing in both the higher and lower mortality clusters, but much more in higher mortality states. In higher mortality states, the inter-quartile range as well as the absolute mean difference from overall mean were the lowest during 2012-19.

Figure C.5: Box and whisker plots according to national policy periods, states, (SRS, 1997-2019)



Few studies have looked at district heterogeneity in NMR, as it requires considerable modeling to obtain district estimates for comparable years. The IHME's GBD recent publication[105] reported heterogeneity in NMR across 677 districts using the coefficient of variation and showed that this differed greatly by state but increased in 24 of 29 states between 2000-2017.[106]

Our analysis of inequalities in IHME estimates of NMR between districts looked at the IQR and absolute difference from the overall mean, in addition to the coefficient of variation (Table C.1). The coefficient of variation increased somewhat, indicating that heterogeneity between districts was increasing in both the state clusters, particularly before 2010. In contrast, the median NMR across districts has been declining and the inter-quartiles were shrinking for India overall (Figure C.6). There appeared to be an even more reduction in district heterogeneity, as measured by inter-quartile range and absolute difference from the overall mean, in both the state clusters after the HPD focus in 2013.[107]

Table C.1: District inequality in neonatal mortality rate, according to policy periods, India and state clusters, (GBDS, 2000-17)

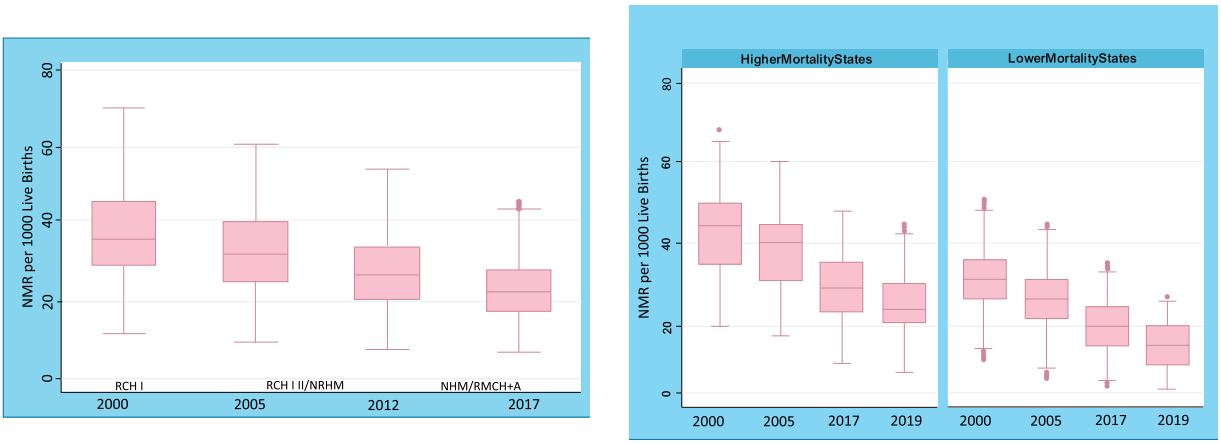
	Coefficient of variation			Inter-quartile range			Absolute mean difference from overall mean		
Year	India	Higher mortality states	Lower mortality states	India	Higher mortality states	Lower mortality states	India	Higher mortality states	Lower mortality states
2000	30.1	20.3	25.4	16.8	12.7	7.9	9.2	9.6	7.9
2005	31.0	20.2	25.5	15.9	11.8	8.0	8.3	8.7	6.9
2012	34.8	23.3	27.6	14.1	11.3	6.9	7.7	8.3	6.6
2017	35.6	23.8	30.0	11.0	8.6	6.4	6.4	6.8	5.8

[105] The district level NMR estimates from IHME were based on multiple data sources including the SRS, vital registration system, censuses, as well as complete birth history data from household surveys such as the NFHS, DLHS and AHS. District-level neonatal mortality rates were estimated by fitting an indirect, discrete-time, generalized additive hazard model with covariates at 5 x 5 km grids (GBDS, 2017).

[106] The greatest increases in district-wise inequalities were found for Assam and Odisha (categorized as having a low socio-demographic index), as well as Meghalaya, Arunachal Pradesh and Haryana (middle socio-demographic index) (Dandona et al. 2020).

[107] The interquartile range is generally a more robust measure than the coefficient of variation, as it reflects the middle half of data rather than every value, therefore not being influenced dramatically by outliers.

Figure C.6: Box and whisker plots by policy periods overall and state clusters, districts, (GBDS, 2017)



Causes of Death and Age-Specific Mortality

Trends In Stillbirths And Age-Specific Neonatal Mortality: Literature Review

There have been relatively few empirical studies in India on trends in stillbirth or perinatal mortality rates (PMR). There is some evidence of declines in PMR and stillbirths in both the RCH II/NRHM period (2005-12) and NHM (2012-17) periods.[108, 109]

The Global Network Women's and Children's Health Research study has looked at trends in stillbirths and perinatal mortality among community samples in Belagavi (previously Belgaum) district, Karnataka and Nagpur district, Maharashtra (both lower mortality states). It used routinely collected population-based data from women 6 week postpartum and applied an algorithm to determine cause of death in line with the International Classification of Disease (ICD) system.[110]

They found that the SBR across the two sites reduced from 31.3 (28.5-34.4) to 23.8 (20.9-27.1) per 1000 births between 2010 and 2016, with an AARC of -4.5%.[111] Another article on this study reported that the PMR and SBR went down between 2010 and 2013 in Belagavi, from 41.3 to 34.6/1000 births ($p<0.01$), and 22.5 to 16.3/1000 births ($p<0.01$) respectively. [112]Yet in Nagpur, the PMR did not decline significantly (47.7 to 40.8/1000 births; $p=0.09$), because even though SBR declined (29.3 to 21.1/1000, $p<0.01$), early NMR went up from 18.7 to 20.4/1000 live births ($p<0.05$).[113]

[108] Singh et al. 2012;

[109] According to the recent UN-IGME estimates, India accounted for 30% of global stillbirths in 2000 and 17% in 2019 (IGME SBR report 2020; https://childmortality.org/data/). IGME estimated that India's SBR halved from 29 to 14 per 1000 births, or 4% average annual reduction. India's rate of reduction in stillbirths was greater than in Southern Asia overall, where the AARC was estimated at 3% between 2000-19.

[110] McClure, E. M., et al. (2015). "Global network for women's and children's health research: a system for low-resource areas to determine probable causes of stillbirth, neonatal, and maternal death." Maternal health, neonatology and perinatology 1: 11.

[111] Saleem, S., S. S. Tikmani, E. M. McClure, J. et al. (2018). "Trends and determinants of stillbirth in developing countries: results from the Global Network's Population-Based Birth Registry." Reproductive health 15(Suppl 1): 100.

[112] Goudar, S. S., et al. (2015). "Institutional deliveries and perinatal and neonatal mortality in Southern and Central India." Reproductive Health 12 Suppl 2: S13.

[113] The authors discuss the possible reasons for the improvements in Belagavi (northern Karnataka) could be related to a shift in age and parity, more education and lower fertility, as well as resuscitation training of birth attendants as part of the Global Network's EmONC trial, the Helping Babies Breathe (HBB) studies, and the NHM's program Navajat Shishu Suraksha Karyakram for basic newborn care and resuscitation. Meanwhile, they posited that the increase in the early neonatal mortality rate in Nagpur (Maharashtra) may be related to an increase in C-sections, responding to fetal distress, as in studies in Bangladesh (improved demand due to financial incentives, but not quality of C-section deliveries) (Goudar et al. 2015)

The AMANHI population-based study reported on stillbirths occurring between 2012-16 in their two sites in India. The SBR per 1000 births was 22.3 (95% CI: 20.8, 23.82), and 37.6 (95% CI: 35.8, 39.5) in Haryana of Haryana (lower mortality state cluster) and Uttar Pradesh (higher mortality state cluster) respectively.[114]

The proportion of antepartum compared to intrapartum stillbirths varied somewhat between sites in these studies. In the Global Network sites, 36% and 21% were classified as fresh (or intrapartum) stillbirths and the rest occurred in the intrapartum period in Belagavi and Nagpur respectively.[115] In the AMANHI study, among the stillbirths where timing was known (just over half), 39% and 57% occurred in the antepartum period respectively with the remaining occurring during labour or delivery. [116]Comparatively, across the South Asia sites in the latter study the proportion of antepartum stillbirths was just over half (52%) (and this was higher at 63% across the Sub-Saharan Africa sites).

Regarding timing of neonatal deaths, a multi-country review with pooled estimates from studies between 2006-16 showed that in South-East Asia studies (including India) 75% of all neonatal deaths occurred in the early neonatal period: a third occurred on the first day, and 57% within the first three days.[117] The AARC for early NMR in India increased very slightly between the pre-NHM (1990-2005) to the early NHM era (2005-2012). In contrast, the rate of reduction in late NMR and post-neonatal mortality was three and four-fold higher respectively in the early NRHM than in the pre-NRHM period (ibid). A study based on the NFHS 1-3 also showed that early NMR had not declined notably, suggesting India's NMR reductions were largely due to reducing late neonatal deaths in the pre-NRHM period.[118] By 2017, the GBD study estimated that nearly 80% of neonatal deaths were in the early neonatal period.[119]

Causes Of Stillbirth

The study's findings on causes of stillbirths in 2014-15 are shown in Table C.2. The overall stillbirth rate was 24.1 per 1000 birth in Belagavi and 20.9 per 1000 births in Nagpur.[120] They found that the main causes of stillbirths in the Belagavi and Nagpur study sites in 2014-15 were: asphyxia at around 50%, followed by congenital causes (10 and 19%), prematurity (around 9-11%), and then infections (9 and 3% respectively). Around 15-20% of stillbirths were due to undetermined causes as well (ibid). Given the pre-dominance of intrapartum causes, notably asphyxia, it is likely that a reduction of intrapartum mortality has contributed to this decline.

[114] Baqui, A. H., et al. (2018). "Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study." Lancet Global Health 6(12): E1297-E1308.

[115] McClure, E. M., et al. (2015). "Stillbirth rates in low-middle income countries 2010 - 2013: a population-based, multi-country study from the Global Network." Reproductive Health 12 Suppl 2: S7.

[116] Baqui, A. H., et al. (2018). "Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study." Lancet Global Health 6(12): E1297-E1308.

[117] Sankar et al. 2016

[118] Kumar et al. 2013

[119] Dandona et al. 2020

[120] McClure, E. M., et al. (2018). "Global Network for Women's and Children's Health Research: probable causes of stillbirth in low- and middle-income countries using a prospectively defined classification system." BJOG: an international journal of obstetrics and gynaecology 125(2): 131-138.

Table C.2: Cause-specific stillbirth rate, Karnataka and Maharashtra (Global Network study, 2014-15)

Cause-specific stillbirth rate, per 1000 births (95% CI)	Global Network for Women's and Children's Health Research – McClure et al. 2018	
	Belagavi, Karnataka	Nagpur, Maharashtra
Prematurity	2.4 (1.7-3.0)	2.3 (1.6-3.0)
Infection	2.2 (1.6-2.9)	0.5 (0.2-0.9)
Asphyxia	11.2 (10.1-12.3)	11.5 (10.3-12.6)
Congenital abnormalities	4.7 (3.8-5.6)	2.1 (1.4-2.8)
Unknown causes	3.6 (2.8-4.3)	4.5 (3.6-5.5)
Total SBR (per 1000 births)	24.1	20.9

From the same study, another paper reported that the risk ratio for stillbirth in Nagpur and Belagavi, among births occurring between 2010-13, was highest for preterm birth at 12.4 (11.2-13.6), low birth weight at 12.1 (10.8-13.5), and then congenital anomaly at 9.1 (7.3-11.4).[121]

The AMANHI study also looked at causes separately for antepartum and intrapartum stillbirths for around 57% of reported stillbirths.[122] It found that the predominant causes of antepartum stillbirths were maternal infections, hypertensive disorders (greater in Haryana), complications of the placenta leading to antepartum haemorrhage (higher in UP), with fewer due to other fetal or maternal conditions, and congenital malformations. The main causes of intrapartum stillbirths were due to complications of labour and delivery (nearly 50%), a third due to maternal medical conditions including maternal infections, placental complications leading to antepartum haemorrhage, and hypertensive disorder of pregnancy, followed by specific fetal causes (7% Haryana, 20% UP) or congenital abnormalities (13% in Haryana, 2% UP). Perinatal asphyxia was considered as a cause only for neonatal deaths in that study.

Causes of Neonatal Death

Timing Of Neonatal Deaths By Major Causes

Neonatal mortality risks vary greatly within the first month, with at least 75% of neonatal deaths taking place during the first week and as much as half within the first two days of life in most higher mortality settings.

The main causes of death have different age-specific mortality patterns within the neonatal period. In the systematic review of studies in South Asia and sub-Saharan Africa (Figure C.7) common patterns were identified.[123] Asphyxia strikes primarily in the first 24-48 hours after birth and is much less common after 2-3 days. Prematurity / low birth weight is also concentrated on the first two days of life but continues to be an important cause in the remainder of the first week of life, and even later in the neonatal period. It is also important to note that prematurity and LBW can be a risk factor for other causes like pneumonia and respiratory distress or hypothermia, leading to overlap in the causes that can be hard to fully disentangle.[124] Infectious causes, including sepsis, are most prominent later in the neonatal period. Deaths due to congenital anomalies predominantly occur on the first day, but as much as half of the deaths take place later in the neonatal period.

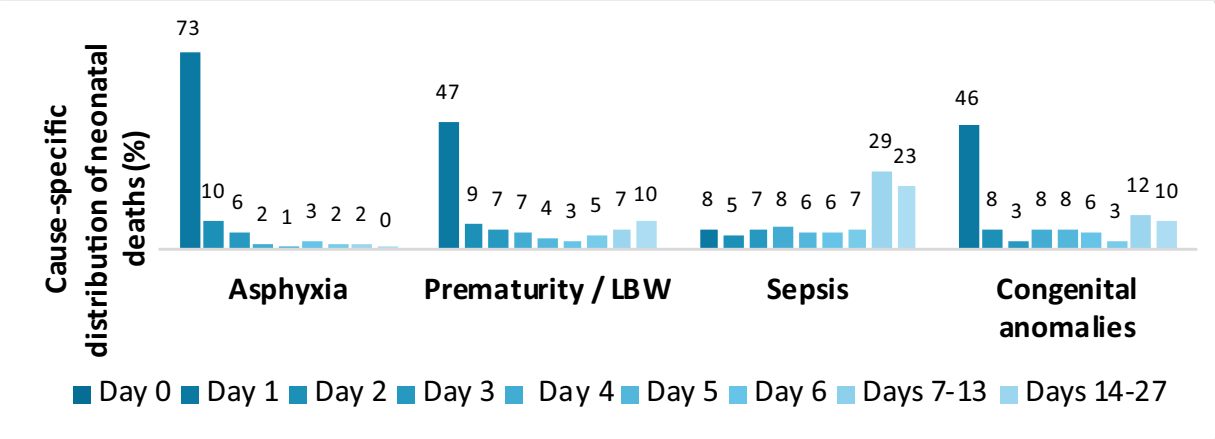
[121] McClure, E. M., et al. (2015). "Stillbirth rates in low-middle income countries 2010 - 2013: a population-based, multi-country study from the Global Network." Reproductive Health 12 Suppl 2: S7.

[122] Baqui, A. H., et al. (2018). "Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study." Lancet Global Health 6(12): E1297-E1308.

[123] Sankar, M. J., C. K. Natarajan, R. R. Das, R. Agarwal, A. Chandrasekaran and V. K. Paul (2016). "When do newborns die? A systematic review of timing of overall and cause-specific neonatal deaths in developing countries." Journal of Perinatology 36: S1-S11.

[124] World Health Organization. The WHO application of ICD-10 to deaths during the perinatal period: ICD-PM. Geneva. 2016. https://apps.who.int/iris/bitstream/handle/10665/249515/9789241549752-eng.pdf;sequence=1.

Figure C.7: Timing of neonatal deaths by major cause (%) in SE Asia and S.S. Africa studies (Sankar et al. 2016), 2006-16



A few studies in India confirmed these age-cause patterns of mortality. In the Gadchiroli trial, the mean day of neonatal death for those caused by birth asphyxia was between day 1-2, for preterm-related complications it was day 2, and for sepsis it was much later at day 12.5.[125] The NMR reduced from 52.5/1000 in 1995-6 to 15.4/1000 in 2001-3 during the HBNC intervention trial period. Most of the reduction was found to be among sepsis-related deaths, which accounted for the greatest proportion at baseline. Asphyxia, and prematurity-related neonatal deaths were fewer at baseline, and also reduced by endline, but to a lesser extent than sepsis-related deaths

A study in Barabanki and Unnao districts, UP, in 2006 found that the primary causes of neonatal mortality were preterm birth, sepsis or pneumonia, followed by birth asphyxia/injury.[126] By day of death, the largest proportion on days 0-1 were preterm birth and LBW (26.4% of deaths on day 0, 37.5% of day 1) and birth asphyxia/injury (31% of day 0, 12.5% of day 1 deaths). Sepsis or pneumonia accounted for 8.1% of deaths on day 0 and 25% on day 1. After day 2, asphyxia caused a declining proportion of the deaths. Conversely, between days 2-7 sepsis/ pneumonia and preterm birth were each estimated to cause between 20-30% of deaths, and sepsis caused around the same proportion in both weeks 3-4.[127]

Based on the Ekjut trial data from rural Jharkhand among births occurring between 2005-8, the majority of neonatal deaths on death 0 and 1 were caused by birth asphyxia or preterm birth, while infection caused the majority on day 2 onwards during the first week.[128]

As shown in Figure C.8, India's national HMIS facility-based data gives estimates on the proportion of deaths in early and late neonatal periods attributed to three major causes (asphyxia, LBW and sepsis). An unusually high large proportion of early and especially late neonatal deaths neonatal deaths were attributed to causes other than asphyxia, LBW and sepsis. For the rest, the largest proportion of the early neonatal deaths were due to LBW (over 30%), followed by asphyxia at closer to 20%, and then sepsis (10% or less). For late neonatal deaths, the highest proportion were also attributed to LBW at around 27%. This was followed by sepsis, which was higher than early neonatal deaths, and increasing over time from 12 to 19%. Around 10% of late neonatal death were attributed to asphyxia.

The MCCD data between 2008 and 2018 showed small changes in the relative proportion of neonatal deaths by major causes (Figure C.9).[129] Birth asphyxia, trauma and other respiratory conditions accounted for the highest proportion at 42% in 2008-10, which declined a few units by 2016-18. Causes related to prematurity and LBW was the next leading cause at 38%, with only a marginal decline over time. Other perinatal causes accounted for around 19% in 2008-10 and increased to 22% in 2016-18.

[125] Bang, A. T., H. M. Reddy, M. D. Deshmukh, S. B. Baitule and R. A. Bang (2005). "Neonatal and infant mortality in the ten years (1993 to 2003) of the Gadchiroli field trial: effect of home-based neonatal care." Journal of perinatology : official journal of the California Perinatal Association 25 Suppl 1: S92-107.

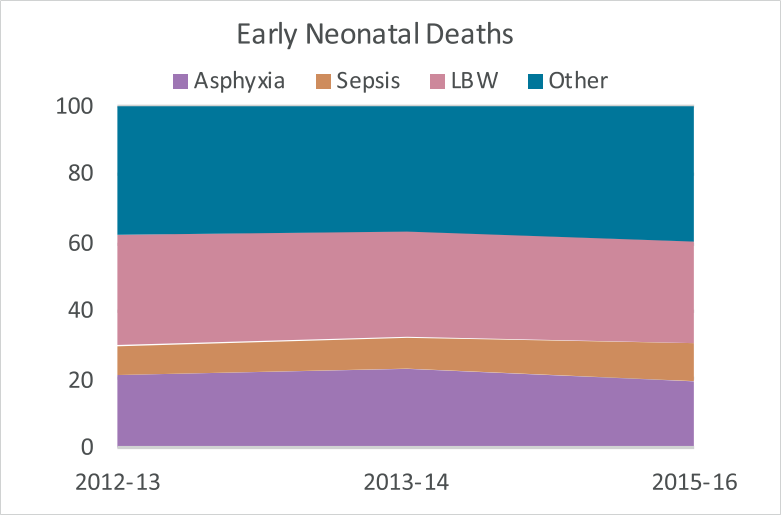
[126] Baqui, A. H., G. L. Darmstadt, E. K. Williams, V. Kumar, T. U. Kiran, D. Panwar, V. K. Srivastava, R. Ahuja, R. E. Black and M. Santosham (2006). "Rates, timing and causes of neonatal deaths in rural India: implications for neonatal health programmes." Bulletin of the World Health Organization 84(9): 706-713.127. Baqui, A. H., et al. (2006). "Rates, timing and causes of neonatal deaths in rural India: implications for neonatal health programmes." Bulletin of the World Health Organization 84(9): 706-713.

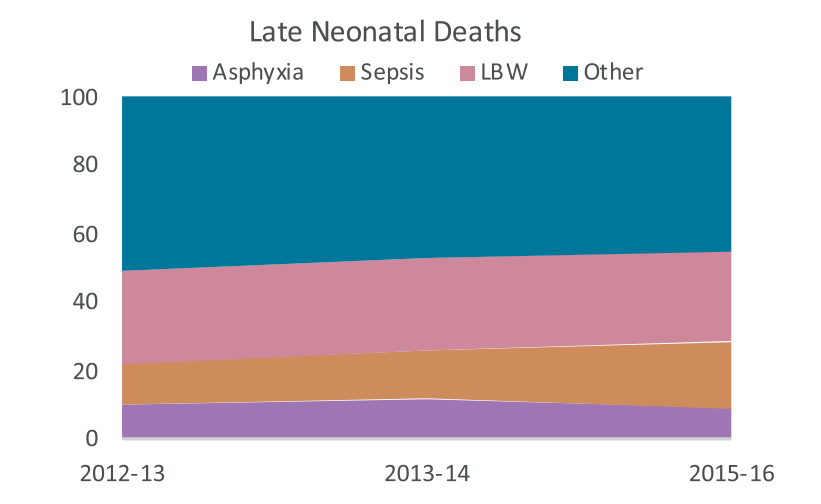
[127] Baqui, A. H., et al. (2006). "Rates, timing and causes of neonatal deaths in rural India: implications for neonatal health programmes." Bulletin of the World Health Organization 84(9): 706-713.

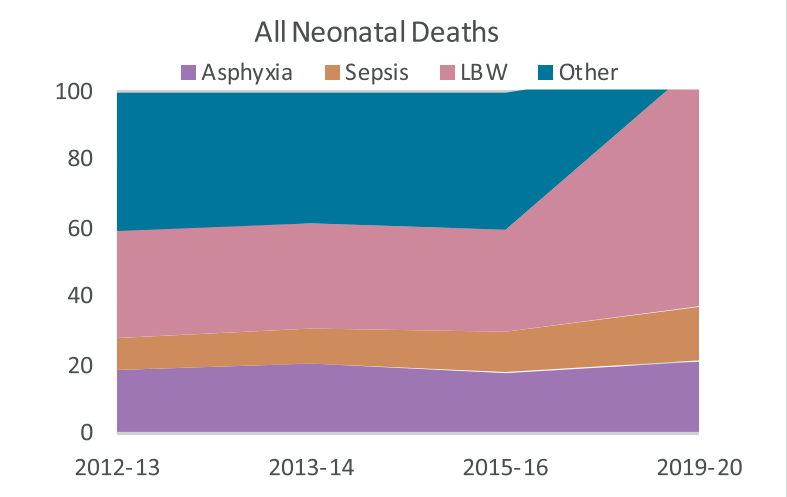
[128] Fottrell, E., et al. (2015). "Cause-specific neonatal mortality: analysis of 3772 neonatal deaths in Nepal, Bangladesh, Malawi and India." Archives of disease in childhood. Fetal and neonatal edition 100(5): F439-447.

[129] Census of India Website: Office of the Registrar General and Census Commissioner, India. https://www.censusindia.gov.in/2011-common/mccd.html.

Figure C.8: Proportion of neonatal deaths attributed to major causes, India (HMIS 2012-13 to 2015-16*)

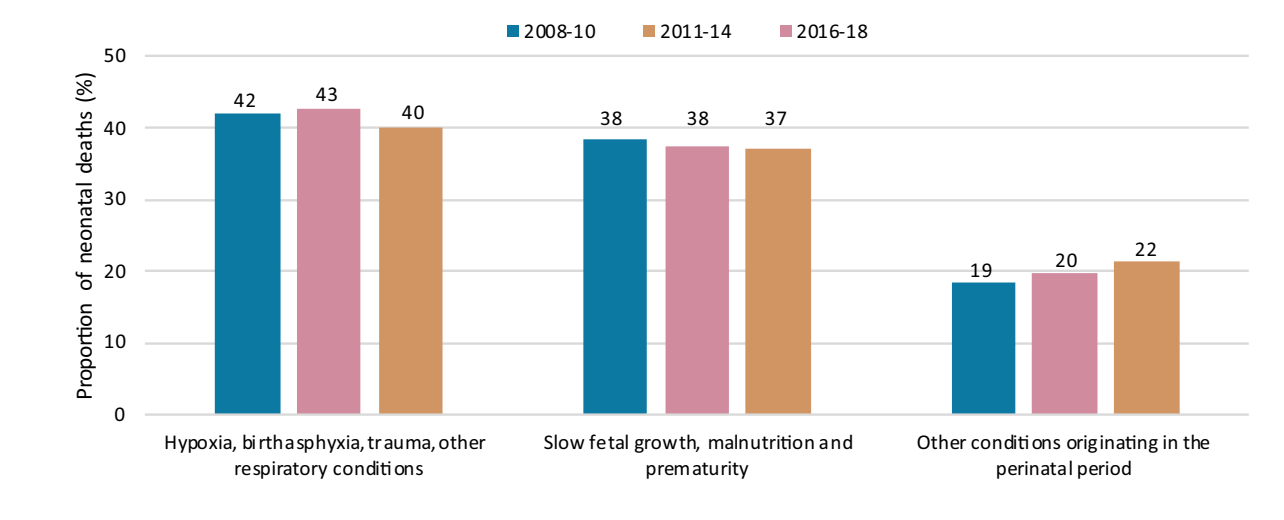






*The latest report of HMIS is available for year 2019-20. However, in the 2019-20 report, the causes of early neonatal and late neonatal is not provided and only all neonatal death cause is provided. Further, the neonatal death due to LBW was not provided separately; only three categories: asphyxia, sepsis and others.

Figure C.9: Neonatal mortality rate per 1,000 live births, by major causes of death, in national and state-level studies in India, 2008-18



Trends in cause-specific neonatal mortality

The trends in cause-specific NMR data from the MDS, global estimates for India (IHME-GBD and WHO-MCEE), and data from state-level community studies, can be found in Tables C.3, C.4 and C.5 respectively. We next compare the main results across the MDS, WHO and IHME national-level studies, and state-specific community studies for the four major causes of death in turn.

Table C.3: Trends in cause-specific NMR, India and cluster of states, (MDS, 2000-2015)

Cause-specific NMR (per 1000 live births)	INDIA				Poorer states†				Richer states†			
	2000	2005	2010	2015	2000	2005	2010	2015	2000	2005	2010	2015
Preterm birth and related complications (prematurity, LBW)	12.3	12.5	14.3	14.3	11.3	13.3	16.5	17.8	13.5	11.5	11.2	9.5
Neonatal infections (sepsis, meningitis/ encephalitis, pneumonia)	11.9	8.1	5.7	4.0	16.5	10.9	7.6	5.1	6.1	4.3	3.0	2.4
Birth trauma / asphyxia / intrapartum events	9.0	6.5	3.9	2.2	10.1	7.0	4.0	1.8	7.4	5.7	3.9	2.8
Non-communicable diseases	2.4	2.5	2.2	2.0	2.6	2.6	2.6	2.4	2.4	2.4	1.8	1.4
Congenital anomalies	1.8	1.7	1.4	1.1	1.7	1.5	1.0	0.6	2.0	1.9	1.9	1.8
Diarrheal diseases	1.6	1.4	1.3	1.1	2.0	1.8	1.7	1.5	1.1	0.8	0.7	0.4
Injuries	0.3	0.4	0.3	0.5	0.3	0.4	0.3	0.7	0.2	0.3	0.3	0.3
Neonatal tetanus	1.6	1.3	0.7	0.0	2.8	2.0	1.2	0	0.2	0.3	0.1	0.1
Other causes*	4.0	3.9	2.9	1.7	4.6	4.6	3.4	2.0	3.3	2.9	2.1	1.4
Total NMR	45.0	38.1	45.0	27.0	51.9	44.2	38.4	31.8	30.0	30.0	25.0	20.1

*'Other' included: polio, measles, malaria, other infectious and parasitic diseases, and nutritional diseases; other perinatal conditions; and ill-defined causes (all ICD-10 'R' codes that have not been assigned to defined cause groups) (MDS 2017 appendix p.11).

† In the MDS study, poorer states included: Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttarakhand and Uttar Pradesh; Richer states included: Gujarat, Haryana, Punjab, West Bengal, Delhi, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka, and Kerala.

Table C.4: Trends in causes of neonatal death from national studies, India, (MCEE, GBD, 2000-2019)

Cause-specific neonatal mortality (per 1000 live births)	MCEE-WHO study				GBD-IHME study	
	2000	2005	2010	2019	2000	2019
Preterm birth and related complications (prematurity, LBW)	14.4	13.6	12.7	8.4	10.2	6.7
Neonatal infections (sepsis, meningitis / encephalitis, pneumonia)	9.9	8.1	6.8	2.6	6.9 (2.0 LRI)	4.1 (2.3 LRI)
Birth trauma / asphyxia / intrapartum-related events	11.7	9.3	7.8	4.7	6.0	3.4
Congenital anomalies	2.7	2.7	2.3	1.9	2.0	1.5
Hemolytic disease and neonatal jaundice	NA	NA	NA	NA	1.4	0.8
Diarrheal diseases	0.5	0.4	0.3	0.3	1.4	0.4
Tetanus	2.7	1.2	0.3	0.03	1.4	0.1
Other neonatal conditions	3.2	2.7	2.3	3.8	8.7	5.3
Other causes	NA	NA	NA	NA	1.4	0.6
Total NMR	45.0	38.8	32.6	21.7	38.0	23.0

*Cause-specific NMR from the WHO-MCEE calculated using the proportions provided by Liu et al.'s study multiplied by the UN-IGME NMR estimates for each year as referenced in that study's appendix.

NA: Not Available

Table C.5: Trends in cause-specific neonatal mortality, India, (State specific studies, 1995-2018)

Cause-specific neonatal mortality (per 1000 live births)	Bang et al. 2005		Baqui et al. 2006	Fottrell et al. 2015	Dogra et al. 2013	Global Network for Women's and Children's Research – Goudar et al. 2015				AMANHI study - Baqui et al. 2018	
	Gadchiroli field trial, Maharashtra		Two districts, UP	Ekjut, Jharkhand	6 districts Rajasthan, Bihar, Odisha	Belgavi, Karnataka		Nagpur, Maharashtra		Haryana	Uttar Pradesh
	1995-6 (baseline)*	2001-3 (endline)*	2006	2005-8	2012	2010	2013	2010	2013	2012-16	2012-16
Prematurity & LBW	7.9	4.9	13.2	19.2	10.0	7.0	7.5	8.5	10.8	10.0	5.4
Infection (sepsis, meningitis/ encephalitis, pneumonia)	27.6	2.8	11.8	19.5	8.5	1.9	2.1	3.2	1.3	10.8	16.3
Birth trauma/ asphyxia	10.5	4.9	6.9	13.2	12.2	9.4	7.6	4.9	7.0	15.6	16.3
Congenital abnormalities	NA	NA	3.2	0.5	2.2	0.5	0.9	1.0	0.8	2.8	1.7
Diarrheal diseases	NA	NA	0.8	0.1	NA	NA	NA	NA	NA	0.1	0.2
Tetanus	NA	NA	2.0	NA	NA	NA	NA	NA	NA	0.0	0.4
Other neonatal disorders	0 (incl. tetanus, aspiration, malformations)	1.4 (incl. tetanus, aspiration, malformations)	NA	0.7	1.5	4.5	4.8	3.3	4.0	NA	NA
Undetermined causes	6.6	1.4	11.2	6.0	2.6	0.9	0.6	3.6	0.5	1.4	1.3
Total NMR	52.5	15.4	49	59	36.6	24.2	23.8	24.5	24.4	40	41.7

*Large confidence intervals likely due to small sample: n=763 and 40 neonatal deaths in 1995-6, n=1415 with 22 neonatal deaths in 2001-3.

As shown in Figure C.10, the MDS showed a major decline in birth asphyxia or trauma related deaths, from 9.0 to 2.2 per 1000 live births. Comparing the local studies over time, they did not show such major changes (median 12 per 1000, range 5-16 per 1000). They ranged from 5 to 16 per 1000 with a median of 12. In studies in higher mortality states, the rates appeared higher and did not reduce much. The AMANHI study in Haryana (lower mortality state) and UP (higher mortality state) showed a much higher proportion of deaths due to birth asphyxia than all other studies. [130]The estimates by GBD and WHO-MCEE showed major declines in India between 2000 and 2019, similar to the MDS, although their absolute levels were vastly different.

[130] Baqui, A. H., R. Khanam, D. K. Mitra et al. (2018). "Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study." Lancet Global Health 6(12): E1297-E1308.

Figure C.10: Birth asphyxia/trauma-related neonatal mortality rate per 1,000 live births, India
(National and state-level studies, 1995-2019)

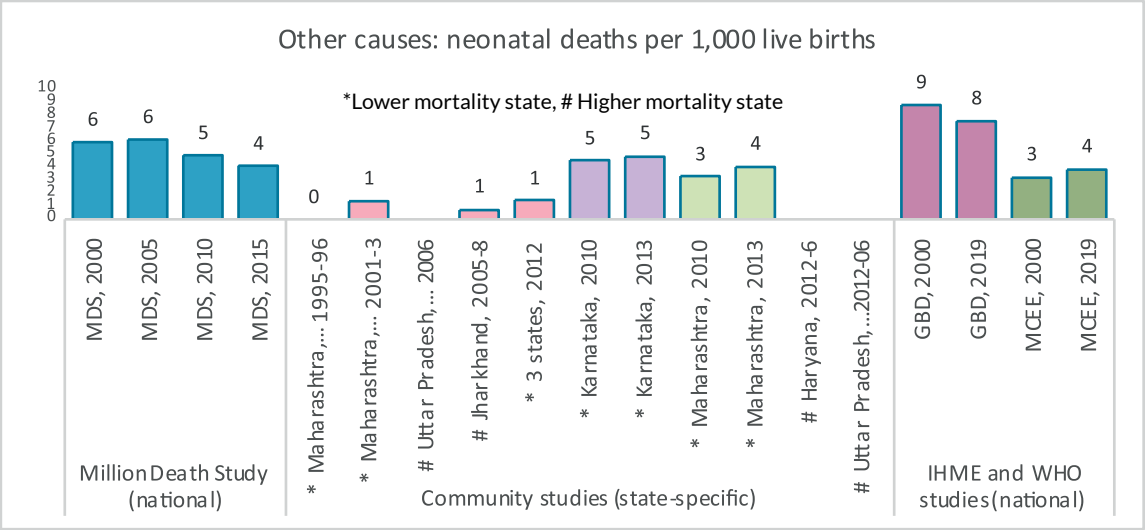
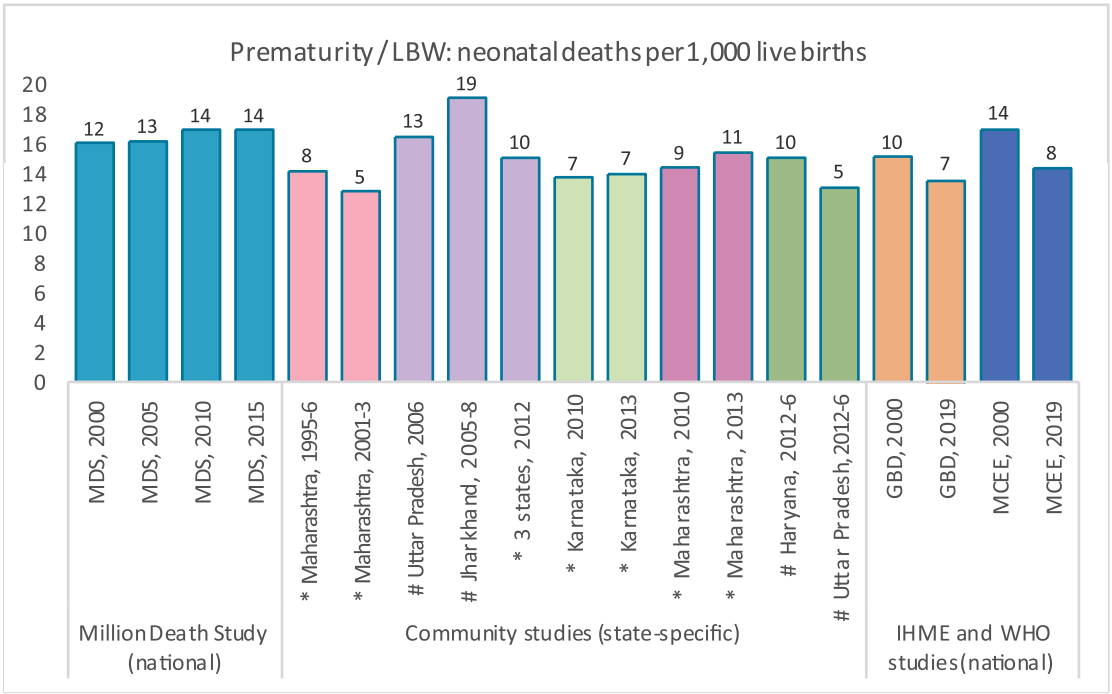


Figure C.11 shows NMR related to prematurity & low birth weight (i.e. preterm birth complications) across national and state level studies. According to the MDS, prematurity & low birth weight was the leading cause in 2000 at 12.5 per 1000 live births, which increased by 2015 to 14 per 1000 live births. The rates were generally lower in the local studies, with a median of 8 per 1000 live births and a range of 5-19. However, two of them conducted before 2010 in higher mortality states (Uttar Pradesh and Jharkhand) had rates at over 13 per 1000. In contrast, the later studies had rates at or lower than 10. Both the GBD and MCEE-WHO estimation studies showed a decline in mortality due to prematurity / LBW, especially the MCEE-WHO.

Figure C.11: Prematurity/LBW-related neonatal mortality rate per 1,000 live births in India, (National and state-level studies, 1995-2019)

*Lower mortality state, #Higher mortality state



We analyzed trends in proportion of newborns with low birth weight using NFHS 3 and 5 information on both reported birth weight and birth size,[131] and adjusting for heaping at 2500 grams[132] (Table C.6). The proportion of low birth weight babies in India declined from 31% in 2005-06 to 28% in 2019-21, at an annual rate of -0.6%. Most population subgroups that had higher prevalence of low birth weight babies in 2005-06 (higher mortality states, rural, females, those with no maternal education, poorer households) also experienced relatively faster declines in this proportion in 22019-21.

Table C.6: Trends in estimated proportion of low birth weight babies by background characteristics (NFHS, 2005-06 and 2019-21)

Characteristic	2005 - 06	2019 - 21	AARC
India	30.9	28.4	-0.6
Cluster			
Higher mortality states	34.1	29.7	-1.0
Lower mortality states	29.7	27.2	-0.6
Place of residence			
Rural	32.6	29.0	-0.8
Urban	28.7	26.7	-0.5
Sex of the child			
Male	28.9	26.6	-0.6
Female	33.1	30.4	-0.6
Maternal education			
None	36.2	31.9	-0.9
Some	29.5	27.6	-0.5
Household wealth tertile			
Poorest	35.4	31.7	-0.8
Middle	31.9	28.4	-0.8
Richest	26.6	25.4	-0.3
Castes/Tribe			
SC/ST	33.0	30.2	-0.6
Non-SC/ST	30.2	27.5	-0.7
Religion			
Hindu	31.3	28.9	-0.6
Non-Hindu	29.1	26.3	-0.7

We combined the deaths due to pneumonia, sepsis, diarrheal disease and tetanus and classified as infection related NMR (Figure C.12). This is because neonatal tetanus was rare in all studies after 2010, and uncommon (below 2 per 1000 live births) in the earlier studies. Diarrheal disease caused only a small proportion of deaths in all studies. Pneumonia is a more common cause of death but was often combined with other infections in the research publications.

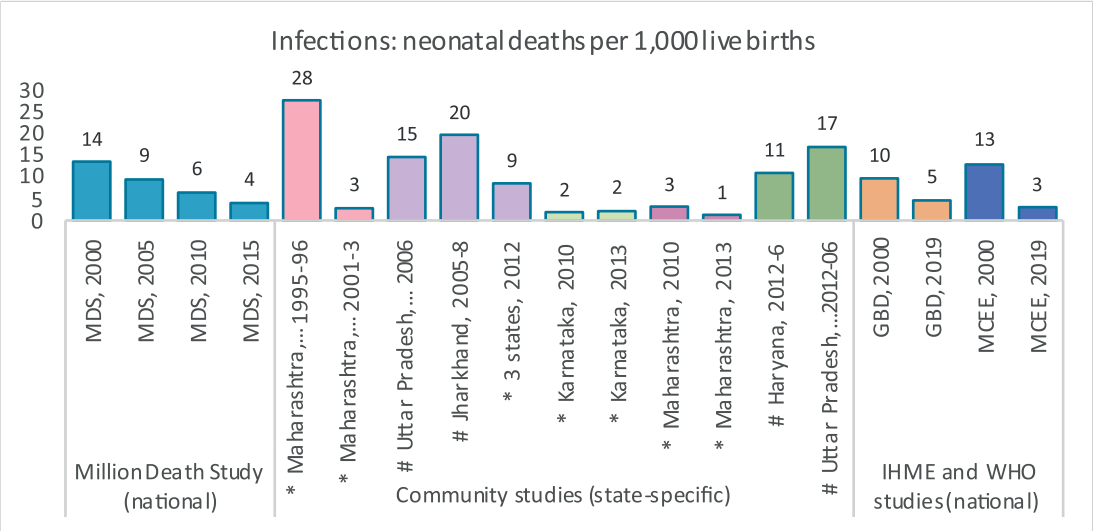
[131] Boerma JT, Weinstein KI, Rutstein SO, Sommerfelt AE. Data on birth weight in developing countries: can surveys help? Bulletin of the World Health Organization 1996; 74:209-16.

[132] Half of infants reported as weighing exactly 2500 grams were counted as having low birth weight. A previous study counted one-quarter of infants reported as weighing exactly 2500 grams as having low birth weight (Blanc AK and Wardlaw T. Monitoring low birth weight: an evaluation of international estimates and an updated estimation procedure. Bulletin of the World Health Organization. March 2005, 83(3).

In the MDS data, there was a major linear decrease in mortality due to neonatal infections from 2000 to 2015 from 14 to 4 per 1000 live births. The community studies showed wide variation in infection-related mortality rate which ranged from below 5 per 1000 in the Global Network sites in Karnataka and Maharashtra to above 10 in the two AMANHI studies in Haryana (low mortality state) and Uttar Pradesh (high mortality state). The major decline from 1995-6 to 2001-3 in Maharashtra reflects the Gadchiroli HBNC trial results, which started at a very high rate in that rural community context. The GBD estimates of neonatal infection mortality rate have reduced by half and MCEE estimates have reduced by four-folds since 2000.

Figure C.12: Infection-related neonatal mortality rate per 1,000 live births, India, (National and state-level studies, 1995-2019)

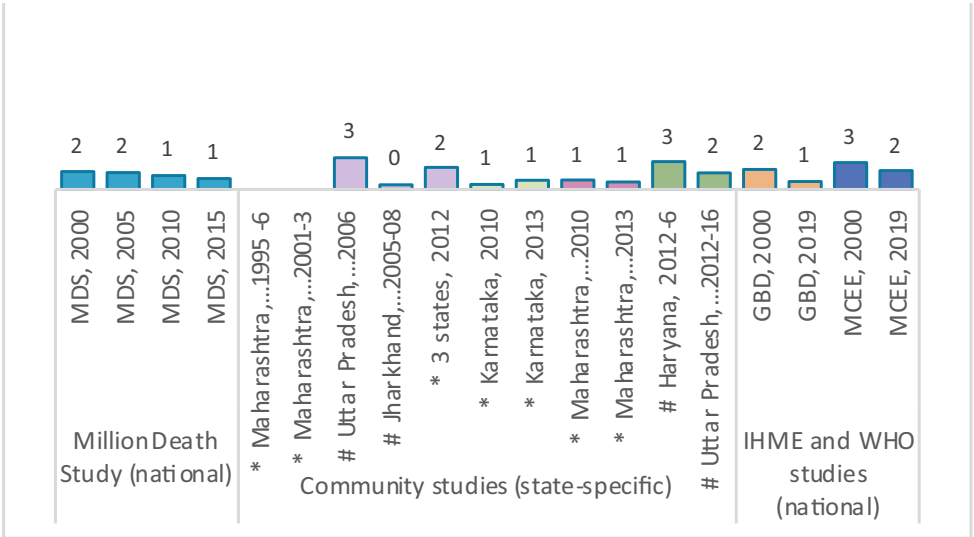
* Lower mortality state, # Higher mortality state



As depicted in Figure C.13, congenital anomalies generally had mortality rates below 3 per 1000 live births across time. In the MDS, mortality due to congenital anomalies declined from 1.8 to 1.1 per 1000 live births. The community studies show similar or lower levels of mortality, especially in the Global Network study in Karnataka and Maharashtra (below 1 per 1000), with little change over time. The GBD and WHO modeling studies showed a marginal decline, and estimated that the most recent rates between 1 and 2 per 1000 live births respectively.

Figure C.13: Congenital anomaly-related neonatal mortality rate per 1,000 live births, India, (National and state-level studies, 1995-2019)

* Lower mortality state, # Higher mortality state



Comparing State Clusters

Comparing the state clusters, Table C.7 shows the results on cause-specific NMR from the Million Death Study (MDS) for poorer (equivalent to higher mortality) and richer (lower mortality) states between 2000 and 2015.[133,134] The study found that in the poorer states, the NMR related to LBW and prematurity increased from 11.3 to 17.8 per 1000 live births, but decreased in the richer states from 13.5 to 9.5. This is an unexpected and improbable finding, given the declining incidence of low birthweight and the results from community studies and other sources. Data quality issues related to the verbal autopsy may play role. Neonatal infections (including sepsis, pneumonia and meningitis/encephalitis) declined in both state clusters: from 16.5 to 5.1 in the poorer, and 6.1 to 2.4 in the richer states. Diarrheal diseases also reduced, a bit more so in the richer states. Between 2000 and 2015, tetanus-related NMR started at 3 per 1000 in poorer states and declined to none, while it started and remained at nearly zero in richer states. NMR attributed to birth asphyxia or trauma also went down, from 10.1 to 1.8 in the poorer states, and 7.4 to 2.8 in the richer states. The declines in the MDS exceed all other data and estimates, and it is likely that the mortality due to birth asphyxia / trauma was underestimated in the MDS. Congenital anomaly-related NMR declined in the poorer states from 1.7 to 0.6 per 1000, but remained at 2 per 1000 in the richer states.

We also analyzed the GBDS (2017) cause-specific NMR in the two state clusters between 2000 and 2017 (Table C.7). In 2017, the leading causes of neonatal deaths for both the state clusters were preterm birth, birth asphyxia, neonatal sepsis and lower respiratory infections were leading causes of neonatal deaths The NMR due to each of these four causes declined relatively faster in the lower than higher mortality clusters during 2000-17.

Table C.7: Trends in cause-specific NMR, India and cluster of states, Million Death Study, 2000-2015 and Global Burden of Diseases, 2000-2017)

Causes: Million Death Study, 2000-2015	Poorer states†			Richer states†		
	2000	2015	AARC	2000	2015	AARC
Preterm birth and related complications (prematurity, LBW)	11.3	17.8	3	13.5	9.5	-2.3
Neonatal infections (sepsis, meningitis/ encephalitis, pneumonia)	16.5	5.1	-7.8	6.1	2.4	-6.2
Birth trauma / asphyxia / intrapartum events	10.1	1.8	-11.5	7.4	2.8	-6.5
Non-communicable diseases	2.6	2.4	-0.5	2.4	1.4	-3.6
Congenital anomalies	1.7	0.6	-6.9	2	1.8	-0.7
Diarrheal diseases	2	1.5	-1.9	1.1	0.4	-6.7
Injuries	0.3	0.7	5.6	0.2	0.3	2.7
Neonatal tetanus	2.8	0	nc	0.2	0.1	-4.6
Other causes*	4.6	2	-5.6	3.3	1.4	-5.7
Total NMR	51.9	31.8	-3.3	36	20.1	-3.9
Causes: Global Burden of Diseases, 2000-2017	**Higher mortality states**			**Lower mortality states**		
	2000	2017	AARC	2000	2017	AARC
Neonatal preterm birth	10.64	6.64	-5.91	10.54	5.2	-8.83
Neonatal encephalopathy due to birth asphyxia and trauma	6.61	3.4	-8.29	5.65	2.67	-9.37
Neonatal sepsis and other neonatal infections	2.63	1.64	-5.89	1.31	0.75	-6.86
Hemolytic disease and neonatal jaundice	1.51	0.83	-7.54	1.28	0.52	-11.3
Other neonatal disorders	9.27	6.01	-5.41	5.32	2.82	-7.91
Lower respiratory infections	6.62	3.15	-9.28	2.77	1.13	-11.22
Diarrhoeal diseases	1.88	0.82	-10.44	0.87	0.24	-16.41
Tetanus	2.21	0.24	-27.71	0.34	0.04	-27.98
Congenital birth defects	1.77	2.04	1.79	2.48	1.52	-6.1
Other causes	1.48	0.83	-7.23	1.27	0.68	-7.86
Total NMR	44.63	25.61	-6.95	31.83	15.57	-8.94

*'Other' included: polio, measles, malaria, other infectious and parasitic diseases, and nutritional diseases; other perinatal conditions; and ill-defined causes (all ICD-10 'R' codes that have not been assigned to defined cause groups) (MDS 2017 appendix p.11).

† In the MDS study, poorer states included: Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttarakhand and Uttar Pradesh; Richer states included: Gujarat, Haryana, Punjab, West Bengal, Delhi, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka, and Kerala.

nc: not calculated

[133] Million Death Study, Collaborators, D. G., Bassani, R. Kumar, S. Awasthi, S. K. Morris, V. K. Paul, A. Shet, U. Ram, M. F. Gaffey, R. E. Black and P. Jha (2010). "Causes of neonatal and child mortality in India: a nationally representative mortality survey." Lancet (London, England) 376(9755): 1853-1860.

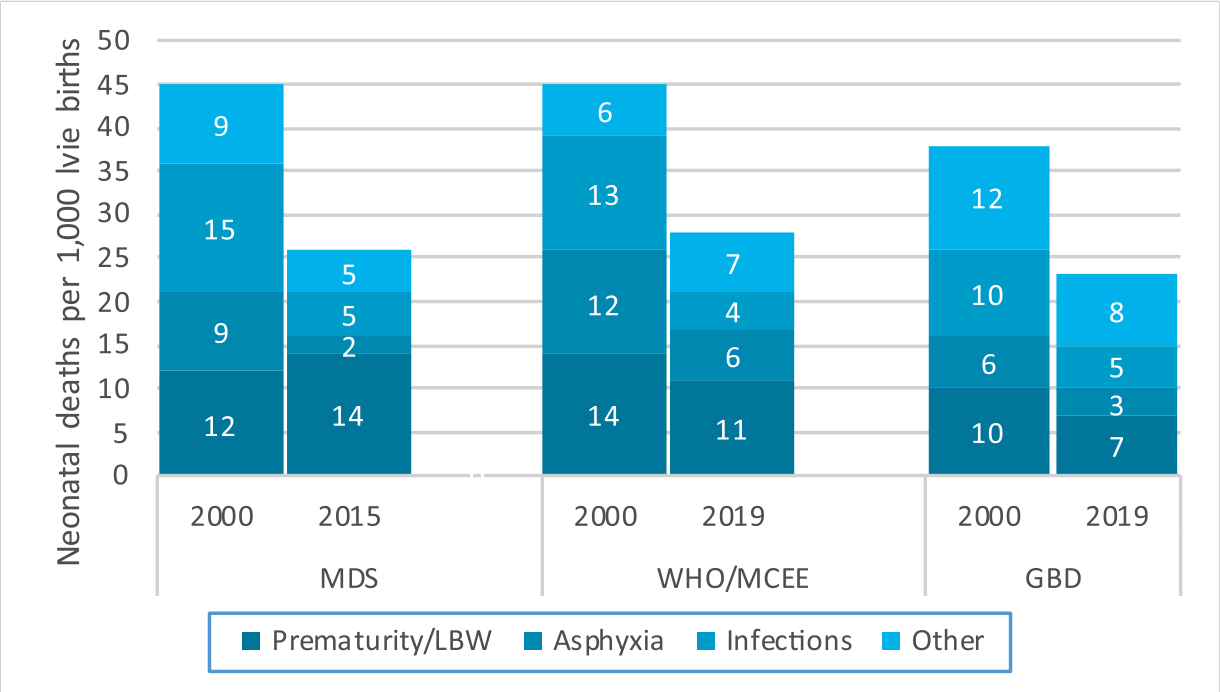
[134] Million Death Study Collaborators. (2017). "Changes in cause-specific neonatal and 1-59-month child mortality in India from 2000 to 2015: a nationally representative survey." Lancet (London, England) 390(10106): 1972-1980.

Summary of Causes of Death Analysis

A summary of India's national cause-specific NMR data from the MDS, MCEE and GBD studies from 2000 and 2015-17 is shown in Figure C.14. Since 2000, the NMR for the three major cause groups (prematurity/LBW, infections and intrapartum-related causes) was estimated to have reduced, though less so for prematurity and LBW than the other causes.

With the declining NMR, particularly in the late neonatal period, prematurity and LBW contributed an increasing proportion of deaths (particularly in MDS) relative to asphyxia and infections. The GBDS estimates indicated most of the decline in infection-related deaths was for lower respiratory infections (LRI), which largely occurred in the late neonatal period where India's age-specific NMR declined most. Across studies, tetanus-related deaths declined to zero, and diarrhoea-related deaths slightly declined, while congenital anomalies-related deaths remained fairly constant or went up slightly.

Figure C.14: Cause-specific neonatal mortality rate per 1,000 live births, India, (National studies, 2000 to 2015-19



Comparing the cause-specific NMR between state clusters since 2000, there appeared to be a less favourable trend in NMR due to preterm birth-related complications in the poorer than richer states, while there was a large decline in NMR due to infection and asphyxia in both clusters. There was some evidence that this was largely due to a greater decline in lower respiratory infections, particularly in the higher mortality states. Asphyxia-related births likely remained as an important cause particularly for stillbirths and day 0-1 deaths in both higher and lower mortality states, as some local studies and the facility-based HMIS showed higher rates even after 2010.

Factors Associated with Mortality Declines

Studying disaggregated neonatal mortality trends has a dual purpose. First is to understand changes in levels of socio-economic inequalities, i.e. whether the gap between the groups has closed. Using measures such as relative risk and AARC, we explore where and for whom has India been most successful in reducing the NMR. These measures will show for instance whether the urban-rural has reduced over time because of a faster decline in births in the rural compared to the urban population, leading to a smaller relative risk in the most recent period.

The second purpose is to examine the relative contribution to national gains in NMR reduction of socio-demographic groups' compositional changes (using simple or univariate decomposition analyses)[135] on the one hand, and reductions in their risk of NMR (through measures such as population attributable fraction or PAF)[136] on the other. For instance, even if there were no changes in relative risk of neonatal mortality by educational status, an increase in levels of female education may lead to a considerable overall mortality decline because more newborns would be in the 'some education' – lower mortality risk category as opposed to the 'no education' – higher mortality group.

Adapting from the conceptual framework, the NMR trends are analyzed by the following factors:

- Sex of the child
- Urban and rural residence
- Household and individual socioeconomic factors: maternal education (no education versus some education), household income groups,[137] caste/tribe (grouped as SC/ST versus non-SC/ST) and religion (Hindu and non-Hindu)
- Fertility factors: Birth order (1, 2, and 3+), maternal age at birth (under age 20, 20-34 years and 35+ years), and previous birth interval (only among the non-first order births, <24 months and 24+ months)
- Use of maternal and newborn health services: whether received any antenatal care[138] (no and yes), quality of antenatal care[139] and place of delivery (home, public health facility and private health facility)

Tables C.8, C.9 and C.10 summarize NMR trends in India and the two state clusters among births in the five-years preceding the NFHS-3 (corresponding to 2001-06) and NFHS-5 (corresponding to 2015-19) by the selected background characteristics.

[135] Univariate decomposition analysis (Powers, Yoshioka and Yun, 2011) is used to measure the contribution of changes in each of the selected socioeconomic, fertility and intervention coverage factors to the decline in neonatal mortality. The technique uses regression to partition the components of decline in neonatal mortality from NFHS-3 and NFHS 4 into a component attributable to compositional differences between rounds (called here compositional changes) and a component attributable to differences in the effects of characteristics themselves (called here changes in relative risk). It helps partition the change over time into components attributable to changing relative risks and changing composition.

[136] PAF=[p*(RR-1)]/[1+[p*(RR-1)]

[137] Absolute income in US dollars based on households' asset rank as well as data on national consumption and inequality levels, using pooled data from 239 nationally representative household surveys from LMICs. Multivariable regression models were used to compare the predictive power of the created income measure with the predictive power of existing asset indicator measures (Fink, Victora et al. 2017). Using the estimated absolute income (provided by the Federal University of Pelotas), the households in NFHS-3 and NFHS-4 are grouped into three categories: poorer households (households in the first tertile in NFHS-3), middle group (households in the second tertile in NFHS-3 and richer households (households in the third tertile in NFHS-3).

[138] ANC coverage among the most recent births in the 5-years preceding the survey.

[139] A new content-qualified antenatal care coverage indicator was used to classify births into two groups: low quality ANC (ANCq score of 0-8), high quality ANC (ANCq score of 9-13). The ANCq score had maximum of 13, based on the number of ANC visits, early first ANC, skilled provider in at least one visit, blood pressure measured, blood and urine samples collected and received at least one shot of tetanus toxoid (Arroayave L, Saad GE, Victora CG and Barros AJD, 2020, A new content-qualified antenatal care coverage indicator: development and validation of a score using national health surveys in low- and middle-income counties), and also included weight measured during ANC, abdomen examined during ANC.

Table C.8: 0-4 years NMR trends by selected background characteristics, India, (NFHS, 2005-06 and 2019-21)

Character-istics	Sub-group	NMR (95% CI)			Relative risk (RR)			Composition		PAF (%)		Contribution (%)	
		2005-06	2019-21	AARC	2005-06	2019-21	AARC	2005-06	2019-21	2005-06	2019-21	Compo-sition	RR
Sex of the child	Male	40.4 (37.2, 43.6)	26.9 (25.7, 28.2)	-2.9	1.1	1.2	0.4	52.1	51.9	5.9	9.0	0.1	99.9
	Female	36.1 (33.0, 39.2)	22.6 (21.4, 23.8)	-3.3	1.0	1.0		47.9	48.1				
Place of residence	Rural	41.8 (39.1, 44.5)	27.4 (26.3, 28.4)	-3.0	1.5	1.5	0.2	74.7	73.4	26.7	27.7	0.9	99.1
	Urban	28.1 (24.6, 31.6)	18.0 (16.0, 19.9)	-3.2	1.0	1.0		25.3	26.6				
Maternal education	No edu-cation	45.0 (41.6, 48.3)	33.8 (31.6, 35.9)	-2.0	1.4	1.5	0.4	50.0	21.3	17.2	9.7	24.1	75.9
	Some education	31.7 (28.9, 34.5)	22.4 (21.4, 23.4)	-2.5	1.0	1.0		50.0	78.7				
Household wealth tertile	Poorest	45.3 (41.8, 48.7)	32.8 (31.2, 34.5)	-2.3	1.9	2.1	0.5	53.4	34.4	32.6	26.6	21.6	78.4
	Middle	34.3 (30.5, 38.0)	25.5 (23.9, 27.0)	-2.1	1.4	1.6	0.7	29.3	32.3	11.5	16.0		
	Richest	23.8 (19.6, 28)	16.0 (14.6, 17.4)	-2.8	1.0	1.0		17.3	33.3				
Caste/tribe	SC/ST	43.3 (39.1, 47.5)	28.9 (27.3, 30.5)	-2.9	1.2	1.3	0.4	30.4	33.3	5.7	8.2	-1.3	101.3
	Non-SC/ ST*	36.2 (33.5, 38.8)	22.8 (21.7, 23.9)	-3.3	1.0	1.0		69.6	66.7				
Religion	Hindu	39.7 (37.2, 42.3)	25.5 (24.5, 26.5)	-3.2	1.2	1.1	-0.3	78.2	79.4	13.5	10.2	-0.3	100.3
	Non-Hindu	33.2 (28.8, 37.7)	22.3 (20.3, 24.3)	-2.8	1.0	1.0		21.8	20.6				
Age at birth	<20 years	53.1 (47.3, 59)	33.7 (30.9, 36.5)	-3.2	1.6	1.4	-0.6	21.1	12.5	10.8	5.3	7.1	92.9
	20-34 years	33.8 (31.3, 36.3)	23.2 (22.3, 24.2)	-2.7	1.0	1.0		74.7	84.0				
	35+ years	44.7 (32.0, 57.3)	31.8 (26.8, 36.7)	-2.4	1.3	1.4	0.2	4.3	3.5	1.3	1.3		
Birth order	1st	46.8 (42.4, 51.3)	26.5 (25.1, 27.9)	-4.1	1.5	1.4	-0.7	30.3	39.1	13.1	12.4	6.4	93.6
	2nd	31.3 (27.6, 35.0)	19.5 (18.1, 20.8)	-3.4	1.0	1.0		27.1	33.6				
	3+ order	36.8 (33.3, 40.2)	29.1 (27.3, 30.9)	-1.7	1.2	1.5	1.7	42.6	27.3	7.0	11.9		
Previous birth interval	<24 months	57.1 (50.8, 63.5)	33.3 (30.8, 35.8)	-3.9	2.2	1.7	-1.7	27.7	27.3	25.4	16.9	8.1	91.9
	24+ months	25.7 (23.0, 28.3)	19.1 (17.9, 20.2)	-2.1	1.0	1.0		72.3	72.7				
Received any ANC**	No	32.0 (26.8, 37.2)	29.0 (24.9, 33.1)	-0.7	1.4	1.9	1.8	22.8	6.1	9.1	5.0	25.6	74.4
	Any	22.2 (20.1, 24.4)	15.6 (14.8, 16.4)	-2.5	1.0	1.0		77.2	93.9				
ANC** quality	0-8	31.2 (27.4, 35.1)	25.0 (22.6, 27.5)	-1.2	1.6	1.7	0.3	54.3	14.3	24.6	8.7	48.6	51.4
	9-13	25.4 (21.2, 29.6)	15.0 (14.2, 15.9)	-1.5	1.0	1.0		45.7	85.7				
Place of delivery	Home	39.0 (36.1, 41.9)	35.4 (32.4, 38.4)	-0.7	1.2	1.5	1.9	61.2	11.2	9.1	5.4	46.7	53.3
	Public facility	33.5 (29.0, 38.1)	23.5 (22.3, 24.6)	-2.5	1.0	1.0		18.1	62.1				
	Private facility	36.5 (31.5, 41.4)	23.1 (21.4, 24.8)	-3.3	1.1	1.0	-0.8	20.7	26.7	1.9	-0.4		

*Includes other backward castes (OBCs), other or general caste Hindus and non-Hindus. **Includes only the last births.

Table C.9: 0-4 years NMR trends by selected background characteristics, Higher mortality states (NFHS, 2005-06 and 2019-21)

Character-istics	Sub-group	NMR (95% CI)			Relative risk (RR)			Composition		PAF (%)		Contribution (%)	
		2005-06	2019-21	AARC	2005-06	2019-21	AARC	2005-06	2019-21	2005-06	2019-21	Compo-sition	RR
Sex of the child	Male	46.4 (41.8, 51.0)	34.0 (32.2, 35.7)	-2.2	1.1	1.2	0.7	51.6	52.0	4.3	9.4	-0.2	100.2
	Female	42.7 (38.3, 47.1)	28.3 (26.7, 29.9)	-2.9	1.0	1.0		48.4	48.0				
Place of residence	Rural	46.1 (42.5, 49.7)	32.6 (31.3, 34.0)	-2.5	1.2	1.3	0.5	82.1	81.9	15.4	20.3	0.1	99.9
	Urban	37.7 (31.5, 44.0)	24.9 (21.9, 27.8)	-3.0	1.0	1.0		17.9	18.1				
Maternal education	No edu-cation	48.2 (44.1, 52.2)	36.5 (34.0, 39.0)	-2.0	1.2	1.3	0.1	63.1	29.7	13.6	7.1	18.8	81.2
	Some education	38.5 (33.8, 43.2)	29.0 (27.6, 30.4)	-2.0	1.0	1.0		36.9	70.3				
Household wealth tertile	Poorest	48.5 (44.3, 52.7)	35.8 (33.9, 37.7)	-2.2	1.5	1.6	0.4	65.2	46.1	25.5	21.7	15.1	84.9
	Middle	39.6 (33.7, 45.6)	31.2 (29.0, 33.3)	-1.7	1.2	1.4	0.8	24.0	30.5	5.6	10.7		
	Richest	31.8 (22.8, 40.8)	22.3 (20.1, 24.6)	-2.5	1.0	1.0		10.8	23.5				
Caste/tribe	SC/ST	51.0 (45.2, 56.9)	35.4 (33.1, 37.6)	-2.6	1.2	1.2	-0.1	31.6	34.1	6.7	6.8	-1.2	101.2
	Non-SC/ST*	41.6 (37.8, 45.5)	29.1 (27.6, 30.6)	-2.6	1.0	1.0		68.4	65.9				
Religion	Hindu	46.3 (42.7, 49.9)	31.4 (30.0, 32.7)	-2.8	1.2	1.0	-1.4	81.6	83.4	16.9	2.2	-0.1	100.1
	Non-Hindu	37.2 (30.6, 43.8)	30.5 (27.6, 33.5)	-1.4	1.0	1.0		18.4	16.6				
Age at birth	<20 years	61.5 (53.1, 69.9)	43.9 (39.8, 47.9)	-2.4	1.6	1.5	-0.3	20.0	11.5	10.1	5.5	10.8	89.3
	20-34 years	39.5 (35.9 43.1)	29.2 (27.9, 30.5)	-2.1	1.0	1.0		74.4	84.8				
	35+ years	52.6 (36.3, 68.9)	39.3 (32.1, 46.5)	-2.1	1.3	1.3	0.1	5.6	3.7	1.8	1.3		
Birth order	1st	58.7 (51.3, 66.0)	35.8 (33.7, 37.9)	-3.5	1.6	1.5	-0.6	25.1	35.1	13.1	14.4	3.4	96.6
	2nd	36.8 (31.0, 42.6)	24.2 (22.4, 26.1)	-3.0	1.0	1.0		22.4	30.9				
	3+ order	41.2 (36.7, 45.7)	32.9 (30.7, 35.1)	-1.6	1.1	1.4	1.4	52.4	33.9	6.1	10.9		
Previous birth interval	<24 months	65.5 (56.9, 74.0)	39.5 (36.3, 42.7)	-3.6	2.2	1.7	-1.9	28.3	29.2	25.5	16.9	3.0	97.0
	24+ months	29.7 (25.9, 33.4)	23.3 (21.7, 24.9)	-1.7	1.0	1.0		71.7	70.8				
Received any ANC**	No	33.5 (27.6, 39.3)	30.8 (25.9, 35.6)	-0.6	1.3	1.5	1.3	35.0	7.8	8.1	3.7	34.7	65.4
	Any	33.5 (27.6, 39.3)	20.6 (19.4, 21.7)	-1.9	1.0	1.0		65.0	92.2				
ANC** quality	0-8	33.5 (29.0, 38.0)	26.6 (23.7, 29.4)	-1.3	1.6	1.3	-1.3	76.1	20.5	31.1	6.3	46.1	53.9
	9-13	27.6 (22.0, 33.3)	20.0 (18.8, 21.3)	0.0	1.0	1.0		23.9	79.5				
Place of delivery	Home	16.4 (11.5, 21.3)	36.7 (33.4, 40.0)	-0.9	0.9	1.3	2.9	77.1	15.8	-11.1	4.6	37.1	62.9
	Public facility	41.6 (38.1, 45.2)	28.1 (26.7, 29.5)	-3.8	1.0	1.0		10.3	64.5				
	Private facility	47.8 (38.8, 56.9)	36.2 (33.1, 39.2)	-2.7	1.1	1.3	1.1	12.6	19.7	1.3	5.3		

*Includes other backward castes (OBCs), other or general caste Hindus and non-Hindus. **Includes only the last births.

Table C.10: 0-4 years NMR trends by selected background characteristics, Lower mortality states (NFHS, 2005-06 and 2019-21)

Character-istics	Sub-group	NMR (95% CI)			Relative risk (RR)			Composition		PAF (%)		Contribution (%)	
		2005-06	2019-21	AARC	2005-06	2019-21	AARC	2005-06	2019-21	2005-06	2019-21	Compo-sition	RR
Sex of the child	Male	32.9 (28.5, 37.4)	17.7 (15.8, 19.6)	-4.4	1.2	1.2	-0.3	52.9	51.9	9.9	7.8	0.2	99.8
	Female	27.3 (23.0, 31.6)	15.2 (13.4, 17.0)	-4.2	1.0	1.0		47.1	48.1				
Place of residence	Rural	35.2 (31.1, 39.4)	18.2 (16.6, 19.8)	-4.7	1.7	1.3	-1.6	65.1	63.2	30.5	18.0	0.6	99.4
	Urban	20.8 (16.7, 25.0)	13.5 (10.7, 16.3)	-3.2	1.0	1.0		34.9	36.8				
Maternal education	No education	37.1 (30.9, 43.3)	24.0 (19.4, 28.6)	-3.1	1.4	1.5	0.8	32.6	10.0	10.9	5.1	13.7	86.3
	Some education	27.0 (23.3, 30.6)	15.6 (14.1, 17.1)	-3.9	1.0	1.0		67.4	90.0				
Household wealth tertile	Poorest	38.4 (32.5, 44.3)	23.4 (19.6, 27.1)	-3.5	2.0	2.0	0.0	38.6	18.9	27.8	15.6	16.9	83.1
	Middle	29.4 (24.3, 34.4)	18.9 (16.6, 21.1)	-3.2	1.5	1.6	0.3	36.1	35.5	16.0	17.6		
	Richest	19.2 (14.7, 23.8)	11.8 (9.8, 13.8)	-3.5	1.0	1.0		25.3	45.7				
Caste/tribe	SC/ST	32.8 (26.5, 39.2)	20.3 (18.0, 22.7)	-3.4	1.1	1.4	1.5	27.8	31.5	3.2	10.8	-1.5	101.5
	Non-SC/ST*	29.3 (25.6, 33.0)	14.7 (12.9, 16.5)	-4.9	1.0	1.0		72.2	68.5				
Religion	Hindu	30.4 (26.9, 33.9)	16.8 (15.3, 18.3)	-4.2	1.0	1.1	0.5	75.4	75.7	1.3	6.0	0.0	100.0
	Non-Hindu	29.9 (23.0, 36.8)	15.5 (12.5, 18.5)	-4.7	1.0	1.0		24.6	24.3				
Age at birth	<20 years	43.6 (35.4, 51.8)	21.9 (17.8, 25.9)	-4.9	1.7	1.4	-1.1	23.4	14.4	13.2	5.7	4.0	96.0
	20-34 years	26.4 (23.0, 29.8)	15.4 (13.9, 16.9)	-3.8	1.0	1.0		74.5	82.7				
	35+ years	19.0 (4.3, 33.7)	19.9 (12.7, 27.0)	0.3	0.7	1.3	4.2	2.2	2.9	-0.6	0.8		
Birth order	1st	36.9 (31.4, 42.3)	16.7 (14.7, 18.7)	-5.7	1.4	1.2	-1.3	37.6	44.7	12.9	6.4	3.2	96.8
	2nd	26.5 (21.5, 31.4)	14.5 (12.5, 16.5)	-4.3	1.0	1.0		33.7	37.4				
	3+ order	26.1 (20.8, 31.5)	20.1 (16.8, 23.4)	-1.9	1.0	1.4	2.4	28.7	17.9	-0.3	6.5		
Previous birth interval	<24 months	43.7 (34.0, 53.5)	21.5 (17.4, 25.6)	-5.1	2.3	1.6	-2.3	26.7	24.7	25.4	13.6	6.4	93.6
	24+ months	19.2 (15.4, 23.1)	13.1 (11.4, 14.9)	-2.7	1.0	1.0		73.3	75.3				
Received any ANC**	No	23.7 (12.0, 35.4)	26.1 (16.9, 35.3)	0.7	1.3	2.6	5.2	7.2	3.7	1.9	5.7	3.9	96.1
	Any	18.7 (15.7, 21.6)	10.0 (8.9, 11.1)	-4.5	1.0	1.0		92.8	96.3				
ANC** quality	0-8	20.8 (13.5, 28.1)	20.1 (14.1, 26.0)	-0.4	1.2	2.0	3.9	27.3	6.3	4.3	6.0	22.9	77.1
	9-13	22.9 (16.4, 29.5)	9.9 (8.8, 11.1)	-4.3	1.0	1.0		72.7	93.7				
Place of delivery	Home	17.4 (14.0, 20.8)	32.0 (23.3, 40.7)	-0.1	1.2	1.9	3.0	39.1	4.2	8.2	3.6	40.5	59.6
	Public facility	32.6 (27.3, 37.9)	17.1 (15.1, 19.1)	-3.2	1.0	1.0		27.9	57.9				
	Private facility	26.6 (21.1, 32.0)	13.6 (11.6, 15.6)	-5.4	1.1	0.8	-2.2	33.0	37.8	2.7	-8.4		

*Includes other backward castes (OBCs), other or general caste Hindus and non-Hindus. **Includes only the last births.

Sex Differentials

Female neonates generally have lower mortality risks and male neonates because of biological advantages. Male child preference may affect overall neonatal mortality trends in two ways. First, sex selective abortion reduces the portion of female neonates and increases the number of males, who have a biological disadvantages and higher NMR. Second, male preference may also drive more resources and care towards male neonates, increasing male survival and decreasing female survival.

In the SRS, the female to male sex ratio at birth was 0.894 in 2000 and 0.899 in 2016-18, showing that the female deficit persisted over time. The NFHS-3 and NFHS-4 showed similar girl deficits (0.919 and 0.916, respectively). The female to male sex ratio at birth was higher if the two previous births were male, but lower if the previous births were female.[140]

Research indicates that there is higher female than male infant and under-five mortality in many settings in India.[141,142,143,144] In the neonatal period male is generally higher than female neonatal mortality based on SRS NFHS and other related surveys.[145,146,147,148,149] One study showed that neonatal mortality among females was higher than males in 2013, specifically in Punjab, Haryana and Tamil Nadu states in NFHS 2 and in Assam in NFHS-3.[150]

NMR was greater among males than females in both NFHS-3 and 5 (Table C.8). For both sexes, NMR declined significantly between surveys and the decline has been faster among the female children. The relative risk for males over females has increased marginally. The proportion of all neonatal deaths in the population that is attributable to being a male child (the population attributable fraction or PAF) has increased between the two surveys. As expected, there was no change in the composition of births in the five years preceding the surveys, by sex of the child. A simple univariate decomposition of the change over time suggests that almost all the NMR decline is due to the changes in relative risk between male and female children rather than due to the changes in composition (as they were negligible). The sex differentials in NMR in the two state clusters follow the national pattern (Tables C.9, C.10).

The SRS does not publish annual NMR by sex. However, the infant mortality rate (IMR) and under-five mortality (U5MR) was greater among females than males (Figure C.15), suggesting a neglect of female babies within the first years of life. The sex ratio at birth (female per 1000 male) in India as per the SRS, has been unfavourable to females, indicating ongoing sex selective abortion of female fetuses.

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[149] Karlsson O, Kim R, Joe W, Subramanian SV. Socioeconomic and gender inequalities in neonatal, postneonatal and child mortality in India: a repeated cross-sectional study, 2005-2016. Journal of Epidemiology and Community Health. 2019;73(7):660-7. Available from: doi:10.1136/jech-2018-211569.

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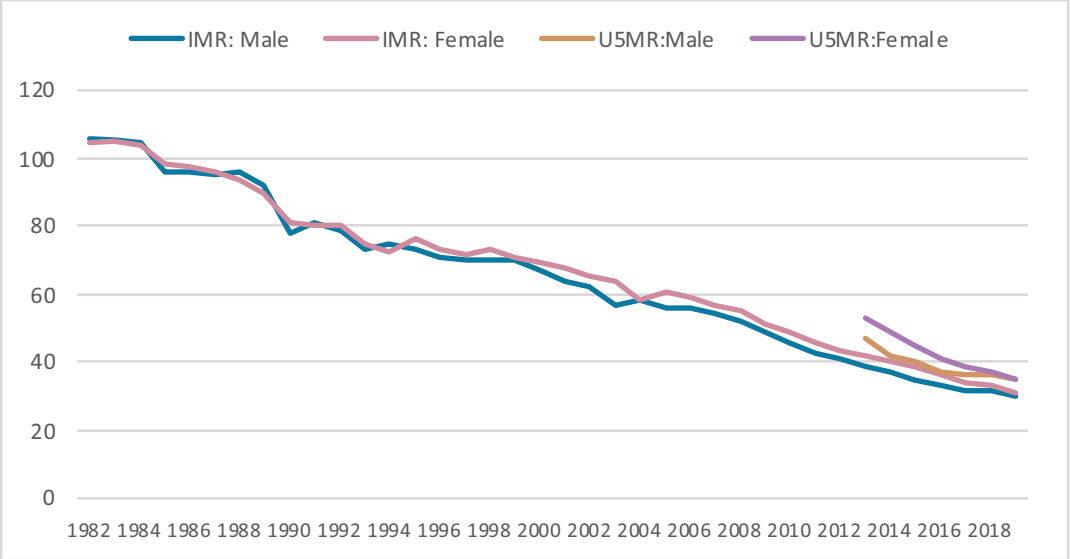
Figure C.15: Trends in IMR and U5MR by sex of the child, India, (SRS, 1982-2019).



Urban-Rural Differences

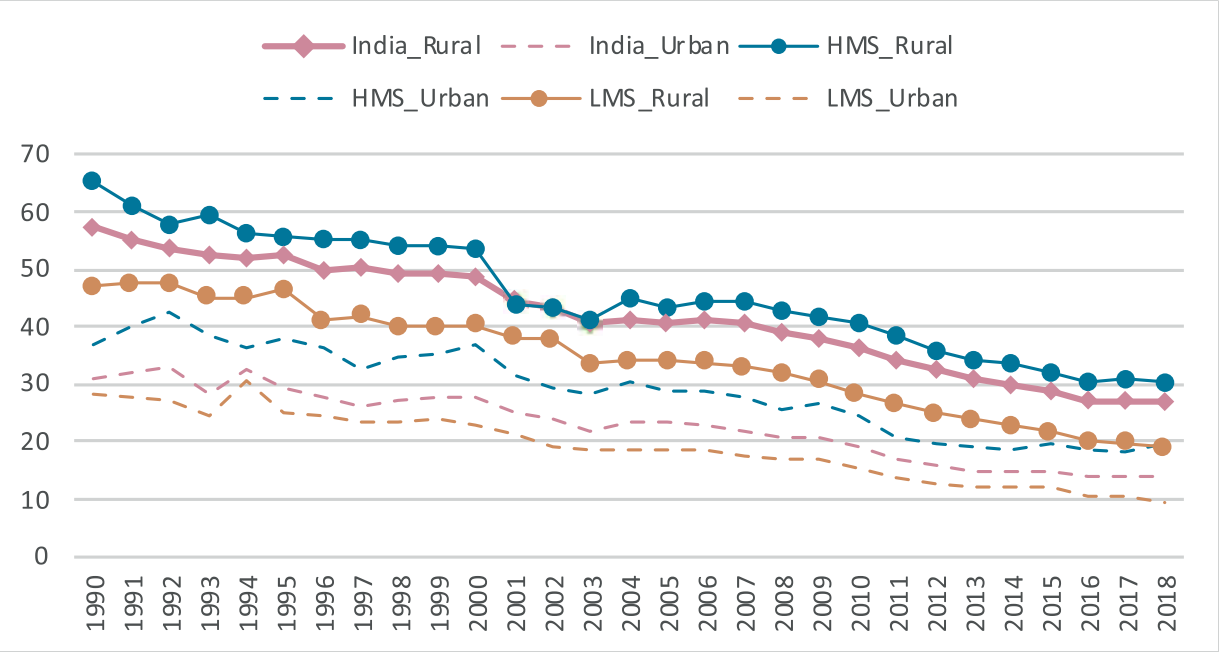
India has been experiencing rapid urbanization. According to the decennial population censuses, India's urban population increased from 20% in 1971 to 31% in 2011, at a rate of 1.1% per year. About 31% of India's population was living in urban areas at the time of NFHS-3, increasing to 33% in NFHS-5.

The SRS between 1990 to 2019 showed that while the NMR has been declining in both rural and urban areas, it is consistently higher in rural areas (Figure C.16). The absolute urban-rural gap remained around 14 points in higher mortality states since 2005. In the lower mortality states, on the other hand, there was a major reduction in absolute urban-rural gap, from 19 to 9 points. Since 2015, the NMR among rural populations in the lower mortality states is no longer higher than among urban populations in the higher mortality states. According to the SRS, the greatest acceleration of the NMR decline occurred during the NHM/RMNCH+A period of 2012-19, both in urban and rural areas, and in both state clusters (Table C.11). These declines were faster in the urban areas in both the state clusters.

Table C.11: Average annual rates of change (AARC) in NMR in rural and urban areas, India and state clusters (SRS, 1992-2019)

Policy period	India		Higher mortality states		Lower mortality states	
	Rural	Urban	Rural	Urban	Rural	Urban
1992-97 (CSSM)	-1.2	-4.6	-0.9	-5.4	-2.6	-3.0
1997-2005 (RCH-I)	-2.8	-1.5	-3.1	-1.4	-2.6	-2.8
2005-12 (RCH-II/NRHM)	-3.1	-5.6	-2.6	-5.5	-4.3	-5.3
2012-19 (NHM/RMNCH+A)	-3.8	-2.7	-3.0	-1.3	-5.0	-5.4

Figure C.16: NMR trends in rural and urban areas, India and state clusters (SRS, 1990-2019)



NMR was greater in rural than in urban areas in both NFHS-3 and NFHS-5 (Table C.8). In both rural and urban areas, NMR has declined significantly between surveys. The decline has been faster in urban than in rural areas. The relative risk of neonatal mortality in rural over urban women has increased. The proportion of all neonatal deaths in the population that is attributable to women's residence in rural areas (PAF) has increased in India between the two surveys. The rural/urban composition of births in the reference period did not change much between the surveys. A simple univariate decomposition of the changes over time suggests that over 99% of the NMR decline is due to the changes in relative risk between rural and urban areas rather than a change in composition. The pattern was similar in higher mortality states (Table C.9). However, in the lower mortality states, the rural areas experienced slightly faster decline in NMR than the urban areas, reducing to that extent, the rural-urban inequities in NMR (Table C.10).

Differences by Socio-Economic Factors

In research to date, the socioeconomic factors found to be associated with NMR in India remained consistent across time periods. Studies analysing NFHS 1 and 2 indicated that having lower risk of neonatal death was significantly associated with 6+ household members (or 4+ people per room), access to improved water and toilets, being from 'other' castes vs. scheduled caste, and maternal education of secondary or higher.[151,152,153] The risk of early NMR was consistently lower among mothers with more wealth, education, or who were Muslim or other religion versus Hindu, but not based on caste status, between 1990-3, 1996-9, and 2003-6 in one study; yet ENMR also did not reduce greatly for any group.[154] Wealth-based inequalities in NMR were notable, but decreased somewhat between 1992 to 2005/6. [155]An analysis of DLHS-3 in 2004-5 identified the same significant predictors, as well as the mother being unemployed (versus agricultural/ farmer/ labourer) and not having access to improved water. [156]Analyses of the more recent NFHS-4 in 2015/16 showed that the factors associated with lower NMR remained very much the same.[157,158,159,160] A study of DLHS-4 in 2012-13 (only in non-EAG states) found significantly lower neonatal deaths among women of general or other caste versus scheduled caste or tribe status, Hindu vs. non-Hindu (counter to the NFHS), clean versus unclean fuel, pucca/semi-pucca (cement floors and/or roof) households, above poverty line status, having health insurance and improved water source and sanitation. [161]

NMR was greater among women with no education than others in both NFHS-3 and 5 (Table C.8). NMR declined at almost the same rate among the two educational groups. The proportion of all neonatal deaths in the population that is attributable to women not having education (PAF) has decreased between the two surveys. Maternal education improved substantially between the surveys: the proportion of births to women with no education reduced from 50% to 21%. Among women with no schooling, the TFR fell from 3.55 to 2.8, a much faster decline compared to the TFR among women with 12 years or more years of schooling (NFHS 3 and 5 reports).

By household wealth, the NMR was the greatest among poorest households in both survey rounds (Table C.8). Yet the NMR declined faster among the richest households, thus widening the gap between poorest and richest households. Household income has improved substantially between surveys: the proportion of births to poorer households declined from 53% to 34%. The TFR in the lowest wealth quintile declined from 3.89 in NFHS-3 to 2.63 in NFHS-5. The comparable TFRs for the highest wealth quintile were 1.78 and 1.57. The proportion of all neonatal deaths in the population that is attributable to being born in poorer households (PAF) has declined between the two surveys.

NMR was greater among women of Scheduled Castes and Tribes (SC/ST), widely considered to be of lower socio-economic position in India, than non-SC/ST groups (including Other Backward Castes and other or general caste Hindus and non-Hindus) in both surveys (Table C.8). NMR has declined at a faster rate among non-SC/ST group compared to the SC/ST group between surveys. The proportion SC/ST did not change much between the surveys. The PAFs for being an SC/ST are relatively small in the two surveys.

NMR was greater among Hindus than among non-Hindus (Muslim, Christian or other religions) in both surveys (Table C.8). For both groups, NMR declined significantly between surveys. There was no change in the sample distribution by religion between the two surveys. The proportion of all neonatal deaths in the population that is attributable to being born to a Hindu family (PAF) has reduced between the two surveys.

Among the four socio-economic indicators considered, the univariate decomposition analyses suggest that improvements in household income (wealth quintile) and in maternal education accounted for about 22% and 24% of the NMR decline, respectively, in India.

The higher and lower mortality state clusters differed somewhat in terms of reductions in inequities by socioeconomic characteristics. For instance, NMR in higher mortality states declined faster among women with no education, among the poorer households, among the SC/ST households and among the Hindus, thus reducing socioeconomic inequities in NMR (Table C.9). The NMR in lower mortality states, on the other hand, declined faster among the better socioeconomic groups including those with some education, richer households, non-SC/ST households, thus increasing the inequities (Table C.10). Similar to the national pattern, there has not been much change in the proportion of SC/ST or proportion non-Hindus between the surveys in the two state clusters. However, there has been much greater improvements in maternal education and household income in lower mortality states than in higher mortality states (Tables C.9 and C.10).

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[152] Arokiasamy P, Gautam A. Neonatal mortality in the empowered action group states of India: trends and determinants. Journal of biosocial science. 2008;40(2):183-201.
[153] Singh A, Kumar K, Singh A. What Explains the Decline in Neonatal Mortality in India in the Last Three Decades? Evidence from Three Rounds of NFHS Surveys. Studies in Family Planning. 2019;50(4):337-55. Available from: doi:10.1111/sifp.12105.
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Differences by Fertility-Related Factors

Total fertility in India declined rapidly during the last two decades from 2.8 children per women in NFHS-2 to 2.7 in NFHS-3 and 2.0 in NFHS-5. Such changes are likely to imply important shifts in the distribution of births by age of the mother and parity/birth order, but less so in birth intervals. As the proportion of births that are higher risk, such as higher parity or older mothers, neonatal mortality levels may fall even without reductions in risks within the specific categories of parity and maternal age.

In both surveys in India, NMR was greater among women aged less than 20 years or 35+ years at the time of childbirth (Tables C.8-C.10). While NMR declined in all age categories, the decline was fastest among the women younger than 20. The proportion of all neonatal deaths in the population attributable to being born to women under age 20 (PAF) has halved between the two surveys. The PAFs for births to women age 35+ years were smaller. The proportion of births to women under age 20 has declined between the surveys from 21% to 13%. A simple decomposition of the change over time suggests that reduction in the proportion of births to women under age 20 or age 35 and over accounts for around 7% of the NMR decline in India.

The NMR pattern is similar by women's birth order (Tables C.8-C.10). First order and 3rd or higher order births had greater NMR in both the surveys. NMR declined between surveys in all birth order categories. The fastest decline was among the first two birth orders. The proportion of all neonatal deaths in the population attributable to being first order births (PAF) has remained more or less constant between the two surveys in India. The PAFs for the third and higher order births were smaller, but had almost doubled between the surveys. A simple decomposition of the changes over time suggests that most of the NMR decline between the two surveys were due to the changes in relative risk rather than changes in the distribution of births by birth order.

The NMR was greater among births with shorter previous intervals in both the surveys. While the NMR declined between surveys for both under and over 24-month interval groups. The PAF for births with less than a 24-month birth interval was around 25% in NFHS-3, and declined by NFHS-5 to 17%. Almost all the NMR decline between the surveys was due to reductions in the relative risk of mortality for births with shorter previous intervals.

Our results are corroborated by multiple analyses based on the same or other data sets.[162,163,164] More detailed classifications, combining birth order, age and birth intervals provide further insights into risk categories. For instance, studies of NFHS-2 in 1998-9 or NFHS-3 in 2005-6 in only the EAG states (higher mortality cluster) found a lower risk of neonatal deaths among women aged 20 to 30, second or third birth order with any birth interval, and fourth or higher order with greater than 24-month interval.[165,166] Another study comparing NFHS-1 to 3 in India found the same characteristics associated with lower NMR, in addition to singleton versus multiparous or multiple births.[167]

162. Ramji S. The National Family Health Survey (1998-99): childhood mortality. Indian pediatrics. 2001;38(3):263-6.

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Findings from the National Level Key Informant Interviews

Introduction

This report presents findings from key informant interviews with India's maternal and neonatal health experts over the past two decades. The key informant interviews are part of a more extensive mixed-methods study led by the National Health Systems Resource Centre (NHSRC), and their research partners, the International Institute of Population Sciences (IIPS), India Health Action Trust (IHAT) and University of Manitoba (UM).

The Exemplars in Maternal and Newborn Health (MNH) study aims to systematically and comprehensively research and document factors associated with rapid reduction in maternal and neonatal mortality over the past two decades in countries that have experienced greater declines than their socio-economic progress. This study is part of the larger initiative called Exemplars in Global Health supported by Gates Ventures, which includes other subject areas such as child mortality, stunting, community health worker programs and vaccine delivery.

India has made major progress in improving maternal and newborn health outcomes over the past two decades. India's decline in mortality outpaced the global decline. By 2000, India accounted for 23% of global maternal deaths and 31% of neonatal deaths. By 2017, India had 12% of maternal deaths and 22% of neonatal deaths globally. Therefore, important lessons can be learned from a systematic investigation of the drivers of India's progress, nationally and sub-nationally, for India to build on its success and for many other countries seeking to accelerate progress in MNH.

Respondent Characteristics

As noted above, we sought a balance of respondents from government administration, government technical experts, development partners, and members of civil society partners and academia. Some respondents changed affiliations across their careers and are counted in multiple affiliations. Table D.1 summarizes respondent genders, affiliations, and years of activity.

Table D.1: KII respondent characteristics

Respondents		N
Gender	Male	8
	Female	5
Affiliation*	Government administrator	2
	Government technical	8
	Development partner	4
	Members of civil society and academia	5
Periods active*	CSSM (1992-1997)	6
	RCH I (1997-2005)	10
	RCH II/NRHM (2005-2012)	12
	RMNCH+A/NHM (2012-present)	11

* NOTE: Does not sum to 13 as some respondents had multiple affiliations and were active across multiple policy periods

Overarching Narratives

Confluence of Factors

Respondents emphasized that India's success in reducing maternal and neonatal mortality is the result of a confluence of factors and synergies: "It's not one strategy, it's a combined, actually all strategies work synergistically" (KI_04, government technical and civil society). The respondents expressed diverse opinions on the relative contribution of improvements in the government health system, the private sector, and the social determinants of health. However, most respondents focused on the interrelated improvements to administrative and technical aspects of government-provided healthcare, emphasizing that strengthening the underlying health system was the "bedrock" (KI_13, government administrator) upon which all other improvements were built. All emphasized the importance of fertility reduction, poverty reduction, road connectivity, and improvements to women's empowerment and education.

From Siloes to Integration

For most respondents, a major driver of success was the shift in the government health system from top-down siloed approaches towards integration across interventions, life stages, and levels of care: "the recognition that we need to tackle multiple things at the same point in time" (KI_09, government technical and private sector). Over the past two decades, the government health system underwent a paradigm shift. Up through the 1990s there was a vertical focus on family planning and immunization, which had "really not benefited the maternal-newborn dyad" (KI_10, government technical and development partner). In the 2000s, focus expanded to integrated healthcare and nutrition services through adolescence, early marriage, the antenatal, intrapartum, postpartum periods, and into neonatal and child health.

> So broadly, if you talk on the CSSM, […] the main focus was population, family planning, and there were of course the components of the maternal health, child health, but it was very limited. […] RCH I tried to focus the operationalization of the first referral unit by supplying various types of kits. So, it was all vertical supply. So the top-down approach was there even in RCH I […] It was the game-changer in RCH II and NRHM when both the things [technical and health system supports] were there (KI_01, government technical)

Many respondents also traced improvements in the continuum of care for maternal and neonatal health from community to tertiary levels through more vigorous outreach, referral, and emergency transportation.

The National (Rural) Health Mission as a Pivotal Event

The National Rural Health Mission (NRHM), launched in 2005, was identified by many to be a "game-changing moment" (KI_03, civil society), or a "tipping point" (KI_13, government administrative), in strengthening government maternal and neonatal healthcare provision, which in turn enabled continued decline in MMR and NMR. The NRHM's significance was attributed first to it being a "complete architectural correction" (KI_10, government technical and development partner) of the health system, which means that it focused not only on strengthening technical services but also on improving administrative processes, human resources for clinical care, planning and management, community-level maternal and neonatal linkages, governance, supply chain, data quality, equity, and demand-side behavioural sciences. Second, as a mission "blessed" by the office of the Prime Minister (KI_10, government technical and development partner) and monitored through clear appraisals, the NRHM brought renewed urgency, decision-making power, and separate budgetary allocation. Third, the NRHM deepened domestic ownership of the maternal and child health agenda. Previously, reproductive and child health interventions were "by and large World Bank funded loan-based" programs (KI_10, government technical and development partner). The NRHM made these programs "government-owned, government-funded, taxpayer-supported, with political will at the highest level possible" (KI_10, government technical and development partner). This domestic ownership extended into state-level ownership as states became increasingly skilled at developing project implementation plans (PIPs) to meet their needs.

And fourth, the NRHM sought to re-orient the Indian health system towards community-based primary health care through launching the Accredited Social Health Activist (ASHA) community health worker program, Village Health and Nutrition Days for outreach maternal and child health services beyond immunization, and Village Health, Sanitation and Nutrition Committees, for community based planning and action. The NRHM followed earlier "transformative experiences" (KI_06, government technical and academic) seeking to strengthen community based primary healthcare, particularly the Bhore Committee report (1943), which emphasized shifting care from hospitals and dispensaries to health centers in rural areas, and the de-professionalization and de-medicalization movement in the 1970s in which primary health care volunteers and health workers were introduced at the community levels.

Massive Increase in Facility Deliveries with Skilled Birth Attendants

Most key informants attributed India's progress on reducing MMR and NMR to the shift of deliveries from homes to facilities and from traditional birth attendants to the trained, skilled birth attendants to provide basic emergency obstetric and neonatal care (BEmONC). Janani Suraksha Yojana (JSY) demand side incentive, and the Accredited Social Health Activist (ASHA) community health worker program played a crucial role in this shift of deliveries into health facilities. The NRHM introduced both JSY and the ASHA program. Under JSY, pregnant women and their ASHAs received a financial incentive if they gave birth in a health facility. The increase in skilled birth attendance was attributed to the 21-day upgrade training wherein staff nurses, and auxiliary nurse midwives (ANMs) were trained in most aspects of BEmONC and refresher training for generalist medical doctors.

Ultimately, many respondents reflected that increasing access to BEmONC provided by skilled birth attendants (nurses and auxiliary nurse midwives (ANMs)) and generalist doctors was the major driver and was the essential input needed in high mortality states. Despite ongoing efforts, widescale access to CEmONC in the government healthcare sector had not been achieved during the study period in the high mortality states.

Several respondents suggested that even less effort should have been invested in building CEmONC capacity in the government sector, particularly facility-based specialist neonatal care. They argued that specialists and comprehensive emergency care should not have been prioritised until MMR reached 200 and NMR 30. A more rapid decline in high mortality states would have occurred if more resources had been invested in basic and home-based neonatal care. On the other hand, low mortality states were praised for strengthening CEmONC, since it was needed to maintain the reduction in maternal and neonatal mortality.

Dissenting View: Few Lives Saved by Improvements to the Government Health System in High Mortality States

A few respondents argued that the government health sector's persistent shortcomings in the high mortality states meant it had done little to provide lifesaving obstetric and neonatal care.

> I actually do not agree that India was able to reduce [MMR] through policies and programs. […] The women whose lives were saved actually happened despite what the government was trying to do. Not because of what the government was trying to do. (KI_08, civil society)

Instead, they suggested that the decline in MMR in high mortality states from over 500 to 200 was driven by contextual improvements particularly reduced fertility, women's empowerment, sanitation, and roads for emergency transportation to private facilities. The increased availability of medical abortion pills, which were distributed by private pharmacies and not officially sanctioned, also averted some death due to unsafe abortion or additional fertility. In high mortality states, they maintained that most government health facilities could not provide even basic emergency care throughout the previous two decades. Thus the only lives saved by government healthcare were the tiny portion that made their way to district hospitals and medical colleges.

The following sections present detailed respondent views on how the government health system has changed over time, drivers of these changes, and then the role played by the private sector and the social determinants of health.

Administrative: Strengthening the Government Health System

Most respondents attributed the decline in MMR and NMR to improvements in the Indian government-provided healthcare system over the past two decades, both in administrative health systems strengthening and improvements to the technical medical care provided. This section presents the administrative changes highlighted by our key informants.

Decentralization and Administrative Capacity Building

Key informants highlighted the importance of decentralization and capacity building by cultivating public health planning, administration, and management skills. The establishment of the National Health Systems Resource Centre (NHSRC) and State Health System Resource Centres enabled program managers and technocrats at the state levels to become increasingly technically grounded in the principles of public health, issues around quality of care, and global perspectives on India's development (KI_07, development partner). The increased capacity of governmental actors decreased India's reliance on external technical assistance.

There was a time, let's say 2010-12-13 where a lot of …..some of the newer programs were dependent on external technical assistance to run. Now a lot of that capacity actually internally exists. LaQshya initiative, NQAS, they are led by an NHSRC and others. So that ability also exists in the system, which also reinforces that political commitment and attention. (KI_07, development partner)

State and some district-level actors started thinking in relation to goals and targets for health progress rather than just implementing the programs they were asked to implement.

The clear big change is that now everyone talks outcomes all the way down the line. And earlier when we were there, that wasn't the case. So now, at least even districts make a plan saying, "This is our MMR, IMR, and institutional delivery," and so they'll set targets that they'll try and achieve the end of the year. And there's some kind of a monitoring system in place on what happens. (KI_05, government administrative & private sector)

Technical support units at the national level and in some states were also identified as an important support for the NRHM. These units helped the Mission Directors plan, monitor, and embed new activities within their system. These expert groups were not part of the system; they were "a bit of an arm's length" and started "providing a mirror to the system" (KI_12, government technical and development partner). They analyzed problems, suggested and identified innovations, and then got funding (often from donors) to scale them up.

Empowering the States through Pips and State Health Societies

Key informants discussed the valuable but slow process of decentralizing power and strengthening planning and management capacity from the centre to the States, particularly in high mortality states. The NRHM introduced planning and management structures that encouraged state-level leadership and decision-making.

… Prior to that [NRHM], you do not have a concept of even a state-level plan with outcomes and so on. Starting from a base where the central government is looking for a plan where you [state governments] come back and commit to a certain level of MMR and so on. You never had that. So first, getting to the state level and thinking in terms of outcomes itself was a big challenge (KI_05, government administrative & private sector)

India's high mortality states initially lacked the capacity to critically assess their own data and develop their own strategies. Instead, they adopted the centre's policy directives to receive NRHM/NHM financing and had little ownership over the programming. Thus, despite political will "at the national level, at the policy level, at the budget allocation level" (KI_10, government technical and development partner), some states failed to implement programs due to poor governance and low ownership of state-level problems and nationally-conceived programs to address these problems.

The NRHM introduced detailed state health plans (called Program Implementation Plans (PIPs)) with state-set outcome indicators, which were a major change from the previous top-down approach of national directives. State PIPs "galvanised the system" (KI_12, government technical and development partner) by pushing State governments to take a "systematic, structured approach to develop plans for each geography" (KI_12, government technical and development partner) and answering these plans with an infusion of funding from the NRHM (and later the NHM). It was through PIPs that the health system decentralised planning, built more robust management systems, and introduced innovations, including the contractual hiring of health workers (discussed later in the section "Human resources: increasing the availability of health workers"), setting up blood storage units and blood banks, and referral transport systems: "A lot of these innovative and interesting activities were undertaken through these PIPs" (KI_12, government technical and development partner).

In addition to PIPs, the NRHM appointed a point person at the state level akin to the centre's Mission Director: "So, a similar guy from the same services was there. So, there was a synergy" (KI_04, government technical and civil society). States were empowered to think of locally appropriate mechanisms to achieve centrally set goals:

We used to tell them, 'you are here and you have to reach this destination basically, you know, programs or initiatives which will help you in reaching over there'" (KI_04, government technical and civil society).

Each State also opened a State Health Society, which was a separate legal entity from the state treasury. These bodies had numerous benefits. Money for the NRHM was sent directly to the state health society and thus could only be used for health. Before this, central transfers to the state may not always be spent on health.

> Historical experience suggested that some of the states will receive the money from the central government, but they have other priorities and they may decide to starve health of funds. Now, to circumvent this central government said, "All states must open up a separate legal entity called a State Health society,'" And then central government said, they said we will send the money directly to the health society so that the health department gets access to the funds right away. (KI_05, government administrative & private sector)

In addition, State Health Societies integrated multiple sectors: health, nutrition (ICDS in the Ministry of Women and Child Development), water, and sanitation to become the "apex body" to solve "inefficiencies if they don't work together" (KI_05, government administrative & private sector). State health societies also approved the overall state health budget for the year. They monitored progress against the PIP once the plan was approved, These new practices empowered states to plan and monitor their own progress. Finally, State Health Societies could change financial rules quickly to address financial bottlenecks. In contrast, financial regulations in the centre and state treasuries were considered archaic and difficult to change.

Initially, even when high mortality states did innovate in their PIP, the central government often used their "soft power" to redirect the states to implement a centrally determined plan (KI_07, development partner). Over time, the centre's openness to state priorities and perspectives increased, as did state ownership and capacity, albeit in a "highly variable" manner closely linked to the state's leadership:

> So if you have a really strong health leadership within the state and many of these bureaucrats actually they move from state cadre to national and go back etc. It's like sometimes there are like really senior bureaucrats, which have that sense of power, where they can negotiate well with the Government of India. (KI_07, development partner)

Alongside an increase in state-level agenda-setting capacity came increasing state financial contributions (KI_04, government technical and civil society). Initially, the centre funded 90% of the NRHM/NHM ,and the state supported the remaining 10% . Gradually, the states drew more funding (KI_04, government technical and civil society).

The wealthier southern states, which also had lower mortality, had the stronger pre-existing administrative capacity to conduct their problem analysis and planning: "Tamil Nadu and Kerala are way ahead because they have a strong public health cadre" (KI_13, government administrative). Southern states tended to "leverage" the project implementation plan (PIP) process to do "their own advanced programming" to address their specific contexts and needs (KI_07, development partner).

Decentralization to Districts, Blocks, and Facilities

Decentralization below the state level made some progress as well, from an initial stage where districts often had extremely low planning and management capacity. (Decentralization to communities through panchayats and village health committees was not considered to have been achieved and was not identified as a driver.)

> If you can believe me that initially, a district would develop a work plan, say in Hisar in Haryana. I would receive a plan from Karnataka or Tamil Nadu where they have changed the state's name and loaded information on the same district. I have seen those days and from those days, there has been a significant improvement. (KI_02, government technical and development partner)

The decentralization of power to districts, blocks, and health facilities created space and provided tools for highly motivated district or facility level leaders to rapidly improve the health services offered in their area (KI_05, government administrative & private sector). While this was often beneficial, local empowerment hindered change in the areas that lacked motivated leaders:

> It depends on the individual too because then it throws up a challenge to that individual DM or individual CMHO of that district. And if they are good, they'll do a wonderful job. They will beg, borrow, hire HR, get the help and get the policy, the rules change, giving them more money, more salary. (KI_02, government technical and development partner)

High priority districts (later "aspirational districts") were identified as those with the poorest indicators, and received additional funding (30% extra), and technical support from partners who implemented new flexibility, "thought processes" and technology (KI_04, government technical and civil society). Targeted inputs for the highest-need districts slowly increased, including on social determinants of health in these areas:

> The idea was for the district to be capable of making its own decisions by providing support services in terms of managerial, financial, techno-managerial expertise which will help the districts use their own data and plan. (KI_11, government technical and academic)

However, several respondents indicated that India has much farther to go in empowering districts and below to analyze their own needs and set their own priorities (KI_02 government technical and development partner; KI_11, government technical and academic).

Increasing the availability of health workers in facilities and communities, and expanding their legal scope of work.

Increasing The Availability of Human Resources for Health in Government Facilities

Many respondents closely linked saving maternal and neonatal lives to increasing the availability of human resources for health in government facilities. The specific cadres discussed included specialists, particularly obstetricians and anesthesiologists who could together perform caesarean sections and other CEmONC, nurses and ANMs, who if properly supported could perform a range of BEmONC functions, and management or administrative professionals such as data entry operators and supply chain managers, whose presence freed clinicians to spend more time practicing medicine.

> Health is very much human resource intensive. It cannot be any other way. [It's not] only doctors, nurses: a whole gamut of allied professionals need to be in place. So, I think this filling the gap of the human resource is a critical factor and whichever states have managed to do that effectively have also been able to deliver and we're seeing the outcomes. (KI_11, government technical and academic)

Each successive policy period from CSSM (1992-1997), to RCH I (1997-2005), to RCH II and the NRHM (2005-2012) has sanctioned additional positions at healthcare facilities; however, filling these positions has been an enduring challenge. RCH II / NRHM marked a change to human resources for health policy by introducing contract hiring to recruit and retain staff better. Under the NRHM, states were permitted to hire workers on contracts, which simplified the recruitment process and allowed more competitive salaries. States were given "complete flexibility to pay differential salaries for difficult areas and hard-to-reach-areas" (KI_13, government administrative).

> The logic of the market salaries was, you know, extended to even models like 'you quote-we pay'. So, you know, states were told that you give anything that it takes to get the human resources. So, states would come out with advertisements where they would ask the specialists to quote their salary. So, so, you know, for difficult areas, there they pay three hundred thousand, three and a half hundred thousand rupees per month to get specialists. So, I think that's the important part of HRH. (KI_13, government administrative)

The NRHM also granted states the flexibility to develop context-specific incentives to recruit and retain personnel in underserved areas (KI_04, government technical and civil society) such as compulsory or incentivised rural service (KI_12, government technical and development partner).

> States came up with all kinds of options based on the local conditions. I think in 2009 or 2010, we made a list of all of possible innovations that different states were trying. But those innovations were at preliminary stages. But, I think we came up with something like a hundred of them. Different guys trying out different things. And although, not too many of them really got scaled up and some did like the special transport business, but nevertheless, I think it had a big impact on the human resource. (KI_05, government administrative & private sector)

One respondent (KI_02, government technical and development partner) noted that contractual hiring has turned into "a double-edged sword" whereby it was used successfully in some regions to rapidly fill vacancies but failed to address the root causes of insufficient staffing in regular government positions: insufficient pay for non-contract positions and overly complex recruitment processes. Another respondent (KI_08, civil society) observed that contract hiring simply re-created the same issue as regular hiring: the need to pay bribes to receive appointment letters. This respondent found that many positions (both contract and regular) remain vacant because bribes have not been paid in the "massive sub-industry" of bribery related to transfers, promotions, and postings.

> Transfers, promotions and postings are a massive subindustry, churning out, you know, astronomical amounts of money in terms of bribes paid and received. […] What actually happens and why a lot of positions are vacant is because the bribes have not been paid. And this includes regular appointments, as well as contractual appointments (KI_08, civil society)

Nonetheless, even the most critical key informants did consider changes in recruitment policies to have had some success, at least in some states, in improving health workforce availability. Overall, contract hiring was considered more successful in filling vacancies at the level of BEmONC provider (generalist medical officers, nurses, ANMs) or health facility administration, but to have had "very marginal" (KI_12, government technical and development partner) success in recruiting specialists who could provide CEmONC. Improving the availability of specialists in government healthcare facilities is stymied by the fact that highly trained medical professionals simply do not want to live in marginalized rural areas: "in remote areas [there's] no education for children, and no development, they don't want to stay" (KI_12, government technical and development partner).

Developing a Community-Based Care

The NRHM's development of the Accredited Social Health Activists (ASHAs) community health worker cadre (launched in 2005) was also considered a driver of reduced MMR and NMR: "ASHAs were a game-changer in India's journey for improved health" (KI_03, civil society). ASHAs encouraged women and their families to have institutional deliveries, thereby increasing the percentage of facility births, by explaining the Janani Suraksha Yojana incentive to families, helping them receive the incentive, calling emergency transportation vehicles, and escorting women to facilities. In addition to demand generation for antenatal care and facility child birth, ASHAs also encouraged behavior change for nutrition, rest, and home-based care. While the NRHM included a broader vision for community ownership and accountability through health committees and panchayat respondents reflected that this had not been realised.

The Confidence to Try: Expanding Legal Protections for Health Workers

Several key informants noted that even when personnel were recruited and trained, health workers often lacked the confidence to attempt potentially lifesaving interventions for intrapartum women and newborns. This lack of confidence arose from health worker's recognition of their insufficient skills and lack of supervision, as well as from fear of reprisal if their intervention failed to avert a maternal or neonatal death. These reprisals could be legal, reputational, or in the form of direct physical violence from the patient's family members. In order for health workers to gain the confidence to attempt lifesaving measures, they required opportunities to practice skills, leadership that encouraged implementing new interventions, and a supportive legal environment.

> If something goes wrong, the community will blame them and the repercussions you keep reading the newspaper how the public medical interface results in so much of violence. So, nobody wants to get into that. (KI_11, government technical and academic)

Efforts to improve healthcare provider skills and leadership is an ongoing project discussed further in "Technical: lifesaving interventions in the government health system" below. Health workers' reputations and safety are protected by ensuring they have adequate skills and health system support and building relationships with families and communities. Several legal changes in India's obstetric and neonatal guidelines and regulations also encouraged health workers to expand the range of lifesaving care that they provided. One legal and regulatory change considered "a real game-changer" (KI_01, government technical) was authorizing ANMs and nurses to undertake active management of the third stage of labor (AMTSL) in emergency situations. Another was the 2014 update to home-based newborn care guidelines that permitted ANM to provide a "pre-referral dose" of Gentamicin (injection) and Amoxicillin (oral syrup) for sepsis in young infants and to provide the complete 7-day course at home in cases where the family did not accept a referral to a facility. By considering the first dose as a "referral dose" and by allowing home treatment only when the family refused or were unable to proceed with a referral, ANMs were not then liable if the treatment was unable to save the neonate.

> It's been saying that okay she gives the first pre referral dose. The idea is that we safeguard and say you're only giving the first dose. You refer the child. Or in the event let's say where the family refuses to accept to go and say "okay, you go ahead and treat my kid. And I take responsibility." Then she can [treat the child at home]... (KI_11, government technical and academic)

Generalist medical officers (MBBS doctors) who received skills upgrade training in lifesaving anesthetic skills (LSAS) and in emergency obstetric care were concerned about liability if the emergency interventions were unable to save a maternal or newborn life. In one state (Uttar Pradesh), the government provided them with legal protection, as discussed below.

> And also one of the big factor for these doctors were because they were generalist doctors were trained, some of them were also concerned about in case anything any complications etc. that happens if there are legal challenges around that. So government provided indemnity also. (KI_07, development partner)

In the private sector, hospitals that undergo the Federation of Obstetric and Gynaecological Societies of India (FOGSI) quality improvement program called Manyata became entitled to legal support from FOGSI in the event of an adverse outcome.

> FOGSI has said that if it is an accredited centre through the FOGSI-Manyata program, if there is any setback in case handling and litigation, then FOGSI will stand by it because it's all documented that these are the measures that were followed, but this case was so-and-so, so it's not negligence, it is, it's a one off thing, it can happen. So to that extent, yes, Medico-legal we can. (KI_09, government technical and private sector)

Overall, several key informants noted the value of combining quality improvement initiatives, skills training, supervision, and revisions to regulations and legal protections to ultimately increase staff willingness to intervene to save maternal and neonatal lives.

> The adequacy and the courage to give the right dose of magnesium sulphate and then transfer it [...] These things have really made a [difference]. And then the one golden minute for the newborn resuscitation: not waiting on the paediatrician who may be stuck in the traffic, but you can do it yourself kind of a training. So that way yes there has been a significant improvement in terms of the outcome and in terms of the complication minimisation and readiness for action. (KI_09, government technical and private sector)

Increasing Financial Flexibility and Accelerating the Flow of Money

The overall percentage of GDP spent on healthcare in India did not dramatically increase over the study period. Yet, several key informants suggested that a lack of funds was not the main issue as in many cases available funds remained underutilized.

> We stopped asking for an increase in the percentage of GDP, quite some time back. Because I think the problem was the utilisation rates. (KI_03, civil society)

The NRHM began to improve utilization by improving financial management and monitoring.

> I think what happened with NHM was that states had to kind of pull up their shoes [socks], and explain, why have I been able to spend the money, or not being able to spend the money. So I think what happened, was, see, the push was never vertical. So there were HR initiatives, there were infrastructure initiatives, there were community initiatives, there was training of, you know, the set-up of the cadre, there were untied funds given to the sub-centres. Um, so I think, I think, what happened with this intense, kind of, reporting back, monitoring, etc. was that states started utilising the money better. (KI_03, civil society)

Before the NRHM, state expenditure was "straight-jacketed" (KI_04, government technical and civil society) by strict financial accountability norms at the Centre. The Ministry developed RCH flexi pools, wherein states could spend money, such as paying out JSY, and from a pool rather than a tight line item. This ensured that the outgoing payments could continue uninterrupted from the flexi pool if the budgeted money fell short. The flexi pool could be replenished based on the state's financial reports.

> If you are short on money, kindly take money from other sources which you are not spending. And later on you can come back to us and say that this was the money which was, and you can write to us and we will, you know, give you sanction. (KI_04, government technical and civil society).

> With RCH I there was no flexibility at all. The center told you exactly what they should do, how much money you will get and where you're supposed to spend it. But in the RCH II they basically said, "Look, there are wide variations across states, you have unique state level and district level problems, so while certain things may be, like say JSY how much money should be given to a woman, but we'll also give you a certain percentage of the money as flexible so you can use that either for innovations or for plugging in gaps. It's really up to you." This, I think made a big difference. (KI_05, government administrative & private sector)

Financial flexibility extended to the facility level, wherein an untied fund was made available for each facility to use on purchases that prevented service disruption. This flexibility across the system had tangible benefits of enabling continuous financial flows ("When there is a need of money [...] everything comes to a standstill" (KI_05, government administrative & private sector) and supporting context-specific innovation. It also had the "intangible" benefit of boosting health worker morale and confidence.

> I remember meeting a head of the hospital in Madhya Pradesh a civil surgeon [who] had been given a discretionary amount which I believe was INR 5,000 a year. And he said, "For this INR 5,000, I don't have to consult anyone and if I see something, I want to get something painted or something else I can use the 5,000 on my own. I don't have to consult anyone." And I felt so embarrassed because that was sort of an amount I was spending on my hotel every day. But the message given here is that I think it also had an intangible impact on their jobs. Normally you see, for any district-level planner, it is very intruding if someone is constantly telling you, "This is what you need to do." So, what kind of planning do you do when there is no scope for doing anything worthwhile, even if you are imaginative? But here I think in my view, it made a difference also to them, to the quality of their jobs and that is very difficult to capture tangibly. So I think it made some difference. (KI_05, government administrative & private sector)

Efforts were also made to ensure that the centre's transfer of funds to the states and movement within the states were timely. "The financial management group spent a lot of time making sure that the financial systems in terms of ensuring that states got money on time, also speeded it up" (KI_05, government administrative & private sector). These efforts included the use of electronic wire transfers and an online Public Financial Management System (KI_04, government technical and civil society): "nobody writes a cheque anymore but at that time [the early 2000s], sending the money to the states was a big nightmare. So, I think they started doing this electronically" (KI_05, government administrative & private sector).

The government also expanded the availability of financially literate staff at all system levels, inculcated a problem-solving approach to addressing financial bottlenecks, and clarified expenditure guidelines. Prior to the NRHM period, the next disbursement of funds to a facility would be blocked when a health facility failed to produce a utilization certificate for the previous tranche of funds. But the NRHM introduced a new approach of hiring program managers who sought to understand why utilization certificates were not available and how these certificates could be accessed to fix the bottleneck. This new approach was aided by the hiring of financial experts who had essential qualifications such as MBAs in finance and chartered accountants. This shifted the burden of financial management away from "ward boys and nurses" (national stakeholder meeting). Administrators were given clearer guidelines and supported in "proactive spending" because "people used to be afraid" to spend and later be accused of a criminal offense (KI_04, government technical and civil society).

One key informant (KI_08, civil society) expressed disagreement, arguing that insufficient funding for government health care continued to be a fundamental issue rather than poor financial management. They explained that the majority of public money spent on health in India went to tertiary facilities and special health care for government employees: "if 10,000 rupees per capita is spent on a central government health employee, it's 600 for the ordinary citizen on the street" (KI_08, civil society). States also struggled to spend budgeted money not because of poor financial management but because their transfers came at the very end of the fiscal year, leaving no time to disperse the money.

Performance-Based Distribution to States Combined with Special Support for Those in Greatest Need

The Central government simultaneously rewarded high-performing states with additional funding and provided targeted management support for poor-performing states (called Empowered Action Group (EAG) states). Taken together, some key informants identified these two strategies as essential drivers of success in improving maternal and neonatal health care. High-performing states such as Tamil Nadu could access even more money to try new things while poor-performing states such as Uttar Pradesh received targeted support to improve their performance.

> […] Then if you do well, you get more money. […] In my eyes, this [performance based distribution] is one of the procedural reasons why states also paid ample attention in reaching NHM goals" (KI_03, civil society)
>
> Early on, Tamil Nadu was first off the block, a blue-eyed boy - blue-eyed girl, rather, and you know, they got financial envelopes even to do better. But for states which were not doing pretty well, they got clustered under the empowered action group, and more efforts were devoted to help, what they call the laggards. So I think it just, it just wasn't - it was a carrot and stick kind of a policy, right. It worked in the longer run. If you look at the trends in certain states like Bihar, which were really behind, they have almost caught up. I think that's a testament, in a way, to how some of the state-driven initiatives kind of showed results. (KI_03, civil society)

High mortality states received financial support, oversight and capacity-building inputs from the Central government.

> The major states which we visit in the northern and the middle, you know, states which are, you know, where the indicators are bad. So, we used to concentrate more on these states so that we could find out, you know, what their issues are, how we can solve them. […] These visits involved some accountability/oversight but also a lot of support in terms of enabling these states to utilise available funds to actually implement programs (KI_04, government technical and civil society).

> It wasn't just money. It was strength or capacity building, having workshops close and monitoring. And, I think that's the reason you'll find that the gap in performance between the high mortality and the lower mortality states, the gap is narrows typically. And apart from low-hanging fruit, I think it's also because there was an honest push from the centre level. (KI_05, government administrative & private sector)

Progress Review, Accountability, and Data

Many key informants emphasized the value of "more rigorous reviews and monitoring" (KI_12, government technical and development partner) introduced during the NRHM period, which took a supportive, problem-solving rather than punitive approach. This improved monitoring extended from high-level Missions down to staff supervision at facilities. Annual Joint Review Missions and Common Review Missions, most of which focused on high mortality states, standardized data reporting, and "made the system accountable" through visits to "check each and every thing" (KI_04, government technical and civil society). These review processes focused on recommendations and developing action plans for future improvement: "The more something is monitored and flagged, the impact does get better" (KI_12, government technical and development partner). The concept of supportive supervision came into being to encourage solving rather than hiding problems. The Health Management Information System was simultaneously developed during the NRHM period and supported this monitoring process.

> Monitoring also improved a lot, and there was a big focus, but the difference was that from the word monitoring came – supportive supervision. So, monitoring earlier was a sort of inspection. And, when it is inspection, people try to hide their fault and try to show you that everything is good. And then the scope of improvement is less. So instead of monitoring, we started calling it supportive supervision. There is a guideline RMNCH+A on the supportive supervision, where we've focused on the fact that you go there, not for the fault-finding, you go there to support the staff. If you see and observe any gaps, you don't start chiding them. You try to solve it. (KI_01, government technical)

Demand Generation: JSY and Health Care Markets

Janani Suraksha Yojana (JSY) considered to be the major driver of the shift from home birth to facility birth. Launched in 2005 as a component of the NRHM, JSY is a conditional cash transfer program given to the women who gave birth in health facilities and their ASHAs.

> JSY was a really kind of flagship program because at that point in time it was really, really important to increase the coverage of essential maternal health services. And a primary way to do that was to get women to come to hospitals. Because I think in 2005, uh, institutional deliveries were around, I don't know, 20-25%, I mean, there were a lot of home births, etc. So I think this trend of getting women to point-of-care started with JSY. (KI_03, civil society)

JSY's success was closely linked to the simultaneous rollout of the ASHA program because ASHAs helped spread awareness of the program and helped women navigate access to facilities. JSY was instituted because "in the early 2000s the [government] priority was really to get women into institutions for childbirth" (KI_06, government technical and academic), under the assumption that facility birth was safer than home birth. Several key informants (KI_08, civil society; KI_10, government technical and development partner) were critical of this assumption, arguing that almost all government facilities in the high mortality states lacked the staff and equipment to save maternal lives. They argued that this focus on generating demand for institutional birth came at the expense of strengthening the supply of lifesaving care at facilities and maximizing lifesaving care in communities, including reducing maternal anemia to avert postpartum hemorrhage.

> In 2005, when the JSY was announced, there was DLHS facilities survey data that said that public institutions did not have any capacity. So you pushed through a policy without having your system in place to handle what was going to happen. And the brunt of this was not borne by the providers. It was borne by the women. And their families. (KI_08, civil society)

What JSY did achieve, according to these key informants, was to "open up health markets" (KI_08, civil society) in states that had earlier not had much demand for private sector maternity care. Families no longer accepted home delivery and recognized that government facilities lacked capacity or referred them away from their local facility. Thus many turned to the private sector, despite many private facilities not providing JSY payments.

> So you had, with design, actually changed the whole ecosystem. From a continuum of care approach to a facility-based approach which was so incentivised. (KI_10, government technical and development partner)

> Health markets have been opened up in the northern states as a result of the JSY policy. […] If you look at states that already had a well-functioning private sector, Delhi definitely, then states like Punjab, Himachal Pradesh, Maharashtra, and the Southern states, you know they already had a functioning private sector. […] But the NRHM, JSY policy move opened up health markets in the northern states because women were already coming out of home for institutional childbirth, and the public system was failing them and turning them away. So, already, they were away from home, so they couldn't - most of them did not choose to go home, for a home delivery, they chose to try another hospital which was most likely going to be a private hospital. […] So a lot of normal childbirth, which is turned away by health facilities in the public sector, you know, a lot of sub-centers and PHCs turn away women who are going to have a normal childbirth anyway. Even the normal childbirth ends up going to the private sector. (KI_08, civil society)

While all key informants recognized shortcomings in government facility based care, especially when demand increased rapidly due to the JSY rollout, most felt that JSK's push into government facilities nonetheless saved maternal lives. Janani Shishu Suraksha Karyakram (JSSK), which was stated in 2011, was also identified as an important follow-on-demand side program that sought to minimize out-of-pocket expenditure by families who used government facilities for childbirth.

> Janani Shishu Suraksha Karyakram was a very thoughtful gesture, kind of recognising the out-of-pocket expenditure on transport and food, etc., and you know, ensuring that at least that got covered. And that did work, it actually did work. Because wherever you have money tied, or budgets tied to a scheme, it does actually get monitored. You know, because there's money. (KI_08, civil society)

JSSK was considered by some to be "a step in the direction of universal health care" (KI_04, government technical and civil society) because it ensured that families receiving delivery care and child health care (until the age of one year) in public health facilities will not incur any cost.

Maternal Survival

Access to BEmOC Through SBAS was the Major Driver of Reduced MMR in High Mortality States

In terms of technical changes, key informants emphasized the value of "low-cost, high-impact interventions" (KI_13, government administrative) in the high mortality states. Expanding access to BEmONC through training ANMs, staff nurses, and doctors in skilled birth attendance (SBA), and increasing access to these providers through facility births, was considered the central driver of reduced maternal and neonatal mortality in high mortality states. Access to CEmONC and specialists (particularly paediatricians, obstetrician-gynecologists, and anesthesiologists) in high mortality states increased only gradually and thus was not considered to have been a major contributor: "expecting medical officers and specialists to be there at the peripheral level, at PHCs, CHCs was a very, very difficult task. […] Some states did not succeed" (KI_12, government technical and development partner).

In high mortality settings, respondents noted that basic interventions, in conjunction with reduced fertility and improvements to the social determinants of health (discussed in "Context"), are sufficient to reduce maternal deaths to fewer than 100 per 100,000 live births and neonatal mortality to below 30 per 1000 live births. Several respondents drew from historical cases in other countries, showcasing how much could be achieved without widespread access to caesarean sections and neonatal intensive care units.

> To save the lives of mothers and newborns, you don't really need specialists. […] There will be few, very severe cases where you need them. But in our current situation where mortality is above 70-80 of MMR, you can manage with BEmONC and SBAs. You know, in 1930s, 40s, 50s, in U.K., the mortality reduced from 500-600 to less than 100, just by introduction of antibiotics and oxytocin use, and maybe use of eclampsia cocktails. Caesarian sections started after 1955 . But UK/Europe had reduced mortality substantially with infection prevention, with PPH [post-partum hemorrhage] prevention, PPH treatment, and maximum death reductions had happened even before caesarian section was introduced (KI_12, government technical and development partner).

The specific BEmONC components that became available at many health facilities, and that could be administered by ANMs and nurses without doctors' prescriptions, were: antibiotic use to prevent or treat maternal or neonatal infections, magnesium sulphate for pre-eclampsia, the active management of the third stage of labor through prophylactic administration of misoprostol or oxytocin, digital removal of visible parts of the placenta remaining after birth, neonatal resuscitation, and the use of IV drips.

> Not many people may talk about it or even understand the enormity of it, but I think under the SBA initiative when tasks were shifted and the government allowed and trained ANMs and staff nurses to do some of the skills, I think that was, that would have ended up in saving many, many lives. (KI_03, civil society)

> 70-80% of deaths could be avoided just by a judicious use of managing PPH, oxytocin, misoprostol, having proper antibiotic coverage to prevent sepsis, and giving mag-sulf for eclampsia; these were all the things nurses could do. […] These were low-hanging fruits, and unnecessarily women were dying, which could be prevented using these simple tools (KI_12, government technical and development partner)

The introduction of simplified partographs during SBA training to monitor foetal heart sound and cervical dilatation were also highlighted as an important improvement to maternity care: SBAs were told, "If that graph changes from alert to action at that point of time, you just refer, don't apply your gray matter" (KI_01, government technical), which increased timely referrals. SBA training improved not only intrapartum and postpartum care but also improved antenatal care, mainly through the identification of high-risk pregnancies.

A critical feature of the increase in access to BEmOC was the decision to stop training traditional birth attendants (TBAs) and instead focus on skilled birth attendant training for ANMs, staff nurses, and doctors. During CSSM and RCH I, TBAs received training in clean home delivery and timely identification of complications and referral. However, global recommendations were shifting away from TBA trainings. Several studies in India found that TBAs "were not able to identify the complications on time" (KI_01, government technical).

> So, at that point of time, we decided that this is the time that we should shift from TBA to SBA. There was big resistance from the NGOs and other groups and many of the public leaders also because that a big force at that point of time, but then we tried to convince, we tried to resist. And what we did was that at that point of time, we said, "Okay, TBAs will be there in the scene, but they will be there for all the activities except deliveries. So, they will be there for neonatal care, some care to the child, bringing women to the health facility, bringing them to the health facility and from health facility to follow up and so on. So we had identified certain things, for the TBA and incentives were also being given to them, but we shifted to SBA and a three weeks training were organised. (KI_01, government technical)

While the country shifted away from TBAs, it simultaneously tapped into the potential of AYUSH doctors as skilled birth attendants. AYUSH doctors are trained in Indigenous and alternative systems of medicine (Ayurveda, Yoga, Naturopathy, Unani, Siddha, Sowa-Rigpa and Homoeopathy) and were more widely available at health facilities than MBBS doctors and, when provided with SBA training, were found to be "able to conduct deliveries and also manage initial or basic complications" (KI_01, government technical).

What Enabled the Shift towards SBA?

The shift towards skilled birth attendance necessitated that the MoHFW push through two major policy shifts: phasing out TBAs from intrapartum care and training ANMs and nurses as skilled birth attendants. Removing TBAs from an intrapartum role was fraught. Some key informants (KI_06, government technical and academic) were critical of this decision, noting that the Jamkhed project in India and Bangladesh's experience showed that trained traditional birth attendants and home births were compatible with a decline in maternal mortality. However, government actors became convinced that TBAs could not become skilled birth attendants based on several domestic studies finding that even with training, TBAs could not appropriately identify and refer complications during childbirth.

Expanding the role of ANMs and staff nurses was also controversial, albeit less so. Some informants argued that it is not advisable to expand ANMs roles because of weak referral network: "there were many who were saying, no-no-no, ANMs, you know, there's no referral network, uh, you know, they will end up just killing women" (KI_03, civil society). Others worried about both ANMs and nurses administering antibiotics and magnesium sulfate without a doctor's supervision: "people were skeptical" (KI_12, government technical and development partner). However, the Ministry was convinced that task shifting to ANMs was essential to reduce MMR and convened 26 meetings in the space of 7 or 8 months in 2003-2004 to bring all stakeholders on board with the changing roles for ANMs and nurses as SBAs: "Ministry organised, Ministry convened and led meetings, where everybody was brought to one room" (KI_03, civil society).

> We worked really, really hard to bring around complete consensus from [the] private sector, from government, from practising physicians in the government sector, to ensure that task shifting happened. (KI_03, civil society)

Using the most recent international evidence available, the authorities carefully debated and discussed every decision, including details on how the new roles would be performed,. Ultimately, even FOGSI, which could have been expected to oppose "giving away skills" (KI_03, civil society) from doctors to nurses and ANMs, supported task shifting. The reality of insufficient access to specialists and even generalist doctors was clear, leading to alignment and even excitement that this change would move India towards the goal of saving women's lives: there "was something really, really optimistic and encouraging which happened at that time, and we were all so excited that it's going to happen" (KI_12, government technical and development partner). A "media out lash" that some predicted never transpired because of widespread support and justification for these changes (KI_12, government technical and development partner).

Furthermore, the task shifting of work to nurses and ANMs resulted in medical officers (generalist MBBS doctors) approaching the Ministry for their own skill upgrades that would enable them to perform the skilled birth attendance roles that nurses and ANMs would be trained in. In addition, task shifting was extended to train general doctors in life-saving anaesthesia skills and EmOC emergency obstetric care skills.

Neonatal Survival

India showed global leadership in community based neonatal care policy and improved capacity to avert later neonatal deaths (deaths after the first 48 hours)

CSSM first introduced neonatal survival to the national strategy (KI_11, government technical and academic), but it was not until the development of India's integrated management of neonatal and childhood illness (IMNCI) strategy in 2003 that targeted efforts were made to address mortality in the first month of life. IMNCI (delivered primarily by ANMs) was considered the major driver of reduced NMR in the 2000s (KI_10, government technical and developvment partner; KI_11, government technical and academic), with HBNC delivered by ASHAs subsequently playing an important role from its initiation in 2011: "These community based interventions played a big role in reducing the neonatal mortality and morbidity" (KI_01, government technical). Taken together, these two strategies "demystified" neonatal care, creating an understanding that families, health workers in the community, and at lower-level facilities could take action to improve neonatal survival.

> I think it was in India that home-based newborn care originated. It demystified the newborn. They actually removed the medicalization and the infrastructure, and the institutionalisation of newborn care, from a nursery, or an intensive care nursery, to the family home. (KI_10, government technical and development partner)

Early newborn survival policy focused primarily on infection, hypothermia, and asphyxia, the main drivers of death. Low birth weight and preterm infants were not prioritized in high mortality states (KI_11, government technical and academic). Thus efforts to save neonatal lives primarily involved home and community-based care for preventing and treating infection, promoting breastfeeding, and ensuring warmth, with some efforts to improve delivery room management: "these were the pillars around which the initial newborn essential care program was launched" (KI_11, government technical and academic). "India was one of the first countries to start continuous home visitation for newborns and then added young infants" (KI_02, government technical and development partner). Foetal heart monitoring devices, pulse oximeters for pneumonia, and KMC innovation intervention "have added up over time" (KI_02, government technical and development partner). Key informants ultimately credited low-tech, community, and behavioral interventions (including reduced fertility) with saving most neonatal lives.

India benefited from the presence of neonatologists who crossed over from clinical practice to public health in order to shape public policy. Through the leadership of these neonatologists, India extended the WHO's IMCI guidelines to include neonatal illness, thus introducing IMNCI and building the WHO's essential newborn care guidelines.

Global resistance to adding the "N" was tied to the number of days of training required to include neonatal care and the budget to pay for that additional training. But India's public health leadership was adamant that neonatal care had to be included in IMNCI, and, later, that home-based newborn care be implemented. Their confidence in these stances was tied to the Society For Education, Action, and Research in Community Health's (SEARCH) work showing that rural community health workers in Gadchiroli dramatically reduced NMR and follow up research through the Indian Council of Medical Research (ICMR) that showcased the ability for community health workers to save newborn lives. Widespread recognition that doctor-based tertiary care was unfeasible in the near future solidified willingness to implement community-based strategies.

Innovation and Partnership Were Crucial for Training Frontline Workers in Newborn Care

Implementing the N in IMNCI and later training ASHAs in home-based newborn care required innovation and partnerships. Many ASHAs lacked basic numeracy and literacy, and skilled trainers were in short supply. Tools to facilitate counting were developed, and movie-based training and simulations were used (KI_11, government technical and academic). UNICEF and the WHO were instrumental in rolling out IMNCI training in Madhya Pradesh, as was the Norway-India partnership (NIPI) for HBNC training in Bihar.

Averting Early Neonatal Deaths (First 48 Hours) Remains a Challenge

While there was significant progress on community-level care for newborns, key informants expressed that interventions to save small and sick newborns in the first 48 hours of life lagged behind interventions for maternal survival (KI_11, government technical and academic). As primary care interventions (such as thermal care, hygiene, and exclusive breastfeeding) brought NMR down, primarily through preventing later neonatal deaths, the cause of death shifted from infection and hypothermia to low birth weight and preterm babies who require "intensive technology-driven care" to save (KI_11, government technical and academic). In addition, increased access to caesarean sections saved maternal lives but resulted in a greater portion of preterm births; preterm infants are a "relatively bigger challenge" (KI_11, government technical and academic) compared to low birth weight full term infants (who experienced intrauterine growth restriction). While preterm infants require lung support, low birth weight full-term infants, while still very fragile, require fewer interventions (feeding support, temperature control). Moreover, many women came for institutional delivery who had not had adequate antenatal care so would arrive anemic, hypertensive, or with a growth-restricted fetus. In these cases, "while the mother may be salvaged because you reach the hospital [...] the baby can't be sorted out because he's lived for 8 months or whatever period in an adverse environment, comes asphyxiated..." (KI_11, government technical and academic). There was no one with neonatal lifesaving skills such as resuscitation. And even if the infant were resuscitated, "it's a very tiny baby. So, you run into other complications. Your health systems are not ready to answer those" (KI_11, government technical and academic).

While CHCs/FRUs were supposed to have newborn stabilisation units that could handle most small and sick newborns, the reality was that most small and sick newborns only received basic interventions such as kangaroo mother care and had to be referred to special newborn care units (SNCUs) at District Hospitals for more comprehensive care. Without a paediatrician available at PHCs and CHCs/FRUs, even nurses and doctors who received training in lifesaving technical neonatal interventions (neonatal resuscitation, sepsis treatment, etc.) would be unlikely to apply these skills. District Hospitals too often operated without paediatricians or other specialists on the floor (KI_11, government technical and academic). However, the periodic availability of specialists, while sub-optimal compared to 24/7 availability, at least enabled nurses and medical officers who had been trained in neonatal health to perform interventions with periodic supervision.

Infrastructure: Strengthening the Capacity of Some Delivery Points

The Ministry of Health and Family Welfare has launched successive policies to improve health facilities in terms of human resource availability and infrastructure. Under CSSM, first referral units (FRUs) were introduced, which were health centres that had 24-hour capacity to provide caesarean sections. RCH I involved efforts to operationalize these FRUs but most continued to lack the specialists (obstetricians and anesthesiologists) as well as blood storage capacity. The NRHM brought another round of efforts to equip FRUs through contract based hiring and skills up-gradation (both discussed above), and changes to regulation that enabled facilities to set up blood storage units (KI_01, government technical). SBA training within the NRHM was coupled with improvements to the clinic environment, by focusing on recruiting support staff and improving supply logistics, to facilitate ANMs and nurses to apply what they learned (KI_12, government technical and development partner). Over 600 Maternal and Child Health wings were set up in District Hospitals and FRUs to expand their in-patient capacities.

The NRHM also introduced geographic mapping, and demand-based planning wherein states identified the number of deliveries that could be expected in each block and the facilities currently handling deliveries. The NRHM then provided the facilities with the necessary financial support to improve capacity to handle deliveries while also building additional facilities to fill gaps (KI_04, government technical and civil society; KI_12, government technical and development partner). Furthermore, the NRHM period saw the introduction of the Indian Public Health Standards (IPHSs) to set standards for care in all health facilities, including the equipment that must be available in each room (KI_04, government technical and civil society).

However, several key informants (KI_08, civil society; KI_11, government technical and academic) explained that, in high mortality states, the IPHSs were rarely met, and sub-centres, primary health centres, and most community health centres continued to lack the capacity to deliver all aspects of BEmOC, much less CEmOC. Staffing shortfall remained an ongoing issue. In some particularly high-need areas, the only government facilities conducting caesareans in the public sector were medical colleges and some District Hospitals.

There was more than 80% shortfalls in CHCs of gynecologists, surgeons and anesthesiologists [...] if the health workforce is not in station, the best policy cannot be implemented. And I am telling you that 90% of doctors in India are not in public hospitals. They work in the private sector. So no matter that you try to make your FRU well equipped with an OT [operating theatre] and all the equipment needed, if you do not have the human resources needed for a functional FRU, the buildings and the equipment and the budgets are not really going to lead to an effective outcome. [...] You know, I'm not imputing that the policies were wrong. The policies were completely well intentioned. But they missed out the elephant in the room which is the fact that there is no skilled workforce. (KI_08, civil society)

So, where were maternal lives being saved? Respondents generally agreed that in high mortality states, lives were saved in PHCs and CHCs by ANMs, nurses and generalist doctors practicing aspects of BEmOC. Additional lives were saved through referral or direct access to CEmOC at activated FRUs, District Hospitals, and medical colleges. In low mortality states, deliveries were increasingly channeled directly to hospitals where access to CEmONC was increasingly the norm. Across almost all states, health sub-centre deliveries were slowly phased out so that deliveries happen at better-staffed and equipped facilities and so that health workers are exposed to sufficient patient load to keep their skills up (KI_04, government technical and civil society)

We conduct deliveries only at medical colleges, District Hospital, Sub-Divisional Hospital or maybe Community Health Center. That's the end of it. Don't deliver below because complication happens and then, you know, people run around and it's very difficult for people to get proper care in the time which we have. It's a very limited time in which complication happens. You are left with very little time. (KI_04, government technical and civil society)

In terms of neonatal lives, many infection and hypothermia related deaths are averted through community and home based interventions. Lifesaving care for small and sick newborns was only available at the District Hospital and Medical College levels in high mortality states. While CHCs/FRUs are to have newborn stabilising units with a pediatrician, short-term oxygen, fluid and warmth to stabilize neonates before referral, these stabilization units at FRUs "didn't take off" (KI_11, government technical and academic)

Unfortunately, the middle level that the newborn stabilising units didn't take off. We still know in most of India the middle level is really non-functional. [...] Now largely every sick kid lands up being referred to the District Hospital, to the SNCUs, which are quite, quite oversubscribed" (KI_11, government technical and academic)

The Pendulum Swings: Facility- Vs. Community-Based Care

Several key informants (e.g., KI_12, government technical and development partner; KI_08, civil society; KI_10, government technical and development partner) said that the mortality decline, particularly for neonates, could have been faster if the government had focused even more on basic interventions rather than facility-based CEmONC (which did not improve that much) in high mortality states. For instance, KI_08 (civil society activist) pointed to Sri Lanka's experience, showing that MMR can be brought down from over 500 to 200 with basic interventions and fertility reduction; to further bring it down, attention should be given to reaching the most marginalized population pockets – "migrants, adivasis, and people working in closed-off areas such as tea estates, coffee plantations" (KI_08, civil society) – and then to CEmONC. KI_10 (paediatrician and neonatologist, advisor to government) explained that facility-based interventions had become "sensationalized" with, for example, special newborn care units (SNCUs) being prioritized at the expense of home-based newborn care (HBNC) or a continuum of care approach. Instead of providing both HBNC and SNCUs with the budgets and incentives they needed -- with equal political will, data collection, computers, data analysis, human resources, mHealth/digital health, training modules – SNCUs received far better inputs. It was "almost a decade later on" that the health system leadership realized that home-based care was necessary and had been neglected, and recognized that facilities were failing to deliver necessary services.

And lo-and-behold, when Lancet started talking about it, when the global leaders started talking about it, when there were academic institutions in India that were raising that red flag, you said, 'Oh my god, we need a continuum of care and we also to look at the home, and we need to look at all of that'. But I think the damage had been done. The behaviours in families, specifically with regard to rural families had been changed. That you get money to go to a place to deliver, why not, why not go there? And the health provider got a share of that, the facility got a share of that, the development partner)

Some respondents reported that although this pendulum swung too far towards trying (with limited success) to strengthen FRUs and hire specialists for CEmONC, it has gradually found a degree of equilibrium due to two changes. First, basic and home-based interventions have increasingly received the attention they need. Second, efforts to strengthen comprehensive, higher-level facility interventions have continued, but these efforts now better meet the states' stage in the obstetric transition, wherein mortality rates are now low enough that a focus on CEmONC makes sense to go the "next mile" (KI_12, government technical and development partner): "I think that we saw the pendulum actually swing, to-and-fro, till we reached a point in time where now there's a bit of a semblance" (KI_10, government technical and development partner). This equilibrium has enabled most of the population in high mortality states to access BEmONC and some to access CEmONC through referral.

> To some extent this did have a good impact. … All these strategies when taken in a holistic way, […] districts with very high mortality did show a turnaround over these 10-15 years. (KI_13, government administrative)

> And now, thankfully, coming back around to the continuum of care. […] Home-based newborn care […] is today accepted. But we lost almost a decade in between where there was a polarity between the advocates of home-based newborn care versus the advocates of the facility-based care. (KI_10, government technical and development partner)

Safe Abortion

Although legal for over 50 years, around the launch of NRHM, there was renewed effort to make abortion safe and accessible.

> I think around the mid-2000, right after the launch of NHM, the safe abortion policies and programs also, […] the kind of priority placed on safe abortion programs also contributed to the decline of maternal mortality. (KI_03, civil society)

However, most of the improvement in access to safe abortion was an increase in the availability of medical abortion: "the significant determinant was this, rampant use of medical abortions" (KI_12, government technical and development partner). Most of these medical abortion pills were made available through private sector pharmacies rather than government efforts (KI_08, civil society).

Emergency Transportation and Referral

Many respondents emphasized that emergency medical transportation has played an important role in reducing MMR and NMR. "Close to 28,000 vehicles were added" during NRHM/NHM (KI_04, government technical and civil society). Ambulances increase the speed and reduce the cost of reaching healthcare. Moreover, the ambulance drivers know to take patients to the facilities that have supplies and staff.

> Referral transport was scaled up across the states in a big way. And I think that helped in terms of very fast, shifting of bleeding or an eclamptic woman. So, right from the village of Primary Health Centre levels, straight away a woman could be taken to a medical college or a district hospital (KI_12, government technical and development partner)

In high mortality state clusters, where women will continue to deliver at PHCs that lack CEmOC capacity, saving lives is "completely dependent upon the network of transport" (KI_08, civil society). Improved referral protocols have been designed, wherein providers call ahead to check that the obstetrician is available and to alert higher-level facilities to an incoming referral (KI_04, government technical and civil society).

> The health personnel is going to phone call. Give a call that is facility available and is the obstetrician there and if they say no, it's not...he's not available, he's on leave or like that then the patient has to be transferred to District Hospital. (KI_04, government technical and civil society)

While intrapartum emergency transportation was greatly strengthened in high mortality states, a key informant asserted that neonatal transportation had remained "pathetic" (KI_11, government technical and academic). Preterm or sick infants are often moved without proper emergency support and even stable babies can decline in transport, arriving at tertiary facilities in very "bad shape": "How to offset the damage of two hours or three hours of transport?" (KI_11, government technical and academic). Tamil Nadu was highlighted as a low mortality state with excellent emergency transport for neonates.

> Tamil Nadu set up some dedicated neonatal transport systems when they set up the transport systems, aware... It would transport babies from one place to another in a very stable manner. It had all the warming facilities, oxygen, everything else that's required. And it used to be accompanied by a trained nurse or a doctor or often a nurse would make sure that the kid was deposited there. (KI_11, government technical and academic)

From Access to Quality

Many respondents reported that maternal and neonatal survival momentum in India was sustained into the 2010s through increased attention to the quality of care.

> From the years, 2010-12 onwards until now where there has been this intended intentional, transition from being focused or even just monitoring access [...] to get into quality of services. Both at facilities and outreach [...] So, so that shift from numbers to quality of care approach or paradigm. (KI_07, development partner)

Indian Public Health Standards (IPHS) for facilities and guidelines for HBNC were developed and periodically updated beginning in the 2000s, which signaled greater attention to standards and quality.

> Bringing IPHS helped the States in getting a vision that you have to achieve up to these standards. The standards helped, and the various guidelines also helped the states in achieving the standards and the quality. (KI_01, government technical)

The NRHM's extension into the National Health Mission in 2012 brought with it several quality improvement initiatives: the introduction of quality assurance guidelines; Kayakalp awards given to facilities that met sanitation standards; LaQshya, a flagship quality improvement program; Navjaat Shishu Suraksha Karyakram (NSSK), basic newborn care and resuscitation training; the safe childbirth checklist initiative by Jhpiego in Rajasthan; SUMAN, the government of India's service assurance program; and Daksh and Dakshata national and state-level skill labs and training.

> And of late there have been a lot of focus in terms of primarily for the quality improvements whether in terms of facilities, caesarean deliveries and now the accreditation with LaQshya. (KI_02, government technical and development partner)

Over time the government came to understand that "not everything can be solved by competency building initiatives" (KI_07, development partner). Thus structural supports were provided to the states to build an enabling context for these quality improvement initiatives: operational guidelines and FRU operationalization, funding for training of trainers, and additional program monitoring. More recently (from 2017), the government has sought to improve pre-service education for ANMs and nurses though improving the management of nursing colleges and the capacity (in terms of both teaching skills and clinical knowledge) of faculty (KI_04 government technical and civil society).

This shift from access to quality arose from two inputs: First, the NHM evaluation's (2010-2012) finding that, despite increasing institutional deliveries, maternal and newborn survival was not as impressive as other countries. Second, a large national conference called "moving away from numbers to quality of care for RMNCH services" was organized by the MOHFW. This conference was attended by the Additional Secretary and Mission Director for the NHM and several state secretaries and mission directors. It solidified the government's shift in focus and sent a clear message to the states.

Enablers of Change

What drove improvement in India's government health system, particularly with the major health system changes introduced in the NRHM? Respondents reflected on the sources of political will and the role of evidence, domestic leadership, external development partners, and processes that encouraged and motivated national and state-level actors.

Confluence of Factors Generated Political will

The government of India's willingness to develop and launch the NRHM arose from a confluence of factors: "There were a lot of different kinds of events, data, coming together of people, which kind of helped bring in many elements in the National Rural Health Mission" (KI_03, civil society). The newly elected United Progressive Alliance government was motivated to introduce a dramatic new health policy. Data showing an unexpectedly high MMR galvanized national leadership and development partners to act. National Family Health Survey (NFHS) 2 results released in 1999 - 2000 showed that India's MMR was "way higher" (KI_03, civil society) than what the sample registration survey had estimated caused alarm and spurred action. "Large international initiatives" (KI_07, development partner), particularly the Millennium Development Goal on maternal mortality, were discussed by multiple respondents (KI_03, civil society; KI_07, development partner) as an essential source of pressure to improve maternal survival.

> Why this happened was because there are international commitments. The MDGs were being highlighted, international conferences and seminars on maternal mortality, child mortality were being organized and there the political leaders and the ministers and the administrators were being invited to chair the session, to organize different topics. WHO was involved, UNICEF was involved so many other organisations were there. Safe motherhood campaign came, White Ribbon Alliance came. So, all this movement helped in sensitisation of the political people also. (KI_01, technical government)

> India wanted to reach, try and reach the maternal mortality - MDG 5 -- at that point in time. We sometimes undermine the interest of a country to reach some global goals, to look good, in front of a kind of global community. (KI_03, civil society)

> So all these international platforms [...] started us on that path of understanding why these areas are so important to address [...]. So that's one big element. (KI_07, development partner)

India was interested in presenting a modern and progressive international image; being "at the bottom of the heap" (KI_03, civil society) in terms of maternal and child health indicators was at odds with this image

> I wouldn't want to get into the [...] the political party thing, because the whole problem of so many mothers and babies dying, it resonates across the political spectrum. Its, it doesn't look good for a country like India to have such disappointing level of status indicators. (KI_12, government technical and development partner)

While India was heavily influenced by international pressures and expert advice on maternal mortality, KI_10 (government technical and development partner) suggested that "it was the Indian story that was influencing global dialogues" on neonatal mortality. Indian experts were "very well represented" (KI_10, government technical and development partner) in global platforms focused on neonatal survival. It is noteworthy that grassroots citizen demand for progress on maternal and neonatal survival did not emerge as a major driver of political will.

Evidence-Based Decision Making

Several respondents discussed strong use of evidence generated through academic studies, routine surveys, and program evaluations in driving policy. The NRHM was designed based on research conducted in India and other countries to "understand what really works and not invest resources and time in reinventing the wheel [or in] something that has proven to be a failure" (KI_03, civil society). For example, evidence from Egypt and Sri Lanka presented at White Ribbon Alliance conferences provided insight into how these countries achieved rapid reductions in maternal mortality in the early 2000s (KI_03, civil society). Published academic literature, such as a 2014 Lancet paper on the timing of maternal and neonatal death (KI_04, government technical and civil society), spurred Indian health system actors to improve SBA. When developing the SBA initiative, the Ministry drew from WHO and EU guidance around allowing auxiliary workers to provide Misoprostol, Oxytocin, and Magnesium Sulfate. The use of Antenatal Corticosteroids for immanent preterm birth was ramped up then slowed down at the periphery in India based on global evidence. Initially, these steroids were rolled out for use by ANMs and nurses to improve lung function in premature neonates. However, implementation research from several Asian countries found that the use of these steroids caused more harm than benefit in settings without accurate gestation age estimates, resulting in India scaling back this intervention (KI_11, government technical and academic).

As noted above, the impressive reduction in NMR achieved by SEARCH's work with community health workers in Gadchiroli and follow-up research on the same model conducted by the ICMR generated proof-of-concept for HBNC delivered by ASHAs. Routinely collected survey data and evaluations all generated information on progress and shortcomings, and motivated change.

> Periodic NFHS surveys, DLHS was started at that time, every two years. The data which comes and which shakes up the system, that old things are stagnating, and nothing is improving and you need to do more. (KI_12, government technical and development partner)

The 2010-2012 NHM evaluation showed that despite moving deliveries into health facilities, the decline in MMR and NMR was "much flatter than what was probably seen elsewhere in the world" (KI_07, development partner). This research "triggered the whole dialogue on what's missing in our case" (KI_07, development partner) and led to a shift toward quality of services rather than just access to facilities. While all respondents agreed that India has a strong evidence-based policy environment, several (KI_02 government technical and development partner; KI_08, civil society) noted that implementation of these policies has been poor and inconsistent:

> India is very rich in terms of policy ... in terms of globally accepted evidence-based public health interventions. There, yes, India is probably one of the richest countries in the world... But in terms of implementation, there are a lot of differences across the country. (KI_02, government technical and development partner)

Exceptional Leaders

A major driver of improved neonatal and maternal health identified by several respondents has been issue-specific "champions" in different stakeholder groups (political, bureaucratic, academic, civil society, corporate, media).

> So at times we have had political champions, at times we have had bureaucratic champions, at times we've had civil society champions, at times we have had corporate champions, at times we have seen media play a role of a champion. Which, I think, has contributed as a driver in a big way. (KI_10, government technical and development partner)

The NRHM was celebrated for bringing together leaders from multiple groups to collaborate on its design. Government policy particularly benefited from engaging leaders from academia, civil society, and the private sector, the leaders of the Indian Academy of Paediatrics, the National Neonatology Forum, FOGSI, the All India Institute of Medical Sciences, PGI Chandigarh, CMC Vellore, Belgaum Medical College, etc. (KI_10, government technical and development partner).

> So, if you look at policy level change, yes of course, eventually the letter gets signed by a government official. A bureaucrat, or a technocrat. But if you look at who brings that story to them, who advocates for that particular story, who ensures that the story moves, it has been academia. And in academia, it has been the private sector providers, Gynaecologists, obstetricians, neonatologists, paediatricians, who have been the leaders. (KI_10, government technical and development partner)

Several key informants (KI_10, government technical and development partner; KI_09, government technical and private sector) noted that the program failed to utilize the influence of private sector leaders to push tertiary level care that benefited private practice. Instead, these leaders encouraged primary level basic lifesaving interventions such as misoprostol, thermal protection, the early initiation of breastfeeding, and chlorohexidine. There were "many champions from within FOGSI" (KI_09, government technical and private sector) for emergency obstetric care training for ANMs, nurses, and generalist doctors.

Specific state-level leaders were also noted as instrumental in leveraging the structural changes brought about by the NRHM, to initiate rapid changes to reduce MMR and NMR. Multiple respondents (KI_05, government administrative & private sector; KI_10, government technical and development partner) highlighted Bihar's leadership, especially the chief minister, who introduced "dramatic" changes that "were way ahead of central government" (KI_05, government administrative & private sector).

Development Partners: A Little Money, A Lot of Influence

Despite the fact that development agencies (WHO, World Bank, UNICEF, USAID, DFID) contributed a very small portion of India's health expenditure, these actors have had a major influence over policy changes in the last 20 years.

> Well most of the changes in the developing countries in general, and India is no exception to it, most of it is externally driven. You see, it is World Health Organization and then World Bank, UNICEF. (KI_06, government technical and academic)
>
> I'd still say that it [policy] is largely driven by that global movement and that movement coming into India and turning into a local movement. (KI_07, development partner)

Although donors had a "miniscule" financial contribution to the NRHM/RCH II, their contribution was "in terms of the intellectual debates, the focus on the right priorities and the most high impact interventions, the kind of discussions which take place, using all the global evidence available" (KI_12, government technical and development partner). Donor involvement "opens the mind of bureaucrats and leaders" (KI_12, government technical and development partner) and donor funding is far more flexible than government budgets. Thus donor money was used to try out or scale up innovations that were identified by the technical support units. Donors also enabled consultants to be hired whose inputs improved a range of health system functions, including the supply chain and data management and analysis. In many cases, the Government realized the value of these external technical professionals and, when the donor project ended, embedded these positions in the NHM budget as a government employed public health experts, data managers, and supply chain managers at the block and district level. The government's investment in these actors "are very important building blocks" – and early investment in this area of human resources "all started with the donors, but it was taken up and adopted by the government" (KI_12, government technical and development partner).

Many KIs considered development partners to have been largely an asset, who brought evidence-based approaches, built domestic capacity, fostered political momentum to improve maternal health, and introduced Indian governmental actors to experiences that had worked in other countries.

> Development partners [...] actually brought in that ecosystem understanding on where we are and what we need to do to address some of these challenges, which are actually important, not just from Indian perspective but from a global disease burden perspective. (KI_07, development partner)

However, some key informants (KI_06, government technical and academic; KI_10, government technical and development partner) considered these international agencies to have pushed a problematic public health agenda in India, and overall had a negative or mixed influence. Specifically, international donor agencies were seen to have too much of a Western-centric approach to healthcare that prioritized high-tech facility-based care over home- and community-based strategies. For example, KI_10 explained that UNICEF "unfortunately" pushed the agenda on SNCUs right before HBNC could start making an impact. "And the SNUCs had the backing of the UN. UNICEF were the ones who funded the initial pilots, the UN mandated their scale-up" (KI_10, government technical and development partner). This focus on facility-based care undermined efforts to save neonatal lives through HBNC.

Motivating National and State Level Actors

Encouraging and motivating national and state level government health system actors was another important driver of change. Global exposure and cross-pollination between states were both identified as mechanisms that encouraged health system administrators and technical advisors and enabled them to learn about the latest evidence and governance systems.

> For example, in 2017, I was sent to Japan. And from where I came and I told our, you know, higher ups that midwifery needs to be implemented in India. [...] The program officer at the central level was exposed to the global arena where they used to travel, they used to travel the states also." (KI_04, government technical and civil society)

Under the NRHM, health system managers from multiple states were brought together to "cross-pollinate" – e.g., to share ideas and exchange advice, support, and stories. Activities that brought program officers together and exposed them to issues beyond their region included common review missions and joint review missions, as well as annual innovation summits and workshops convened by the Government of India.

> We used to have regional workshops, where we would get these four to five states together and spend two days discussing what they're doing. It helps enormously, they feel motivated and it's also a means of disseminating ideas across other states. So, the head of one state will listen in and then he'll find something interesting with another state which is doing something but has some relevance for his own state or scheme. So informally, they exchange notes. (KI_05, government administrative & private sector)

The (limited) role of the private sector in India's success

Most respondents considered the private sector to have played a limited role in reducing India's overall MMR and NMR compared to the "massive expansion of public sector" that has occurred to serve the populations with the highest need: "the interiors, the blocks and villages and in remote tribal areas, very poor population, vulnerable groups" (KI_12, government technical and development partner). "Number wise, I probably say that their [the private sector's] contribution to reduction might not be substantial" (KI_07, development partner). In high mortality states, a relatively small percentage (20%) of deliveries occur in the private sector (KI_03, civil society). In low mortality states, the private sector handles a much higher percentage of deliveries (KI_04, government technical and civil society). But in both clusters, the private sector has generally continued serving the same, wealthier portion of the population throughout the last two decades.

> Private sector has been and will continue to be serving a segment of population which has always been there. And the mortality in that segment of relatively wealthier population is miniscule. Because of their overall vulnerabilities and poor access and lower socio-economic status the poor quintile go to public sector and have a higher mortality risk. The same kind of people are not going to private, which are going to public. Woman with higher mortality risks are being treated at public facilities, therefore contribution of private sector in mortality reduction is limited. (KI_12, government technical and development partner)

> I think private sector alone cannot make too much of a dent as far as newborns are considered. I think we need to augment our public health facilities. Without that I don't think anything's going to happen because most of the places where this mortality is happening are in states where the capacity of the population to pay for private is not good. (KI_11, government technical and academic)

The higher percentage of caesarean sections among private sector births was not considered a sign that the private sector is "picking up the slack" from the public sector to save lives through CEmOC (KI_07, development partner). In fact, respondents explained that the private sector often refuses to receive obstetric emergency referrals from the public sector (KI_07, development partner; KI_09, government technical and private sector). In high mortality states in particular, private facilities often refuse to treat patients who arrive in crisis and are unknown to the staff because of fear that the family will "ransack" the facility in the event of an adverse outcome (KI_09, government technical and private sector). Moreover, private-sector providers are known to try to push their high-risk cases to the public sector to avoid liability (KI_04, government technical and civil society): "they'll just chuck them to the public sector" (KI_09, government technical and private sector) so that the morbidity and mortality data "sticks with the public [sector]" (KI_09, government technical and private sector).

While the higher rates of caesarean sections in private facilities are unlikely to increase MMR or NMR, these interventions were generally not considered to be lifesaving either. This overmedicalization of childbirth was, according to KI_09 (private sector obstetrician), driven not by a desire to charge more money to families, but because of the need to practice defensive medicine, to meet patient requests, and because private facilities share anesthesiologists and thus can only schedule c-sections during certain hours (as opposed to waiting to see if the normal birth can proceed and then not having an anesthesiologist when you need one).

Respondents gave the private sector some credit in reducing MMR and NMR in particular regions, specifically urban areas and some rural pockets of high and low mortality states. They explained that in some specific geographies, the private sector has become the primary provider of caesarean sections, even for the poor, and that some of these c-sections are lifesaving (KI_08, civil society). In low mortality states, private sector facilities are more likely to accept risky cases that arrive at their doorstep, partially due to their greater confidence in their capacity to successfully intervene to save patients' lives (KI_09, government technical and private sector).

Specific to neonatal care, respondents noted that many private facilities in both urban and rural India had far lower capacity to handle sick newborns compared to obstetric emergencies. Comprehensive state-of-the-art care for small and sick neonates was only available at the "five-star facilities" (KI_03, civil society), which were financially inaccessible to the majority. While few families with sick children could access these top-tier facilities, they tended to nonetheless seek private-sector care, and spend large amounts on it.

> A baby is looked at much differently by the set of parents and the family themselves. They will invest anything and everything to get the baby well. And they feel that they will get the value and the services into a very optimal level in a private facility - no matter at what cost. So that is the mindset. (KI_08, civil society)

The private facilities accessed by non-elites were generally expensive mid- and lower-tier facilities with low capacity to save neonates or somewhat more affordable informal (non-biomedical) providers who offered "irrational" care (KI_10, government technical and development partner). Private facilities were said to have poorer infection control, poorer infrastructure, less competent nurses and technicians, and a lack of capacity to conduct newborn resuscitation (KI_07, development partner).

For both maternal and neonatal care, the private sector had not been subject to the same degree of quality improvement attention as the public sector, and regulation is "nowhere near where it should be" (KI_03, civil society). While the Clinical Establishment Act was an attempt to regulate the private sector, regulation remains very poor. Very few states maintain data on the private sector in the Health Management Information System (such as the number of deliveries, c-sections) (KI_04, government technical and civil society).

> I don't think the government is pushing the private sector to do anything better than what they're doing. Because they don't know what we are doing. That's the truth of the matter. […] We don't have a regulation on actually strictly following the protocols or what are the government of India recommendations or the WHO, whether we are aligned with that, or FOGSI's recommendation for example. So its each one to themselves. (KI_09, government technical and private sector)

While some respondents noted that medical associations lobbied against the enforcement of standards in the private sector, many considered FOGSI (the Federation of Obstetric and Gynecological Societies of India) to have been a valuable actor in improving clinical standards for maternal health.

> And I personally feel that the medical associations play a lobbying role against the government, in not having strict enforcements of that. So, the public sector has to fall in line, because they have no option. But the private sector tries to hoodwink to the last mile. (KI_10, government technical and development partner)

FOGSI's inputs were said to have strengthened clinical capacity in the private sector, while also supporting public-private partnerships and the development of standards for the public sector. New initiatives such as LaQshya-Manyata accreditation has been launched for private facilities. While there are no formal requirements that private facilities receive accreditation, it is slowly becoming a source of prestige.

> The one golden minute for the newborn resuscitation, not leading on the paediatrician who may be stuck in the traffic, but you can do it yourself kind of a training, so that way yes there has been a significant improvement in terms of the outcome and in terms of the complication minimisation and readiness for action, yeah, I think that bit of difference certainly we can see. (KI_09, government technical and private sector)

FOGSI also contributed to "multiskilling" medical officers and to the Pradhan Mantri Surakshit Matritva Abhiyan (PMSMA) program, a public-private partnership wherein private sector obstetricians and gynecologists voluntarily provide specialists antenatal care in government facilities.

Changes in the Broader Indian Context

Respondents were unanimous in recognizing the enormous contribution of "synergistic" (KI_04, government technical and civil society) contextual changes in reducing MMR and NMR: "I would put it [the contribution of broader changes] at 50% at least" (KI_10, government technical and development partner). Progress on multiple determinants of health, particularly education, nutrition, women's empowerment, infrastructure (roads, sanitation, water, electricity, mobile phones), and economic development, were identified as driving progress on maternal and child health. In addition to their indirect benefits to health via economic development, roads and communication had direct, immediate benefits to saving maternal and neonatal lives:

> Roads are very, very important. You can transfer a patient from one place to another very quickly if you have a road. (KI_04, government technical and civil society).
>
> You know, just a simple thing, if from a PHC, a woman is being sent to the district hospital, somebody just gives a quick phone call that this woman is coming, get the operation theatre ready, you know! This is something remarkable, so we need to look at what has worked. (KI_12, government technical and development partner)

The empowerment of women plays a crucial role in enhancing maternal survival and reducing fertility. Women's empowerment was highlighted as "actually the cornerstone of everything: gender, human rights, health decision-making, and so on" (KI_10, government technical and development partner). Educated women have more agency over their choices and "better decision-making" or "better absorption" of health message (KI_07, development partner), and greater ability to negotiate with their partners, the larger family, and health workers, including to demand higher quality, respectful maternity care.

Although it is "a slow, painful road to women empowerment" (KI_07, development partner) there are very few unreached pockets that have seen no progress or change.

Many of the improvements were linked to pro-poor policies and programs over the last 20 years, including the National Food Security Program and the Mahatma Gandhi National Rural Employment Guarantee Act. Efforts to retain girls in schools such as providing bicycles, uniforms and scholarships for girls, economic and social incentives to families for girls to finish school and delay marriage, and self-help groups (women's savings collectives) and NGO programs, have ultimately reduced fertility, reduced early childbearing and improved maternal and neonatal survival.

Low Versus High Mortality State Clusters

What enabled the low mortality states to continue bringing down NMR and MMR, despite having already "plucked the low hanging fruit" (KI_12, government technical and development partner)? Better governance and stronger, better funded government health systems emerged as the most important underlying factors driving continuous improvement in this cluster.

> If you will say that in one word, it was the governance. [...] So, when the flexibility came in HR, in finance, in infrastructure, in hiring, in capacity-building, in training, whatever you want to do, you can do. So, these states where mortality was very high, was a big boon for them because till then they have not enjoyed this flexibility. Whereas in other [low mortality] states they had some flexibility from beginning and their governance system was also better. So, they were utilizing it, but the funding might not be enough for utilizing them. So NHM gave them the funding. So, their utilization further improved, as a result their decline also took place. (KI_01, government technical)

> The bottom line for all this is good governance [...] The so called high mortality states and low mortality states is essentially an issue of governance. (KI_11, government technical and academic)

> "Much, much higher [...] per-unit cost fund availability of the southern states" (KI_10, government technical and development partner)

Low mortality states (respondents usually spoke of Kerala and Tamil Nadu) had the administrative and clinical capacity to make the most of what central government could offer, including public health trained management staff, lower administrative staff turnover, and better data systems.

> Some states they would do brilliant analysis of their own data. They will say, "We have analysed this, this is reason that this is this way, we think there's a problem, and this is how we are tackling it. (KI_05, government administrative & private sector).

When the central government offered deeper decentralization to the state and access to additional financing, lower mortality states took greater and faster advantage of these opportunities to innovate and improve their government health system (KI_11, government technical and academic): "the advantage with the low mortality states was they used to lap it up and, you know, implement it faster" (KI_04, government technical and civil society). The high mortality states "needed some handholding," which led to delays in implementation (KI_04, government technical and civil society). Tamil Nadu's drug management system was identified as an innovation made possible by the underlying strength of their health system (KI_05, government administrative & private sector). In low mortality states, particularly Kerala, government actors were said to have a greater openness to problem identification and learning, rather than a culture of fear and resistance to change.

> They [Kerala] used to share those findings [from maternal death reviews] with the other states which are not able to capture that. Because in the high mortality states, people were wary of reporting because they were fearful that some action will be taken against them" (KI_04, government technical and civil society)

[In high mortality states] it takes a while for you to convince them about what's to be done. And by the time you convince them you find in the next year or two this administrator changes. You start back at square one. (KI_11, government technical and academic)

[In low mortality states] whatever the previous incumbent did, the next government just took it forward. They did not put a hurl and stop it. […] The rate of transition of administrators at the helm of affairs their departments have been very very stable from many years. People don't change every year, every six months. (KI_11, government technical and academic)

The health systems in low mortality states were much stronger in terms of their "basic fundamental capacity, not just content, quality, competency of healthcare workers" but also "overall supply chain capacities, the use of data systems and system monitoring, ability, accountability, program management structures" (KI_07, development partner). Low mortality states also produced more health workers per capita, with more medical colleges, nursing schools and ANM schools (KI_01, government technical). In states such as Tamil Nadu, there are public health experts at the block level who have decision-making capacities (KI_10, government technical and development partner). Moreover, the technocrats and administration in low mortality state technocrats were empowered and capable. In high mortality states, programs are driven by the management bureaucratic cadre. In contrast, in "almost all the southern states," the technocracies are empowered: "you will find a significant difference in their ability and relative power in decision making" (KI_07, development partner).

This stronger management and technical capacity was attributed to "political prioritization of health and development agenda" (KI_07, development partner). While elections in northern states are "not always fought on development agenda" (KI_07, development partner) southern states had far greater political will to improve public health. In addition, southern states have a better pipeline of institutional training and supply in terms of public health expertise. Medical colleges are integrated with district hospitals, which encouraged movement and exchange between colleges and facilities.

Southern states were noted for both stronger community-level primary health care and widespread availability of CEmONC. Southern states had well-equipped and trained frontline providers for community-based antenatal care and postnatal care. They also sought to channel deliveries to CEmONC capable government facilities (FRUs or higher). Public facilities for childbirth offer "a tertiary care centre of excellence" with a doppler, partograph, all the drugs available: "it's a different ballgame" (KI_10, government technical and development partner). In the high mortality states, PHCs were still considered appropriate delivery locations, necessitating referral for emergencies (KI_04, government technical and civil society).

Several respondents also attributed the ongoing improvement to maternal and neonatal survival in low mortality states to better infrastructure, especially roads, and social determinants of health in these states. Southern states generally had a stronger longstanding public investment in education, WASH, nutrition, women's empowerment, and respectful maternity care: "I mean, it just goes on and on and on and on" (KI_10, government technical and development partner).

The private sector in low mortality states was also discussed as a more substantial contributor to maternal and neonatal survival compared to in high mortality states. In the lower mortality states, private tertiary level care was more accessible because the population was wealthier and thus better able to pay for healthcare. It was also of higher quality.

These low mortality states [...] the private sector is quite evident working over there [...] states like Kerala, states like Maharashtra, state like Gujarat. (KI_04, government technical and civil society)

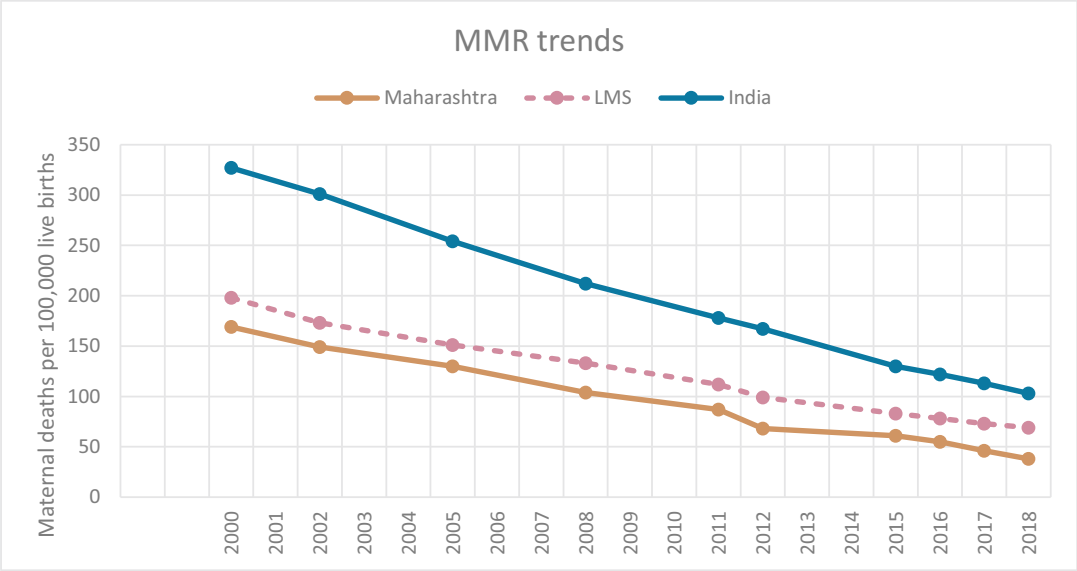
One key informant (KI_11, government technical and academic) also suggested that the private sector better "complemented" the public sector in low mortality states wherein the private sector provided decent tertiary care while the public sector invested extensively in primary care.

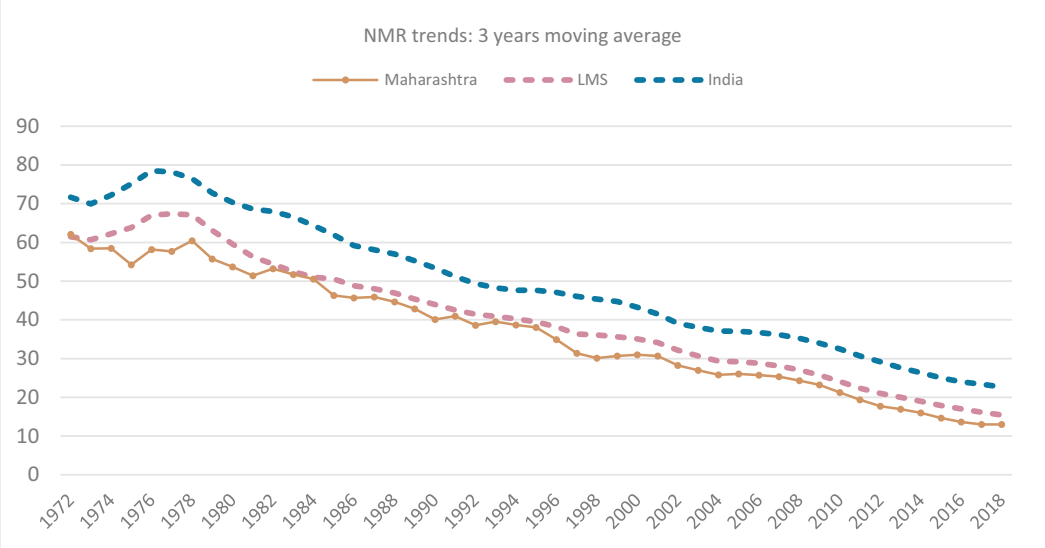
So, Kerala is a great example where out of pocket expense for the family is high. Expenditure as a fraction of the money spent by government public health is also high. So, each one is complementing the other and they have the lowest mortalities that you see. (KI_11, government technical and academic)

Annex E: Maharashtra State Summary

Maharashtra made major progress in reducing maternal and newborn mortality during 2000-2018, greater than most other lower mortality states, achieving the SDG 2030 target for MMR and nearing the SDG target for NMR (Figure E.1).

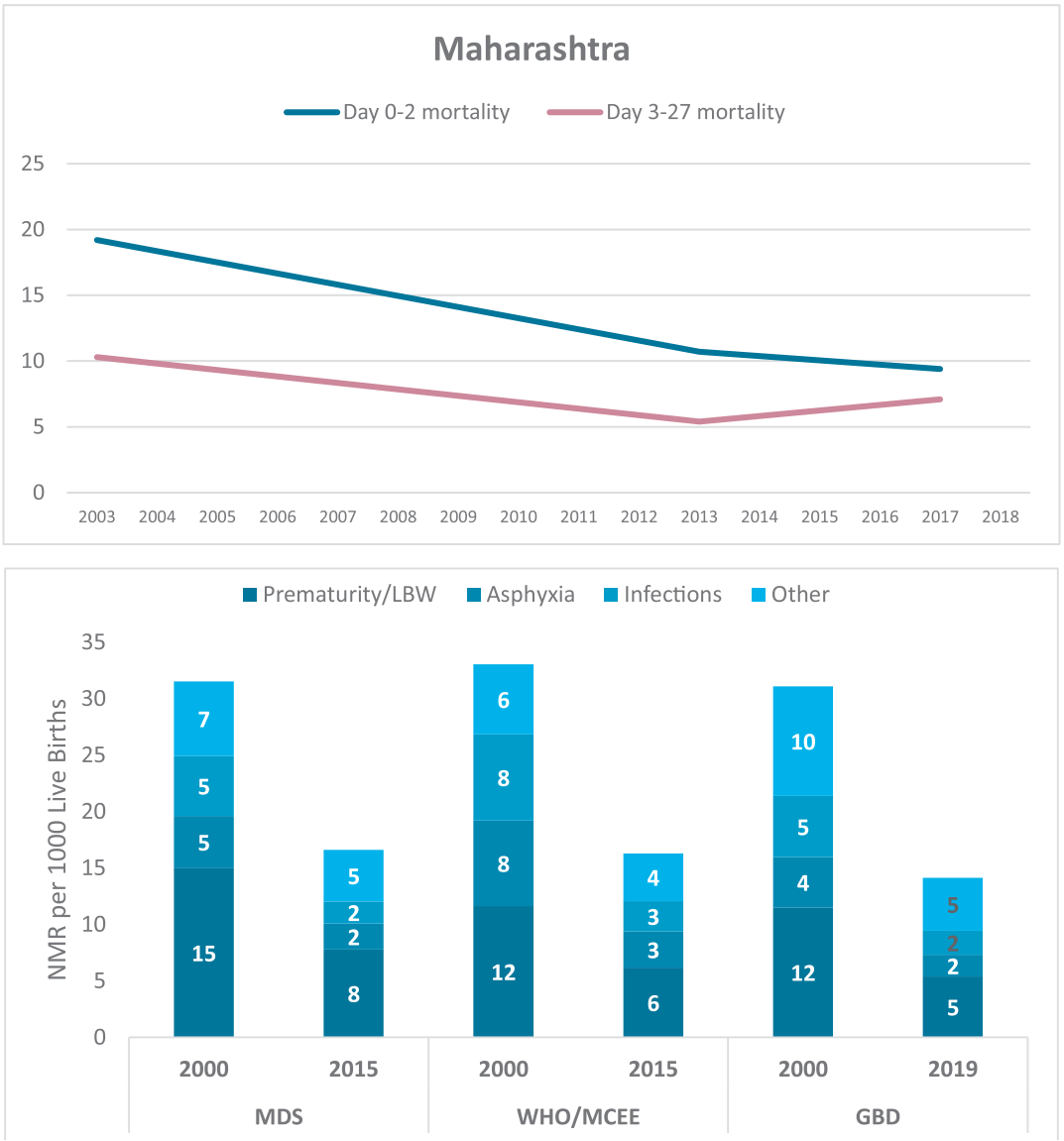
Figure E.1: Maharashtra's MMR (2000-2018) and NMR (1971-2019) levels and trends compared to its state cluster and all India (SRS)





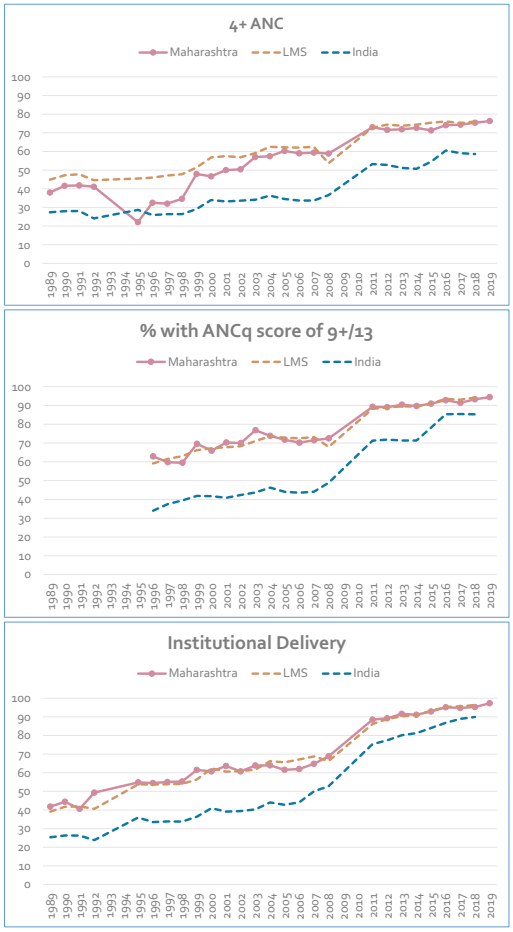
All major causes of neonatal death have reduced (prematurity, birth asphyxia, infections) but the greater mortality reductions in the first days of life suggest better intrapartum care and better newborn health and nutritional status (Figure E.2).

Figure E.2: Age- and cause-specific neonatal mortality in Maharashtra (2000-2019)



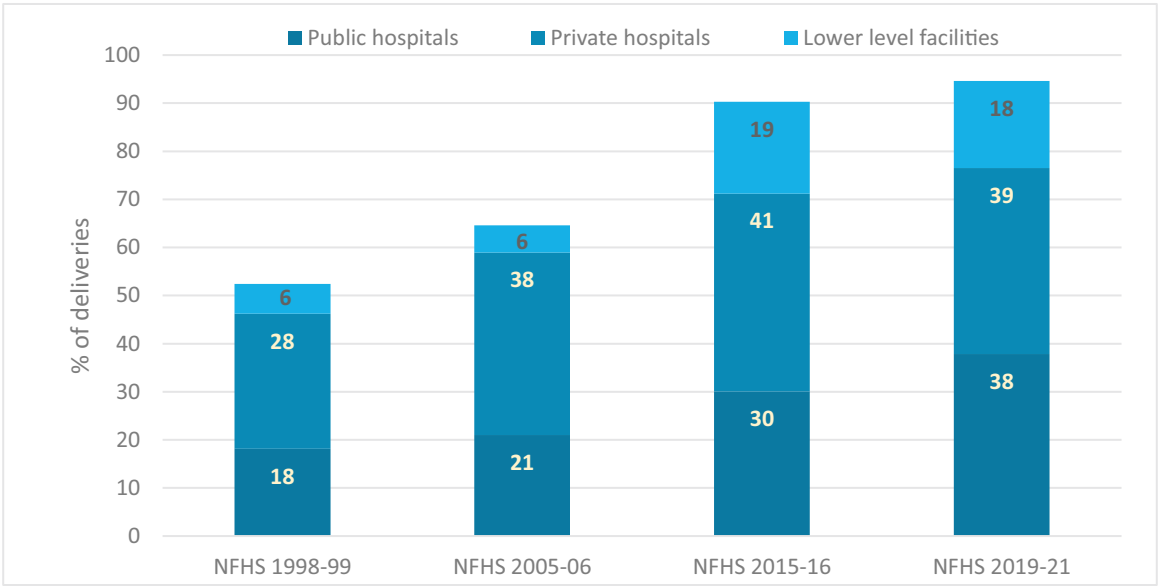
The gains in intervention coverage – antenatal care with contents, institutional deliveries notably in hospitals and C-sections among rural and the poorest – have been marked and are greatest in the RCH II/NRHM period (2005-2012) (Figure E.3).

Figure E.3: Trends in antenatal and delivery care coverage, Maharashtra (NFHS and DLHS pooled data, 1989-2019)



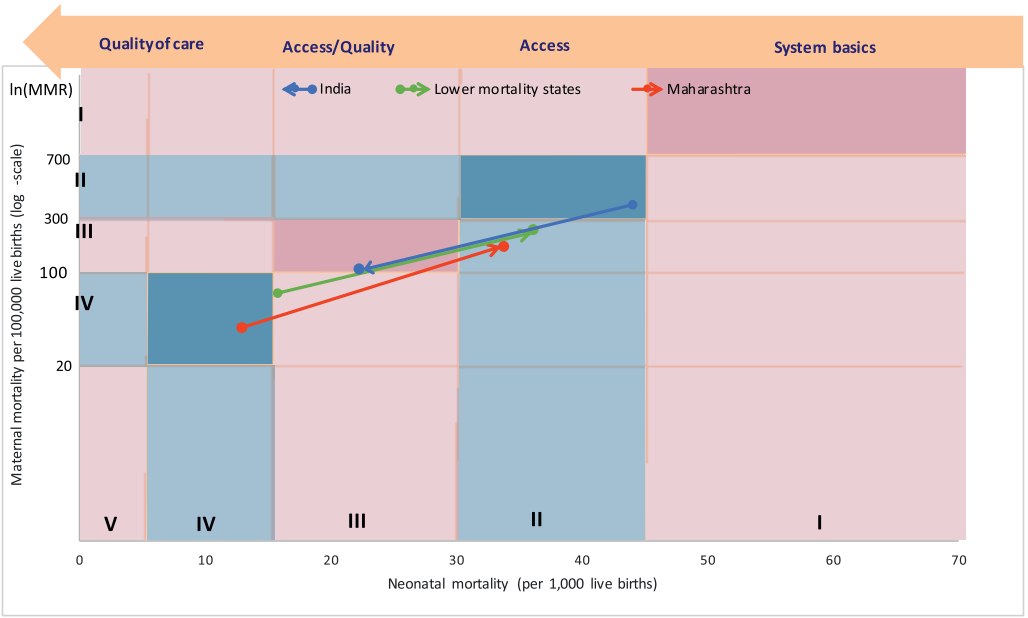
Hospital deliveries have driven this increase, accounting for 77% of deliveries, where neonatal mortality rates have reduced, more so in private hospital deliveries (Figure E.4).

Figure E.4: Trends in institutional delivery by facility level, Maharashtra (NFHS 1998-99 to 2019-21)



Maharashtra has continued to progress (into late Stage IV of the transition) (Figure E.5) owing to reaching near universality of key interventions among disadvantaged populations, improving quality of care (increased ANC with contents and reduced NMR in hospitals) and most women delivering in facilities with comprehensive emergency capacity (C-sections and Sick Newborn Care Units).

Figure E.5: Mortality transition in Maharashtra, its state cluster and all India (2000-18)



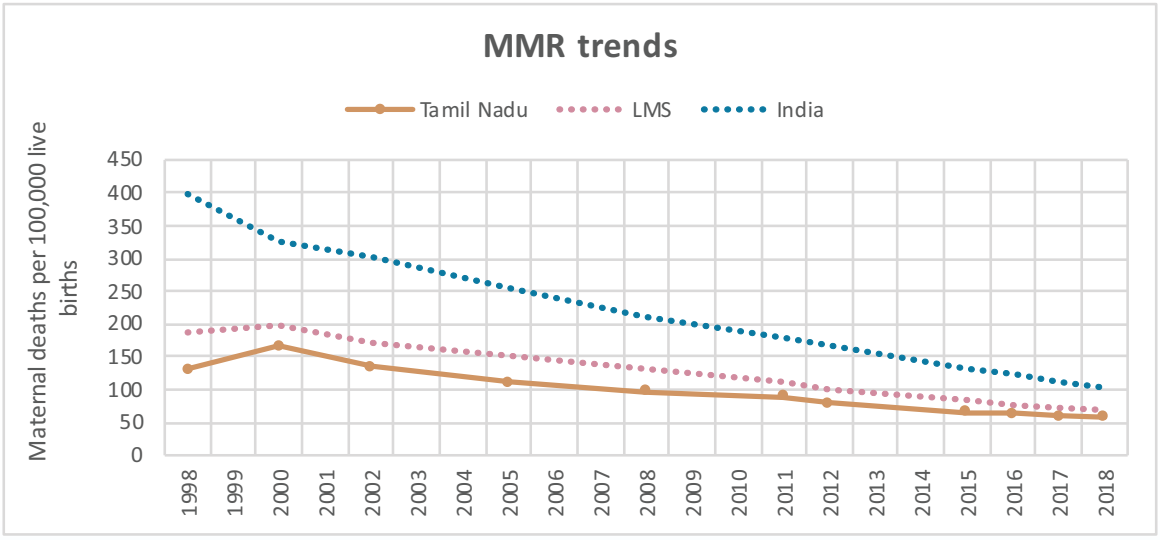
Several health policies and system reforms have contributed to Maharashtra's success:

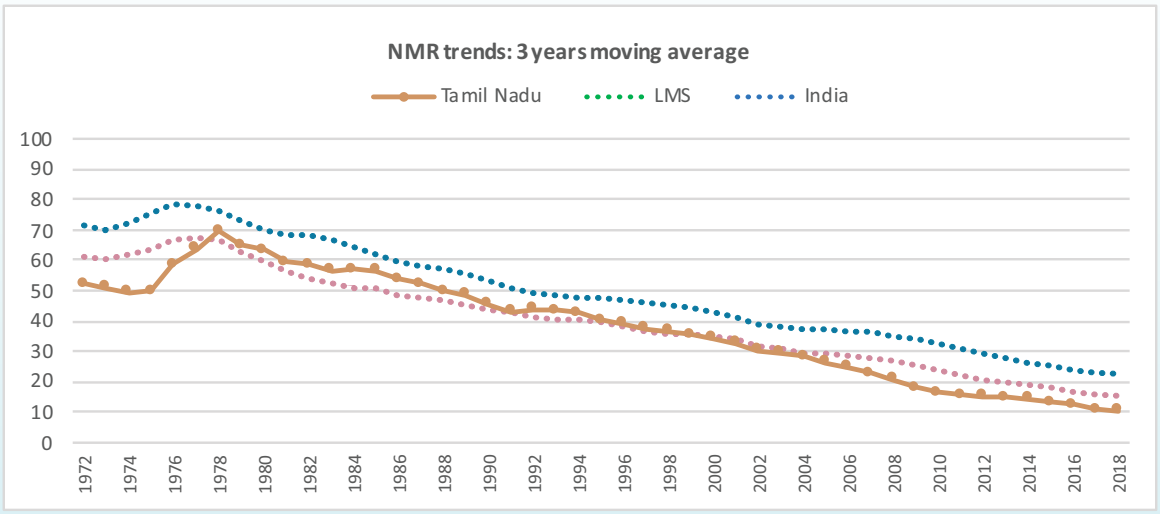
- The state has focused on improving services in underserved (particularly tribal) areas and service/human resource availability at the existing facilities
- It also prioritized in-service training for medical officers, nurses, and ANMs through the Medical Officer Certificate Program and a decentralized training system
- The state amended recruitment processes to attract MOs with higher level degrees and rewarded high performing health workers
- The state has prioritized in-service training and education for health workers (ASHAs, medical officers) and sought to implement the Indian Public Health Standards and assurance of essential drugs and commodities at all levels and locations of government health facilities
- The state has improved the early identification of high-risk pregnancies and obstetric complications, enabling timely intervention
- The state has been particularly open to working with specific private sector actors: While the private sector overall has resisted regulation, specific private sector practitioners and associations (particularly the Maharashtra chapter of FOGSI) have been important partners to the Government of Maharashtra in developing and running trainings
- The government of Maharashtra endorsed FOGSI's private maternity care facility accreditation program, called Manyata, to utilize the government's LaQshya quality standards thereby creating the unique LaQshya-Manyata initiative
- Leaders in the state government and its Ministry of Public Health and Family were highly motivated to improve maternal and newborn health and operated in
- Pressure to improve maternal and child survival came from the state administration, as well as Maharashtra's particularly strong panchayat structure, health activists, and media
- Maharashtra embraced geographic targeting, with intensive inputs and scrutiny given to tribal areas and was a state that took data analysis seriously for planning and accountability
- Maharashtra decentralized responsibility for aspects of the government health system at the state-level and to the Zilla Parishad (district level local governance), which distributed power and responsibility more widely, and enabled responsive decision-making
- While financial decentralization within the state began in the 1960s with direct funding for Zilla Parishads to manage primary health centres and sub-health centres, the NRHM brought additional financing and financial flexibility to the state itself
- Maharashtra has robust community level engagement in health through committees and community-based monitoring of government health services and ASHAs, grounded in a history of community health worker programs since the 1970s

Annex F: Tamil Nadu State Summary

Tamil Nadu, which has the second lowest NMR among the major states in India in 2018, made major progress in reducing maternal and newborn mortality during 2000-2018, greater than most other lower mortality states, achieving the SDG targets for both MMR and NMR (Figure F.1).

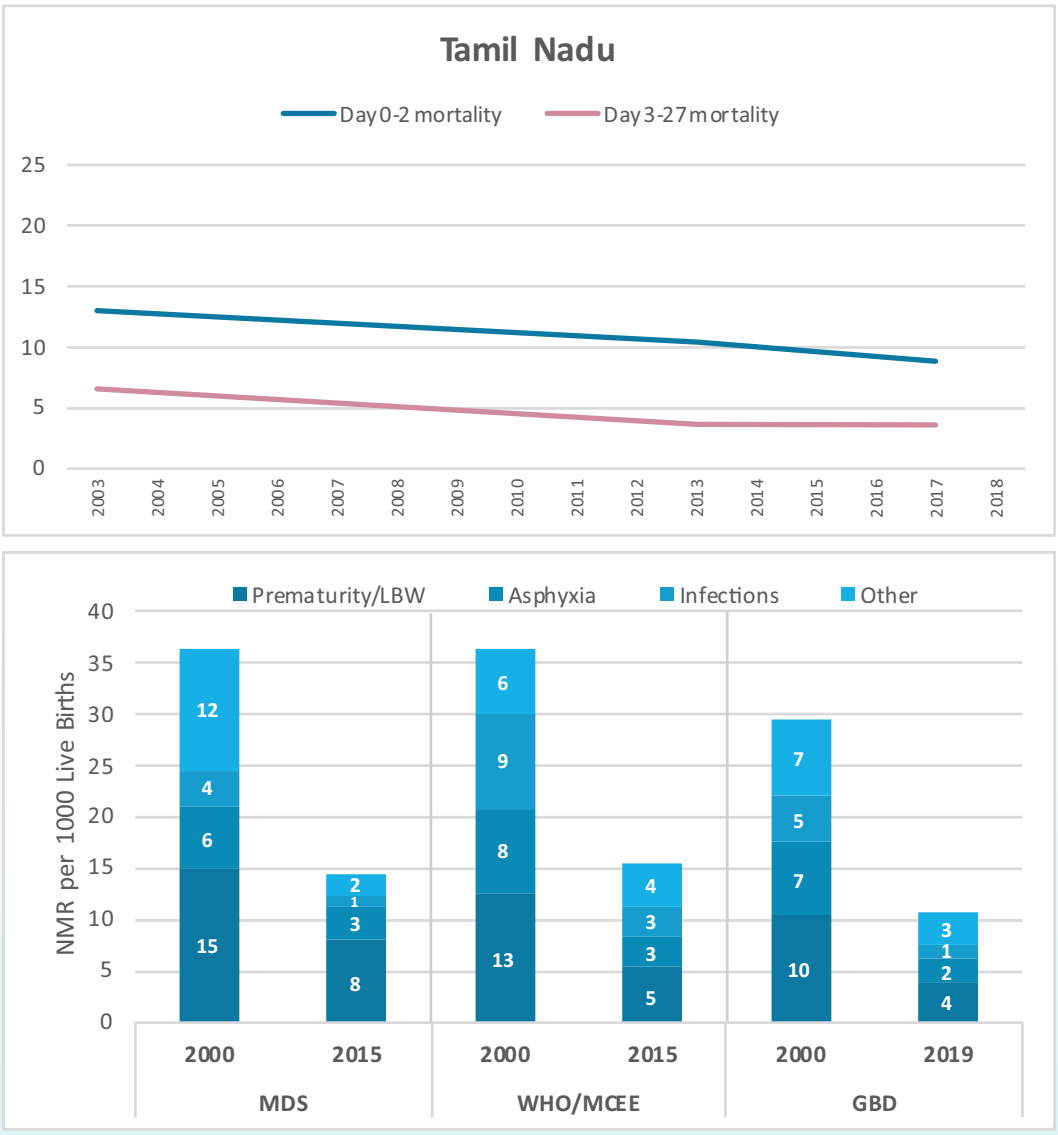
Figure F.1: Tamil Nadu's MMR (1998-2018) and NMR (1971-2019) levels and trends compared to its state cluster and all India (SRS)





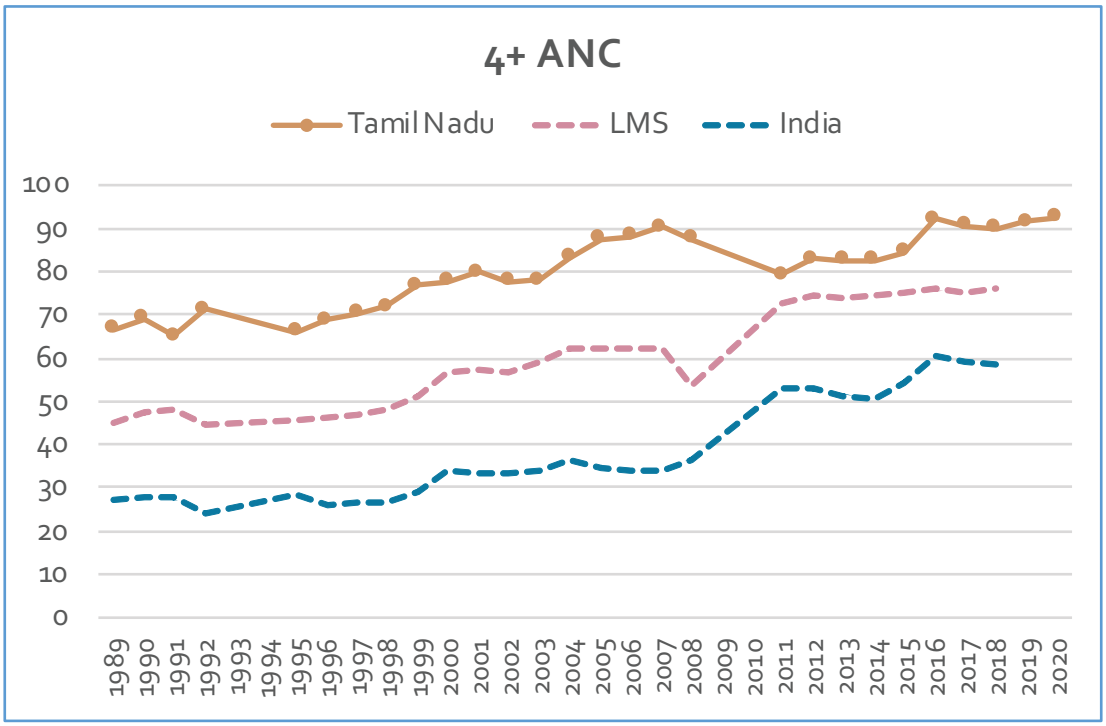
There was a major decline in neonatal mortality due to prematurity, followed by infections, perhaps indicating improved early and later neonatal period (Figure F.2).

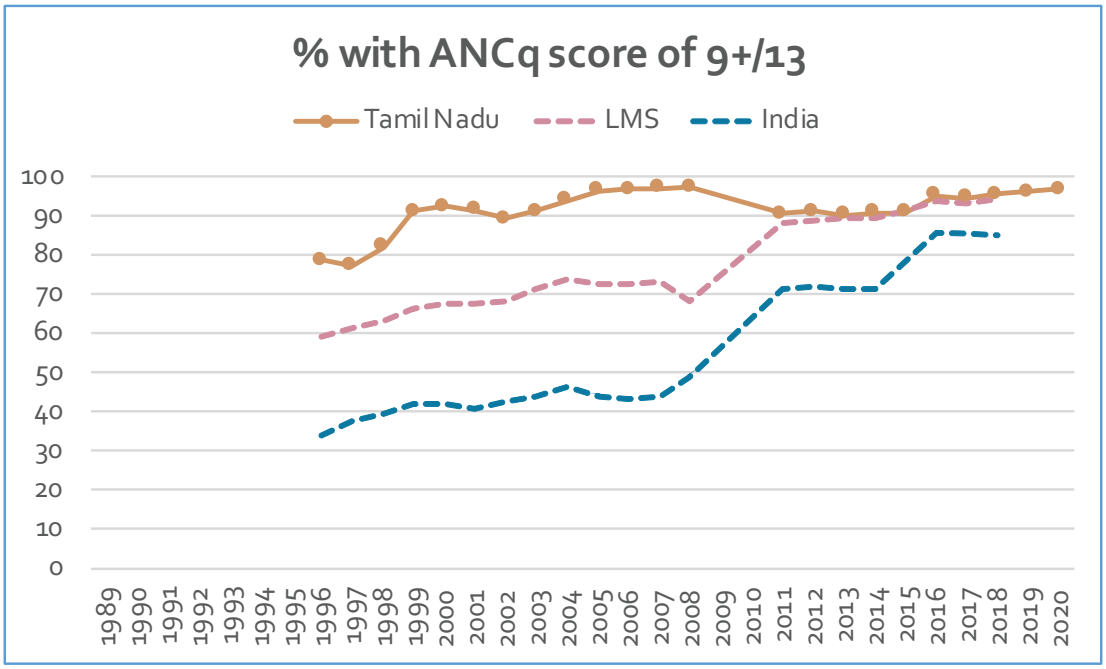
Figure F.2: Age- and cause-specific neonatal mortality, Tamil Nadu (2000-2019)



Gains in intervention coverage – rapid increases in 4 or more antenatal care visits, antenatal care with contents, institutional deliveries notably in hospitals during the CSSM and RCH-1 periods; and rapid increases in C-sections among rural and the poorest in the NHM/RMNCH+A period – have been marked (Figure F.3).

Figure F.3: Trends in antenatal and delivery care coverage, Tamil Nadu (NFHS and DLHS pooled data, 1989-2020)





Note:ANCq was obtained excluding NFHS 1 and DLHS 1 because some of the components are not available in these surveys.

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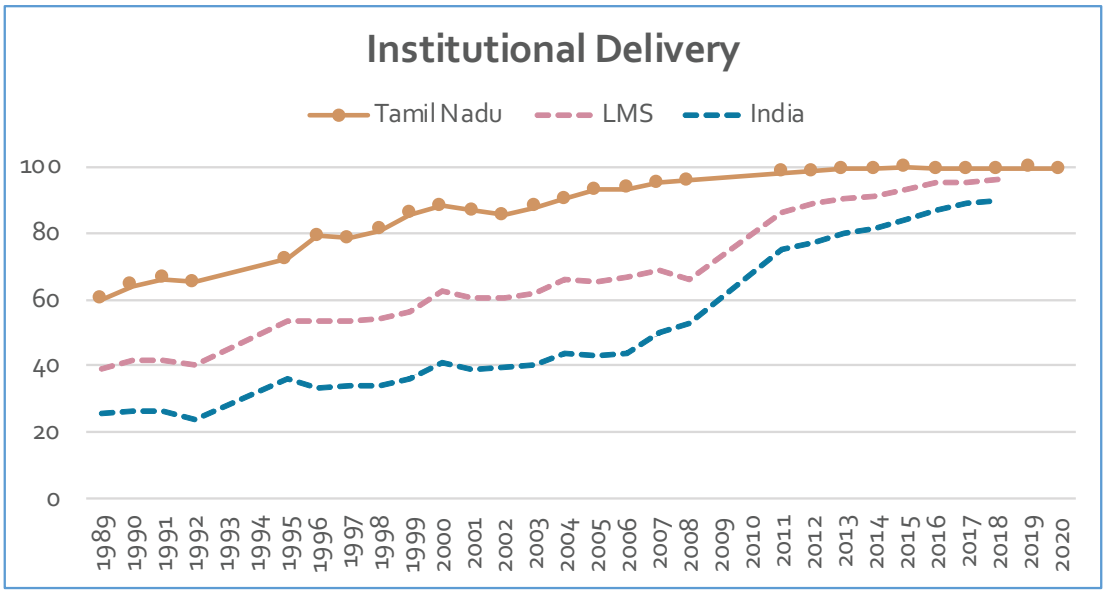
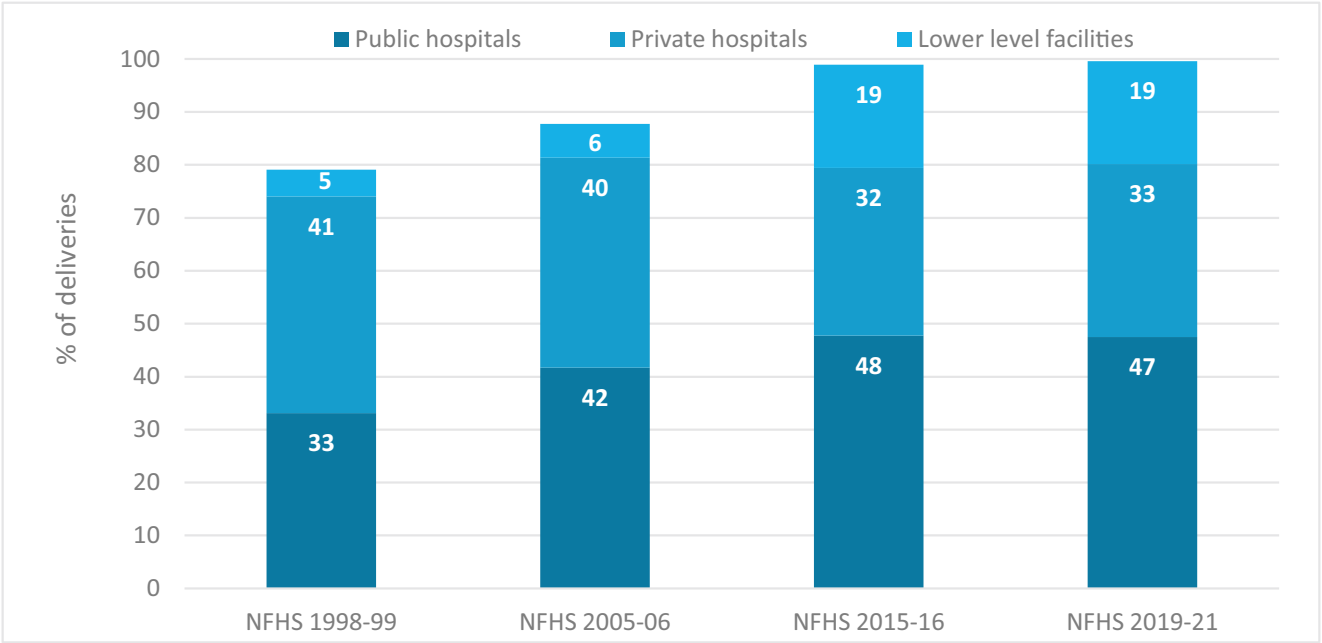


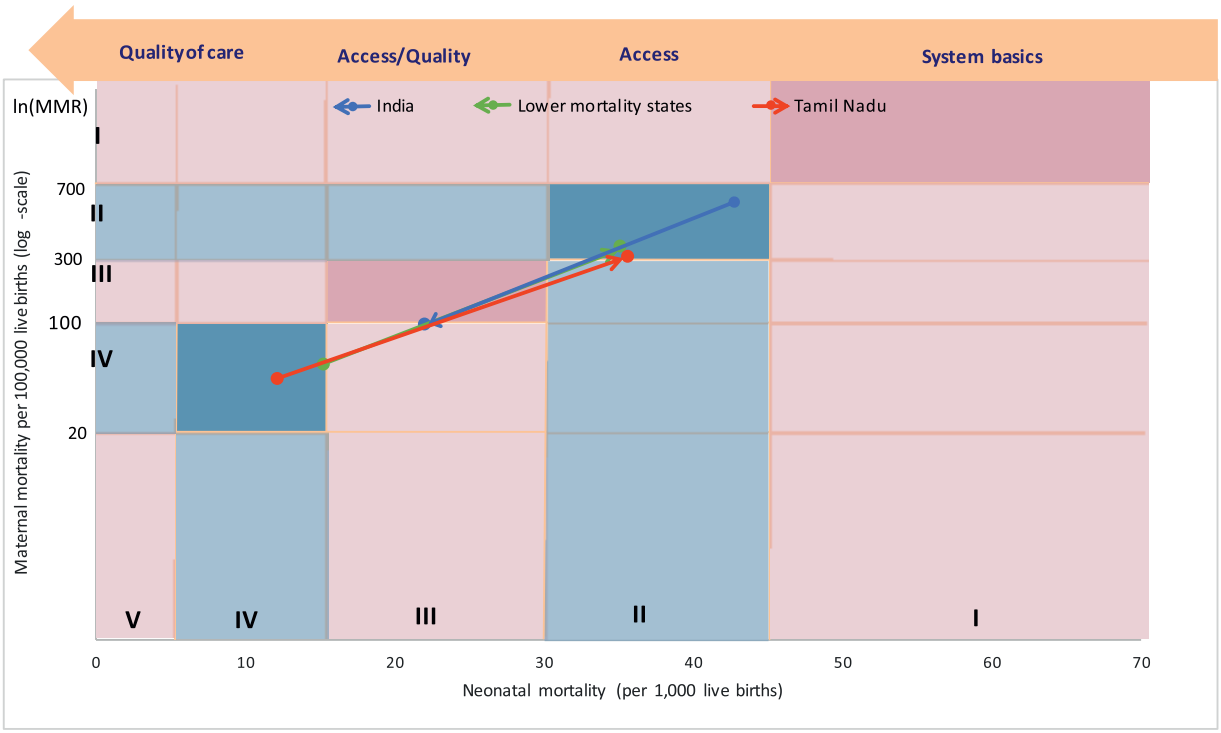
Hospital deliveries have driven this increase, accounting for 80% of deliveries, where neonatal mortality rates have reduced, more so in private hospital deliveries (Figure F.4).

Figure F.4: Trends in institutional delivery by facility level, Tamil Nadu (NFHS 1998-99 to 2019-21)



Tamil Nadu has continued to progress (into late Stage IV of the transition) (Figure F.5) owing to reaching near universality of key interventions among disadvantaged populations, improving quality of care (increased ANC with contents and reduced NMR in hospitals) and most women delivering in facilities with comprehensive emergency capacity (C-sections and Sick Newborn Care Units).

Figure F.5: Mortality transition in Tamil Nadu, its state cluster and all India (2000-18)



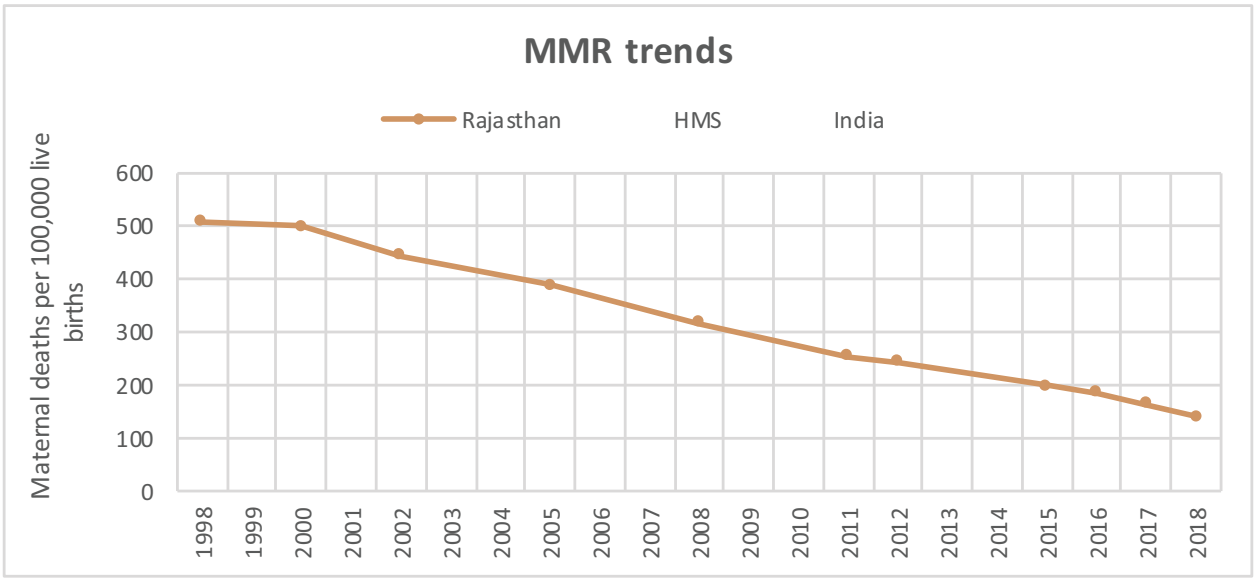
Several health policies and system reforms have contributed to Tamil Nadu's success:

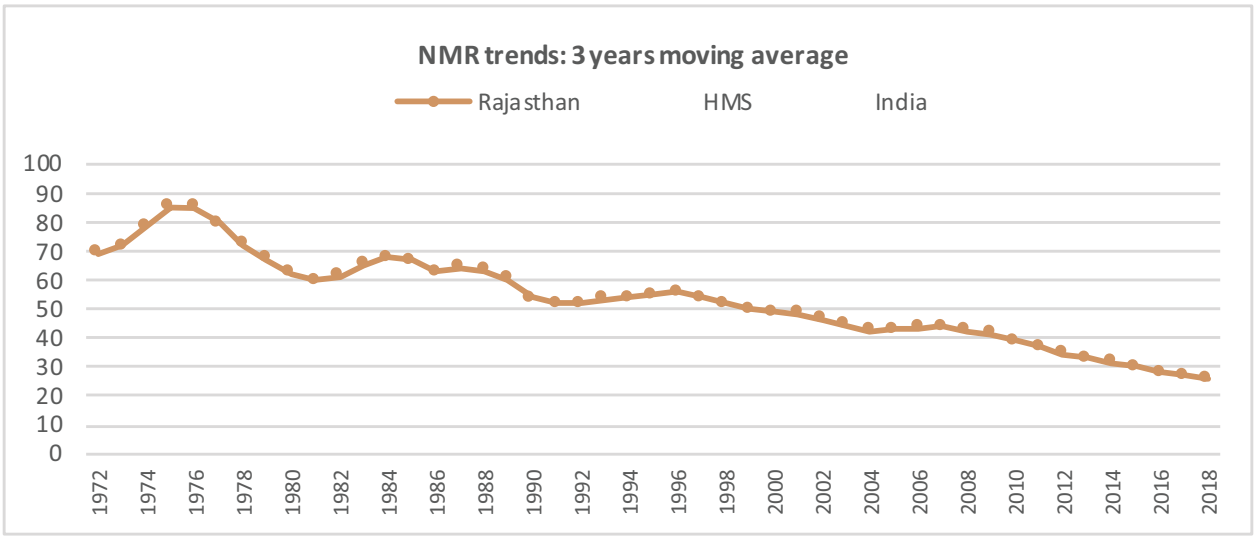
- The state has greatly strengthened the BEmOC capabilities in PHCs with SBA-trained staff nurses and medical officers as well as has increased the density of community health centres, thereby increasing the availability of CEmONC-enabled delivery points.The state has invested in public medical colleges and has incentivized doctors to work in rural government facilities. The state's unique public health management structure has enabled integrated, primary healthcare oriented public health management by experienced and highly trained public health professionals.
- The state has led the country in major clinical and quality improvement processes, including the maternal death review (and addition of referral reviews and near miss audits), prenatal screening, IV anemia care for pregnant women, birth companionship, neonatal screening, breast feeding support, and monitoring and birth planning for high-risk women.
- The formation of the Tamil Nadu Medical Service Corporation introduced a robust health system procurement system that ensures citizens access free medicines in the facility.
- The government has supported private facilities to improve quality of care by allowing them to access public training and protocols; private facilities offering free and high-quality services to the poor can also enroll in the Dr. Muthulakshmi Reddy Maternity Benefit Scheme, meaning that women who deliver there can still receive their conditional cash transfer for choosing an institutional delivery
- The welfare state model of development has historically received widespread support across the general population and among politicians across major parties
- The state's leadership drove progress on maternal and newborn survival through targeted interventions (using data to focus on marginalized areas and populations) and an ethos of constant improvement (building from blood availability to blood availability next to the labour room, from maternal death review to "near miss" review, from infrastructure to quality, from access to care within an hour to within 30 minutes)
- Tamil Nadu's government has prioritized primary healthcare and funded it accordingly
- The state was the first to introduce a maternity benefit scheme: the Dr. Muthulakshmi Reddy Maternity Benefit Scheme encouraged healthcare use among the poor and increased women's access to nutrition.

Annex G: Rajasthan State Summary

Rajasthan made major progress in reducing maternal and newborn mortality during 2000-2018, greater than most other higher mortality states (HMS). In 2018, Rajasthan's MMR and NMR of 141 per 100,000 live births and 26 per 1,000 live births, respectively, were lower than the MMR and NMR for HMS 145 and 28, respectively (Figure G.1).

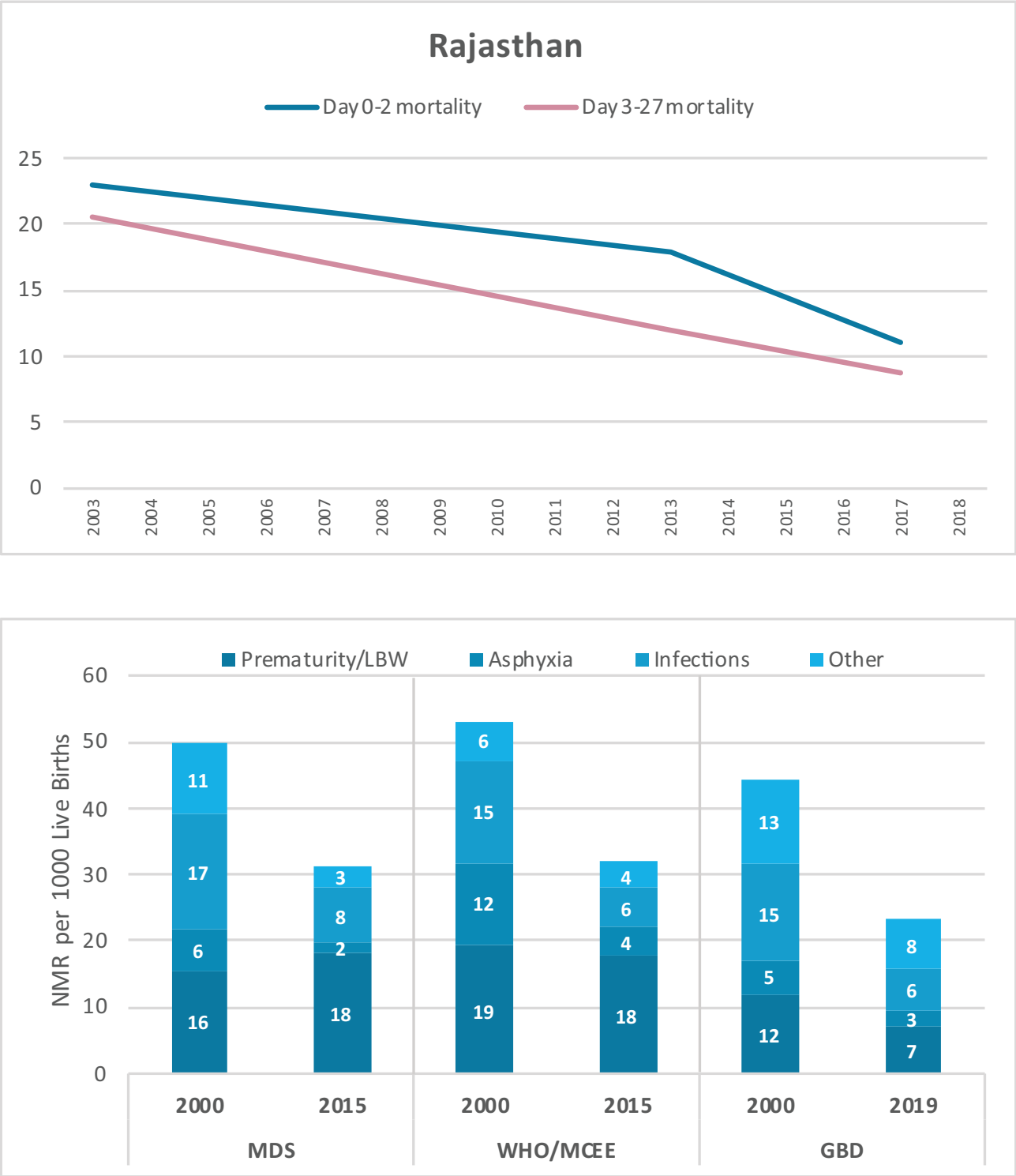
Figure G.1: Rajasthan's MMR (1998-2018) and NMR (1971-2019) levels and trends compared to its state cluster and all India (SRS)





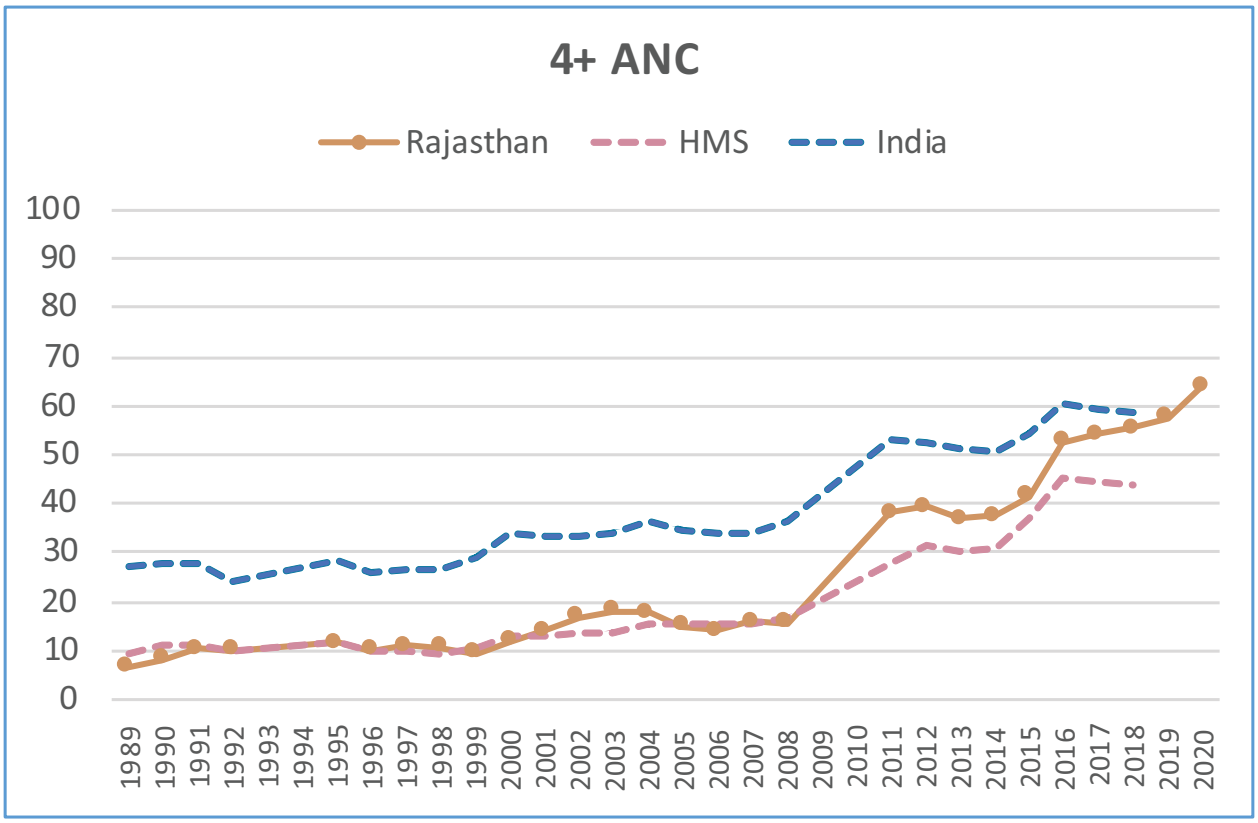
During 2003-18, Rajasthan was successful in bringing down mortality both on days 0 to 2 days and on days 3 to 27, with a greater decline in the latter (Figure G.2). All major causes of neonatal death have reduced (prematurity, birth asphyxia, infections) (Figure G.2).

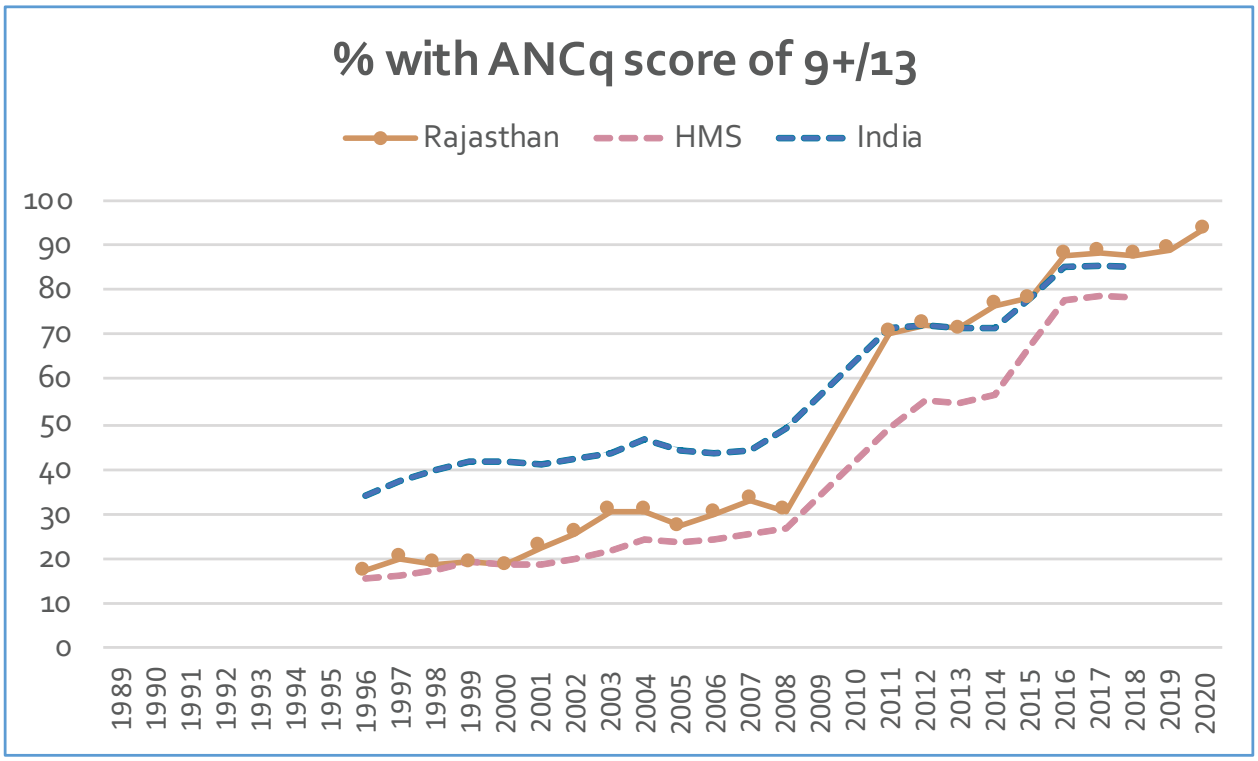
Figure G.2: Age- and cause-specific neonatal mortality, Rajasthan (2000-2019)



The gains in intervention coverage – antenatal care with contents, institutional deliveries notably in hospitals and C-sections among rural and the poorest – have been marked and are greatest in the RCH II/NRHM period (2005-2012) (Figure G.3).

Figure G.3: Trends in antenatal and delivery care coverage, Rajasthan (NFHS and DLHS pooled data, 1989-2020)





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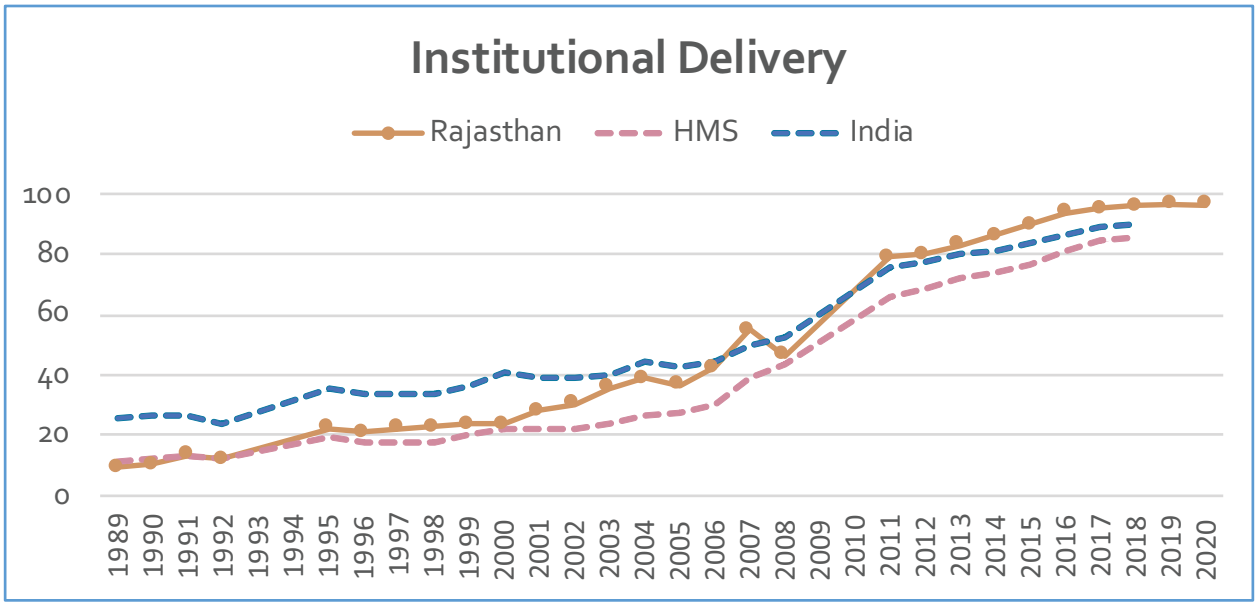
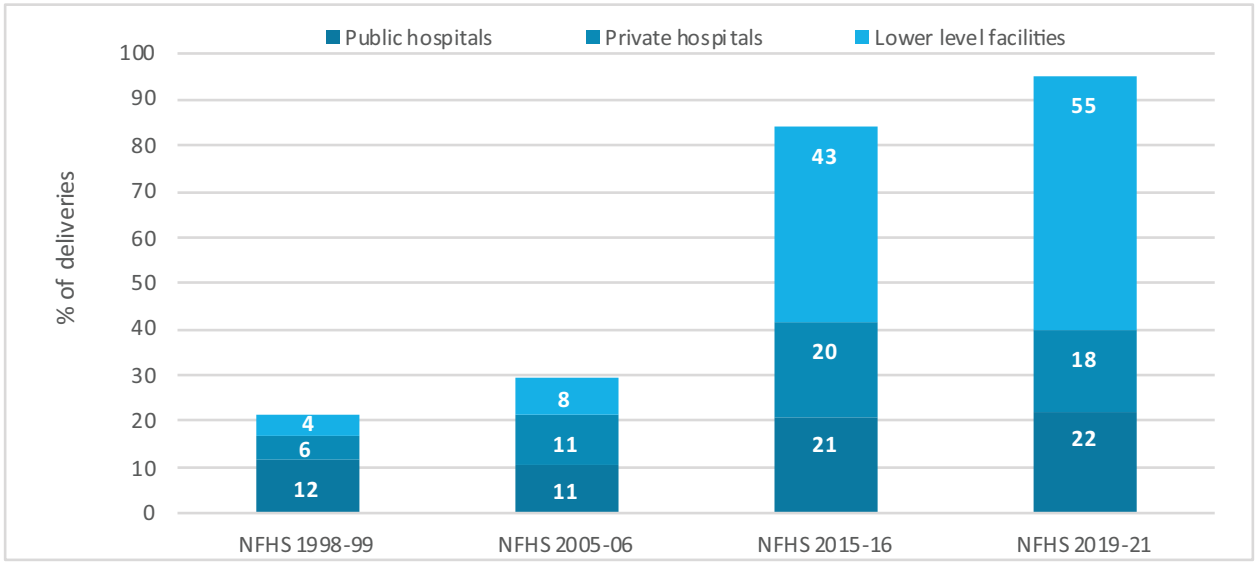


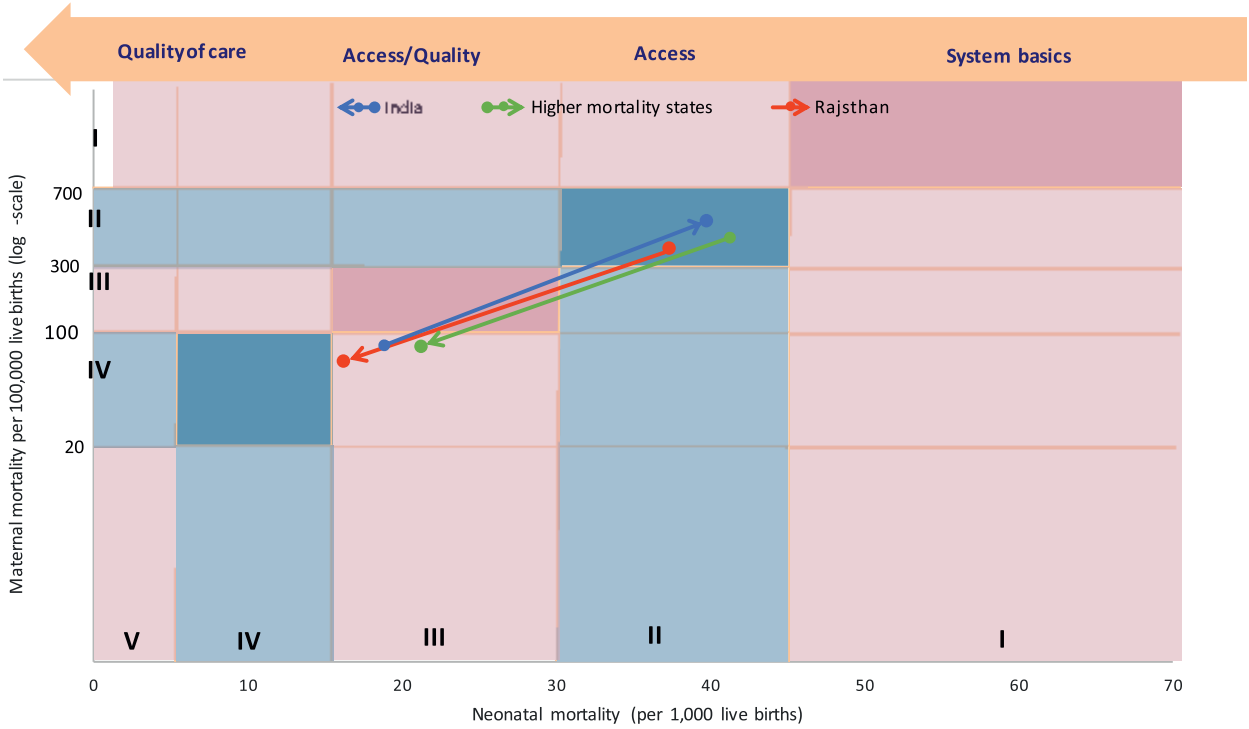
The public sector has driven this increase, accounting for more than 70% of deliveries, and institutional neonatal mortality rates were substantially reduced (Figure G.4).

Figure G.4: Trends in institutional delivery by facility level, Rajasthan (NFHS 1998-99 to 2019-21)



During 2000-2018, Rajasthan has transitioned from Stage I to Stage III, achieving a nearly four-fold reduction in maternal mortality and reducing the peri-neonatal mortality by half (Figure G.5), owing largely to the gains in intervention coverage – antenatal care with contents, institutional deliveries notably in hospitals and C-sections among rural and the poorest.

Figure G.5: Mortality transition in Rajasthan, its state cluster and all India (2000-18)



Peri-neonatal mortality is estimated as 1.75*NMR. MMR and NMR are from the SRS

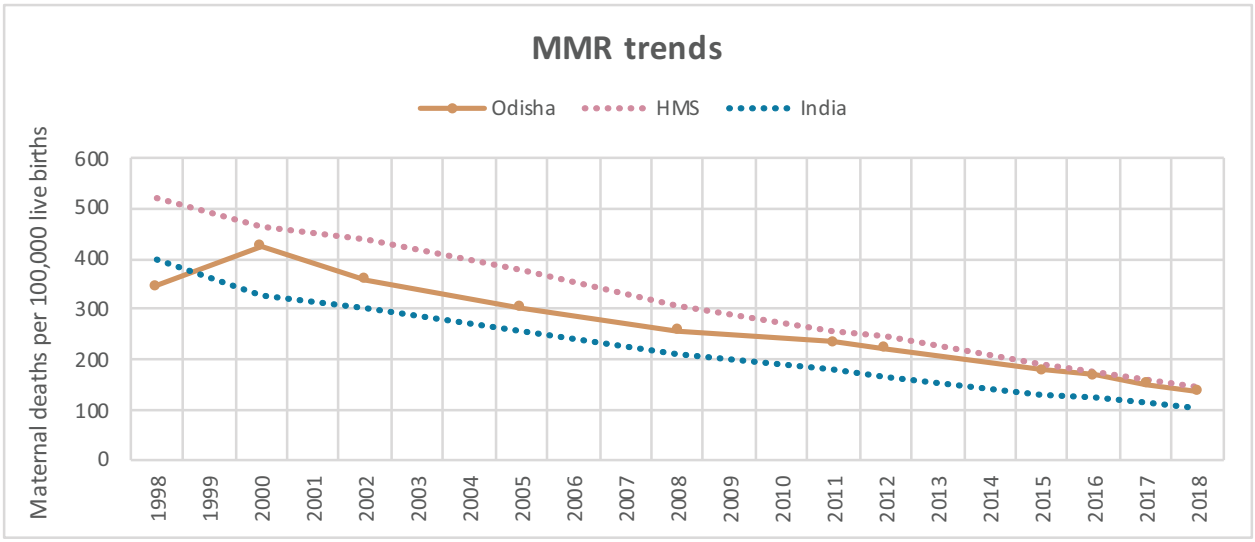
Several health policies and system reforms have contributed to Rajasthan's success:

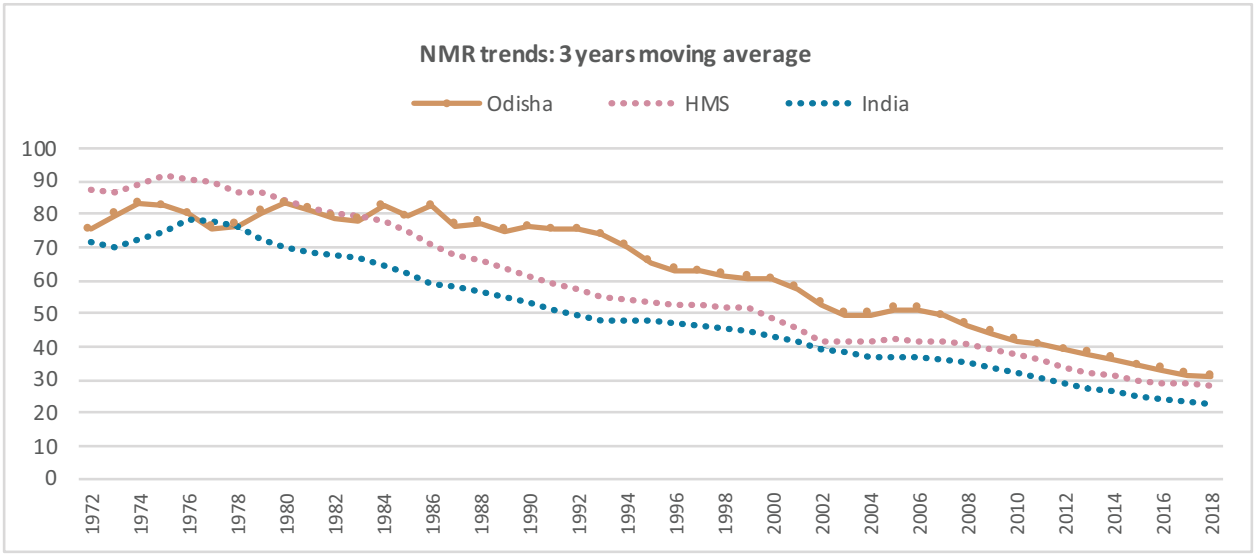
- Rajasthan has made some improvements in facility density (particularly CHCs) and larger improvements in emergency medical transportation and quality of care (including clinician skills, labour room cleanliness and organization, and birth companionship). The state has increased the availability of tertiary care through maternal and child health wings in 38 hospitals and creating sick newborn care units in each district.
- Rajasthan has focused on improving the capacity of nurses through in-service training and implementing labour and delivery protocols and checklists. It also improved pre-service education for ANMs and general nurse midwives through creating skill labs, IT labs and libraries in ANM and GNM schools.
- ASHA Sahyogini training and support has been a priority in the state. The ASHA Sahyogini was credited as central to community mobilization and demand generation for maternal and child health in Rajasthan.
- The ASHASoft program has increased timely payment, thereby increasing ASHA motivation.
- Rajasthan has been a leader in the use of digital services, including for JSY payments, ASHA payments, and HMIS for monitoring and accountability.
- The state has focused extensively on implementing quality assurance programs at scale and with sufficient monitoring and oversight, including the use of mentors, safe birth checklists, JSY case sheets, Kayakalp, and the National Quality Assurance Standards.
- Leaders in the state government and within the Department of Health were very supportive of experimentation and adaptations suggested by program implementers
- Good governance and ambitious leadership in health underpinned Rajasthan's progress
- Rajasthan has encouraged diverse approaches to meet the diverse needs of the districts
- The NRHM was "catalytic" and enabled a "different level of intervention" through decentralization and financial flexibility.
- Accountability in government health service provision was emphasized by government leaders and supported by media interest.
- JSSK has supported demand for government health services through nearly eliminating OOPE
- Rajasthan has benefited from technical expertise and support from international development partners, particularly in improving quality of care. The state government's approach to these partnerships was characterized by active and equal engagement, rather than passivity.
- The national government, along with Rajasthan's medical colleges, hospitals and academic institutions all provided valuable support through creating standards and guidelines and providing in-service training for health workers.

Annex H: Odisha State Summary

Odisha made major progress in reducing maternal and newborn mortality during 2000-2018, greater than most other higher mortality states (Figure H.1).

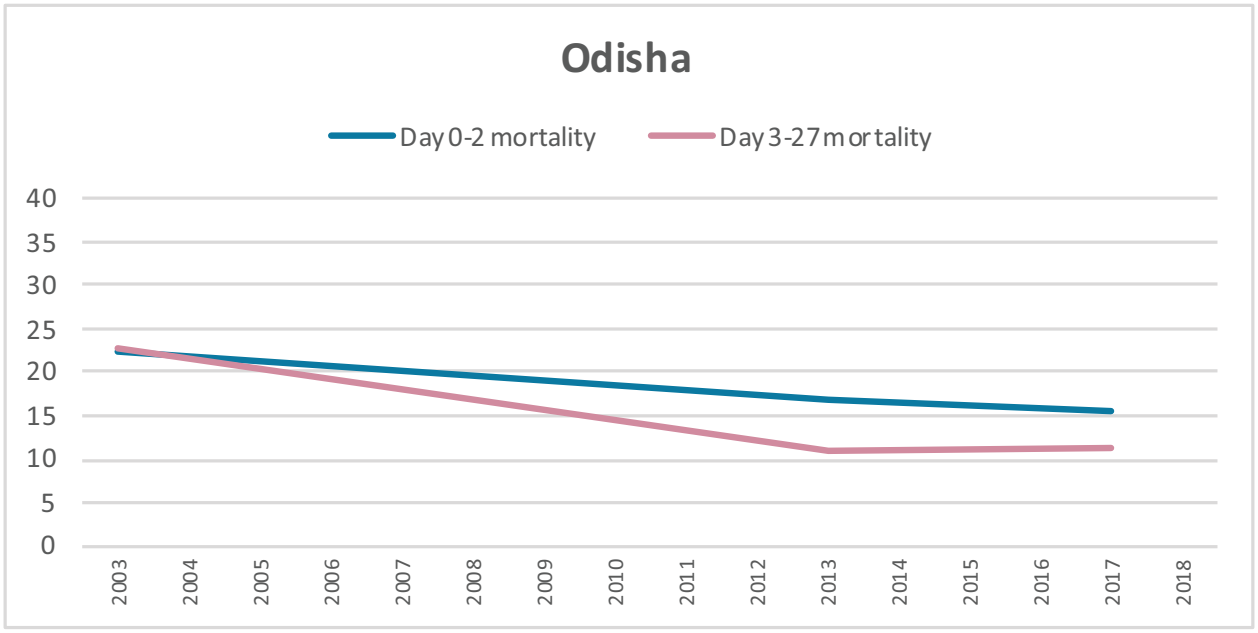
Figure H.1: Odisha's MMR (1998-2018) and NMR (1971-2019) levels and trends compared to its state cluster and all India (SRS)

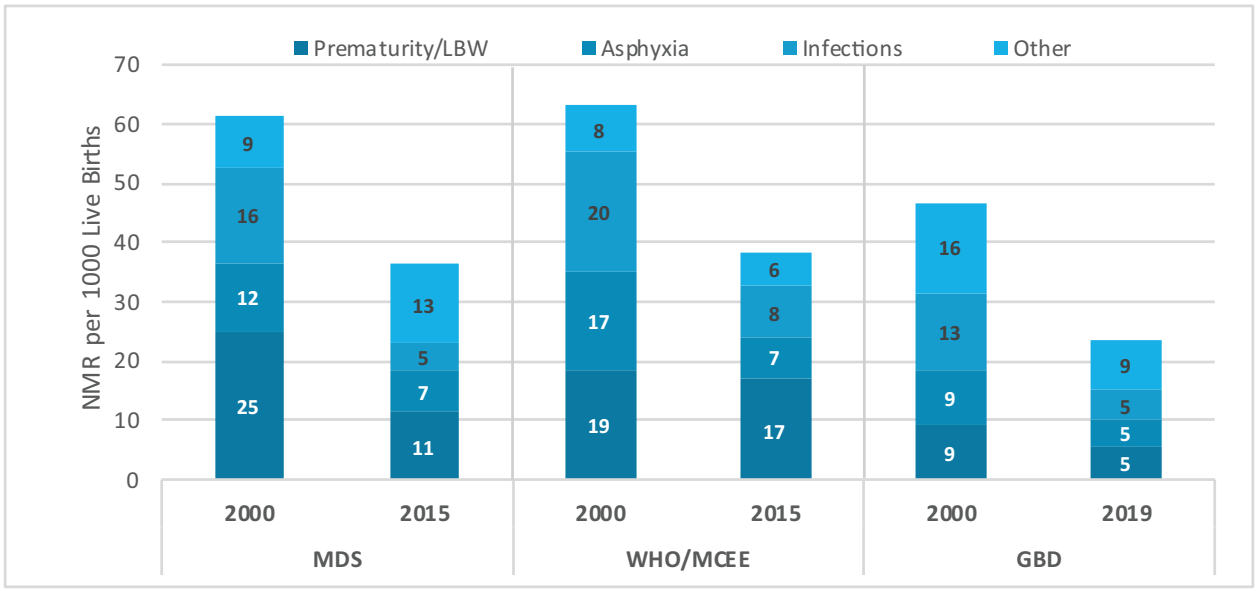




During 2003-18, Odisha was successful in bringing down mortality both on days 0 to 2 and on days 3 to 27, with a greater decline in the latter (Figure H.2). All major causes of neonatal death have reduced (prematurity, birth asphyxia, infections) (Figure H.2).

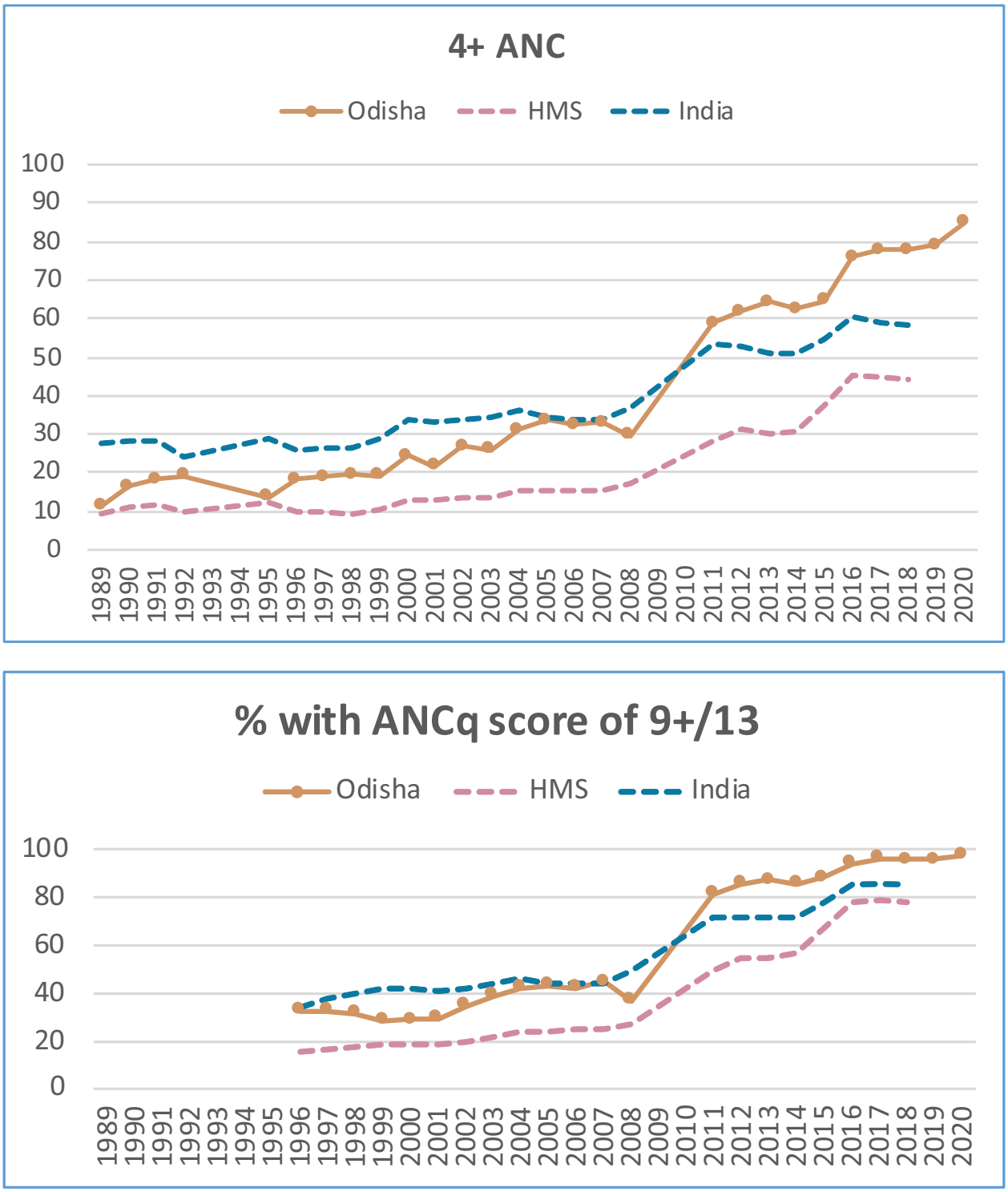
Figure H.2: Age- and cause-specific neonatal mortality, Odisha (2000-2019)





The gains in intervention coverage – antenatal care with contents, institutional deliveries notably in hospitals and C-sections among the rural – have been marked and are greatest during the NRHM/NHM periods (post 2005) (Figure H.3).

Figure H.3: Trends in antenatal and delivery care coverage, Odisha (NFHS and DLHS pooled data, 1989-2020)



Peri-neonatal mortality is estimated as 1.75*NMR. MMR and NMR are from the SRS

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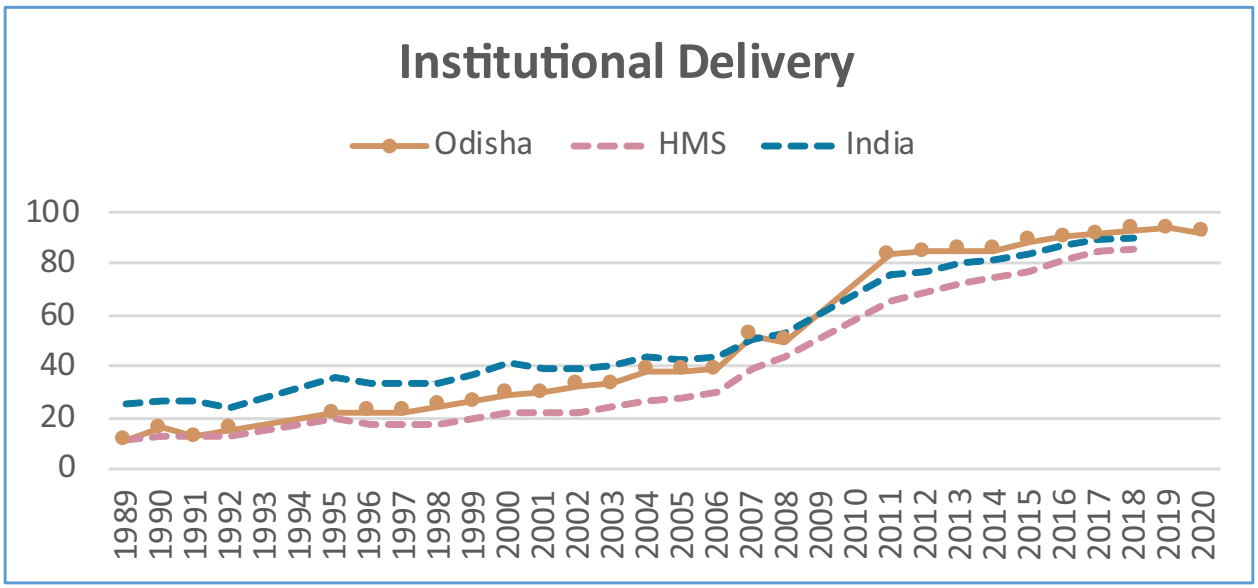
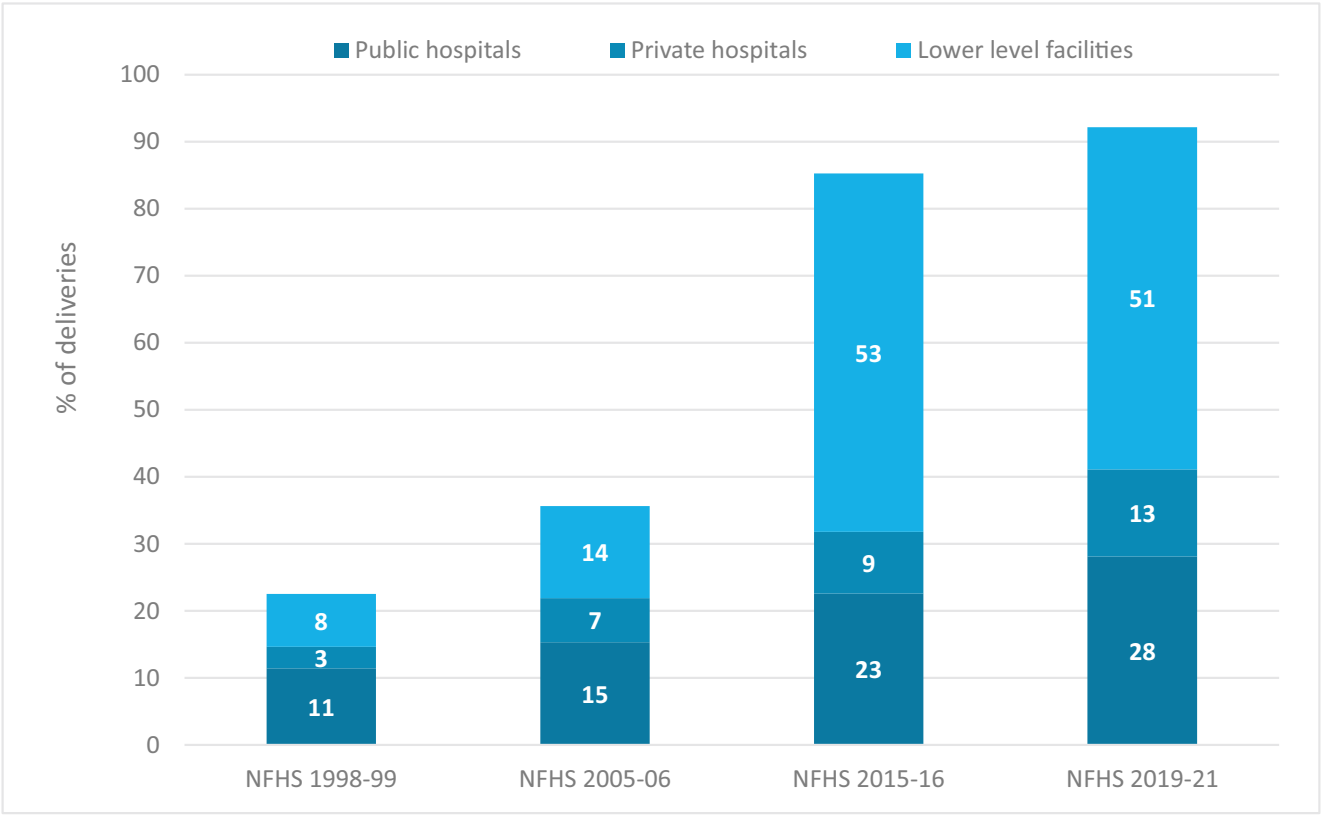


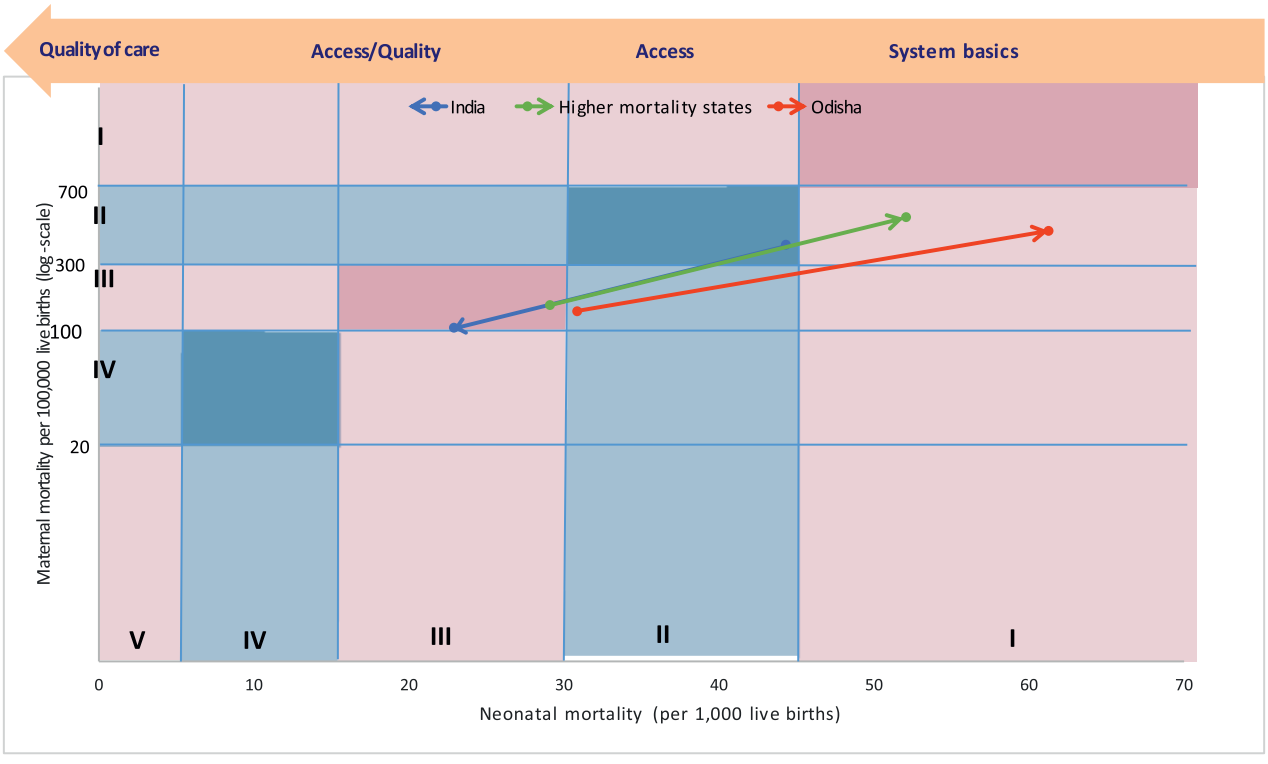
The public sector has driven this increase, accounting for nearly 90% of deliveries, and institutional neonatal mortality rates are substantially reduced in private hospitals and lower-level health facilities (Figure H.4).

Figure H.4: Trends in institutional delivery by facility level, Odisha (NFHS 1998-99 to 2019-21)



During 2000-2018, Odisha has transitioned from Stage I to Stage III, achieving a three-fold reduction in maternal mortality and reducing the peri-neonatal mortality by half (Figure H.5), owing largely to the gains in intervention coverage – antenatal care with contents, institutional deliveries notably in hospitals and C-sections among the rural.

Figure H.5: Mortality transition in Odisha, its state cluster, and all India (2000-18)



Peri-neonatal mortality is estimated as 1.75*NMR. MMR and NMR are from the SRS

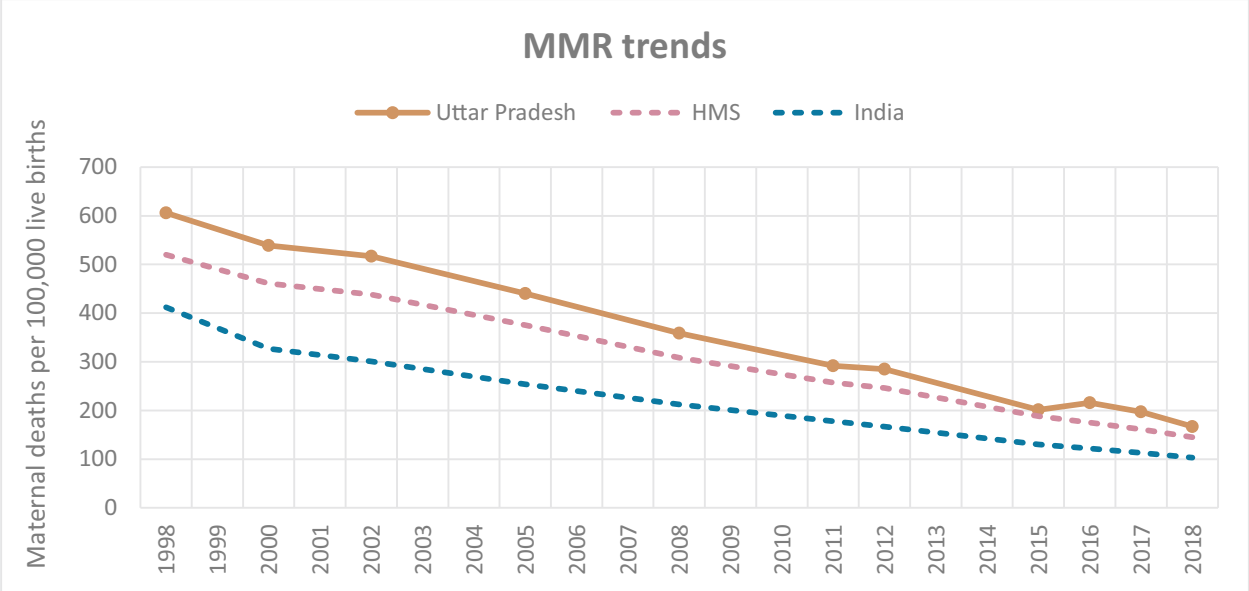
Several health policies and system reforms have contributed to Odisha's success:

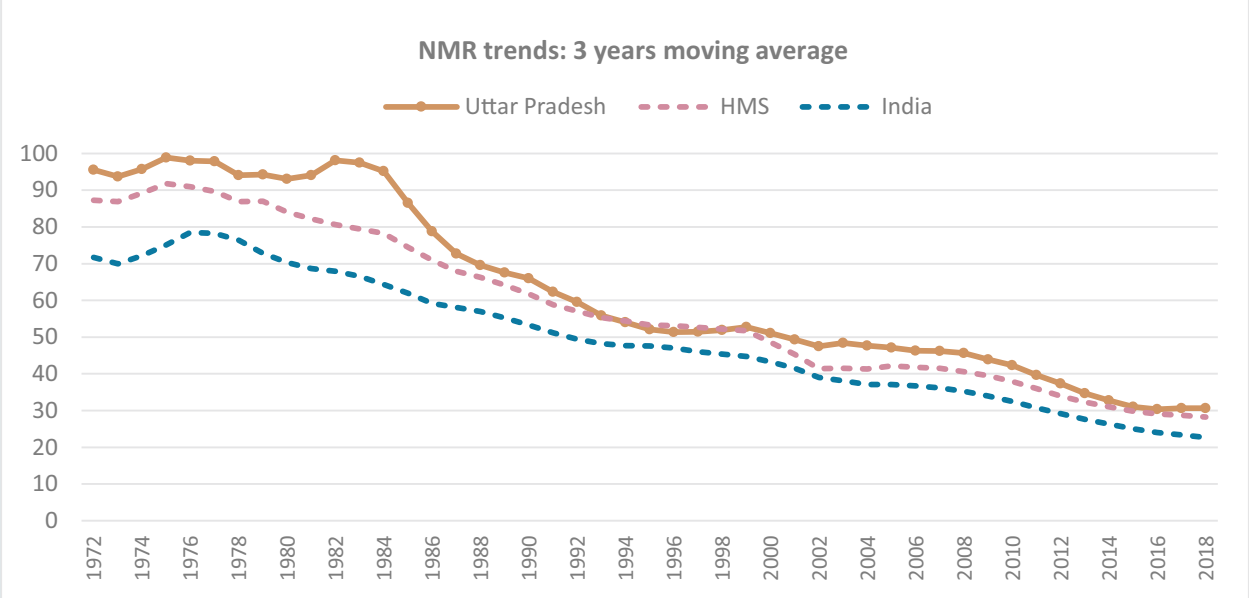
- The state invested in rural government infrastructure, particularly in building health centres in under-served areas, and upgrading CHCs into FRUs by improving the labour rooms, operating theatres, equipment, and instruments and posting required health workers.
- The state sought to provide every pregnant woman with at least one ANC from a doctor and at least one ultrasound.
- Odisha introduced maternity waiting homes, travel support, and additional outreach visits for hard-to-reach areas.
- Investments in NICUs, SNCUs and NCCs have been ongoing.
- Health worker training has been a big focus in Odisha: it has implemented the 21-day national skilled birth attendant training program, LSAS and EmOC training for medical officers, national training for newborn care, training on pneumonia management, and developed skill labs.
- Odisha was the first state to create a separate nursing directorate, which introduced systematic improvement to nursing education
- The state has invested in clinical and technical trainings, and has tapped into expertise from state medical colleges, from experts across India, and from international partners including UNICEF and the Liverpool School of Tropical Medicine
- Odisha was the first state to extend SBA training to AYUSH doctors, has implemented the national policy of expanding ANM responsibilities to include offering first dose of antibiotic injection gentamicin and amoxicillin, and has created ongoing education opportunities for medical officers
- Intrapartum care now includes new surgical techniques and the use of pneumatic anti-shock garments.
- Newborn care has ramped up access to tertiary care for fragile neonates, increased use of antenatal corticosteroids, encouraging universal screening, vitamin K injection, kangaroo mother care and very high rates of home-based newborn care by ASHAs
- Health workers and facilities are increasingly incentivized to improve patient care and patient satisfaction through reward- rather than punishment-based approaches
- Procurement was shifted to the Odisha State Medical Corporation Limited, set up after an exposure visit to Tamil Nadu, that brought speed and transparency to supply chain management
- Strong political will underpinned the state's progress with the Chief Minister paying specific attention to progress on health
- Leadership of the Odisha health department and NHM was stable, without frequent short-term transfers; the technical and administrative actors within government worked together closely
- Odisha mobilized substantial state-level financial resources for maternal and newborn health to add to funding from the NHM

Annex I: Uttar Pradesh State Summary

Uttar Pradesh made major progress in reducing maternal and newborn mortality during 2000-2020, greater than most other higher mortality states (Figure I.1).

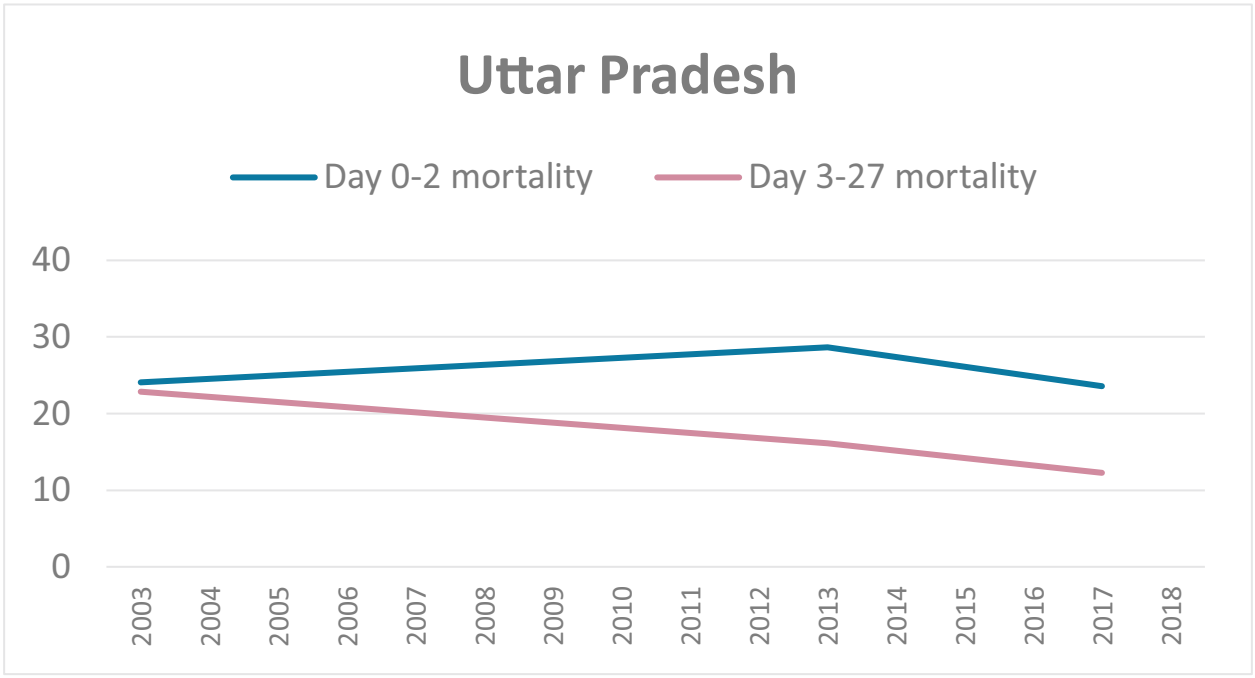
Figure I.1: Uttar Pradesh's MMR (1998-2018) and NMR (1971-2019) levels and trends compared to its state cluster and all India (SRS)

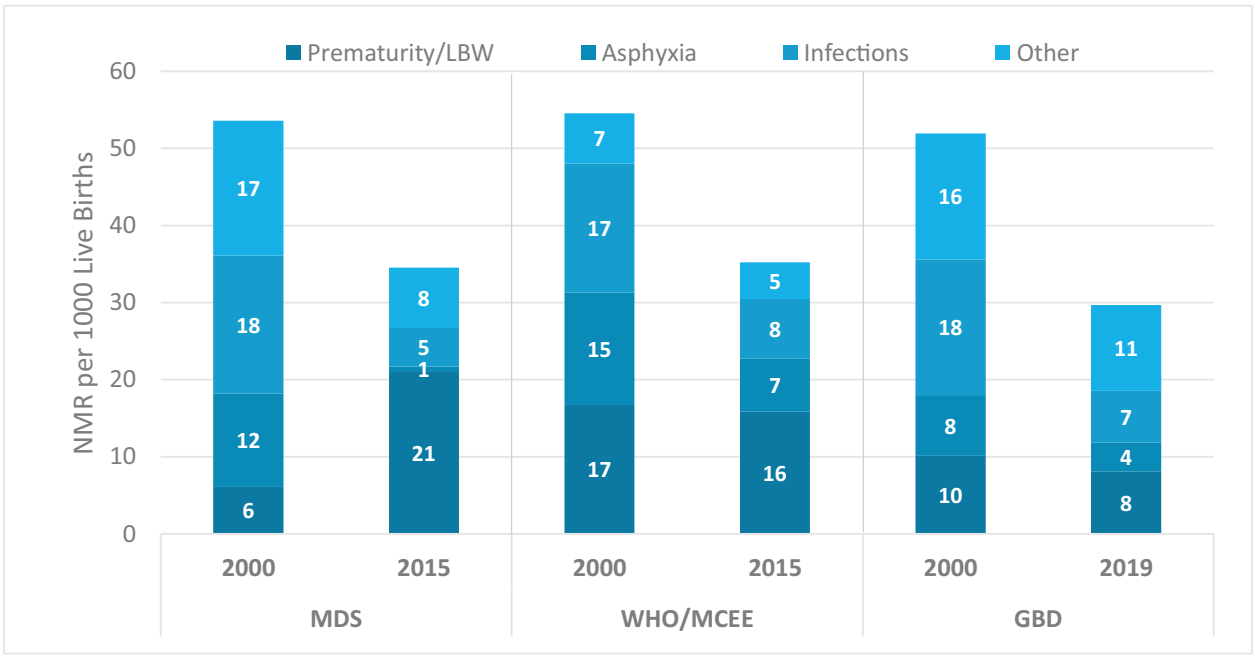




During 2003-17, Uttar Pradesh was successful in bringing down mortality on days 3 to 27, with a very small decline in the mortality in the first days of life (0-2 days) (Figure I.2). Yet during 2013-17, the state recorded faster declines in 0-2 days mortality (AARC of -4.9%), indicating improvements to intrapartum care and newborn's health status in the recent times. All major causes of neonatal death have reduced (infections, birth asphyxia, prematurity) (Figure I.2).

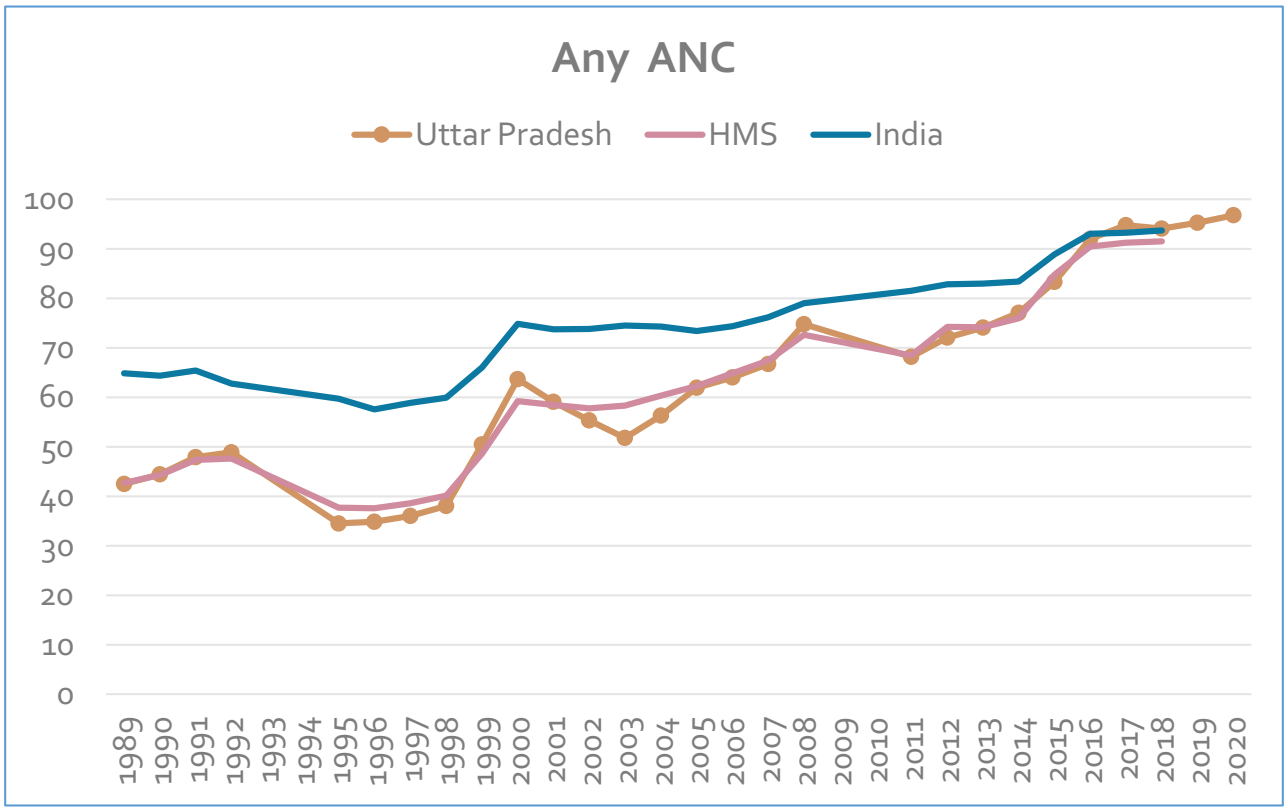
Figure I.2: Age- and cause-specific neonatal mortality, Uttar Pradesh (2000-2019)

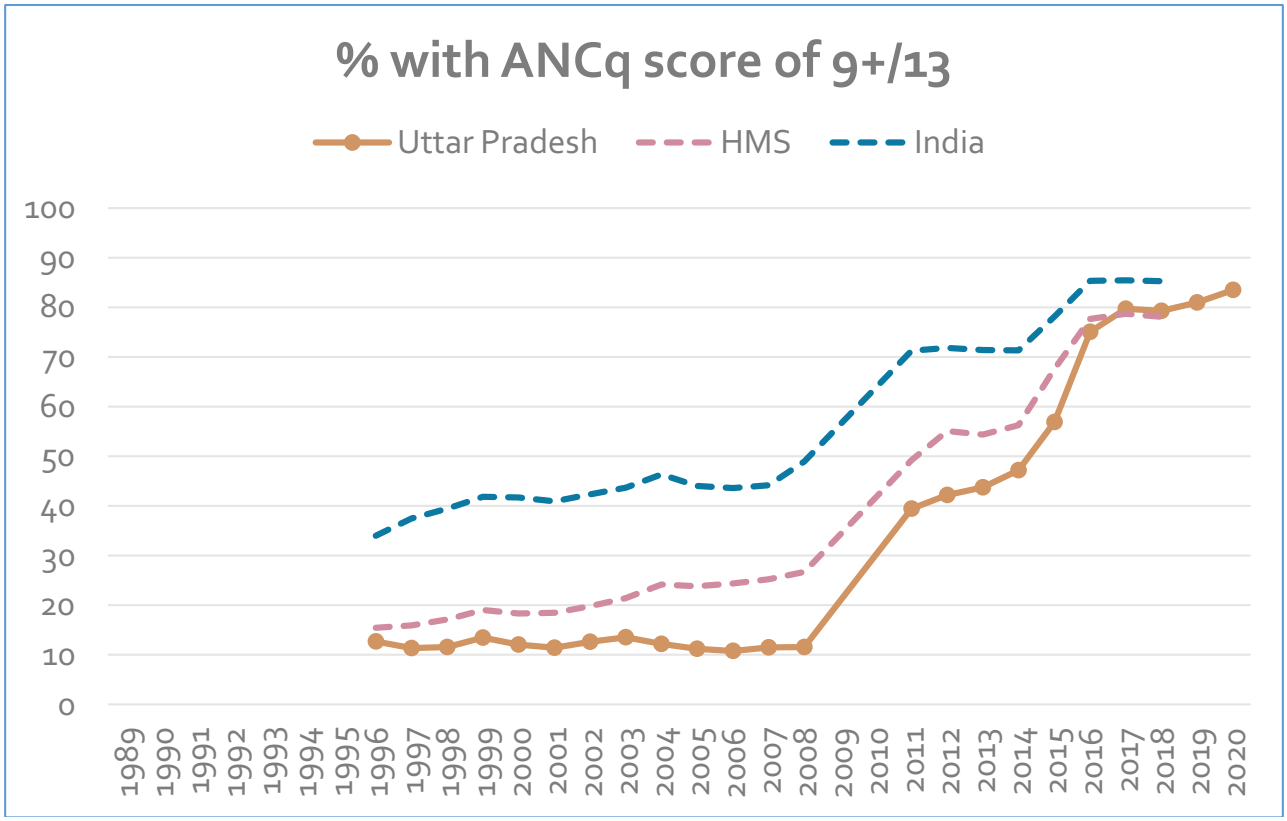




The gains in intervention coverage – antenatal care with contents, institutional deliveries, and C-sections among rural women – have been marked and are greatest in during the NRHM and NHM periods (post 2005) (Figure I.3).

Figure I.3: Trends in antenatal and delivery care coverage, Uttar Pradesh (NFHS and DLHS pooled data, 1989-2020)





Note:ANCq was obtained ecluding NFHS 1 and DLHS 1 because some of the components are not available in these surveys.

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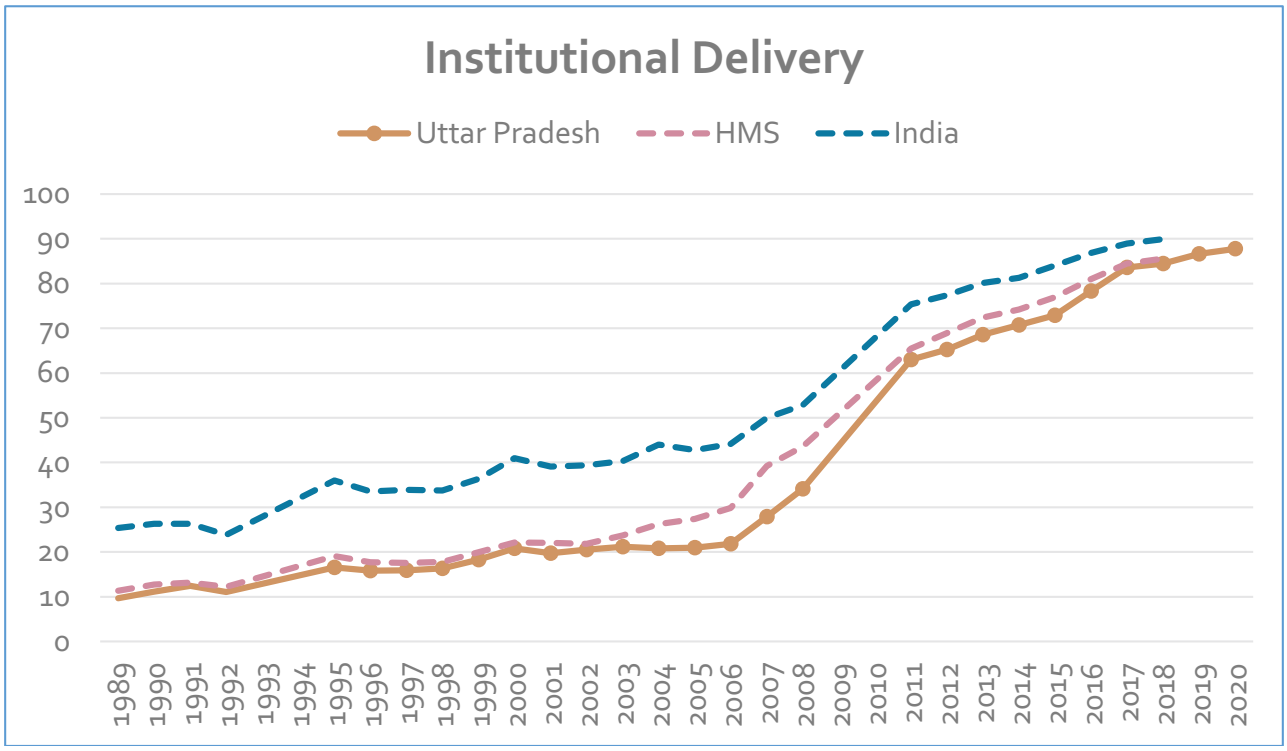
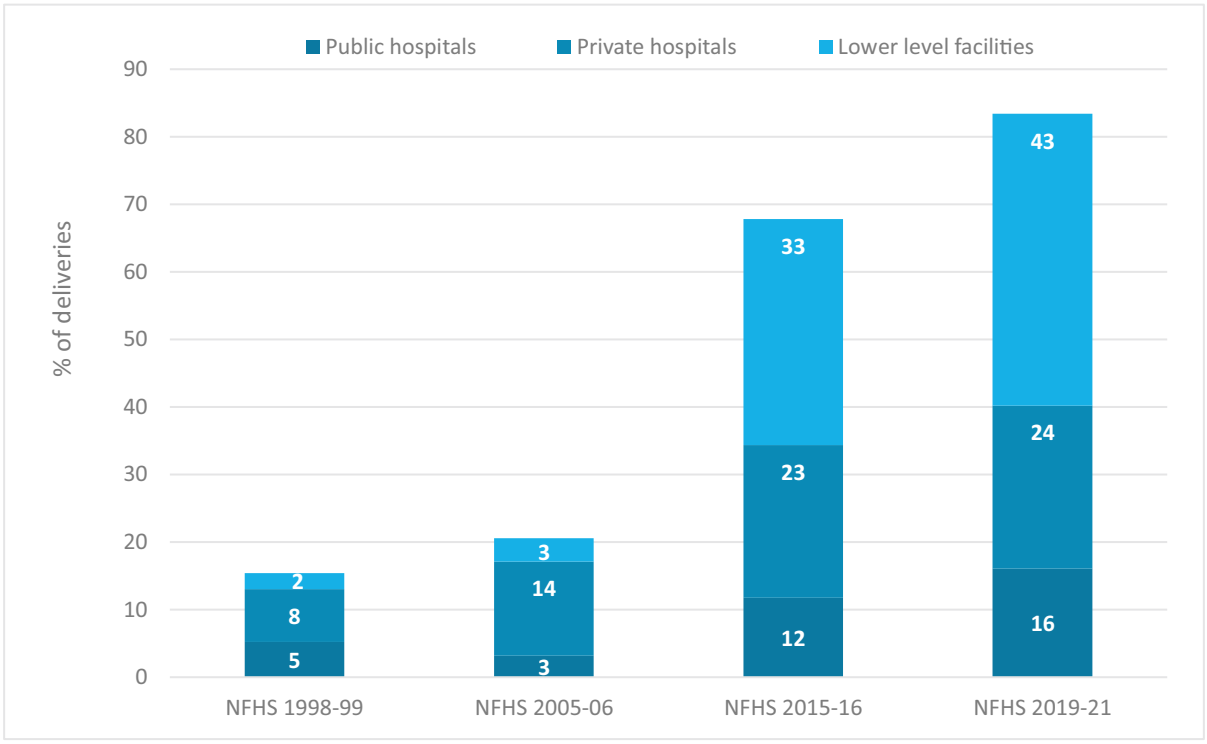


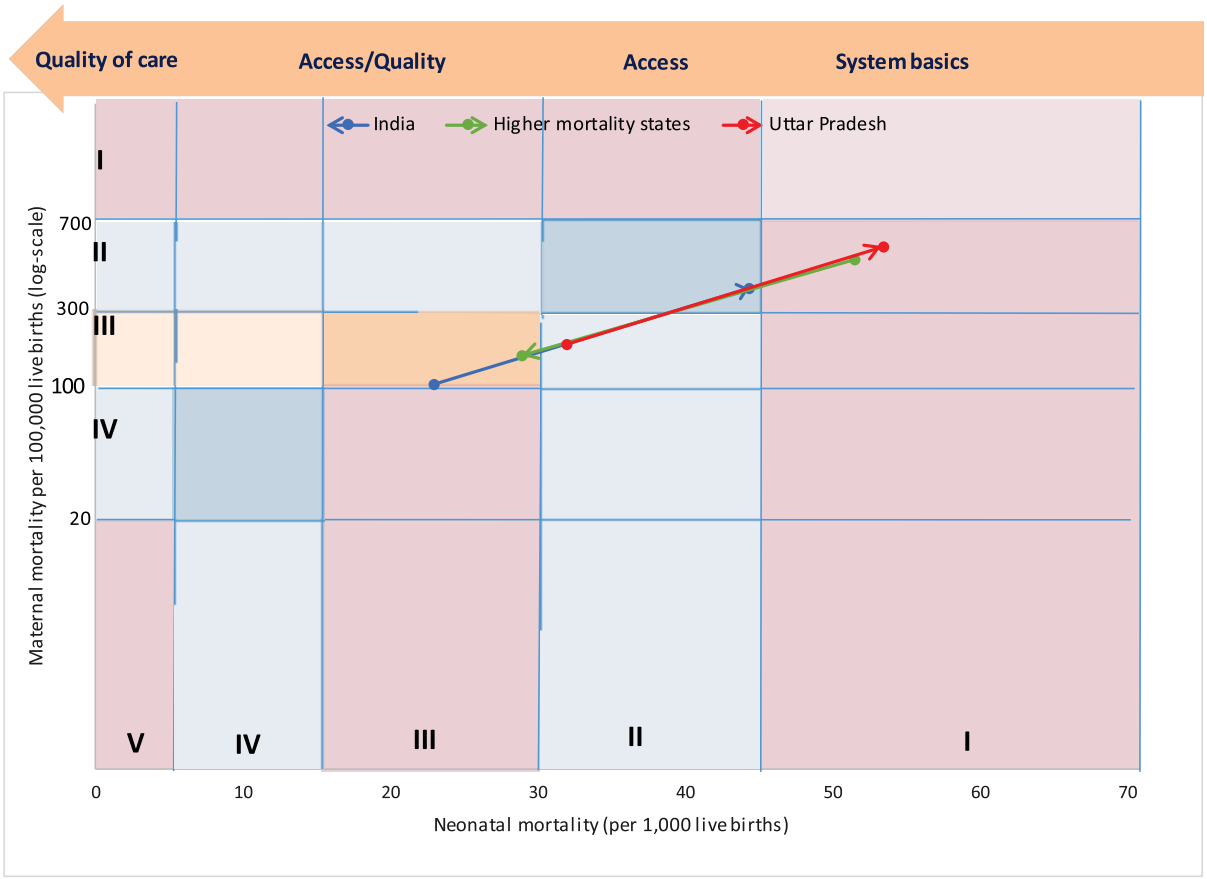
The public sector has driven this increase, accounting for nearly 90% of deliveries, particularly among lower-level facilities more than public hospitals (Figure I.4).

Figure I.4: Trends in institutional delivery by facility level, Uttar Pradesh (NFHS 1998-99 to 2019-21)



During 2000-2018, Uttar Pradesh has transitioned from Stage I to early phase of Stage III, achieving more than a three-fold reduction in maternal mortality and reducing the peri-neonatal mortality by around 40% (Figure I.5), owing largely to the gains in intervention coverage – antenatal care with contents, institutional deliveries notably in hospitals and C-sections among the rural.

Figure I.5: Mortality transition in Uttar Pradesh, its state cluster, and all India (2000-18)



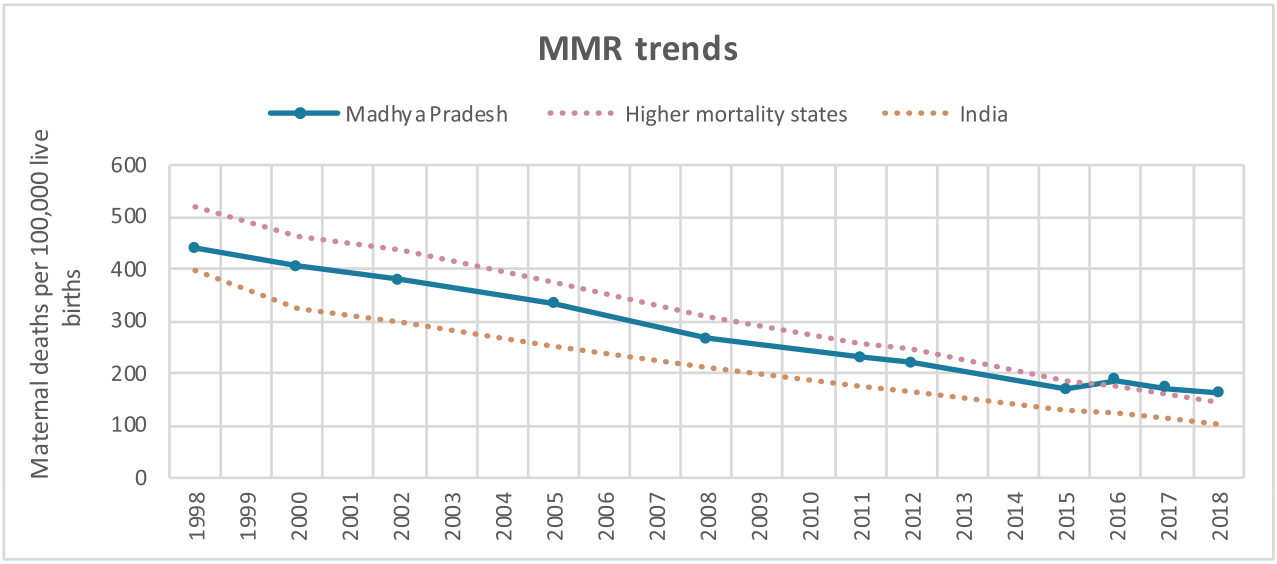
Several health policies and system reforms were found to have contributed to Uttar Pradesh's success:

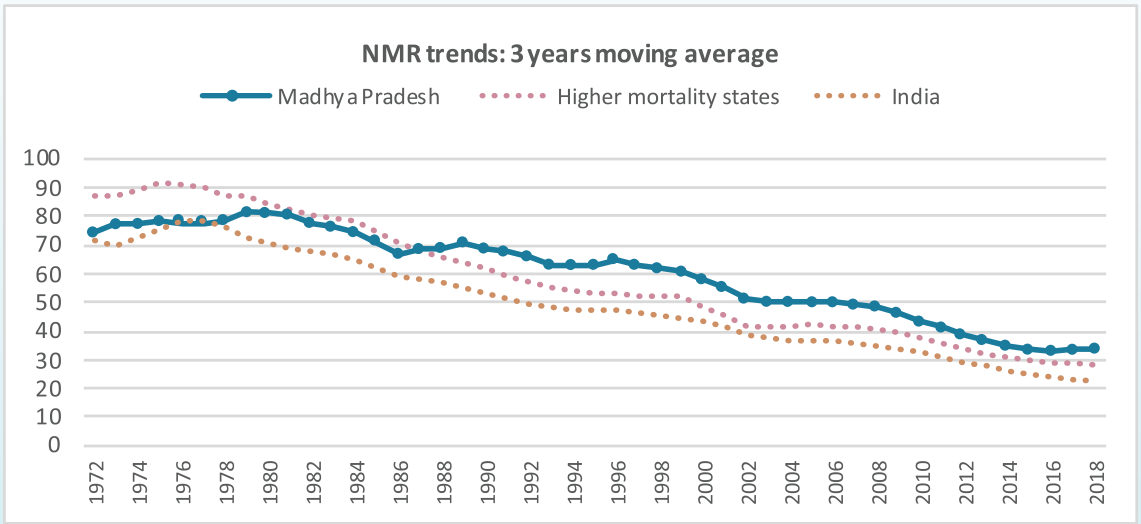
- Uttar Pradesh benefited from the central government's support, including technical advice, programs, and protocols; this guidance resulted in the implementation and strengthening of core NRHM initiatives (JSY, 108/102 emergency transportation, and community engagement through the ASHA program, Village Health and Nutrition Days, and Village Health, Sanitation and Nutrition Committees)
- Health financing and management systems in Uttar Pradesh have gradually been strengthened to use NRHM funding to meet rising demand for institutional delivery
- Uttar Pradesh has implemented the centre's quality improvement and capacity building initiatives for health workers, with particular focus on in-service upgrade training nurses and ANMs in basic emergency obstetric and neonatal care, as well as post-partum haemorrhage training for doctors; Uttar Pradesh was also the first state to introduce nurse mentorship for labour room nurses
- Uttar Pradesh improved quality of ANC and developed a model of providing ANC at a fixed time each month in government facilities at block (CHC) or village level (Village Health and Nutrition Days), with the support of private sector doctors, which the central government adapted into what is now Pradhan Mantri Surakshit Matritva Abhiyan
- Referral protocols and linkages between facilities were strengthened: high risk pregnancies were flagged as priorities for referrals, doctors were required to sign referral slips (instead of nurses), and WhatsApp groups were formed and use to track women during referral
- Procurement has improved through the creation of the Uttar Pradesh Medical Supply Corporation, strengthening supply chain management, and managing all equipment maintenance through a state-wide contract
- Leaders were attentive to technical and programmatic issues, there was strong collaboration between administrative and technical officials, and the state developed a forum to manage and collaborate effectively with development partners (particularly UNICEF, BMGF and the World Bank)
- Uttar Pradesh was able to implement the NRHM's decentralization processes, including district monitoring, in part because it had strong divisional and district project management units
- District Magistrates, District Collectors and technical partners were brought together by the District Health Society for regular progress review meetings at the district level
- Uttar Pradesh took a data-driven approach wherein interventions were developed after data analysis and assessment of evidence; data was collected through several digital programs including the ASHA app and MCTS, which then was updated to RCH, then amalgamated and examined by decision-makers through dashboards
- The NHM's financial flexibility enabled Medical Officers in Charge, Chief Medical Officers, and Chief Medical Superintendents to allocate funds based on local need
- ASHAs were able to be effective because of the supervision and supports put in place for them through block and district community process managers, and online payment systems

Annex J: Madhya Pradesh State Summary

Madhya Pradesh made major progress in reducing maternal and newborn mortality during 2000-2020, greater than most other higher mortality states (Figure J.1).

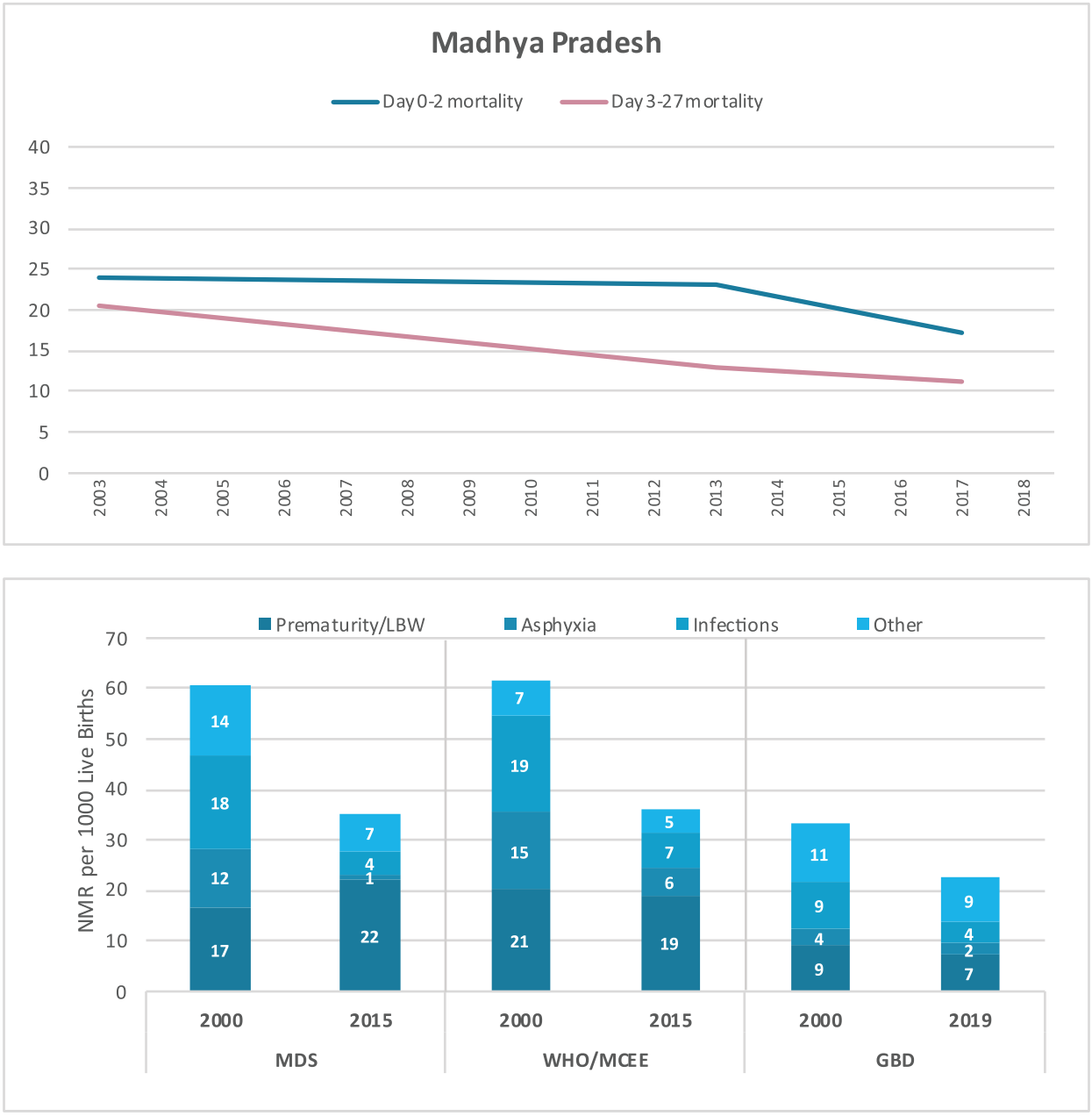
Figure J.1: Madhya Pradesh's MMR (1998-2018) and NMR (1971-2019) levels and trends compared to its state cluster and all India (SRS)





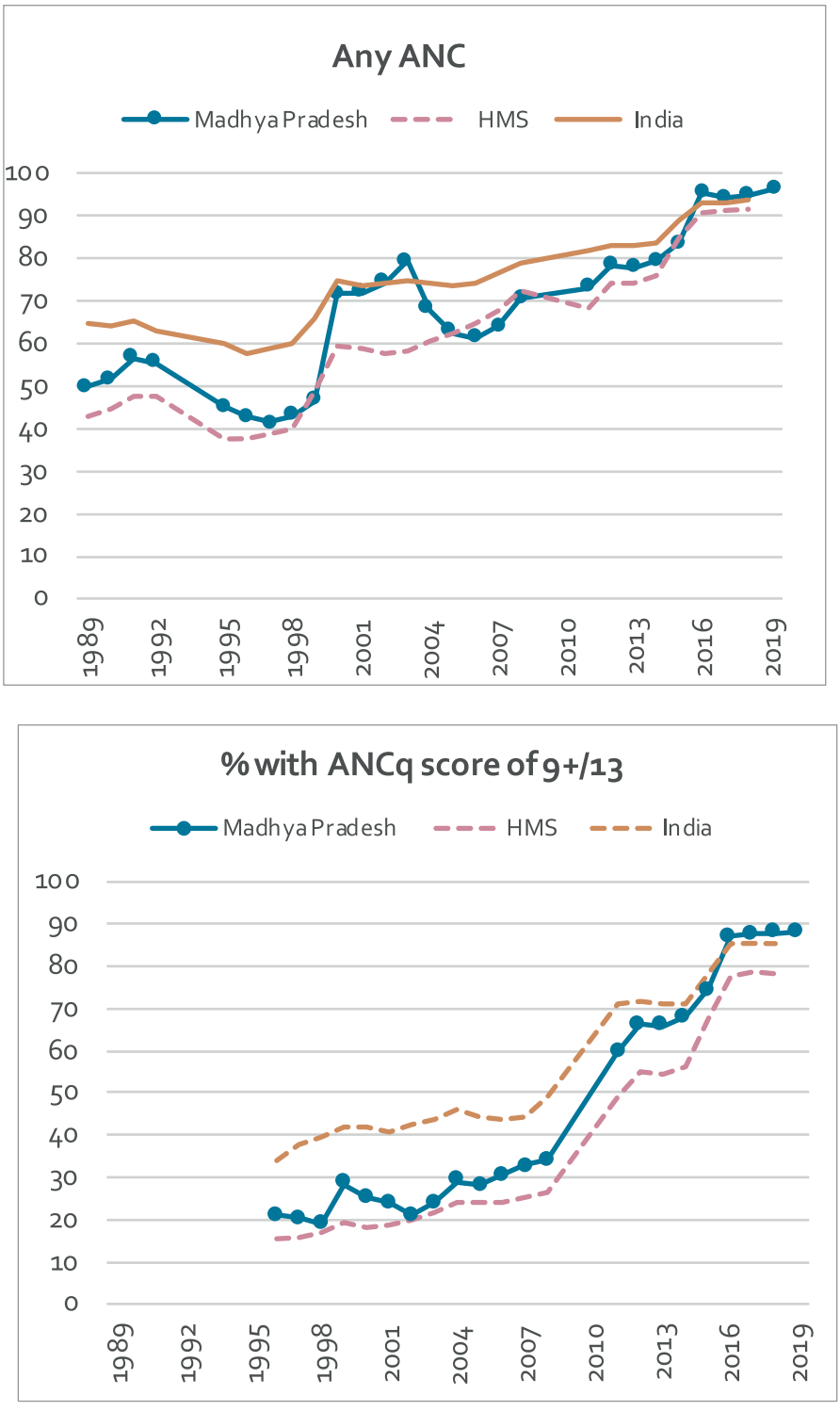
During 2003-18, Madhya Pradesh was successful in bringing down mortality both on days 0 to 2 days and on days 3 to 27, with a greater decline in the latter (Figure J.2). However, during 2013-18, the state recorded faster decline in 0-2 days mortality (AARC of -7.5%), indicating improvements to quality of delivery care and newborn's health status in the recent times. All major causes of neonatal death have reduced (infections, birth asphyxia, prematurity) (Figure J.2)

Figure J.2: Age- and cause-specific neonatal mortality in Madhya Pradesh, 2000-2019



The gains in intervention coverage – antenatal care with contents, institutional deliveries, and C-sections among rural – have been marked and are greatest in during the NRHM/NHM periods (post 2005) (Figure J.3).

Figure J.3: Trends in antenatal and delivery care coverage, Madhya Pradesh (NFHS and DLHS pooled data, 1989-2020)



Note:ANCq was obtained ecluding NFHS 1 and DLHS 1 because some of the components are not available in these surveys.

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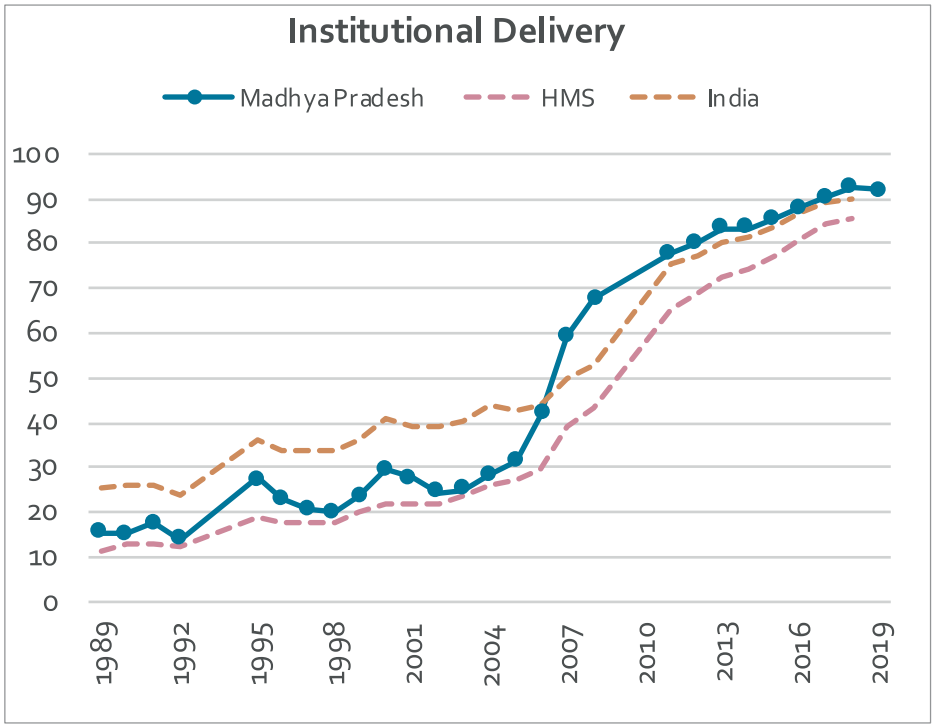
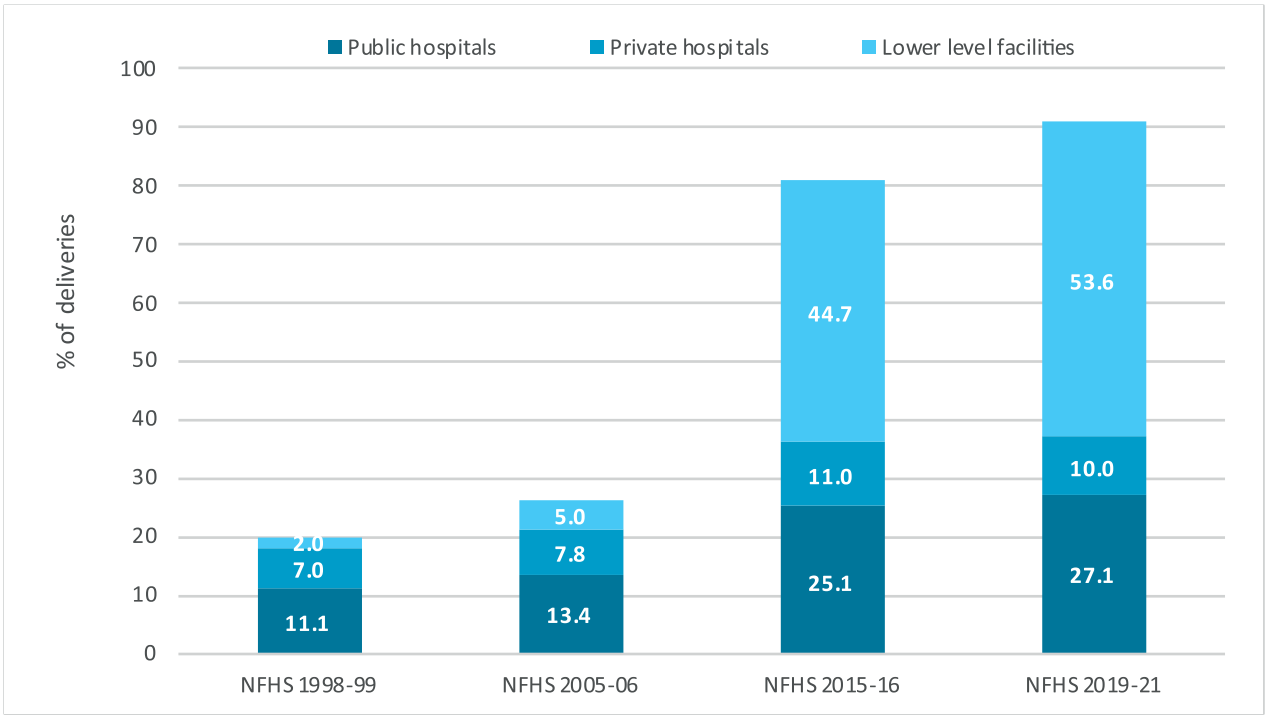


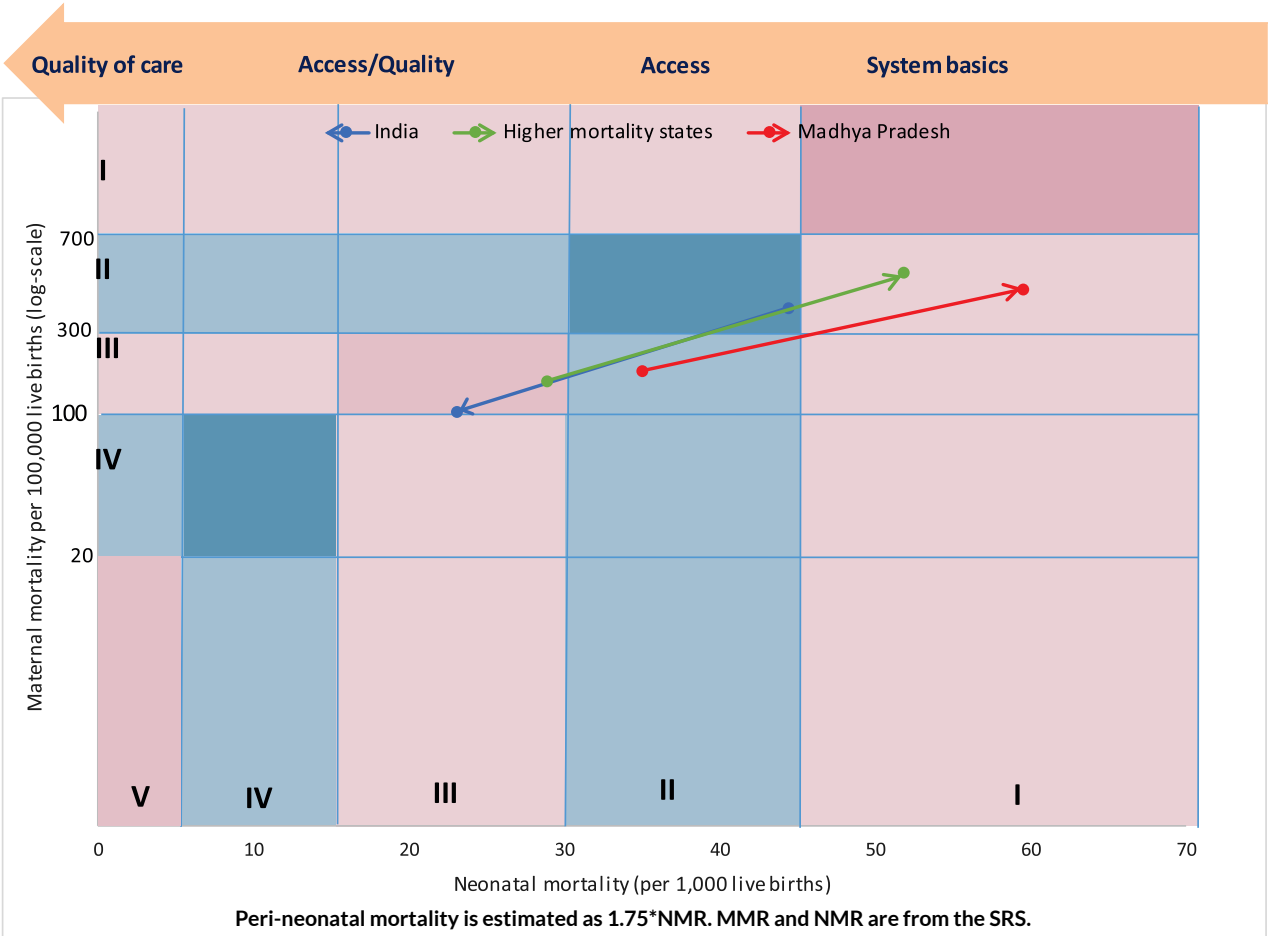
The public sector has driven this increase, accounting for nearly 90% of deliveries, and institutional neonatal mortality rates are substantially reduced in lower-level health facilities (Table J.4).

Figure J.4: Trends in institutional delivery by facility level, Madhya Pradesh (NFHS 1998-99 to 2019-21)



During 2000-2018, Madhya Pradesh has transitioned from Stage I to late Stage II, achieving a nearly two-fold reduction in maternal mortality and reducing the peri-neonatal mortality by half (Figure J.5), owing largely to the gains in intervention coverage – antenatal care with contents, institutional deliveries notably in hospitals and C-sections among the rural.

Figure J.5: Mortality transition in Madhya Pradesh, its state cluster and all India (2000-18)



Peri-neonatal mortality is estimated as 1.75*NMR. MMR and NMR are from the SRS.

Several health policies and system reforms have contributed to Madhya Pradesh's success:

- Madhya Pradesh has focused on mapping and identifying high need areas, and then increasing delivery points there, including capacitating some sub-health centres to manage deliveries
- The state introduced free referral transportation and was the first state to create district level vehicle control cells
- Madhya Pradesh invested in improving the capacity of their human resources for health through in-service trainings, fellowship for medical officers to access diploma courses, and post training mentorship, supportive supervision, and skill labs
- The state was also the first to incentivize doctors to work in rural government facilities by posting medical students to PHCs and reserving post graduate training seats for "in-service" government candidates
- While shortages of medical officers and specialists are a persistent issue in the state, the state did create and fill additional staff nurse positions at delivery centres and tighten retention bonds for medical officers
- Madhya Pradesh focused on the "basics" of ANC, identifying high risk pregnancies, and improving timely referrals
- The state implemented and benefited from the central government's quality improvement trainings, standards, and guidelines
- The state pioneered their design approach to new MCH wings and SNCUs through involving technical experts as well as engineers and architects to ensure all design considerations contributed to high quality care provision
- Blood transfusion availability has been improved through developing storage facilities at FRUs and hospitals
- The Madhya Pradesh Public Health Services Corporation Limited was set up and has streamlined drug and equipment procurement
- Financial policies have been adjusted to increase program officer flexibility in re-allocating funding and reduce use of maternal health funding for non-obstetric purposes
- The state has sought to make "judicious" use of available funding by mapping expenditure and supply for drugs and equipment
- Madhya Pradesh has instituted a time-bound grievance redressal system with strict hierarchical accountability
- Routine reviews (maternal death review, state reviews, divisional reviews) have created a structure for accountability
- Data systems have been strengthened over time through adopting the MCTS digital health records in the early 2000s and replacing it with the RCH system in 2016 that allows name-wise tracking; additional human resources for frontline data management have also been hired

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